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Winu Waste Characterisation

– Tailings

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Cover image: Saturated leach column tests.

Revision History

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Winu Study

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Version	Date	Author	Reviewer	Changes
4	4/07/2025	RG		Additional kinetic test work
3	20/06/2024	RG	PM	Additional kinetic test work
2	14/01/2022	MHA	RG	Updated with new samples.
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EXECUTIVE SUMMARY

Copper is removed from the mineral resource grade material via grinding and flotation. A Carbon In Leach (CIL) process is proposed to recover gold. Following these processes, a tailings waste stream will be generated. The environmental geochemistry risks of tailings for the Winu project have been studied within this report.

Forty nine metallurgical tailing's samples from 36 different mineral resource feed composites have been analysed. These samples reflect one of several potential processing schemes identified for treating the Winu mineral resource. Fourteen samples are High Sulfur (HS) flotation tailings (from the cleaner flotation circuits as proposed for either primary, secondary or oxide mineral resource types) and the remainder are Low Sulfur (LS) flotation tailings (from the rougher flotation circuits). The CIL process is relevant for the LS tailings and a detoxification process will occur to reduce cyanide species concentration.

Pyrite and chalcopyrite are the dominant sulfide minerals in the mineral resource material. After copper recovery through flotation, pyrite will be the dominant sulfide mineral in the flotation tailings. Whilst some dolomite and calcite can be present in tailings, siderite is the dominant carbonate mineral and hence carbonate buffering of acidity generated could be limited. Moderate concentrations of silicates such as biotite, muscovite and chlorite (chlinochlore) can be present, offering some neutralisation potential in the long term.

Acid Neutralisation Capacity (ANC) was low to negligible in the tailings samples generated from oxides (4.5 kg H_2SO_4/t) and secondary sulfide (median of 5.3 kg H_2SO_4/t) mineral resource feed and the ANC due to carbonates alone was even lower. The tailings generated from primary sulfide feed material generally had the greatest ANC (median of 9.1 kg H_2SO_4/t), including both carbonates and silicate ANC.

Sulfide content, and hence acid generation potential, were variable with the LS tailings containing up to 35 kg H_2SO_4/t. HS tailings (excluding the oxide circuit HS tailings sample) contained over 300 kg H_2SO_4/t. Due to the very high sulfide contents and negligible ANC, all the HS tailings samples were classified as Potentially Acid Forming (PAF). The LS tailings samples typically had low capacity to generate acid (PAF-LC), with only samples with sulfur contents below 0.2% weight percent (wt.%) being classified as Non Acid Forming (NAF) or barren (47% of tested samples). Although some of the LS tailings samples were classified as PAF-LC, the acid generation capacity of these tailings would be generally low and they are much lower risk than the HS tailings.

Metal leaching at elevated concentrations was typically only observed in low pH Net Acid Generation (NAG) leachates. Elevated release of metals was typically not observed from deionised water leaches or in tailings supernatant samples. One mafic tailings sample was found to release higher concentrations of constituents (e.g. Cd, Co, Mn, and Ni) .

Under saturated leach test conditions, a first flush of elevated metals concentrations was observed and subsequently decreasing to very low concentrations. However, the Fe and Al concentrations were more consistent with subsequent flushes, due to solubility controls. Neutral pH was maintained for LS and HS tailings under saturated conditions, confirming limited oxygen ingress and subsequent sulfide oxidation when Winu tailings are maintained saturated. Under saturated and unsaturated conditions, cyanide concentrations are low, showing that cyanide concentrations are likely to remain low in Winu tailings.

Under unsaturated leach test conditions, the primary sulfide median sulfur sample and the CIL after detoxification LS tailings samples did not leach significant metals under the circum-neutral pH test conditions. Tailings generated with primary sulfide feed material are expected to represent 85% of the tailings. Manganese and zinc were soluble, but concentrations were low. However, for the secondary sulfide median tailings sample, there was an increase in metals (Co, Cu, Mn, Ni, Si, and Zn) observed, consistent with a lowering

in pH for this sample (decreasing from pH 6.5 to 7.0 before week 21 and then between pH 4.7 and 5.8 after week 38). Samples were selected with extreme or particularly high sulfur concentrations to understand metals release as a worst case. At the onset of acidic conditions, there were elevated concentrations of Al, Be, Cd, Co, Cu, Cr, Fe, Mn, Ni, Pb, sulfate, U, and Zn.

Fluoride release was noted as being elevated for most samples during static leach tests. However, a first flush followed by decreasing concentrations with subsequent flushing were observed under both saturated and unsaturated leach test conditions.

The acidification lag due to neutralising minerals within the tailings are predicted to be months in a PAF secondary sulfide feed sample with very high sulfur concentrations and two to four years in another sample with median sulfur concentrations. The PAF or uncertain primary sulfide feed tailings samples are expected to have an acidification lag of 1.5 to 47 years.

HS tailings are PAF, but if maintained in a saturated state are unexpected to generate Acid and Metalliferous Drainage (AMD). The LS tailings are expected to be NAF in bulk based on the following findings:

- The bulk of the tailings containing primary sulfide feed material (85%);
- The alkaline process solutions;
- The lag time until acidification for tailings classified as PAF and likely burial with new tailings; and
- The expected high degree of saturation.

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1. INTRODUCTION AND BACKGROUND

1.1. METALLURGICAL PROCESS

Process metallurgy testing of different mineral resource types from the Winu copper-gold deposit has been ongoing since early 2019. Tailings samples from these test programs have been continuously collected and characterised to aid with developing the Winu Acid Metalliferous Drainage (AMD) management strategy and plan (Rio Tinto 2024).

The proposed general process for treating Winu mineral resource is summarised in Figure 1 and Figure 2. Two tailings streams will be generated from this process: a rougher (Low Sulfur; LS) tailings and a cleaner (High Sulfur; HS) tailings. The flotation process proposes to use a combination of Cytec 3894, Potassium Amyl Xanthate (PAX) reagents and sodium cyanide (NaCN). The use of NaCN (approximately 30 g/t) is only proposed for the HS tailings process circuit (i.e. cleaner flotation circuit). For secondary sulfide mineral resource types Sodium Meta-Bi-Sulfate (SMBS), Tri-Ethylene-Tetra-Amine (TETA) and Carboxy-Methyl Cellulose (CMC) will be used in place of NaCN. Control of pH, where required, will be achieved via addition of hydrated lime ($Ca(OH)_2$). A frother can also be used, such as Huntsman H27. Oxide ores will use sodium hydrosulfide (NaSH) and PAX. Flocculant will be added to the LS tailings stream to assist in dewatering. Once the CIL circuit begins, NaCN (approximately dosed at 1-2 kg/t) will be used as part of that process for the rougher tailings.

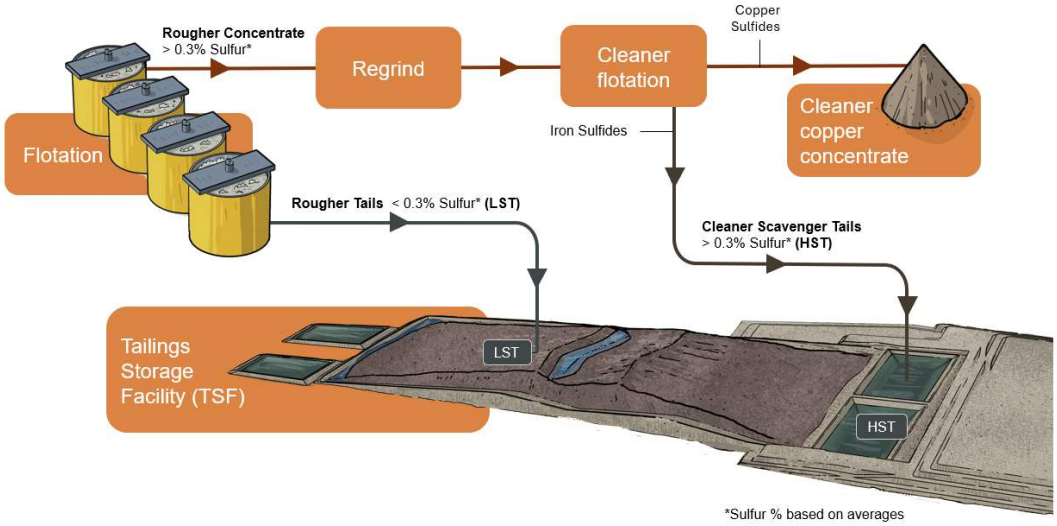

Figure 1: Schematic of the processing plant and waste streams that are sent to the Tailings Storage Facility (TSF).

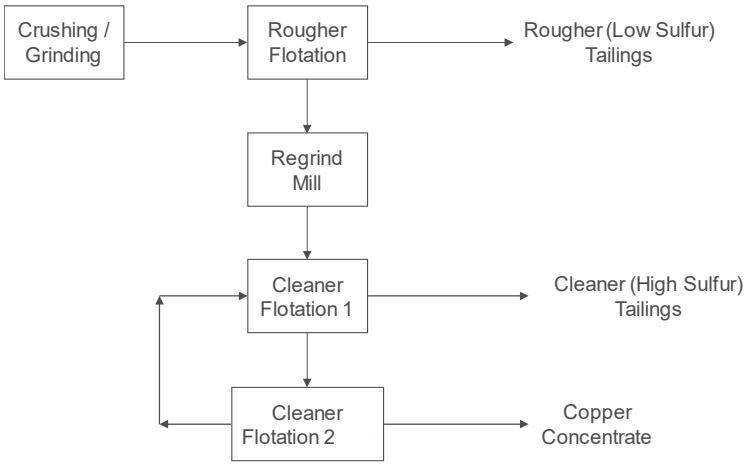

Figure 2: Processing schematic for Winu concentrator.

1.1.1. *CARBON IN LEACH (CIL)*

The LS rougher tailings will be subjected to a CIL cyanide extraction step to recover gold. The gold dissolved by cyanide (CN) is adsorbed onto activated C which is separated from the leached tailings for elution and gold recovery. The cyanide leached LS tailings will be detoxified using the sulfur dioxide (SO_2)/air process, whereby SO_2 in liquid or gaseous form acts with air to oxidise weak acid dissociable cyanide (CN(WAD)) to cyanate (CNO^-) and sulfuric acid, while releasing metals into solution.

The cyanide detoxification process that will be used is based on the conversion of the free CN and CN(WAD) to CNO^- using a mixture of SO_2 and air in the presence of a soluble copper catalyst at a controlled pH. The process is normally operated at a pH of ~8.0 to 9.0, and due to the formation of acid in the reactions, lime is normally required for pH control.

During the process, cyanide is oxidised to CNO^- as follows and summarised from SRK (2024):

$SO_2 + O_2 + H_2O + CN^- \rightarrow CNO^- + H_2SO_4$ (Cu *catalysed*)

The process also involves the conversion of CN(WAD) to CNO^- (whereby M indicates applicable divalent metals):

$M(CN)_4^{-2} + 4SO_2 + 4O_2 + 4H_2O \rightarrow 4OCN^- + 8H^+ + 4SO_4^{-2} + M^{+2}$ (Cu *catalysed*)

The M^{2+} metals are then precipitated as hydroxides under neutral to alkaline pH conditions as follows:

$M^{+2} + 2OH^- \rightarrow M(OH)_2$ (s)

In addition, Fe complexed cyanides react with ferric iron to form Prussian blue ($Fe^{III}_4[Fe^{II}(CN)_6]_3$) and/or Turnbull's blue ($Fe^{III}_3[Fe^{II}(CN)_6]_2$), which are stable at near-neutral pH and oxidising conditions.

Thiocyanate (SCN^-) can form when sulfide minerals are present in the tailings. The oxidation of SCN^- occurs according to the following reaction:

$SCN^- + 4SO_2 + 4O_2 + 5H_2O \rightarrow OCN^- + 10H^+ + 5SO_4^{-2}$

The CNO^- that forms in the preceding reactions is hydrolysed to ammonia (NH_3) as follows:

$CNO^- + H^+ + H2O \rightarrow CO_2 + NH_3$

Overall, the SO_2/air process is expected to increase sulfate and dissolved concentrations of SCN^-, CNO^-, NH_3, nitrate (NO_3) and/or dissolved metals in the process solution. The process will also lead to the precipitation of iron-cyanide compounds and metallic hydroxides that will be transported with the tailings solids as stable compounds.

The LS CIL CN-detoxified rougher tailings will be transported to the Tailings Storage Facility (TSF) as a slurry (~pH 8.5 following detoxification) and stored initially in a saturated state.

1.2. MINE PLAN

Sulfide sulfur and total sulfur content are important metrics for understanding potential acid generation on site. Price (1997) initially proposed a cutoff of 0.3 wt% sulfur in the absence of ANC, with the rationale that even though a material can generate acidity, the amount of acid that can be generated is limited. However, more recent studies and research have found that values of 0.1 to 0.5 wt% may be applicable cutoff values (e.g., Lapakko and Antonson 2002). As such, a site-specific cutoff is usually determined as appropriate.

Sulfur deportment to the LS tailings has been tracked through the metallurgical test work program to generate an understanding of likely sulfur grades in the tailings (Figure 3). Based on this analysis by the metallurgical team (Rio Tinto 2021), the 2024 mine plan (Schedule 40) has a projected sulfur grade in the LS tailings of 0.21% on yearly average over life-of-mine. Greater variability is observed using smaller timesteps, however the overall average total sulfur concentration is still similar at 0.23% and 0.24% for monthly and quarterly time steps respectively (Figure 4). This plan also predicted that 7% of the total tailings will be HS tailings, with variability from 0% to 9% on an annual basis (Figure 5).

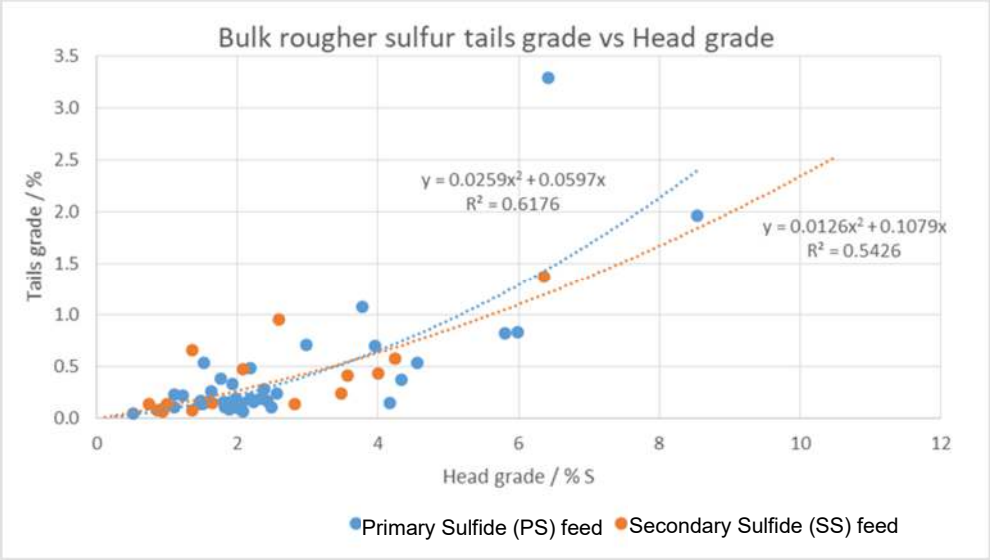

Figure 3: Sulfur grade in LS (rougher) tailings and head grade samples from metallurgical test work.

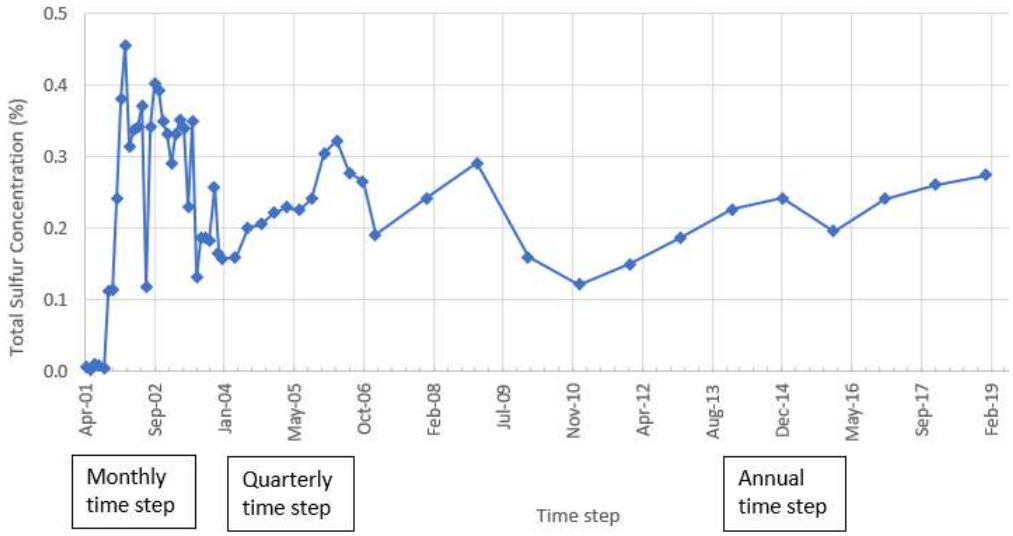

Figure 4: Predicted sulfur grade in LS (rougher) tailings over life of mine (LOM) (Schedule 40 2024 mine plan).

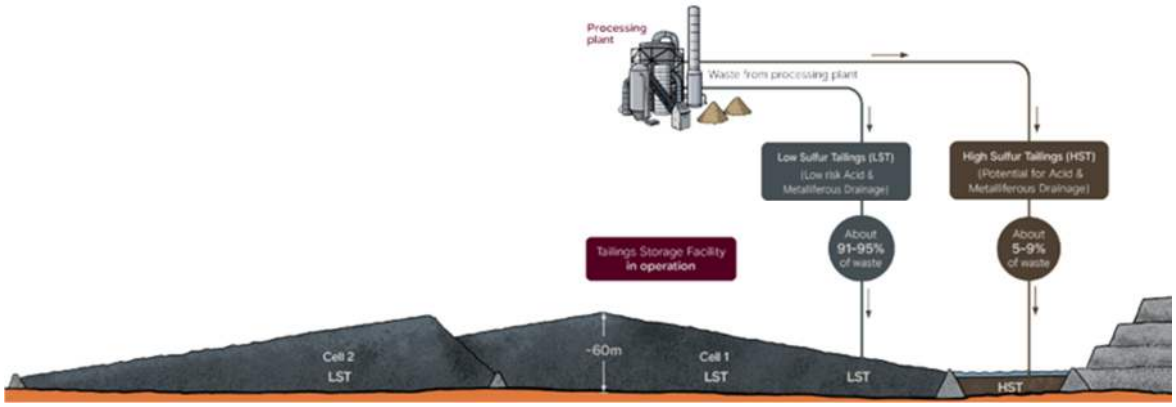

Figure 5: Schematic of the proposed TSF.

1.3. TAILINGS STORAGE FACILITY

LS and HS tailings will be stored separately within the TSF (Figure 6). The main sources of solutes in the tailings are expected to be from:

- Process water (during operations and initial drain-down);
- Oxidation of sulfide minerals during unsaturated conditions; and
- Products formed during the detoxification process (process water and solid compounds).

The solute concentrations in the process water during operations will be a function of many factors, including:

- Make-up water properties (raw water supply);
- Mineral resource type;
- Operational conditions in the mill and the CN detoxification facility;
- Solute release from the tailings beaches to the pond;
- Evapo-concentration (in the decant pond of the TSF); and
- Proportion of process water recycled to the process plant.

Considering that the process plant will be operated at steady-state conditions, it would be expected that solute concentrations in the process water would start low (initially) and increase within the first few months to steady-state conditions. Seasonal variations may be

expected (e.g. seasonal variation in evaporation) and longer-term changes may result from changes in mineral resource type.

Once deposited in the TSF, the tailings porewater concentrations would reflect that of the process water (supernatant). While most free CN would be removed during the detoxification process, free CN that enters the TSF pond would be subject to volatilisation (depending on pH), hydrolysis to NH_4^+ (followed by oxidation to NO_3), or reaction with solutes present in the tailings water. These processes are expected to be rapid and little to no free CN is expected to be present in the tailings water. Solid phases (e.g. Prussian blue and metal hydroxides after the oxidation of the CN(WAD) complexed divalent metals) will accumulate in the sediments/tailings at the bottom of the pond.

While the TSF is in operation, progressive deposition of tailings will wet up underlying tailings. Furthermore, since the TSF will be lined, the water level in the tailings would be expected to be maintained at a high level such that most of the tailings will be saturated, with little or no oxidation occurring within the saturated tailings due to anoxic conditions.

During deposition, the tailings will be managed to form a pond from which water will be decanted for recycling to the process facility. As a result, tailings beaches will be formed around the pond during operations. Only a shallow depth of tailings on the beaches are expected to develop unsaturated conditions. The layer of unsaturated tailings will be inundated when the next layer of tailings is deposited. The sulfide minerals contained in the unsaturated zone of the beaches would be expected to oxidise for the relatively short period of exposure between deposition events when the next layer of tailings is deposited, and the previously exposed tailings become saturated.

After cessation of operations, the pond will be removed from the surface of the tailings in preparation for the placement of a final dry cover. The liner will remain in place but is expected to have decreased effectiveness at some point in the long term.

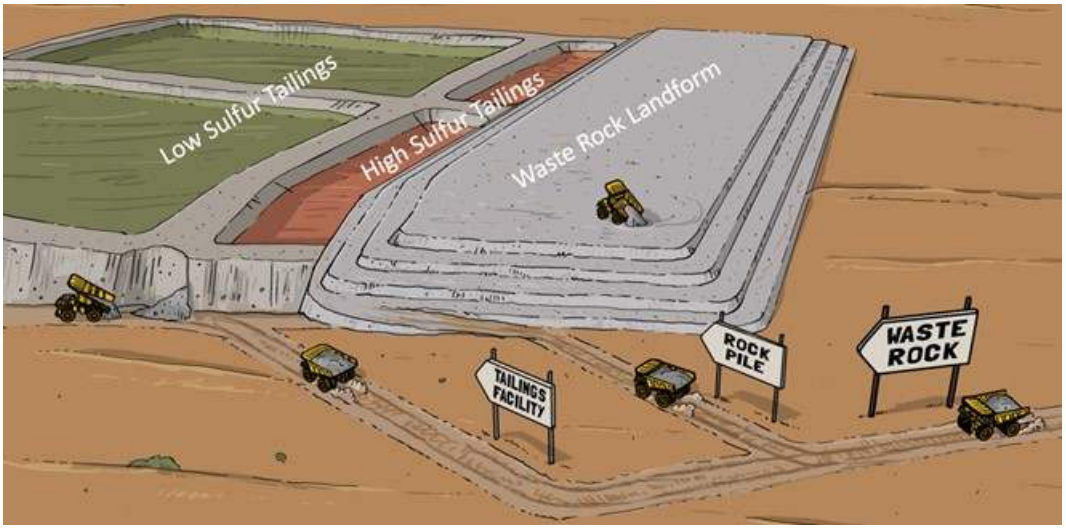

Figure 6: Schematic of the low sulfur tailings, high sulfur tailings and the waste rock landform.

2. SAMPLE SELECTION AND LABORATORY METHODS

2.1. SAMPLE SELECTION

The 2023 mine plan indicated that most of the feed mineral resource will be primary sulfides (85%), followed by secondary sulfides (12%), primary mafics (1.4%), oxides (1.3%), mixed oxides including oxide mafics (0.4%), and secondary mafics (0.01%). Test work targeted a variety of different feed materials and also reflected changes in flotation reagent choices as orebody knowledge evolved. All data are reported here as there are commonalities

observed in the geochemical characteristics, despite changes in the processing objectives. However, as processing schemes develop further in the future, test work should be continually undertaken to expand the dataset and continue to assess the geochemical risks.

A summary of the tailing's samples tested to date is given in Table 1. Feed materials have been taken mostly from the primary sulfide zone, however secondary sulfide mineral resource composites, oxides and one mixed sulfide mineral resource (containing both chalcopyrite and chalcocite) were also tested. HS tailings samples are grouped with the relevant LS tailings sample generated during the same flotation test. Feed materials to generate the HS tailings samples are listed as the concentrates from the rougher flotation circuit ("Ro Con").

Table 1: Description of feed materials and conditions for generating each tailings sample.

Sample ID	Feed material	Feed S %	Primary reagents used	Process flowsheet[1]
Primary Sulfide feed				
DP1471 LS tail #3	Jan Master Composite	2.6	25 g/t 3894	1
DP1555-1560 HS tail	DP1471 Ro con	32.5	8.9 g/t 3894	1
DP1648 LS tail	Jan Master Composite	2.6	25 g/t 3894	2
DP1649 LS tail	Jan Master Composite	2.6	12.5 g/t 3894	2
DP1745 LS tail	W338 Primary Quartz Sandstone	2.2	18.8 g/t 3894, 15 g/t MX5149	2
DP1745 HS tail	DP1745 Ro con	29.4	3 g/t 3894, 30 g/t NaCN	2
DP1750 LS tail	W338 Primary Sulfide Intermediate Gold	4.4	18.8 g/t 3894, 15 g/t MX5149	2
DP1802 LS tail	W332 Primary Sulfides 2	4.0	7.5 g/t PAX	2
DP1802 HS tail	DP1802 Ro Con	33.0	3 g/t 3894, 30 g/t NaCN	2
DP1804 LS tail	W37 Primary Sulfide 2	0.9	7.5 g/t PAX	2
DP1804 HS tail	DP1804 Ro con	18.3	3 g/t 3894, 30 g/t NaCN	2
DP1931 LS tail	Initial Mining Area Primary Sulfide	2.0	5 g/t 3894, 15 g/t PAX	2
DP1970 LS tail	W332 Altered Primary Sulfide	1.5	5 g/t 3894, 15 g/t PAX	2
DP1970 HS tail	DP1970 Ro Con	25.0	3 g/t 3894, 30 g/t NaCN	2
DP1971 LS tail	W332 Primary Sulfide - Siderite	2.2	5 g/t 3894, 15 g/t PAX	2
DP1971 HS tail	DP1971 Ro Con	26.0	3 g/t 3894, 30 g/t NaCN	2
DP1972 LS tail	W333 Primary Sulfide - Quartz Sandstone	1.6	5 g/t 3894, 15 g/t PAX	2
DP1972 HS tail	DP1972 Ro Con	26.9	3 g/t 3894, 30 g/t NaCN	2
DP1975 LS tail	W93 Primary Sulfide 1	2.0	5 g/t 3894, 15 g/t PAX	2
DP1975 HS tail	DP1975 Ro Con	22.5	3 g/t 3894, 30 g/t NaCN	2
DP2003 LS tail	W333 Primary Upper Mafic	5.8	5 g/t 3894, 15 g/t PAX	2
DP2003 HS tail	DP2003 Ro Con	37.2	3 g/t 3894, 30 g/t NaCN	2
IMAPS LS tail (DP2007)	Initial Mining Area Primary Sulfide	2.0	5 g/t 3894, 15 g/t PAX	2
IMAPS HS tail (DP2007)	Initial Mining Area Primary Sulfide	32.4	3 g/t 3894, 30 g/t NaCN	2
DP2001 LS tail	W345 Primary Sulfides Carbonates	1.9	5 g/t 3894, 15 g/t PAX	2
DP2002 LS tail	W345 Primary Sulfides Siderite 2	3.8	5 g/t 3894, 15 g/t PAX	2
DP2004 LS tail	W333 Primary Sulfides Upper Mafic	5.8	5 g/t 3894, 15 g/t PAX	2
DP2042r LS tail	W332 Primary Sulfides 4	1.1	5 g/t 3894, 15 g/t PAX	3
DP2043 LS tail	W335 Primary Sulfides Arkose	0.5	5 g/t 3894, 15 g/t PAX	3

[1] See Appendix 1 for flowsheet schematics of each process scheme evolution.

Sample ID	Feed material	Feed S %	Primary reagents used	Process flowsheet [1]
DP2044 LS tail	W339 Primary Sulfides Low Copper	1.9	5 g/t 3894, 15 g/t PAX	3
DP2045 LS tail	W81 Primary Sulfides Small	8.5	5 g/t 3894, 15 g/t PAX	3
DP2046 LS tail	W345 Primary Sulfides Siderite 2	3.8	5 g/t 3894, 15 g/t PAX	3
DP2047 LS tail	W346 Primary Sulfides Carbonate	1.5	5 g/t 3894, 15 g/t PAX	3
DP2048 LS tail	W356 Lower Mafic	6.0	5 g/t 3894, 15 g/t PAX	3
DP1999 LS tail	W339 Primary Sulfides High Copper	4.6	5 g/t 3894, 15 g/t PAX	2
DP1947 LS tail	A19905 Primary Sulfide CN-detoxified	2.2	1.5 kg/t NaCN, 0.6 kg/t lime	4
DP2709 LS tail	W337 Primary Sulfide SE CN-detoxified	2.3	5 g/t 3894, 15 g/t PAX, 1.35 kg/t NaCN, 0.6 kg/t lime	4
DP1739 LS tail	DP1739 cycle 4,5,6 (Jan MC)	2.6	7.5 g/t PAX	4
Secondary Sulfide feed				
DP2186 LS tail	W338 Secondary Sulfides 2	1.4	5 g/t 3894, 25 g/t PAX	3
IMASS LS tail (DP2470)	Initial Mining Area Secondary Sulfide	2.2	5 g/t 3894, 25 g/t PAX	4
IMASS HS tail (DP2474)	DP2470 Ro Con	34.2	3 g/t 3894, 250 g/t SMBS	4
DP1803 LS tail	W83 Secondary Sulfides	0.9	7.5 g/t PAX	2
DP1855 LS tail	W335 Small Secondary Sulfide	4.0	5 g/t 3894, 25 g/t PAX	2
DP1855 HS tail	DP1855 Ro con	23.9	3 g/t 3894, 30 g/t NaCN	2
DP1976 LS tail	W337 Mixed Sulfides	1.5	5 g/t 3894, 15 g/t PAX	2
DP1976 HS tail	DP1976 Ro Con	30.5	3 g/t 3894, 30 g/t NaCN	2
DP2728 LS tail	DP2728 cycle 4,5,6 (W366 SS1)	1.1	595 g/t lime, 5 g/t 3894, 25 g/t PAX, 4 g/t H27	4
Oxide feed				
CC18 LS tail	Oxide Pilot Plant Feed (Day 3)	<0.01	150 g/t NaSH, 68 g/t PAX	4
CC18 HS tail	CC18 Ro Con	0.6	7 g/t NaSH, 5 g/t PAX	4

2.2. LABORATORY METHODS

2.2.1. *MINERALOGY*

Mineralogical analysis was conducted at Rio Tinto Development and Technology (Bundoora) on selected tailings and feed composite samples. The mineralogy was based on automated Scanning Electron Microscopy (SEM) using Mineral Liberation Analysis (MLA).

2.2.2. *WHOLE ROCK DIGESTS*

All whole rock assays were determined at Australian Laboratory Services (ALS). The four acid digest and assays were reported for various elements depending on the sample and included: Ag, Al, As, Au, Ba, Be, Bi, Ca, Cd, Ce, Co, Cr, Cs, Cu, Fe, Ga, Ge, Hf, In, K, La, Li, Mg, Mn, Mo, Na, Nb, Ni, P, Pb, Pd, Pt, Rb, Re, Sb, Sc, Si, Sn, S, Sr, Ta, Te, Th, Ti, Tl, U, V, W, Y, Zn, Zr.

The whole rock assay data was collected to allow assessment of trace element elevation and calculation of the Geochemical Abundance Index (GAI). The GAI was calculated using average crustal abundance (Lide 2005) as the background concentration. The GAI is calculated from:

$$\mathrm{GAI} = \log_2\left(\frac{Measured\ Concentration}{1.5 \times Average\ Abundance}\right)$$

The results of the GAI correspond to the relative concentration of an element compared to background concentrations (Table 2). A GAI of three or above indicates where an element

is considered 'enriched'. Although enriched elements may require further investigation, it does not imply that they will be mobile or of environmental concern.

Table 2: Corresponding GAI values relative to global crustal abundance.

GAI	Relative Concentration
0	1–3 times global crustal abundance
1	3–6 times global crustal abundance
2	6–12 times global crustal abundance
3	12–24 times global crustal abundance

2.2.3. *ACID BASE ACCOUNTING*

Acid Base Accounting (ABA) test work was carried out according to the AMIRA (2002) at ALS. Test work included the methods described in Table 3.

Table 3: ABA test methods.

Test	Method
Total sulfur wt.%	LECO furnace.
Sulfide sulfur wt.%	Determined as chromium reducible sulfur in HCl leach.
Total C wt.%	LECO furnace.
Organic C wt.%	HCl leach of carbonate minerals and LECO furnace for residual C.
Acid Neutralisation Capacity (ANC) by Modified Sobek kg H_2SO_4/t	Reaction of sample with HCl and subsequent back-titration with NaOH to determine the amount of acid consumed (AMIRA method).
Custom ANC method (ANC_Custom), kg H_2SO_4/t	Modified Sobek (variation on Lawrence method) developed to reduce contribution of mica dissolution to ANC. See Appendix 2.
Net Acid Generation (NAG), pH and kg H_2SO_4/t	Addition of hydrogen peroxide (H_2O_2) for oxidation of sulfide minerals and subsequent acid generation. Generated acid is consumed by ANC present in the sample during the test. Residual acid is determined via back-titration.

The tests in Table 3 were used to calculate the Maximum Potential Acidity (MPA), ANC by inorganic C (ANC_{TIC}), Net Acid Producing Potential (NAPP) and Neutralisation Potential Ratio (NPR) via the following equations:

- MPA (kg H_2SO_4/t) = Sulfide S% × 30.6[2].
- ANC_{TIC} (kg H_2SO_4/t) = Inorganic C% × 81.7.
- NAPP (kg H_2SO_4/t) = MPA – ANC.
- NPR = ANC/MPA.

On the basis of the above tests, samples are classified as either Non Acid Forming (NAF), Uncertain (UNC) or Potentially Acid Forming (PAF). The following rules are used for sample classification (AMIRA 2002):

- Barren: Total S < 0.1%, ANC ≤ 5 kg H_2SO_4/t
- NAF: NAPP < 0, NAG pH ≥ 4.5.
- PAF: NAPP > 0, NAG pH < 4.5, NAG_pH4.5 > 5 kg H_2SO_4/t.
- PAF-LC (Low Capacity): NAPP > 0, NAG pH < 4.5, NAG_pH4.5 ≤ 5 kg H_2SO_4/t.
- UNC: Samples not assigned as Barren, NAF or PAF.

2.2.4. *STATIC LEACH TESTS*

Static leach tests were conducted on pulverised samples at a Liquid:Solid (L/S) ratio of 2:1 using Deionised (DI) water over 24 hours. The leachate was filtered (0.2 µm) and analysed for a multi-element suite using ICP-AES (Na, Mg, K, Ca, Si) and ICP-MS (Ag, Al, As, Ba, Bi, B, Cd, Co, Cr, Cs, Cu, Fe, Mn, Mo, Ni, Pb, Re, Sb, Se, Sn, Te, Tl, Ti, V, W, U, Zn).

[2] Where sulfide sulfur was not measured, MPA was calculated from total sulfur.

Mercury was analysed separately via a mercury analyser. Anions (Cl, NO_3, sulfate, P, F) and NH_3 were analysed using a ion chromatography and alkalinity was determined by titration.

A zero-headspace leach at L/S of 2:1 over 24 hours was also conducted for some HS tailings where sufficient mass was available. The zero-headspace leach was conducted specifically to determine soluble CN concentrations.

A sequential leach test was completed for one LS tailings sample using an in-house Chemistry Centre protocol for determining type of mobility for constituents under eight varying regimes: (1) water soluble, (2) ion-exchangeable, (3) labile (metal carbonates), (4) easily reducible (amorphous Fe/Mn oxides), (5) moderately reducible (crystalline Fe/Mn oxides), (6) easily oxidisable, (7) recalcitrant oxidisable and (8) total residual (Table 4). The Chemistry Centre method uses a L/S ratio of 1:20 by weight for the water extractable fraction.

Table 4: Leaching regime for Chemistry Centre sequential leach test method.

Step	Fraction	Reagent
1	Water extractable	Deionised water
2	Exchangeable	Ammonium acetate
3	Carbonate	Dilute acetic acid
4	Amorphous Fe/Mn oxide	Hydroxylamine in HCl
5	Crystalline Fe/Mn oxide	4M HCl
6	Easily oxidisable	Sodium chlorate and HCl
7	Recalcitrant oxidisable	H_2O_2
8	Residual	Four acid digest

The mass of the residue following Step seven was recorded and indicated that between 10% and 18% of the sample mass had been lost. The residue was submitted for assay in the final step via four acid digests. Total recovery was calculated by comparing the elemental composition of the head sample with the sum of the leachable mass from Steps one to eight.

2.2.5. *SATURATED COLUMN LEACH TESTS*

Saturated up-flow column leach tests (LEAF 1314: US EPA (2017)) were conducted at Bundoora laboratories on the tailings samples from batch flotation tests using the IMAPS bulk mineral resource composite. Both the LS rougher tailings (IMAPS LS tail) and HS cleaner tailings (IMAPS HS tail) were tested using this procedure. Saturated leach tests assessed the leaching of constituents under anoxic conditions and used groundwater sourced from the Winu boreholes as leachant[3].

Where possible, tailings samples were excluded from oxygen contract, for example by storing under-water and drying in nitrogen-purged ovens. Feed and column eluate was blanketed with nitrogen to exclude oxygen from the liquors. The samples were loaded into the columns and equilibrated with groundwater for 24 hours before eluting groundwater at a fixed rate of 0.75 L/kg/day. Leachates were collected and analysed for the following target cumulative L/S ratios: 0.2, 0.5, 1.0, 1.5, 2.0, 4.5, 5.0, 9.5 and 10.0 L/kg. Assays were conducted as per the kinetic AMIRA columns methodology (Section 2.2.7). Total cyanide

[3] Groundwater collected from Mad Maxx borehole on 19-11-2020.

(CN(T)) was also measured on the later leachates from the HS tailings sample where enough leachate remained after other assays were completed.

2.2.6. *OXYGEN CONSUMPTION RATE TESTS*

Oxygen Consumption Rate (OCR) tests were conducted by Graeme Campbell Associates (GCA) laboratories. OCRs were determined by measuring oxygen consumption over time on as-received tailings samples in an incubator at 30 °C. See the full OCR results in Appendix 3 for further details.

2.2.7. *UNSATURATED FREE DRAINING COLUMN LEACH TESTS*

AMIRA (2002) leach columns are designed to provide a measure of reactivity of a given sample in an oxygenated environment. The column operation is designed to mimic a wet and dry cycle to simulate rainfall and evaporation. Drying was achieved by heating the samples to 35 °C using heat lamps using four x 150 W heat lamps. Sample surface temperature is monitored on a regular basis and recorded for each sample. The samples were 'wetted' every week with DI water at a L/S of 0.1 wt.%. Every four weeks, the samples were 'leached' at a L/S of 0.4 kg/kg. The AMIRA columns were run at ALS in Brisbane. This wet-dry cycle is in place to minimise secondary mineral formation and allow oxygen to freely interact with the sample.

The higher sulfur LS tailings sample (LS tailings - AMIRA) and the whole tailings sample (Whole tailings - AMIRA) were started in April 2020 and were terminated after 46 weeks. For the Whole tailings - AMIRA and LS tailings - AMIRA samples, 1.5 kg of tailings were tested with an initial monthly flush of 600 mL that was increased to 700 mL and then 800 mL by week 22 to achieve proper flushing and sufficient leachate recovery for testing.

Visual inspection of the AMIRA columns during the testing indicated that that there was a hard crust of material on the surface, potentially of evaporative salts forming during testing. This crusting potentially created preferential flows of water through the centre of the material and down the walls of the columns and may also have limited drying or air movement at the centre of the sample.

Monthly leachates (filtered at 0.2 µm) were analysed for:

- Key AMD monitoring parameters: pH, Electrical Conductivity (EC), redox, Total Dissolved Solids (TDS) , acidity, sulfate, alkalinity, Ca, and Mg
- Other major ions: Na, K, Cl, F
- Dissolved nutrients
- Dissolved metals/metalloids

2.2.8. *UNSATURATED HUMIDITY CELL TESTS*

The Humidity Cell Tests (HCTs) were also run at Rio Tinto's Bundoora facility for the LS tailings with higher sulfur concentrations. All other LS tailings HCTs were run at ALS in Brisbane.

HCTs are kinetic tests designed to simulate aerobic weathering conditions to predict primary reaction rates. HCTs are run on a weekly cycle of humid air and dry air, prior to irrigation. The weekly cycle includes three days of continuously passing dry air over the sample, followed by three days of continuously passing humid air over the sample. On the seventh day, DI water is added to the sample and allowed to infiltrate through the sample for at least one hour. The leachate is collected through a drain at the base of the column and submitted for analysis. Standard HCT methods (e.g., MEND 2009 or ASTM D5744-18) recommend a water to rock ratio of 500 or 1000 mL of rinse water per week to one kg of rock (or tailings), and the protocol can be adjusted to achieve proper flushing of a sample.

Non-Agitated testing on Median Sulfur (PS feed) and Median Sulfur (SS feed) samples were initiated on October 2023 at ALS. For these samples, the initial (week 0) flush was with 1250 mL to wet up the sample and then a 500 mL rinse in the following weeks. However, the 500 mL rinse did not result in sufficient flushing of these tailings samples or sufficient volume of leachate for complete testing. The volume was increased to 700 mL in week 5 and thereafter for the Median Sulfur (PS feed) HCT. For the Median Sulfur (SS feed) sample, the rinse volume was changed to 1000 in week 15, 500 mL in week 16, and then 700 mL in week 17 and thereafter. Additionally, with the changes in leaching volumes, cracks in the tailings samples allowing short-circuiting were smoothed and filled in, resulting in some disturbance of the sample in the weeks when the volumes were adjusted. Testing for the Non-Agitated Median Sulfur (PS feed) sample was terminated at week 60 due to a laboratory error that resulted in loss of material from the HCT. This sample underwent post-kinetic ABA testing (Table 12). Testing for the Non-Agitated Median Sulfur (SS feed) sample is still ongoing and results for these are considered “mid-test” and may not represent final conclusions.

Agitated HCT testing on Median Sulfur (PS feed) and Median Sulfur (SS feed) samples were initiated on June 2024 at ALS. For these samples, the initial (week 0) flush was with 1000 mL to wet up the sample and then a 500 mL rinse in the following weeks. However, there were intermittent instances in each sample where the rinse volumes increased to 700 or 1000 mL to achieve sufficient flushing of the samples. Testing for the Agitated Median Sulfur (PS feed) sample was terminated at week 20 as no significant difference in test results was observed between the Agitated and Non-Agitated methodologies for this sample. Testing for the Agitated Median Sulfur (SS feed) sample is still ongoing and results for these are considered “mid-test” and may not represent final conclusions.

The Agitated Low Sulfur (PS feed) sample was initiated in March 2025 at ALS (Table 1). This sample was flushed each week with a 700 mL rinse. The Agitated HCT for the Low Sulfur (PS feed) sample was terminated at week 3 once realised that the sulfur content was low relative to the projected annual sulfur content of the tailings.

The CIL Detox. (detoxified) HCT was started in May 2023 and was terminated after 25 weeks. Weekly flushes were conducted using 1,000 mL for one kg of tailings.

Testing of LS tailings with High Sulfur (PS feed) and High Sulfur (SS feed) started in January 2022 and were terminated after 91 weeks. The method for these HCT samples followed the option in Morin and Hutt (2001) and MEND (2009) for gentle agitation of the tailings after the weekly addition of solution to limit the formation of preferential flow paths and allowed to rest for approximately four hours prior draining the leachate to ensure full contact with the sample.

For the HCTs, weekly leachate samples were analysed for the key AMD parameters (e.g., pH, EC, Fe, sulfate, Ca, Mg, acidity, and alkalinity). An extended analytical suite, including the other major ions, metals/metalloids, nutrients, and CN species, was used for leachates produced during the initial weeks of testing (first four or five weeks) and at regular basis (every four or five weeks) throughout the remainder of the testing duration. Although the different testing campaigns had slightly different analytical suites and sampling approaches, they are generally consistent and comparable.

3. RESULTS AND DISCUSSION

3.1. MINERALOGY

Sulfur in the feed for the mineral resource composites was predominantly present as pyrite, followed by chalcopyrite (Figure 7) with > 80% of sulfides reporting to these two minerals even in the secondary sulfide zone. As a result of copper sulfide removal during flotation,

sulfide in the tailings will be overwhelmingly present as pyrite with minimal contributions from other sulfide minerals.

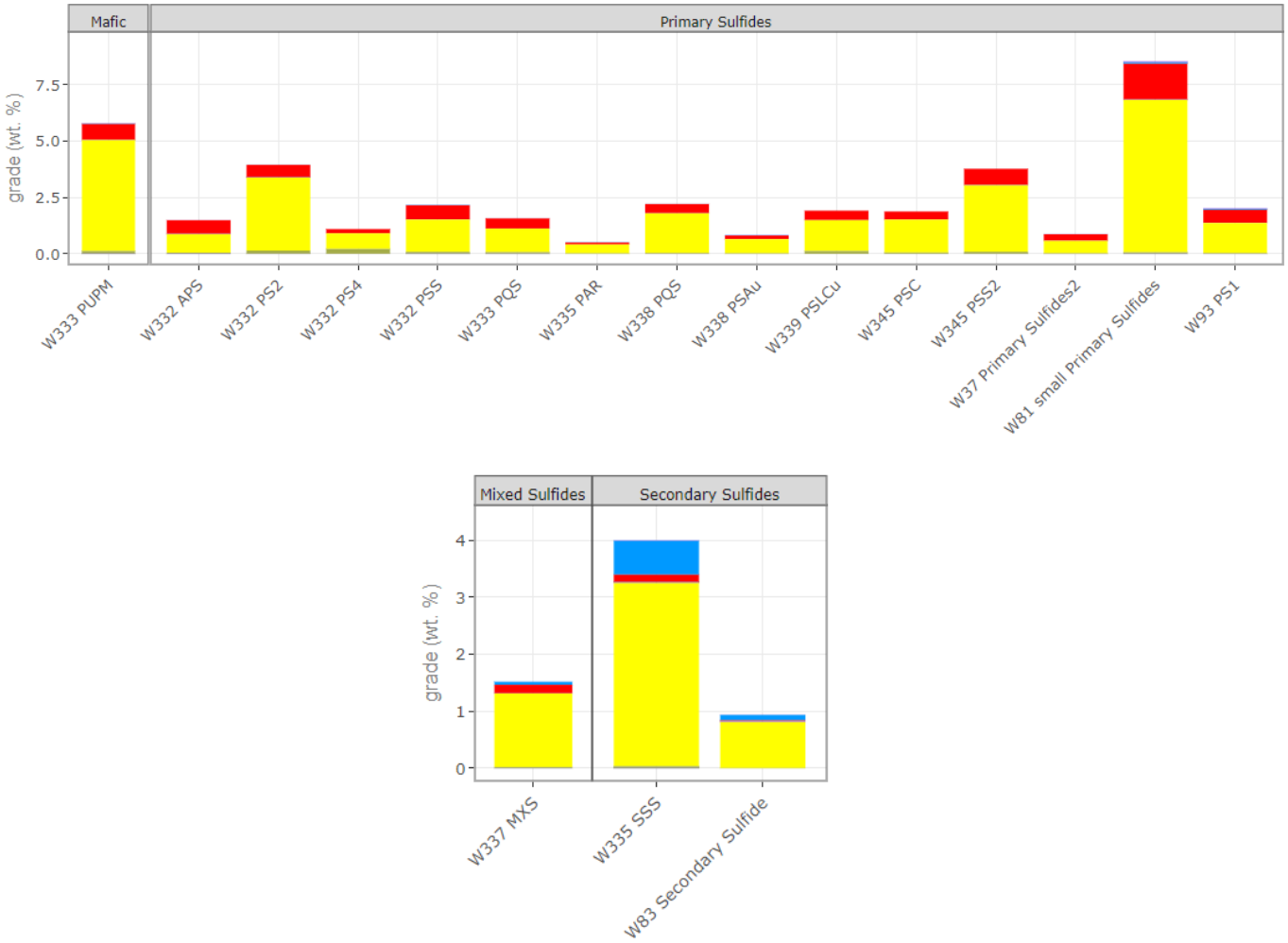

Figure 7: Sulfur grade and deportment for feed materials to metallurgical test work. Sulfur content is coded by colour: yellow is pyrite, gold is pyrrhotite, red is chalcopyrite, and blue is chalcocite.

Carbonates were only present at low concentrations (< 0.5 wt.%) and typically present as siderite (> 50 wt.% deportment on average), although some feed samples did show significant deportment of C to dolomite (W332, primary sulfide 2, W339 primary sulfide low Cu, W345 primary sulfide carbonates and W37 primary sulfides 2: Figure 8). As siderite is not net-acid neutralising, the majority of the C present in these tailings samples will be unavailable for acid neutralisation. Carbonate minerals were not found at appreciable concentrations in the secondary sulfide feed materials (< 0.1 wt.%).

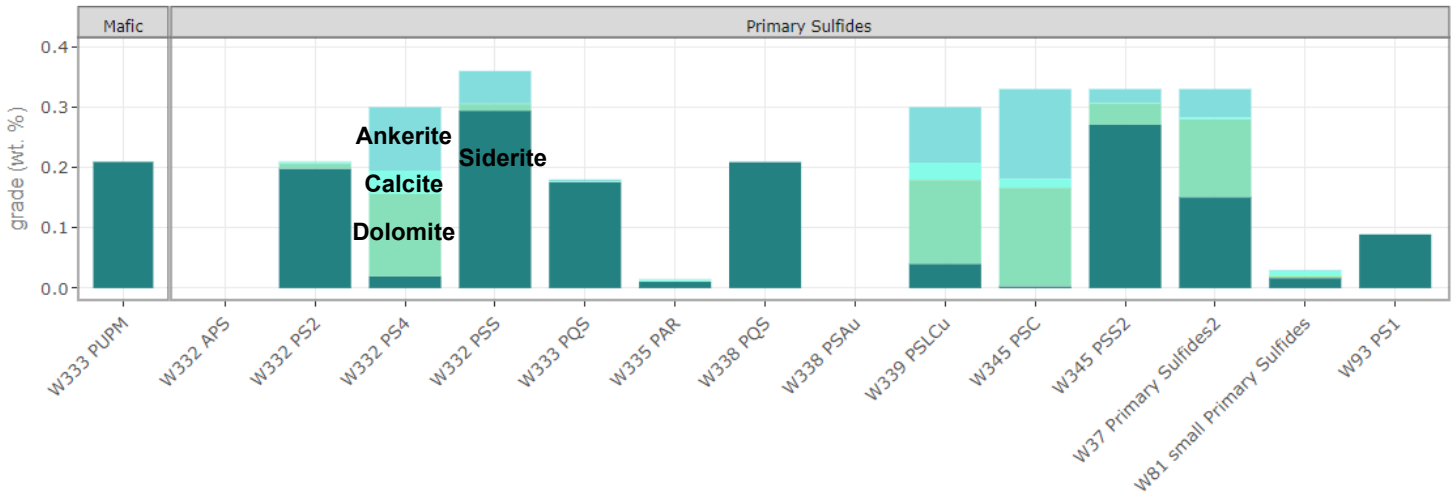

Figure 8: Carbon grade and deportment for feed materials to metallurgical test work reporting mineral species as C%.

Quantitative mineralogy was collected on eight samples of primary sulfide LS tailings (Figure 9) and one sample of HS tailings (IMAPS HS tail). Sulfur in the LS tailings was present predominantly (> 80%) as pyrite, with lesser pyrrhotite and chalcopyrite. Pyrrhotite deportment ranged from 4 to 38% of the sulfur content, although the associated sulfur grade in pyrrhotite was consistently below 0.1%.

Sulfur in the IMAPS HS tailings samples was present as 97% pyrite.

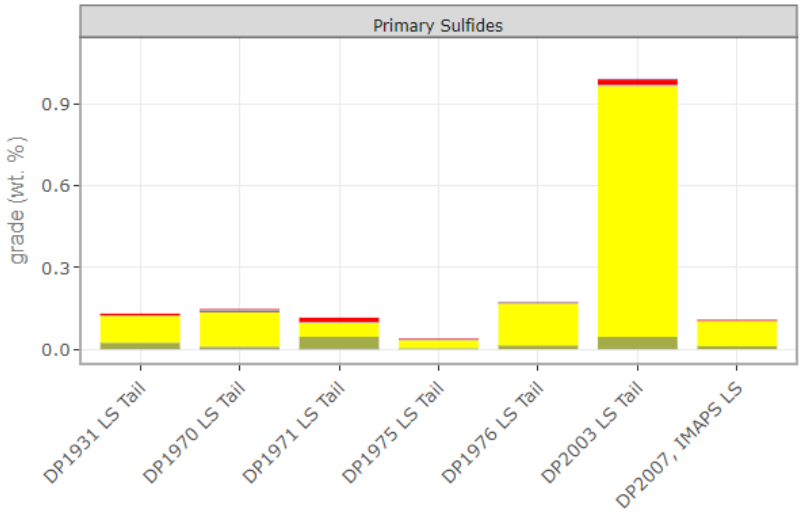

Figure 9: Sulfur grade and deportment in primary sulfide LS tailings samples. Pyrite is yellow, pyrrhotite is gold and chalcopyrite is red.

Carbonate content in the LS tailings samples was typically low (< 0.3%) and deported predominantly to siderite (> 60%) in all cases. Hence, a large proportion of the carbonate ANC in the LS primary sulfide tailings samples is unlikely to be available for acid neutralisation. In saturated, slower reacting, tailings, longer term neutralisation may be available from slower reacting silicate minerals that make up a significant proportion of the tailings: biotite ranging from 0.5 to 35 wt.% and muscovite from one to 22 wt.% (Figure 10).

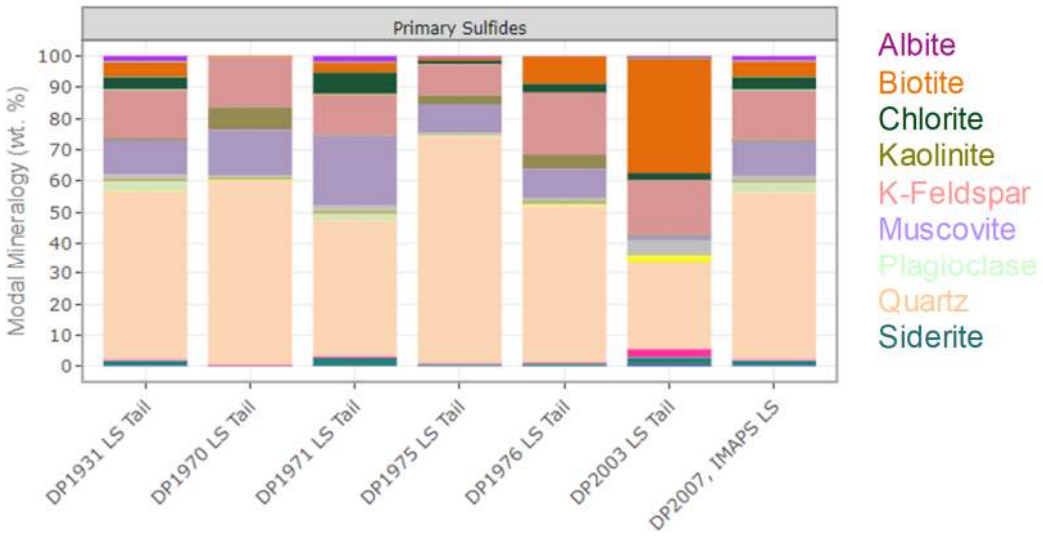

Figure 10: SEM modal mineralogy for primary sulfide LS tailings samples.

XRD analysis of DP1471 LS tail #3 and #4 was analysed by Chemistry Centre. The XRD results were very similar for the two repeat samples and showed similar trends to the modal mineralogy collected from SEM. That is, moderate concentrations of silicates such as biotite, muscovite and chlorite (chlinochlore) were present in an otherwise quartz-rich sample (Table 5).

Table 5: Semi-quantitative XRD results for primary sulfide tailings samples.

	DP1471 LS tail #3	DP1471 LS tail #4
Quartz	48%	55%
Albite	11%	9%
Microcline	12%	7%
Biotite	7%	7%
Muscovite	5%	6%
Clinochlore	16%	14%
Hematite	1%	0%
Magnetite	1%	1%
Siderite	1%	2%

Additional XRD analysis was completed at ALS for the IMASS and oxide pilot plant samples (Table 6). These results again align with expectations from the SEM analysis of the LS tailings, which contained high proportions of silicates and clays and the HS tailings (excluding oxide HS tail, which is actually a LS tailings sample), which contained a high proportion of pyrite. Amorphous material was not quantified for this analysis, so percentages are for crystalline components only.

Table 6: Semi-quantitative XRD results for secondary sulfide and oxide tailings samples.

	IMASS LS tail (DP2470)	IMASS HS tail (DP2474)	CC18 LS tail (Oxide pilot)	CC18 HS tail (Oxide pilot)
Pyrite	-	37	-	< 1
Marcasite	-	2	-	-
Goethite	-	1	-	-
Clay	1	1	-	-
Kaolinite	8	19	54	14
Serpentine	< 1	1	-	-
Chlorite	4	4	3	2
Biotite	9	5	3	2

	IMASS LS tail (DP2470)	IMASS HS tail (DP2474)	CC18 LS tail (Oxide pilot)	CC18 HS tail (Oxide pilot)
Muscovite	13	12	15	11
K-Feldspar	10	5	-	2
Quartz	56	14	24	69
Gypsum	0	< 1	-	-

3.2. ACID BASE ACCOUNTING

As predicted by the high abundance of siderite in the mineral resource material, ANC_{TIC} was often much greater than the measured ANC for both LS (Table 7) and HS (Table 8) tailings samples. For the W338 primary sulfide feed composites (DP1745 / DP1750), the measured ANC was below the laboratory reporting limit (0.5 kg H_2SO_4/t), despite calculated ANC_{TIC} of up to 37 kg H_2SO_4/t.

Within the LS tailings samples, the median ANC based on titration was 9.2 kg H_2SO_4/t in the tailings generated from primary sulfide feed and 5.3 kg H_2SO_4/t in the secondary sulfide feed tailings, while ANC_{TIC} was 14.7 kg H_2SO_4/t and 1.6 kg H_2SO_4/t respectively. This highlights a reduced amount of ANC within secondary sulfide feed tailings, particularly the carbonate based ANC.

The HS tailings samples (Table 8), with expected majority pyrite in the feed, were consistently found to be PAF with very high acid generation potentials (> 300 kg H_2SO_4/t). The MPA calculated from sulfide sulfur is likely to be representative for these samples. For comparison, the median MPA for the LS tailings samples was 4.7 kg H_2SO_4/t. The median sulfide sulfur concentrations is 0.15% and 0.2% in the LS tailings from primary and secondary sulfide feeds respectively. Whilst the median sulfide sulfur concentration in the HS tails is 23%.

The median NAPP for HS tailings (excluding oxides) was 648 kg H_2SO_4/t with a median NAG pH of 2. The median NAPP for the LS tailings (including LS oxides) was -2.2 kg H_2SO_4/t with a median NAG pH of 4.6, classifying the LS tailings as NAF based on the median (and also the average) from the tested samples. The mafic samples (in **bold**) had higher sulfur contents in the LS tailings (average of 0.4%), suggesting that LS tailings from the mafic units (which make up 1.4% of the feed) are more likely to be PAF or PAF-LC.

Table 7: Summary of LS ABA data for Winu tailings samples. Values below laboratory reporting limits in blue italics. Mafic samples in bold.

Description	Sulfide %	Paste pH	Paste EC µS/cm	MPA kg H_2SO_4/t	ANC[1] kg H_2SO_4/t	ANC_{TIC} kg H_2SO_4/t	NPR	NAPP kg H_2SO_4/t	NAG pH	NAF / PAF
Primary Sulfides										
DP1471 LS tail #3	0.15	7.8	470	4.6	10.0*	13.1	2.19	-5.4	7.0	NAF
DP1471 LS tail #4[2]	0.347	7.7	382	10.6	12.9*	17.2	1.21	-2.3	4.3	UNC
DP1648 LS tail	0.68			20.8	8.3*	14.7	0.4	12.5	3.0	PAF
DP1649 LS tail	1.13			34.6	7.8*	13.1	0.23	26.8	2.7	PAF
DP1745 LS tail	0.088	7.5	218	2.7	*0.5**	10.6	0.19	2.2	3.9	PAF-LC
DP1750 LS tail	0.292	7.0	599	8.9	*0.5**	19.6	0.06	8.4	4.1	PAF-LC
DP1802 LS tail	0.586	6.9	1780	17.9	3.8	11.4	0.21	14.1	3.0	PAF
DP1804 LS tail	0.064	7.4	566	2.0	10.6	21.2	5.41	-8.6	8.9	NAF
DP1931 LS tail	0.146	7.7	449	4.5	9.5	20.4	2.13	-5.0	7.8	NAF
DP1970 LS tail	0.111	5.5	240	3.4	0.5	*1.6*	0.15	2.9	3.9	PAF-LC
DP1971 LS tail	0.155	7.2	482	4.7	9.1	21.2	1.92	-4.4	7.9	NAF
DP1972 LS tail	0.125	7.2	348	3.8	3.1	10.6	0.81	0.7	4.6	UNC

Description	Sulfide %	Paste pH	Paste EC µS/cm	MPA kg H_2SO_4/t	ANC[1] kg H_2SO_4/t	ANC_{TIC} kg H_2SO_4/t	NPR	NAPP kg H_2SO_4/t	NAG pH	NAF / PAF
DP1975 LS tail	0.081	5.8	409	2.5	3.2	*1.6*	1.29	-0.7	3.7	Barren
DP2003 LS tail	0.407	5.0	797	12.5	6.5	13.1	0.52	6.0	3.0	PAF
IMAPS LS tail[3]	0.079	7.0	512	2.4	9.3	15.5	3.85	-6.9	9.0	NAF
DP2001 LS tail	0.142			4.3		21.2	4.89	-16.9	8.4	NAF
DP2002 LS tail	0.293			9.0		23.7	2.64	-14.7	3.6	UNC
DP2004 LS tail	0.617			18.9		13.1	0.69	5.8	2.8	PAF
DP2042r LS tail	0.313			9.6		18.8	1.96	-9.2	7.7	NAF
DP2043 LS tail	0.094			2.9		*1.6*	0.57	1.2	6.2	Barren
DP2044 LS tail	0.102			3.1		18.0	5.76	-14.9	9.3	NAF
DP2045 LS tail	0.101			3.1		*1.6*	0.53	1.5	2.6	PAF
DP2046 LS tail	0.105			3.2		24.5	7.63	-21.3	3.2	UNC
DP2047 LS tail	0.126			3.9		14.7	3.81	-10.9	8.3	NAF
DP2048 LS tail	0.549			16.8		23.7	1.41	-6.9	4.6	NAF
DP1999 LS tail[2]	0.516	5.8	537	15.8	14.5	13.9	0.92	1.3	5.2	UNC
DP1947 LS tail[2]	0.12	8.6		3.6	30*	24	8.3	-26	8.2	NAF
DP2709 LS tail	0.19			5.8	32	13	5.6	-26	9.2	NAF
DP1739 LS tail[2]	0.17			5.2	14.8	11.4	2.8	-9.6	6.6	NAF
Secondary / Mixed Sulfides										
DP1803 LS tail	0.21	7.5	192	6.4	*0.5*	*1.6*	0.08	5.9	3.4	PAF-LC
DP1855 LS tail	0.418	7.1	498	12.8	0.7	*1.6*	0.05	12.1	3.1	PAF
DP1976 LS tail	0.152	6.8	266	4.7	4	3.3	0.86	0.7	3.4	PAF-LC
IMASS LS tail	0.045	7.2	402	1.4	6.6	1.6	4.79	-5.2	6.9	NAF
DP2186 LS tail[2]	0.301	7.8	353	9.2	7.1	1.6	0.77	2.1	5.0	UNC
DP2728 LS tail[2]	0.18			5.5	7.5	1.6	1.36	-1.99	4.2	UNC
Oxides										
CC18 LS tail	0.012	7.0	680	0.4	4.5	*1.6*	12.3	-4.1	6.7	Barren

1 ANC method used is custom ANC method (Appendix 2) where sample was available, otherwise reported method is AMIRA (*).

2 Kinetic leach tests undertaken, and these samples relabelled for easy reference in Section 3.6.

DP1471 LS tail #4 labelled 'LS tailings – AMIRA'

DP1999 LS tail labelled 'High Sulfur (PS feed)'

DP1947 LS tail labelled 'CIL Detox.'

DP1739 LS tail labelled 'Median Sulfur (PS feed)'

DP2186 LS tail labelled 'High Sulfur (SS feed)'

DP2728 LS tail labelled 'Median Sulfur (SS feed)'

3 Saturated leach tests undertaken.

Table 8: Summary of HS tailings ABA data. Values below laboratory reporting limits in blue italics. Mafic samples in bold.

Description	Sulfide %	Paste pH	Paste EC µS/cm	MPA kg H_2SO_4/t	ANC[1] kg H_2SO_4/t	ANC_{TIC} kg H_2SO_4/t	NPR	NAPP kg H_2SO_4/t	NAG pH	NAF / PAF[3]
Primary Sulfides										
DP1555-1560 HS tail	25		1620	765	5.2*	23.7	0.01	760	1.9	PAF
DP1745 HS tail	25		1780	765	*0.5**	37.6	0.001	765	1.9	PAF
DP1802 HS tail	25			765	*0.5*	10.6	0.001	765	1.8	PAF
DP1804 HS tail[2]	14.3			438	17.5		0.04	421		PAF
DP1970 HS tail	16.2			496	2.7		0.01	493		PAF
DP1971 HS tail	23			704	6.7		0.01	697		PAF
DP1972 HS tail	25.1			768	3.7		0.005	764		PAF
DP1975 HS tail	17.2			526	3.2		0.01	523		PAF
DP2003 HS tail	29.2			894	3.3		0.004	890		PAF
IMAPS HS tail[3]	23.4	7.1	1910	716	18.4	27.8	0.03	698	2.0	PAF
Secondary / Mixed Sulfides										
IMASS HS tail	19.8	7.2	1840	606	6.1	9.8	0.01	600	2.0	PAF
DP1855 HS tail	11.3			346	3.1	*1.6*	0.01	343	2.2	PAF
DP1976 HS tail	23.1			707	7.4		0.01	699		PAF
Oxides										
CC18 HS tail	0.037	6.6	452	1.1	2.8	*1.6*	2.47	-1.7	7.0	Barren

1 ANC method used is custom ANC method where sample was available (Appendix 2), otherwise reported method is AMIRA (*).

2 Sulfide not measured for this sample; result is total sulfur with assumption of zero sulfate.

3 Not enough sample to run NAG test on some HS tails; NAF/PAF classification based on NPR only.

A whole tailings sample was also analysed as discussed separately in the kinetic testing Section 3.6. Whole tailings placement is not the base case for Winu TSF.

The NAPP of the tested LS tailings samples typically ranged from -30 to 30 kg H_2SO_4/t. NAF samples tended to generate a NAG pH of around pH 8, whilst UNC and PAF samples resulted in NAG pH values of three to four. All but one secondary sulfide / mixed sulfide LS tailings, as well as two of the three mafic LS tailings, were classified as PAF (Figure 11). Despite other secondary sulfide LS tailings samples generating acid in the NAG tests, the IMASS LS tail (DP2470) did not generate acidity and was classified as NAF.

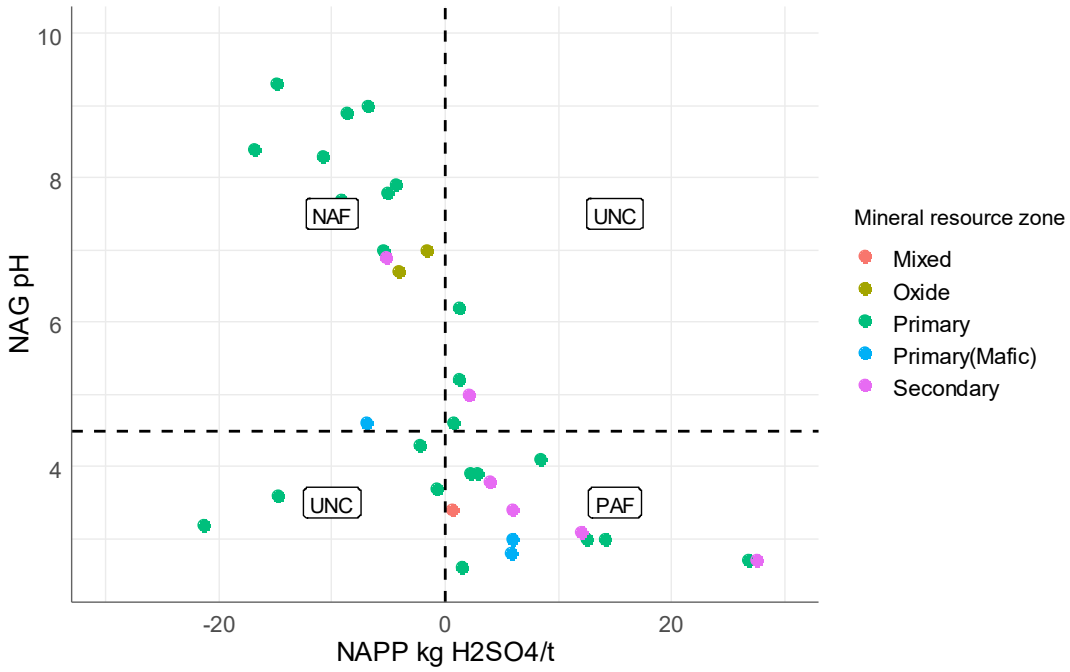

Figure 11: Plot of NAG pH vs NAPP for LS tailings samples only (HS tailings sample results would be far to the bottom right quadrant and obscure the results of LS tailings).

One uncertain sample (DP1471 LS tail #4) was a primary sulfide LS tailings from the same batch of flotation tests as one of the NAF samples (DP1471 LS tail #3), indicating potential variability in the tailings generated during the metallurgical test program. The NAG (to pH 4.5) of the uncertain sample was very low (0.2 kg H_2SO_4/t) and so if the sample were PAF it would be of low capacity.

Repeat analysis of both these sample at another laboratory (Chemistry Centre) resulted in ANC of < 0.5 kg H_2SO_4/t and 0.18% sulfide for both samples (and low sulfate sulfur 0.02%, suggesting minimal oxidation before testing). Duplicate NAG pH values were similar at Chemistry Centre (5.0 and 5.2), which would classify both these sample as uncertain (top right quadrant of Figure 11). The lower ANC measured compared with Table 7 is indicative of a more conservative method that avoids dissolution of mica and other silicate minerals. The difference between sulfide sulfur and NAG pH for DP1471 LS tail #4 measured in this program (ALS) and at Chemistry Centre suggest that potentially an unrepresentative sample was selected for testing at ALS and that an average sulfide grade in the LS tails from this sample is nearer 0.15%.

The IMAPS composite sample resulted in a low sulfur content of only 0.1% and was classified as NAF, suggesting lower risk of generating PAF LS tailings soon after start-up under this processing scheme. There was, however, high variability in the sample classification for the tailings overall. Although the NAF samples had a sulfur content of less than 0.2% sulfur, there were also several samples classified as PAF LC with sulfur contents below 0.2% (Figure 12).

Variability in classification of LS tailings samples was mostly due to the low and unavailable ANC in these samples.

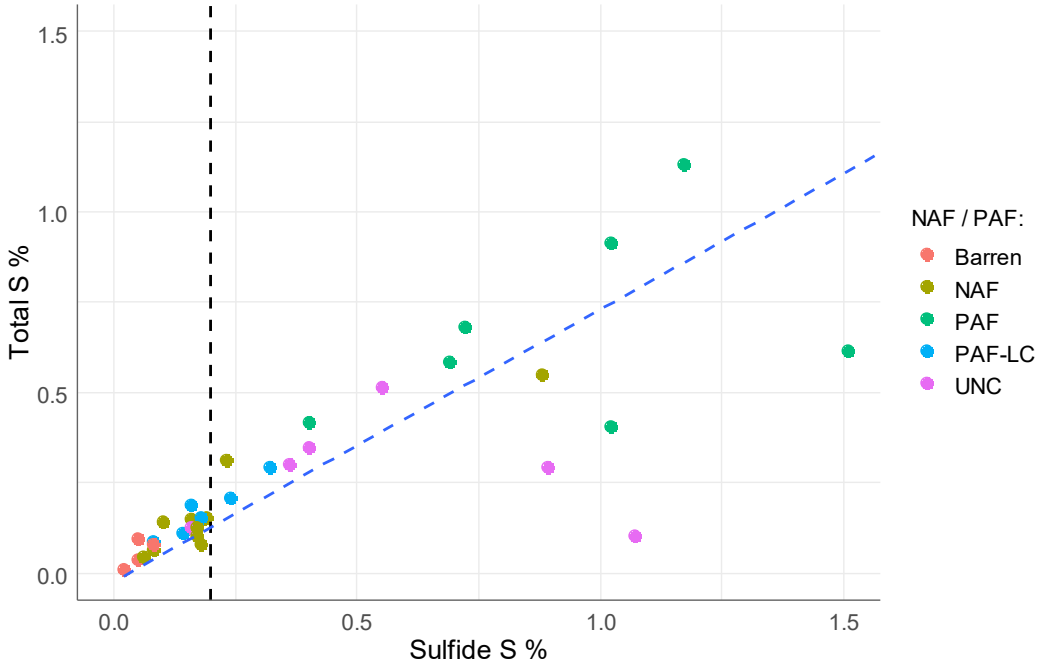

Figure 12: Classification of tailings samples against sulfur and sulfide content.

3.3. WHOLE ROCK DIGEST

Whole rock assay results are shown in Table 9 with elements not measured at a GAI above three excluded. Full whole rock assay results are given in Appendix 3.

Bismuth, P and W were enriched in the tailing's samples consistent with the waste rock and mineral resource grade samples (Rio Tinto 2024b, 2024 c and 2024d). The HS tailings also had some enrichment of Ag, Ni, P and Se. This is likely due to these elements concentrating into sulfide minerals, potentially as inclusions within pyrite. The oxide tailings also had some enrichment of Cu, which would be expected to change in the future as the processing schemes develop.

Table 9: Whole rock assay results (mg/kg). Yellow represents a GAI of 3 - 5, red a GAI ≥ 6. Elements with a GAI < 3 for all samples have been excluded from the list.

Sample ID	Ag	As	Bi	Co	Cu	Mo	Ni	P	Re	S	Sb	Se	Sn	W
Average Abundance	*0.08*	*1.8*	*0.009*	*25*	*60*	*1.2*	*84*	*0.1*	*0.001*	*0.04*	*0.2*	*0.05*	*2*	*1.3*
Primary Sulfides														
DP1471 LS Tail #3	<0.5	<5	35	27	74	32	237				<5			240
DP1745 LS Tail	<0.5	<5	15	21	98	42	295							120
DP1750 LS Tail	1.1	<5	52	42	368	42	305							330
DP1802 LS Tail	<0.5	<5	48	60	208	43	338							320
DP1804 LS Tail	<0.5	<5	27	20	99	41	299							180
DP1931 LS Tail	0.6	<5	75	29	247	54	356				<5	<10		360
DP1970 LS Tail	0.7	<5	**51**	35	134	30	214				<5	<10		120
DP1971 LS Tail	<0.5	<5	24	32	234	34	258				<5	<10		140
DP1972 LS Tail	<0.5	<5	13	35	100	41	299				<5	<10		130
DP1975 LS Tail	0.57	2.3	13	26	180	36	263	130	0.005	0.1	0.2	<1	8	115
DP2003 LS Tail	1.4	1.1	69	60	559	28	191	2470	0.014	1.0	0.2	<1	40	950
IMAPS LS Tail	0.52	1.8	22	32	145	61	446	290	0.009	0.1	0.2	<1	10	357
DP1999 LS Tail	1.7	1.8	81	51	591	44	284	250	0.007	0.6	0.2	<1	12	412
DP1555-1560 HS Tail	20.8	19	127	1460	1760	110	1340				<5			120
IMAPS HS Tail	23.3	34.6	179	1180	1530	80	11210	130	0.014	<10	3.4	20	15	180
Secondary Sulfides														
DP1803 LS Tail	<0.5	<5	29	17	1230	15	119				<5	<10		80
DP1855 LS Tail	1.7	<5	155	35	1530	17	134				<5	<10		40
DP1976 LS Tail	<0.5	1.9	27	40	197	34	251	350	0.005	0.2	0.2	<1	12	188
IMASS LS Tail	<0.4	1.7	23	30	543	36	254	140	0.007	0.1	0.2	<1	10	171
DP2186 LS Tail	0.7	0.8	66	43	688	25	196	140	0.004	0.4	0.2	<1	12	241
IMASS HS Tail	20.2	27.3	114	1395	2720	90	1370	120	0.015		2.1	23	17	174.5
Oxides														
CC18 LS Tail	1.4	<5	85		5780	46	333				<5	<10		190
CC18 HS Tail	3.1	9	133		9950	52	352				<5	<10		230

3.4. METAL LEACHING (STATIC TESTS)

Determination of the potential for constituents to leach from LS tailings followed a protocol developed by Green *et. al.* (2019). This included an assessment of constituent leachability in DI water, release to NAG liquors, and constituent mobility under saline conditions. Saturated dynamic columns (Section 3.5) and kinetic column leaches (Section 3.6) have also been undertaken to assist with determining longer-term release rates on storage in the TSF.

The overall objective of the test program is to generate datasets suitable to support development of predictive models of geochemical behaviour at field scale. It is important to select the method that most closely simulates the site-specific ambient environment and conditions (e.g. low liquid to solid ratios, nature of lixiviant). Leach test work was limited on the HS tailings due to low available sample mass from metallurgical test work. However, as discussed in the AMD management strategy and plan (2024), it is intended that HS tailings are stored sub-aqueously to reduce the risk of chemical reactions and potential constituent mobility. Therefore, the focus of the test program has been on the LS tailings, which represent the larger mass of tailings and may experience some oxidation.

3.4.1. *TAILINGS SUPERNATENTS*

Fluoride concentrations generally increased as pH increased (> pH 7) particularly in the tailings supernatant (also called filtrate) samples (Figure 13). Other elemental concentrations in tailings supernatant samples were similarly often higher than the corresponding DI leach constituent concentrations as discussed in Section 3.4.4 (Saline Leach Tests). Supernatant samples were filtered through a coarse (80 µm) filter paper prior to preservation and before analysis – compared with a fine filter for leach extracts (0.2 µm). The slightly higher concentrations in the supernatant compared with the leachate is likely due to fine solids (e.g., colloids, nanoparticles) passing the filter mesh, rather than dissolved mobile species.

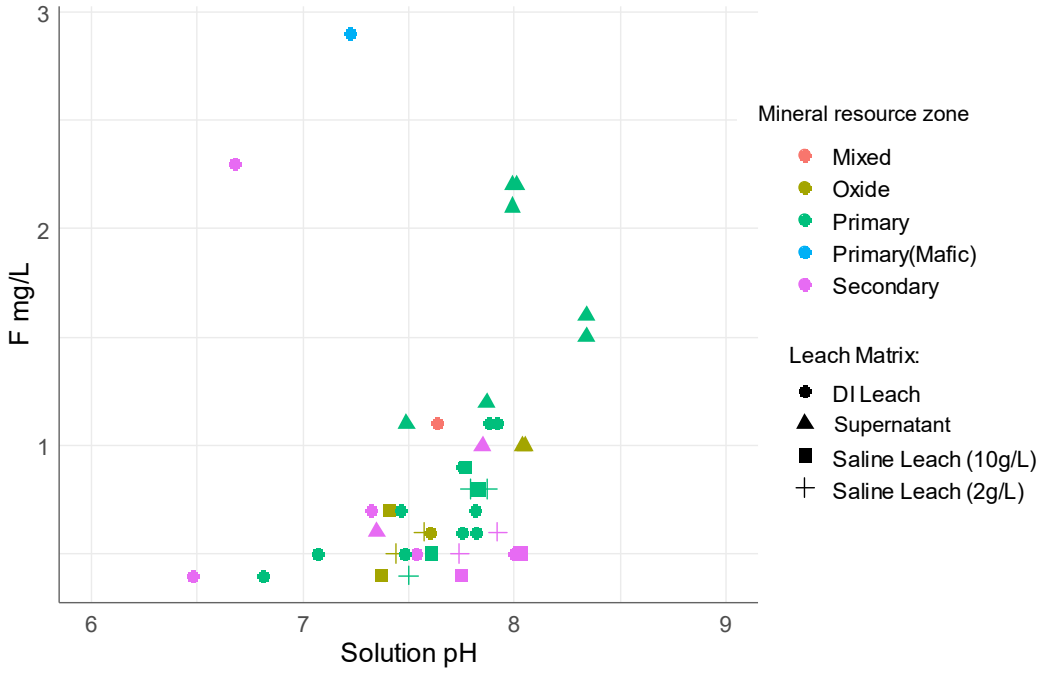

Figure 13: F concentration in leachate against pH (NAG liquors not analysed for F).

An evaluation was undertaken for CN speciation concentrations in HS tailings that are generated from the cleaner processing circuit. Cyanide was measured from four available

HS tailings supernatants where CN had been added (IMAPS HS tail, DP2099 HS tail and DP2100 HS tail). Cyanide concentrations in the tailings supernatant ranged from 1 to 4 mg/L CN(T), speciated predominantly (> 98%) to CN(WAD). These concentrations are significantly lower than a potential tailings supernatant guideline value of 50 mg/L (DFAT 2008).

3.4.2. *DEIONISED WATER 2:1 LEACH*

It should be noted that the physical and chemical conditions of static leach tests are not the same as those that will exist in the field due to differences in solubility constraints, liquid to solid ratios, contact time, liquor compositions. Therefore, the results cannot be directly extrapolated to predict leachate quality in the field. The results are useful, however, to provide a first order indication of the readily leachable elements from the sample material.

DI leachates at L/S of 2:1 did not result in high concentrations of elements typically of concern in copper sulfide deposits (As, Cd, Cr, Co, Ni, Zn, Sb, Se: Table 10). In particular, Cr, Cd and Sb were rarely reported above laboratory reporting limits. The exception to this was the mafic PAF DP2003 LS tail sample, where elevated concentrations of Cd, Co, Mn, and Ni were observed.

The end pH of the leachates from LS tailings DI leaches was near to or above seven and typically concentrations of analytes were below detection. For the elements that were often above quantification limits (Ba, Ca, Cu, Mg, Mn, Mo, Ni, K, Na, sulfur, Sr, W), dissolution extents were typically less than 1% of the available element in the sample, although higher dissolution extents were observed from the one HS tailings sample. Sulfur, Ca and Na were most mobile with an average dissolution for sulfur, Ca and Na of 2 to 4%. Dissolution extents of Mn, Cu and Ni were less than 0.5%.

Salinity values, as represented by paste EC, from the 1:2 leachate were assessed against the guidelines for suitability as a soil growth medium based on a 1:5 leachate (Hunt 1992):

- 0 – 400 micro Siemens/centimetre (µS/cm): suitable for a soil growth medium
- 400 – 1600 µS/cm: suitable for some salt tolerant species
- > 1600 µS/cm: may not be a suitable growth medium.

These guidelines are based on crops used in agriculture and for a 1:5 leach rather than a more concentrated 1:2 leach. The comparison is therefore more conservative and should be used as a guide only.

With the exception of the saline leachates EC values were below 1600 µS/cm. Salinity was, however, often measured above 400 µS/cm in the DI water leach tests, indicating moderate salinity release from the tailings samples. The increased salinity typically correlated with sulfate, except for supernatant samples with high Cl. Higher Cl in the supernatant is expected given flotation took place using Perth tap water (sodium chloride type water).

Soluble CN was assessed from two HS tailings sample where CN was used in flotation (DP1855 HS tail and IMPAS HS tail) to assess the level of remaining CN on the solids after using 30 g/t NaCN in the flotation test (an old scheme). Both CN(T) and CN(WAD) were below the laboratory reporting limit (< 0.004 mg/L) for DP1855 HS tail. For the IMAPS HS tail, CN(WAD) was below the laboratory reporting limit and CN(T) was 0.006 mg/L. Residual CN from processing under this flotation scheme is therefore expected to be present only in the tailings supernatant, not entrained within the tailings solids.

Table 10: Summary of results for L/S = 2:1 DI leach of tailings samples. Analytes below laboratory reporting limits in blue italics. Australian drinking water guidelines included for reference only, actual trigger values will be site specific.

Sample ID	pH	EC µS/cm	sulfate mg/L	F mg/L	As mg/L	Cd mg/L	Cr mg/L	Co mg/L	Cu mg/L	Mn mg/L	Hg mg/L	Mo mg/L	Ni mg/L	Sb mg/L	Se mg/L	W mg/L	Zn mg/L
Aus DW Guideline			*500*	*1.5*	*0.01*	*0.002*	*0.05*		*2*	*0.5*	*0.006*	*0.05*	*0.02*	*0.003*	*0.01*		*3*
Primary Sulfides																	
DP1471 LS tail #3	7.88	366	92	1.1	*<0.001*	*<1e-04*	*<0.001*	*<0.001*	0.002	0.095	*<1e-04*	0.018	0.002	0.003	*<0.01*	0.011	*<0.005*
DP1471 LS tail #4	7.92	337	86	1.1	*<0.001*	*<1e-04*	0.002	*<0.001*	0.001	0.121	*<1e-04*	0.013	0.002	0.002	*<0.01*	0.01	*<0.005*
DP1745 LS tail	6.81	186	42	0.4	*<0.001*	*<1e-04*	*<0.001*	0.001	0.004	0.047	0.0353	0.027	0.004	*<0.001*	*<0.01*	0.014	*<0.005*
DP1750 LS tail	7.07	465	154	0.5	*<0.001*	*<1e-04*	*<0.001*	0.011	0.017	0.123	*<1e-04*	0.008	0.02	*<0.001*	*<0.01*	0.003	0.005
DP1802 LS tail	7.46	533	149	0.7	*<0.001*	*<1e-04*	*<0.001*	0.002	0.002	0.106	0.0006	0.013	0.007	*<0.001*	*<0.01*	0.005	*<0.005*
DP1804 LS tail	7.75	429	126	0.6	*<0.001*	*<1e-04*	*<0.001*	*<0.001*	0.002	0.053	0.0026	0.016	0.002	0.001	*<0.01*	0.057	*<0.005*
DP1931 LS tail	7.81	407	66	0.7	*<0.001*	*<1e-04*	*<0.001*	*<0.001*	0.003	0.026	0.0009	0.023	0.002	*<0.001*	*<0.01*	0.089	*<0.005*
DP1971 LS tail	7.82	392	87	0.6	*<0.001*	*<1e-04*	*<0.001*	0.002	0.002	0.041	0.0018	0.018	0.004	0.001	*<0.01*	0.024	*<0.005*
DP2003 LS tail	7.22	714	236	2.9	*<0.005*	0.0093	*<0.005*	0.479	0.115	0.938	*<5e-04*	*<0.005*	0.307	*<0.005*	*<0.05*	*<0.005*	1.56
IMAPS LS tail	7.75	305	70	0.9	*<0.001*	*<1e-04*	*<0.001*	*<0.001*	0.002	0.046	*<1e-04*	0.015	0.002	*<0.001*	*<0.01*	0.025	0.046
IMAPS HS tail	7.48	1150	429	0.5	*<0.001*	0.0003	*<0.001*	0.044	0.019	0.132	*<1e-04*	0.006	0.038	0.002	0.01	0.001	0.261
Secondary Sulfides																	
DP1803 LS tail	7.32	174	26	0.7	*<0.001*	*<1e-04*	*<0.001*	0.002	0.086	0.01	0.0228	0.006	0.006	*<0.001*	0.05	0.03	*<0.005*
DP1855 LS tail	7.53	315	70	0.5	*<0.001*	0.0006	*<0.001*	0.005	0.104	0.025	*<1e-04*	0.016	0.002	*<0.001*	*<0.01*	0.044	0.007
DP1976 LS tail	7.63	403	78	1.1	*<0.005*	*<5e-04*	*<0.005*	0.01	0.016	0.09	0.0031	0.017	0.012	*<0.005*	*<0.05*	0.018	0.054
IMASS LS tail	7.48	256	44	0.5	0.001	*<1e-04*	*<0.001*	0.002	0.014	0.013	*<1e-04*	0.009	0.001	*<0.001*	*<0.01*	0.034	0.011
IMASS HS tail	8.00	2380	919	0.5	*<0.001*	0.0052	*<0.001*	0.598	0.236	0.271	*<1e-04*	0.004	0.26	*<0.001*	0.01	*<0.001*	0.418
Oxides																	
CC18 LS tail	7.60	212	26	0.6	*<0.001*	0.0001	*<0.001*	*<0.001*	0.043	0.028	*<1e-04*	0.011	0.004	*<0.001*	*<0.01*	0.038	0.046
CC18 HS tail	7.82	310	26	0.8	0.001	0.0001	*<0.001*	0.002	0.097	0.025	*<1e-04*	0.025	0.008	*<0.001*	*<0.01*	0.044	0.067

3.4.3. *NAG LIQUORS*

NAG liquors were analysed to determine potential constituent mobility under harsh oxidising conditions. NAG testing is used to assess whether a sample is capable of neutralising the acid produced by the oxidation of the majority of sulfide minerals present in the sample. The oxidation is achieved using H_2O_2, a much stronger oxidiser than oxygen in air. After complete oxidation of the sulfide minerals within the sample, the NAG solution is analysed for pH and a suite of chemical parameters. It should be understood, however, that the observed concentrations in the NAG leachates are specific to the test protocol, including use of H_2O_2 and a high L/S leaching ratio (100:1).

NAG liquor analysis was conducted on three samples of HS tailings (DP1555-1560 HS tail, IMAPS HS tail and IMASS HS tail) and the "high sulfur" (0.05% S) copper oxide tailings sample (CC18 HS tail). The low pH NAG digest for the HS tailings samples (pH < 2.0) resulted in elevated concentrations of a number of elements (As, Cd, Cr, Cu, Co, Fe, Pb, Mn, Mo, Ni, Se, Sb, U) indicating that oxidation and dissolution of sulfide minerals and the presence of highly acidic leachate from HS tailings could mobilise several elements of concern. This was also evident for NAG leachates of some LS tailings with NAG pH above pH 6 and the supernatant from the IMAPS HS tail sample (Figure 14) where elevated concentrations of Cu, Cd, Cr, Co and Ni were observed (red circle, Figure 14).

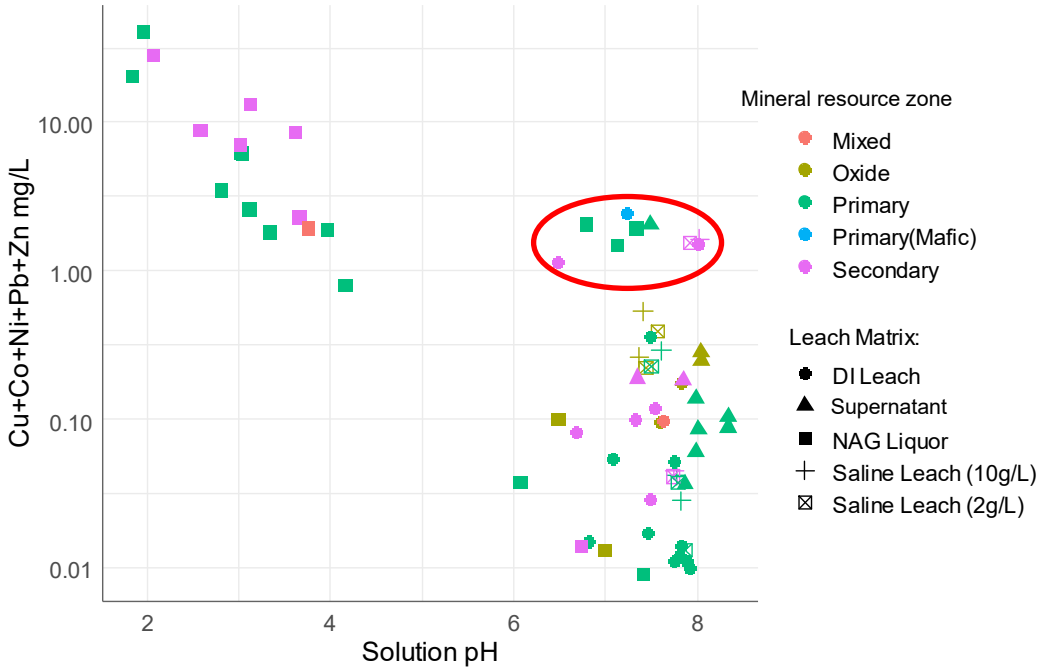

Figure 14: Solution pH against sum of constituent concentrations for various leach matrices.

3.4.3.1. AMD Generation Program

As part of the tailings management program of work for the overall Winu project, a bulk sample of AMD was generated at Bundoora. The synthesised AMD was used with various liner configurations to test durability under extreme conditions, should the HS tailings oxidise.

This sample was generated by recirculating solution (initially DI water) from a 30 L bulk container through an up-flow column containing 300 g of HS tailings (IMAPS HS tail). H_2O_2 (30% w/v) was added to the column feed to increase the ORP of the solution and accelerate AMD generation.

The ORP of the feed solution was kept above the rest potential for pyrite of 450 mV (Ag/AgCl) by addition of the H_2O_2 solution (Figure 15). Over time, the ORP of the bulk

solution started to increase to this value. Once this had occurred (on the 10th November 2021), dosing of H_2O_2 was stopped and the bulk solution was allowed to recirculate through the column with no adjustments.

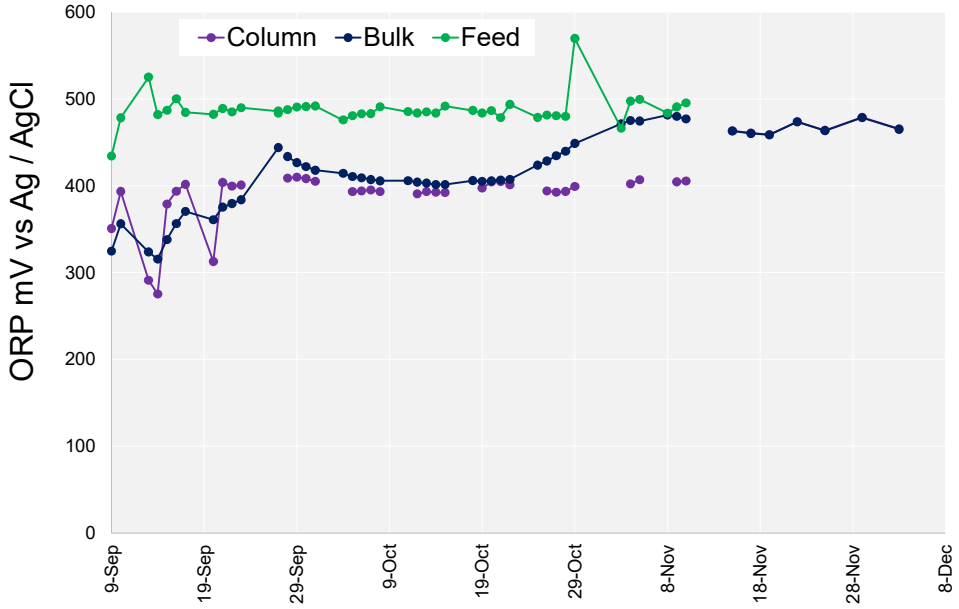

Figure 15: ORP of bulk solution, column feed and column discharge for AMD synthesis test over time.

Once the column discharge pH reached about pH 2.5, no further reduction in pH occurred (Figure 16). It appeared that the pH was buffered at this point and that no further acidification would occur in the short to medium term despite the elevated ORP. At this point the test was discontinued.

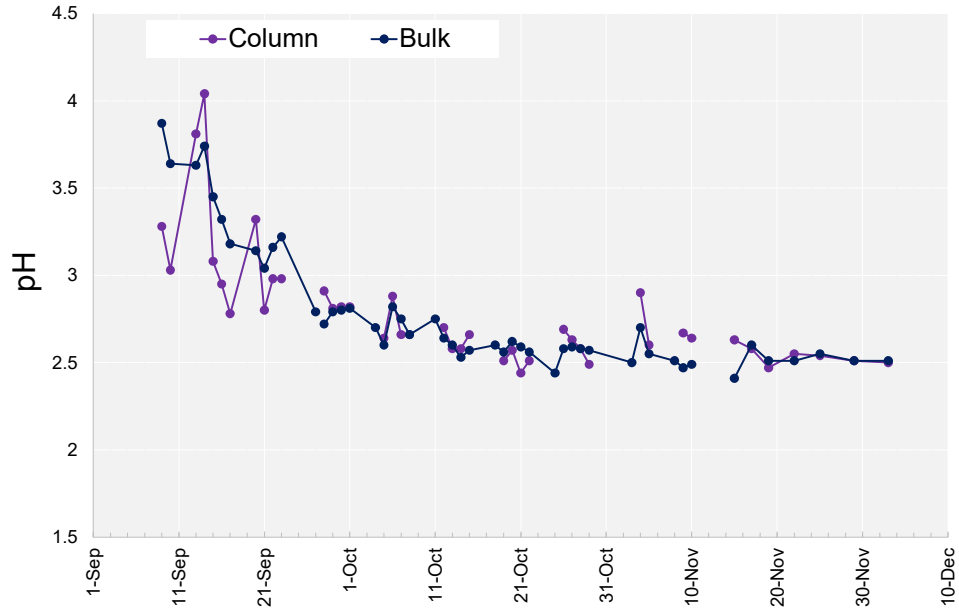

Figure 16: pH of bulk solution and column discharge for AMD synthesis test over time.

The solution assay for the synthesised AMD is given in Table 11.

Table 11: Assay results for synthesised AMD on 1st of December 2021.

Parameter	Unit	Value	Parameter	Unit	Value
pH	pH unit	2.55	Lead	mg/L	0.615
Conductivity	µS/cm	2120	Selenium	mg/L	0.011
Acidity	mg $CaCO_3$/L	599	Hafnium	mg/L	<0.01
Sulfate	mg SO_4/L	738	Zinc	mg/L	4.17
Chloride	mg/L	4	Lithium	mg/L	0.032
Fluoride	mg/L	<0.1	Manganese	mg/L	3.10
Ammonia	mg N/L	2.0	Molybdenum	mg/L	<0.0001
Total Kjeldahl N	mg N/L	3.1	Silver	mg/L	0.0002
Nitrite	mg N/L	<0.02	Strontium	mg/L	0.053
Nitrate	mg N/L	0.1	Tellurium	mg/L	0.033
Reactive Phosphorus	mg P /L	0.02	Thallium	mg/L	0.010
Aluminium	mg/L	13.4	Thorium	mg/L	0.002
Antimony	mg/L	<0.0002	Tin	mg/L	0.004
Arsenic	mg/L	0.001	Titanium	mg/L	<0.01
Beryllium	mg/L	0.002	Uranium	mg/L	0.006
Barium	mg/L	0.024	Vanadium	mg/L	<0.0002
Rhenium	mg/L	<0.001	Zirconium	mg/L	<0.005
Bismuth	mg/L	<0.001	Boron	mg/L	0.059
Cadmium	mg/L	0.011	Iron	mg/L	82.2
Chromium	mg/L	0.093	Gold	mg/L	<0.001
Copper	mg/L	17.5	Tungsten	mg/L	<0.001
Caesium	mg/L	0.001	Mercury	mg/L	<0.00004
Cobalt	mg/L	1.94	Silicon	mg/L	16.6
Nickel	mg/L	1.39			

3.4.4. *SALINE LEACH TESTS*

Saline leach testing was undertaken to determine the influence of salinity on the leaching behaviour. Testing comprised leaching with DI water containing either 2 g/L or 10 g/L NaCl.

Both the 2 g/L saline leach and 10 g/L saline leach resulted in constituent releases similar to those of the DI leach, at a similar pH. No obvious trends were observed for constituent release between different leach types (Figure 17 to Figure 19), except minor differences for some elements at low concentrations (Figure 18), consistent with an increase in mobility when subjected to more saline 10 g/L leach compared with the 2 g/L leach.

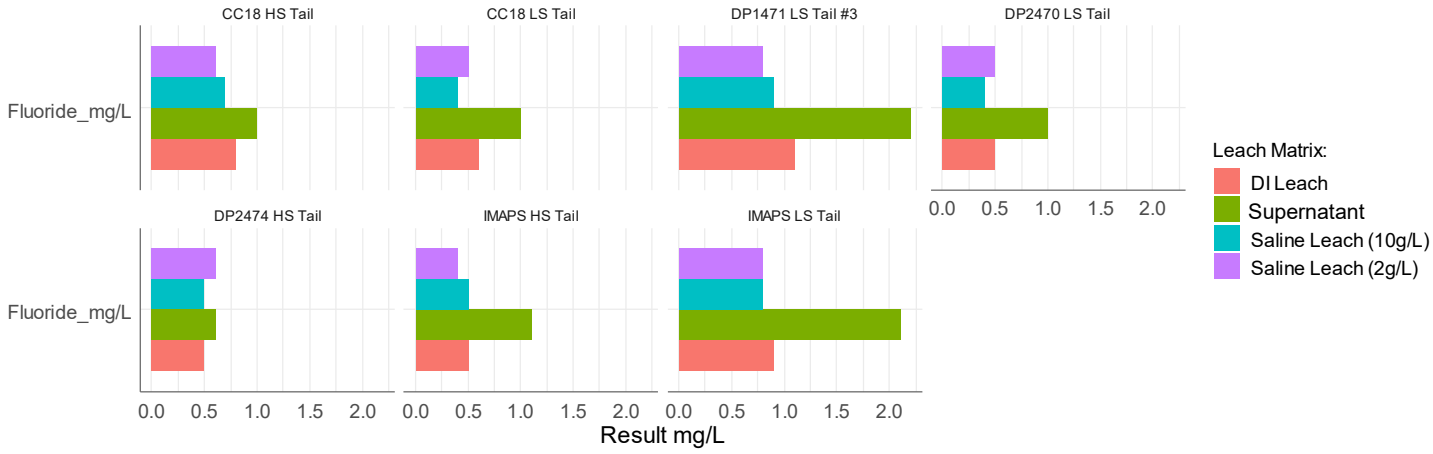

Figure 17: F leach result for different leach type.

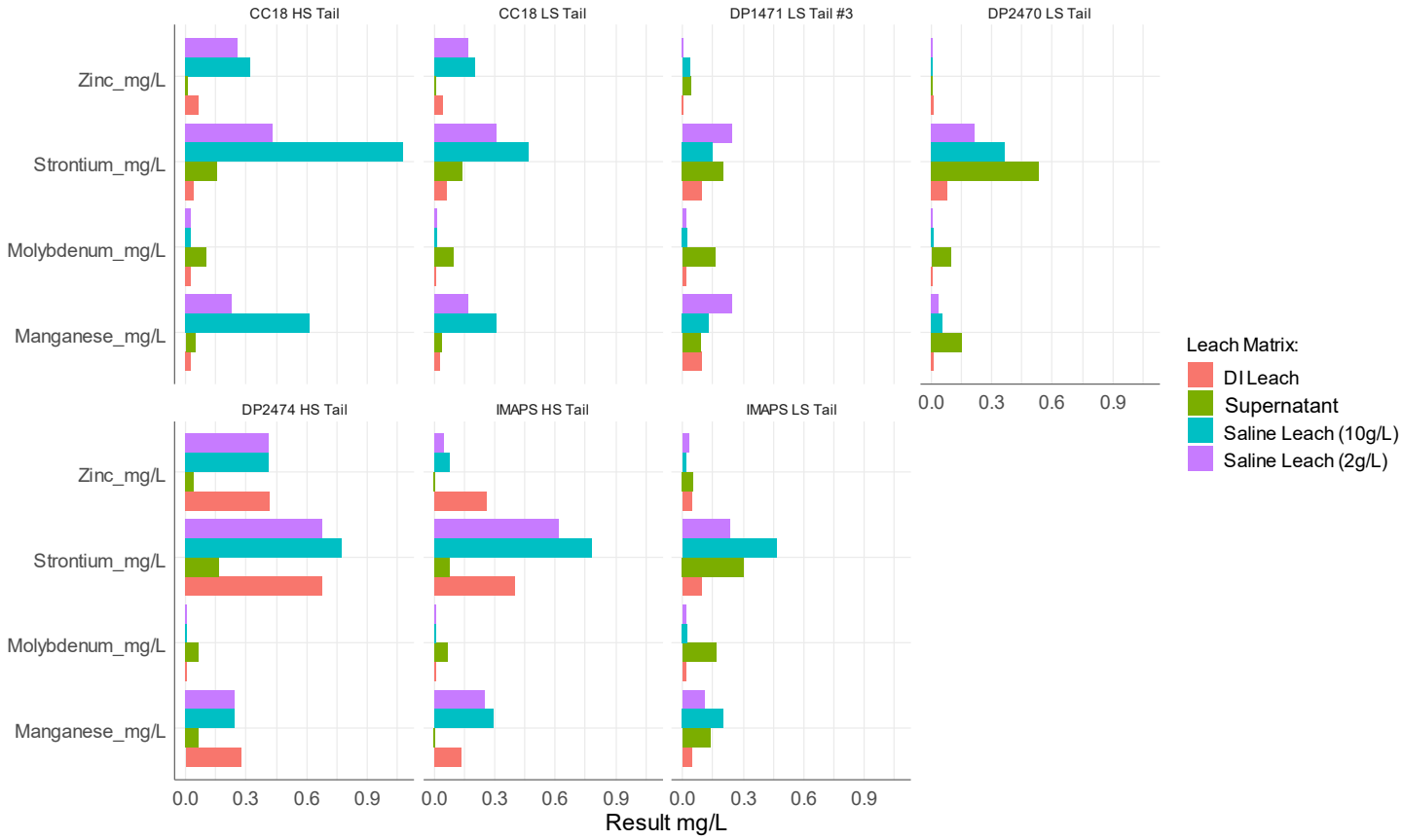

Figure 18: Analyte (Zn, Sr, Mo, Mn, F) result for different leach type.

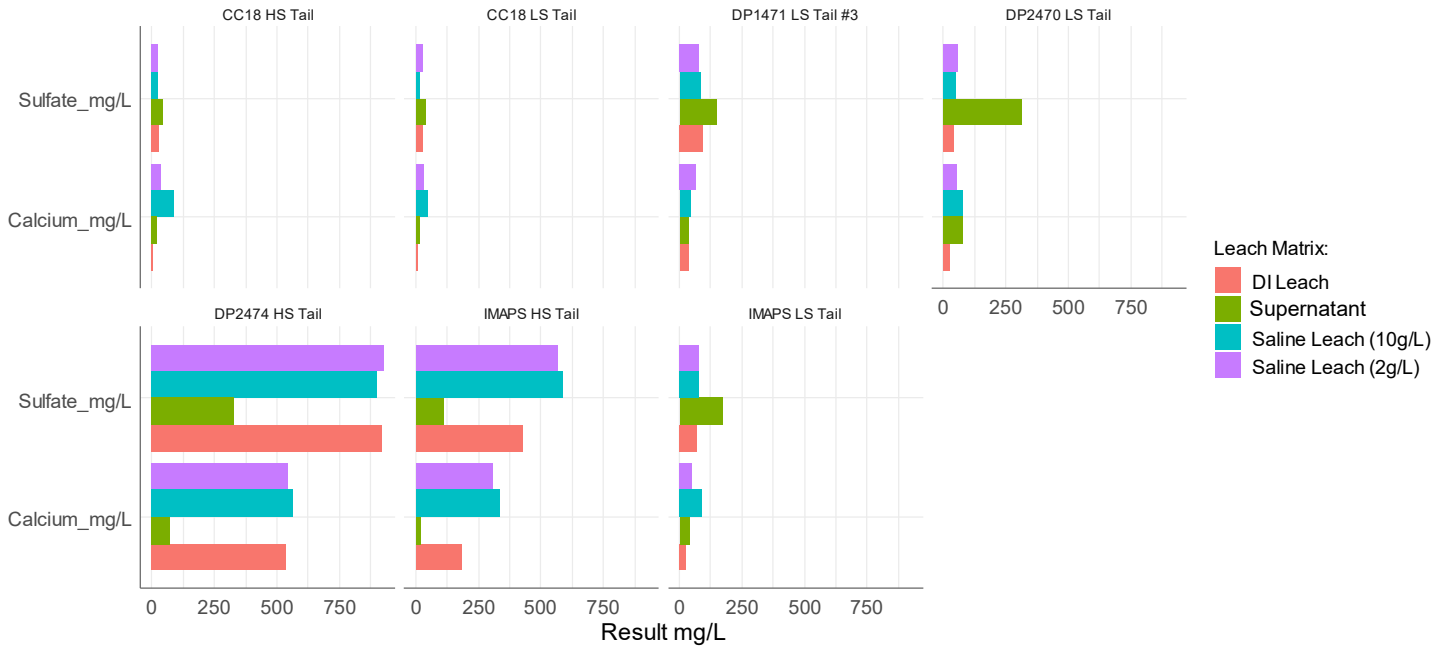

Figure 19: Analyte (sulfate, Ca) result for different leach type.

3.4.5. *SEQUENTIAL EXTRACTION TESTS*

The interpretation of sequential extraction results below were adapted from analysis provided by Claire Linklater (SRK Consulting).

One sample of LS tailings (January Master Composite mineral resource material, DP 1471 LS tail #4) was sent to Chemistry Centre for sequential extraction tests with a repeat sample (DP 1471 LS tail #3) also provided. The results of the two samples were comparable and provided confidence in the reproducibility of the analytical methods used at Chemistry Centre. Total recoveries were also very good for most elements, ± 20% with respect to the head sample. Exceptions were noted for elements present at low levels (< 1 mg/kg) in the head sample (e.g. Cd, Se), or where the element was present in the reagents.

In general, the major elements are distributed within the sequential extraction scheme as would be expected. Aluminium, Si, Ca and K (key constituents of the silicate minerals present) did not leach significantly during Steps one to seven and reported to the residual fraction (Figure 20 and Figure 21). Iron and Mn predominantly reported to Step four and five (targeting amorphous and crystalline Fe/Mn oxides). Significant Mg and noticeable Al and K also leached during Step five, possibly indicating that one of the silicates (e.g. clinochlore) was leaching during this step. Sulfur reported to Step six (easily oxidisable) as was expected.

Trace element leaching is mostly associated with Steps four and five, interpreted as an association with Fe and Mn oxides. Tailings samples contain significant Ni and Cr, which almost entirely leaches during Step four and five. It is notable that the samples also contain relatively high Mo, and that Mo shows analogous leaching behaviour.

Cu, Co, Pb and Zn also leached in some of the other steps:

- Cu, Co, Pb and Zn in Step three (carbonate fraction)
- Cu and Co in Step six (sulfide fraction).

For some trace elements, significant mass remains un-leached after Step seven, reporting to the residual fraction (e.g. Sn, Ti, Sb, Ba, Sr) and is probably associated with silicates or any possibly unreacted crystalline oxide content.

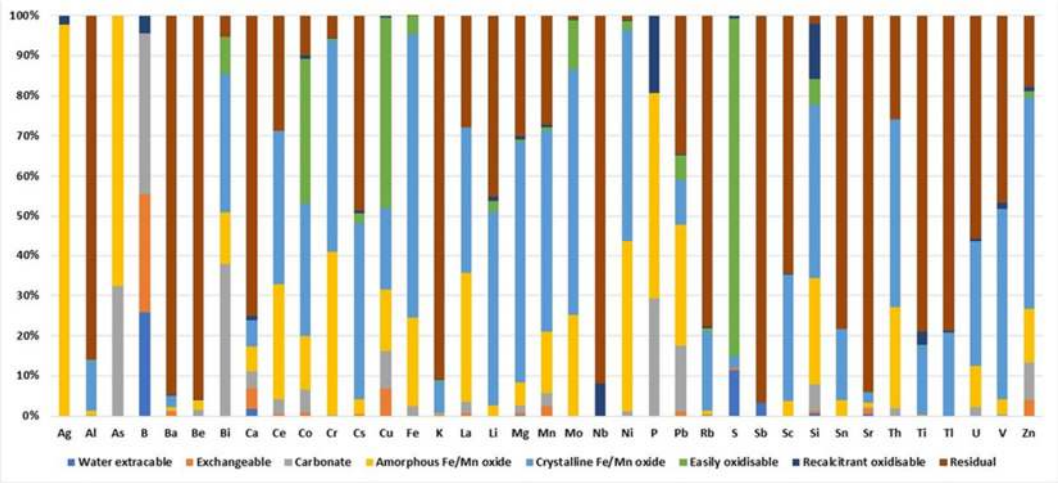

Figure 20: Summary of sequential leach testing showing percent of element leached in each stage for DP1471 LS tail #3.

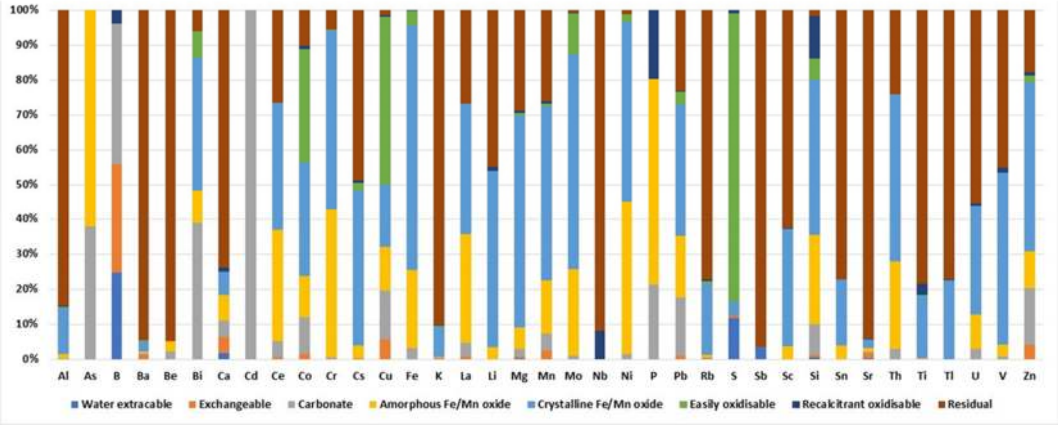

Figure 21: Summary of sequential leach testing showing percent of element leached in each stage for DP1471 LS tail #4.

3.4.5.1. Comparisons with Marandoo Tailings Results

Some comparison of the results against Marandoo tailings is included for reference. Marandoo is an iron ore mine in the Pilbara. Marandoo tailings were submitted for sequential extraction testing as part of a previous study and it was of interest to compare outcomes for tailings derived from different mineral resource types.

Major element leaching behaviour from the Marandoo tailings is very similar to the Winu tailings. That is, it is correlated with Fe/Mn oxides and residual mineral content. The most notable difference between the samples was that the Marandoo tailings contained significantly greater Fe (expected given the different commodity involved). The Marandoo tailings contained more leachable Mn than the Winu samples.

The trace element content of the Marandoo tailings was typically lower than that of the Winu tailings and in most cases masses of leachable trace element were lower during the scheme than observed for Winu samples. Exceptions were As, Se and Sb – all of which were present in higher concentrations in the Marandoo tailings.

Arsenic and Se remained unleached from the Marandoo sample, reporting the residual fraction. Antimony leached in Step five (crystalline Fe/Mn oxide). These elements were present a very low levels in the Winu samples. Arsenic leached in Step three (carbonate) and Step four (amorphous Fe/Mn oxide) while Sb was associated with the residual mineral content. Selenium was below the laboratory reporting limit in the Winu samples.

3.4.5.2. Implications for Management

In the context of tailings disposal within a TSF, two conditions are likely to be encountered:

1. Oxidising conditions in desaturated beaches.
2. Anoxic conditions in a saturated environment.

Direct correlation between the sequential extraction test results and the TSF are tenuous as the reagents used for Steps two to five are unlikely to be encountered. Steps six and seven represent contact with sodium chlorate and H_2O_2 (relatively strong oxidants). While sulfide minerals in the tailings could be expected to oxidise under some conditions, the rate of oxidation would not be reflected in sequential extraction test outcomes. Kinetic testing is therefore required to give a more appropriate basis for establishing release rates and potential constituent concentrations.

The results for Winu LS tailings indicate that a significant proportion of trace element content is associated with Fe and Mn oxide (amorphous and crystalline) and residual mineral content. Noting that amorphous mineral content is not quantified, sample mineralogy for these samples indicated that hematite and magnetite (crystalline Fe oxides)

comprised around 1 wt% of the samples, and silicates (residual mineral content) comprised 97-98 wt%. Leaching potential related to these mineral fractions is low.

The Fe and Mn oxide content, especially if crystalline, is expected to be unreactive unless conditions become either strongly acidic, or strongly reducing. The tailings have been classified as PAF, and acidic conditions are possible if the material not managed properly. The low sulfur content of the tailings would suggest that strongly acidic conditions are unlikely. Strongly reducing conditions are not considered likely unless a reducing agent is introduced (e.g. decomposing organic matter). Overall, if the materials are managed to mitigate risk of acid onset, the leaching potential is low.

3.4.6. Summary of Static Test Work

Sulfur in tailings samples was predominantly deported to pyrite. Due to negligible ANC measured, LS tailings samples often classified as PAF (33% of samples) or uncertain (19% of samples).

Available ANC in the tailings is generally low, particularly in tailings generated from secondary sulfide feed, and often associated only with slow-reacting silicate minerals (biotite, muscovite).

NAF samples had a sulfur content of less than 0.2 wt.%, but some samples with sulfur less than 0.2 wt.% were classified as either PAF-LC or uncertain. The average LOM tailings sulfur grade under the current mine plan and process scheme is expected to be 0.2% and ranges up to 0.35%, suggesting that LS tailings will mostly be classified as NAF or PAF-LC. HS tailings will be classified PAF (except when oxides are processed) and have a median MPA that is 150 times greater than LS tailings.

Fluoride was often present at elevated concentrations for samples of supernatant or DI leachates with pH values higher than 7.5. Mobility of other constituents was generally low, although increasing with decreasing pH.

3.5. SATURATED LEACH COLUMNS (LEAF 1314)

3.5.1. *SATURATED LS AND HS TAILINGS*

Saturated leach columns have been run to assess the mobility of constituents in the tailings under saturated conditions that are expected to occur in the TSF. Earlier eluates provide insight into pore water composition, with later providing information on release and leaching (Section 3.4).

Two samples were selected for saturated leach column test work, IMAPS LS tail and IMAPS HS tail. The IMAPS LS tail sample contained 0.08% sulfide predominantly as pyrite with some pyrrhotite and classified as NAF with a NAG pH of 9. The IMAPS HS tail sample contained 23% sulfide at 97% pyrite and was classified as PAF with a NAG pH of 2. Further sample information can be found in Table 7.

Particle Size Distribution (PSD) analysis was obtained on a sub-sample of column feed material (Figure 22). The two feed materials were both fine grained, although the P80 of the LS tailings (63 µm) was slightly higher than the HS tailings sample (33 µm) due to the regrind occurring before the cleaner circuit.

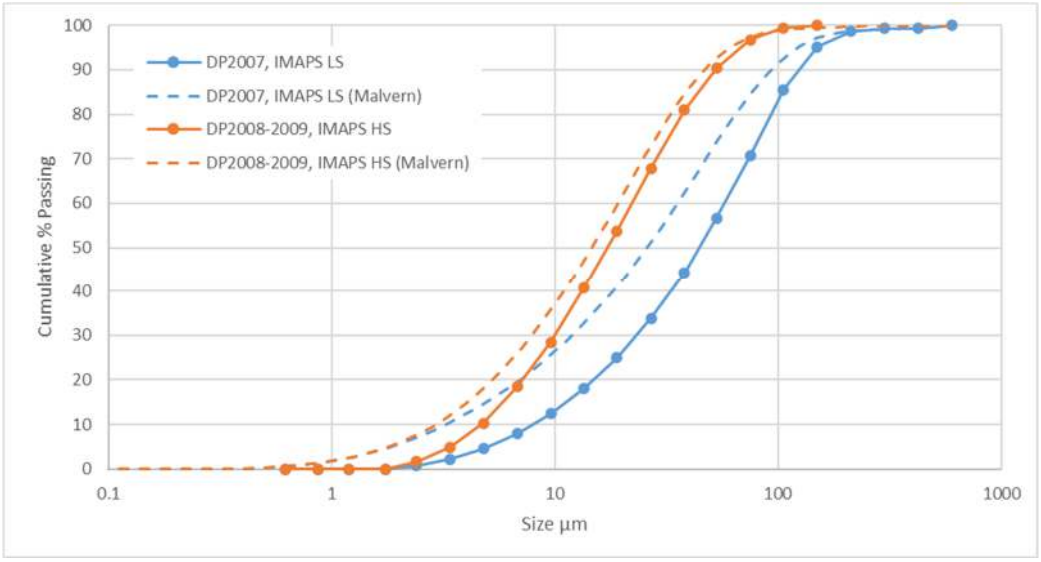

Figure 22: Saturated leach column feed material PSD.

Neither sample generated any acidity over the duration of the test, with the majority of the pH results between pH 7.4 to 8.4 (Figure 23). After an initial flush, IMAPS HS tail produced leachate with EC higher than that of IMAPS LS tail (2750 µS/cm compared to 1700 µS/cm, Figure 24). Final EC produced for both samples were between 600 µS/cm and 1500 µS/cm, indicating slightly brackish solutions. This correlated with elevated Na and Cl in the leachates.

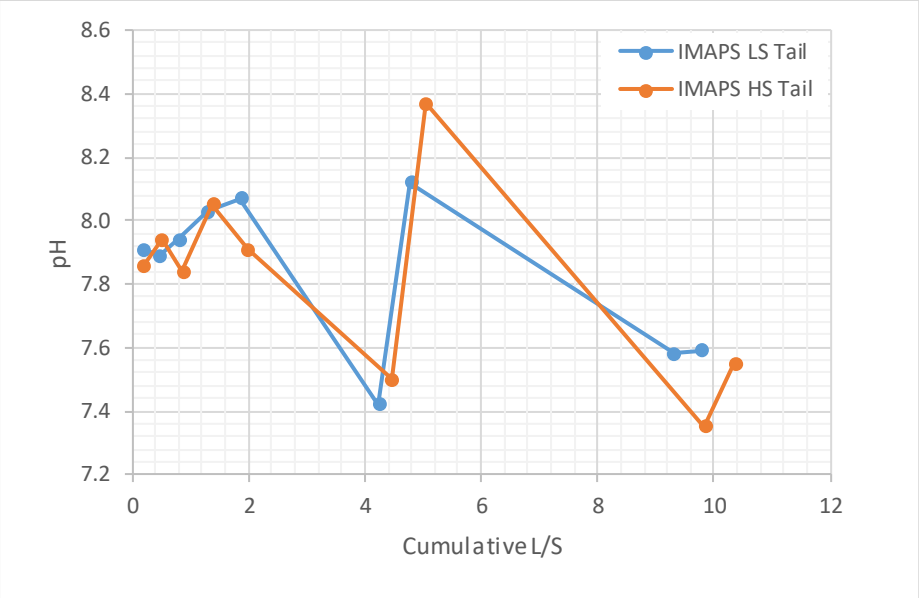

Figure 23: Saturated leach columns pH vs. L/S ratio.

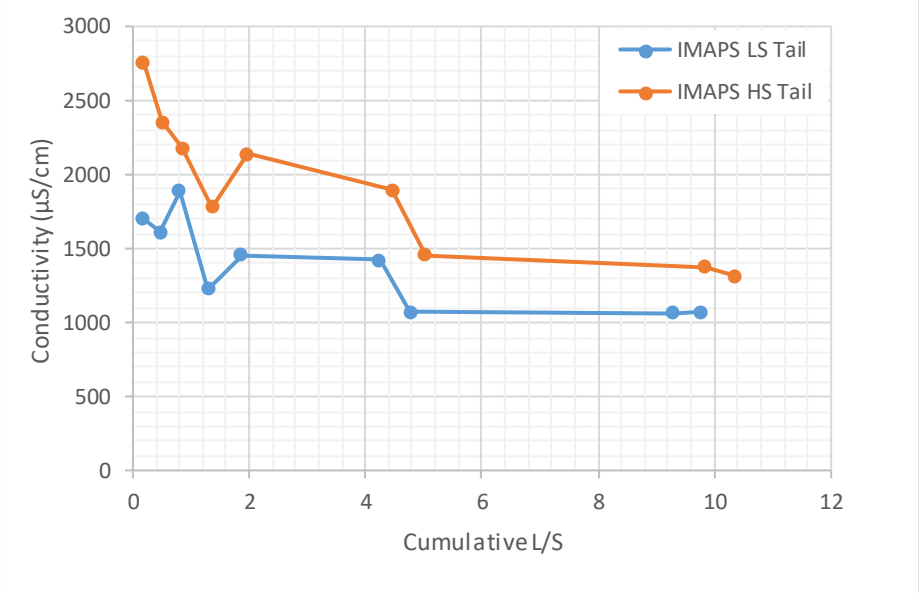

Figure 24: Saturated leach columns EC vs. L/S ratio.

Higher initial EC for sample IMAPS HS tail corresponded to an equally elevated sulfate release (Figure 25), which also correspond to a significantly higher Mg and Ca release suggesting initial flushing of Ca and Mg sulfate from the pore water (Figure 26 and Figure 27). This could potentially have been due to some oxidation of sulfides generating acid that reacted with trace dolomite during sample preparation.

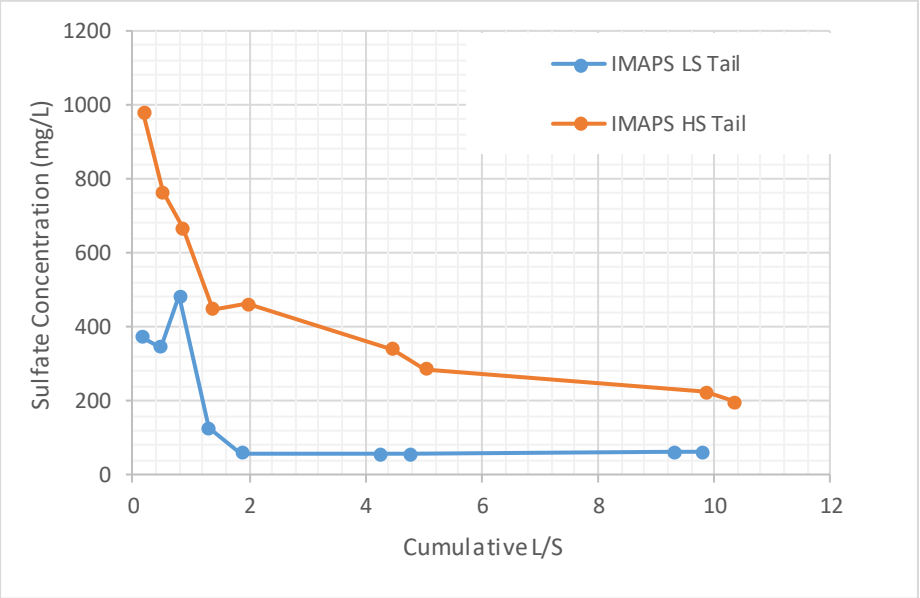

Figure 25: Saturated leach columns sulfate concentration vs. L/S ratio.

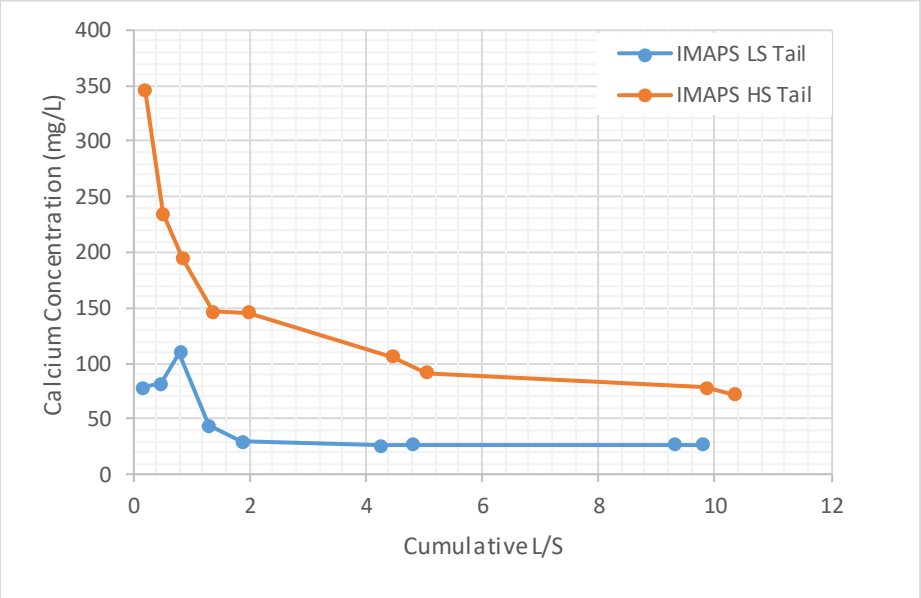

Figure 26: Saturated leach columns Ca concentration vs. L/S ratio.

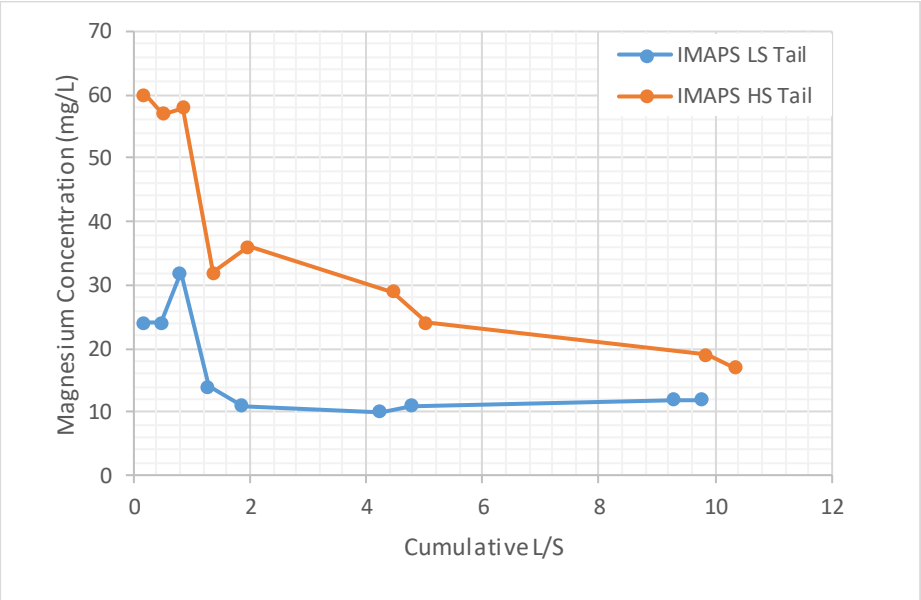

Figure 27: Saturated leach columns Mg concentration vs. L/S ratio.

Both IMAPS LS and IMAPS HS tailings samples have generated leachates with soluble concentrations for some elements, including sulfate, F, Ni, Mo and Sb (Figure 28 to Figure 30). Typically, only the first flushes of the samples at low L/S ratios resulted in elevated concentrations. Later eluates showed lower concentrations of sustained release that generally conformed to a typical decay seen for flushing of constituents. Elevated F in the initial flushing eluates was only observed for the LS tailings but did rapidly decay to lower concentrations at higher L/S ratios.

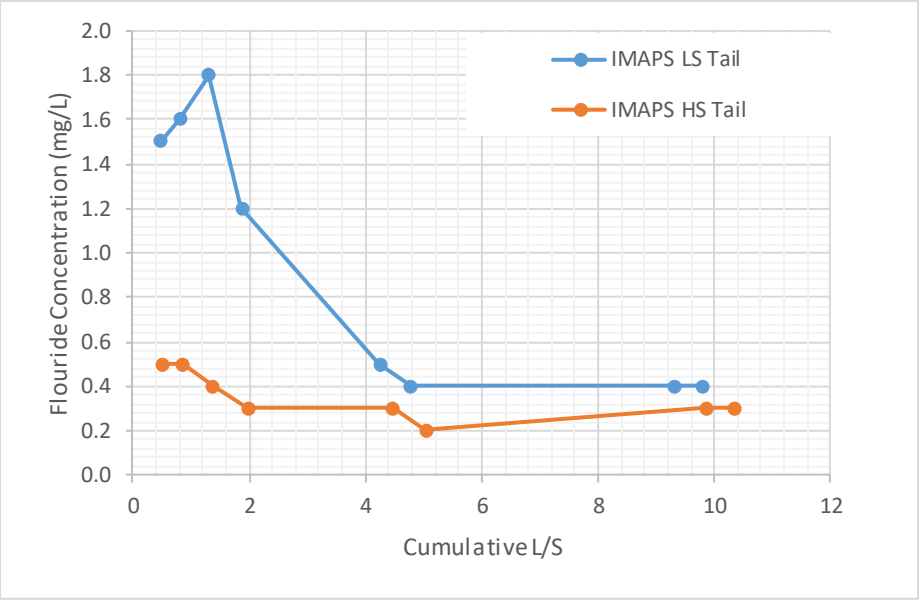

Figure 28: Saturated leach columns F concentration vs. L/S ratio.

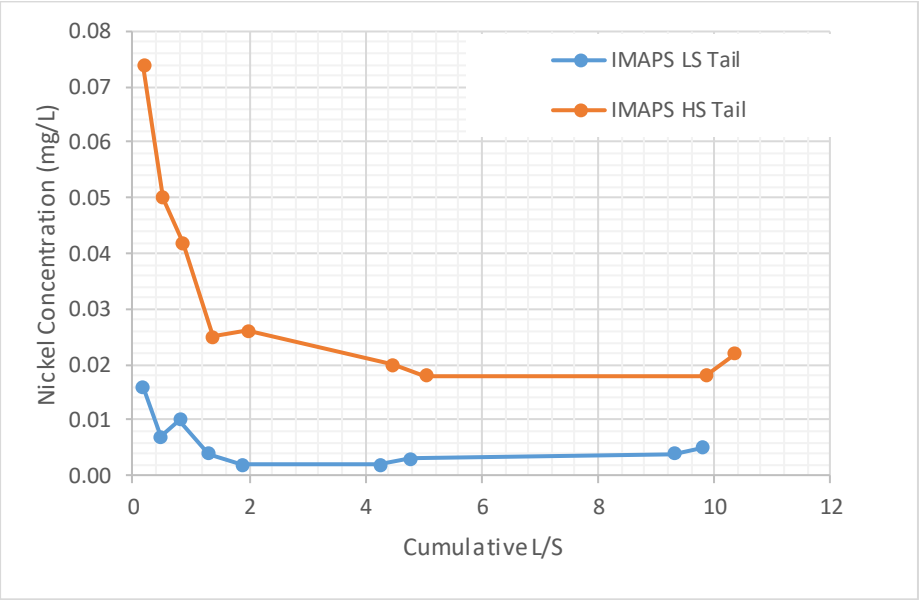

Figure 29: Saturated leach columns Ni concentration vs. L/S ratio.

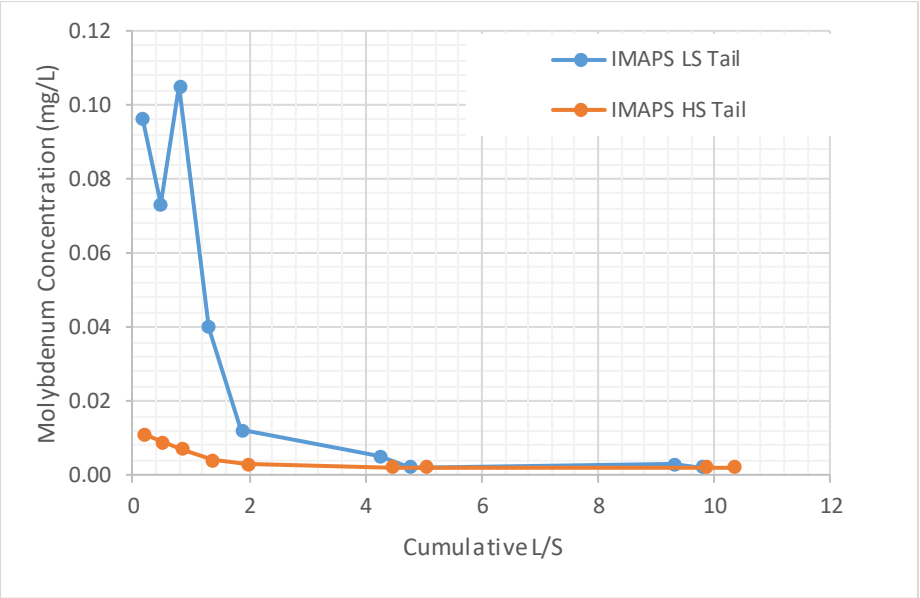

Figure 30: Saturated leach columns Mo concentration vs. L/S ratio.

Although Sb was detected at elevated concentrations in both IMAPS LS tail and IMAPS HS tail (Figure 31), it was also detected in blanks run with sand in the blank tests (0.010 to 0.015 mg/L) and may therefore be artificially elevated.

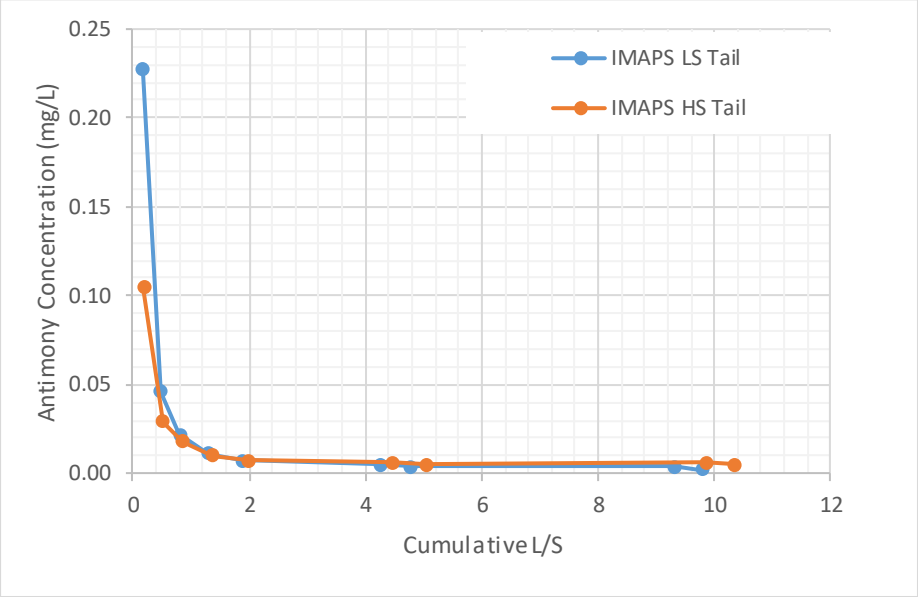

Figure 31: Saturated leach columns Sb concentration vs. L/S ratio.

Cyanide release was analysed for the HS tailings sample, although only for later L/S fractions (1.4 to 10 L/kg) due to limited volume for the first three eluates. Cyanide analyses were not NATA accredited due to the headspace in the collection vessel and because the samples were not preserved with sodium hydroxide prior to analysis. This is not considered a concern, however, as the pH of the column eluate was relatively high (> 7) and CN was therefore unlikely to form HCN gas that would volatilise over time.

Cyanide assays from the saturated column leach were below laboratory detection limits (< 0.004 mg/L), supporting data from the CN-specific leach tests performed on this material, which also resulted in CN concentrations at or below the laboratory reporting limits.

3.5.2. *SATURATED LS TAILINGS AFTER CIL DETOXIFICATION*

Additional saturated leach test work was undertaken by SRK (2024) to evaluate the water quality of LS tailings, following CIL detoxification. The test work was done on samples DP1947 LS tail and DP2709 LS tail (Table 1 and Table 7). The findings from SRK (2024) are summarised in the following section.

The supernatant test results indicated that the SO_2/air process effectively reduced CN concentrations, with the CN(WAD) reduced to well below the no discharge limit of 50 mg/L recommended for TSFs (LPSDP, 2008; ICMI, 2021). However, the tailings supernatant is likely to have elevated TDS, sulfate, Cu and Mo concentrations.

These tailings solids have a low capacity to generate acid due to their low sulfide sulfur content (0.12% and 0.19% S). The tailings solids have sufficient ANC to neutralise the acidity and are classified as both NAF.

The LEAF 1314 testing was undertaken on sample DP1947 LS tail and found that the pH remained with a near-neutral range, decreasing slightly from ~7.5 to 7.0 for the penultimate sample (Figure 32). The pH recorded for the final sample was slightly lower at 6.7. The total alkalinity and bicarbonate alkalinity decreased slightly from ~30 mg $CaCO_3$/L to 25 mg $CaCO_3$/L for the last sample. This may suggest depletion of the more reactive carbonates that were buffering the solution.

The EC decreased rapidly from ~2,200 µS/cm for the first sample to 715 µS/cm and 846 µS/cm for the next two eluates respectively (Figure 33). Thereafter the EC decreased progressively from ~250 µS/cm to less than 70 µS/cm. The change in EC indicates that the more readily soluble solutes were flushed from the sample within the first three steps. The slow decline in subsequent steps is consistent with the depletion of less soluble phases.

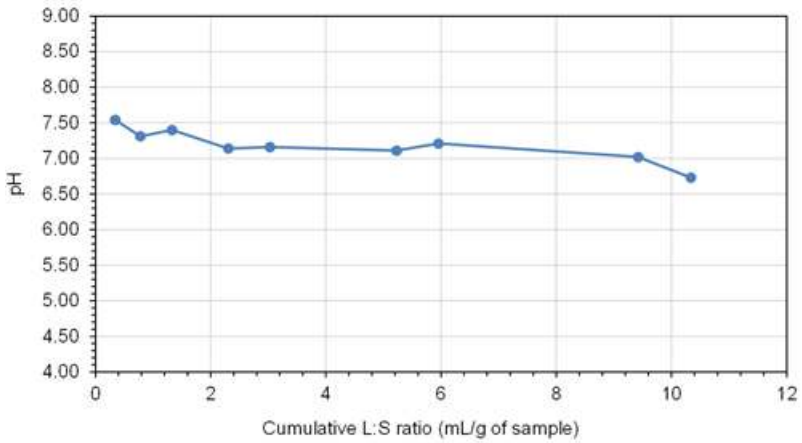

Figure 32: Saturated leach columns pH vs. L/S ratio.

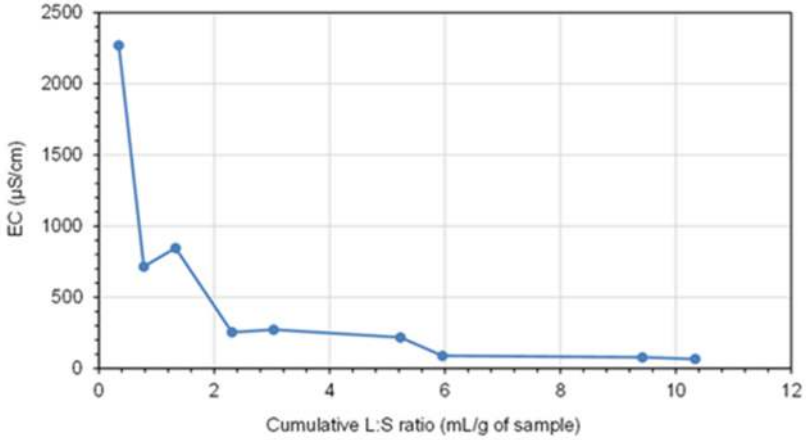

Figure 33: Saturated leach columns EC vs. L/S ratio.

Sulfate concentrations are shown to rapidly decrease to below 10 mg/L at a cumulative L/S contact of six and remain below 10 mg/L in subsequent samples (Figure 34). This is consistent with the flushing of pre-existing sulfide oxidation products, with no further oxidation occurring.

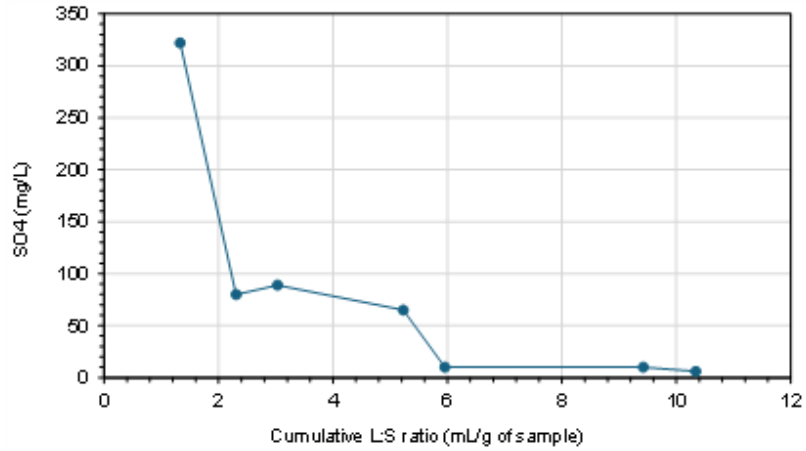

Figure 34: Saturated leach columns sulfate vs. L/S ratio.

Dissolved trace elements that were at very low concentrations (at or slightly above laboratory reporting limits) and above laboratory reporting limits in fewer than half the number of samples included As (≤ 0.003 mg/L), Cu (≤ 0.003 mg/L) and Mn (≤ 0.009 mg/L). The concentrations for Ba, Co, Mo and Sb were low and the profiles are consistent with the flushing of soluble phases from the sample. While the concentrations for Fe (Figure 35) and Al (Figure 36) show some fluctuation, the concentrations are more consistent with a solubility-controlled condition rather than the flushing of more readily soluble phases. Modelling undertaken in PHREEQC for the first available result (i.e. Sample 3) suggests that Al, Ba and Fe concentrations may be solubility limited by amorphous Al hydroxide or alunite, barite and Na jarosite, respectively. In the final eluate, only amorphous Al hydroxide and Na jarosite are shown to be possible solubility controlling phases. This explains the difference in the solute concentration profiles for Al and Fe (remaining relatively constant) compared to other trace elements (showing wash-out).

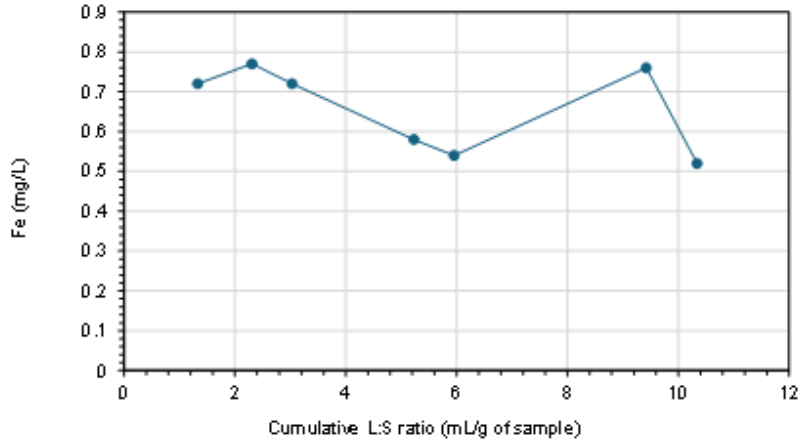

Figure 35: Saturated leach columns Fe vs. L/S ratio.

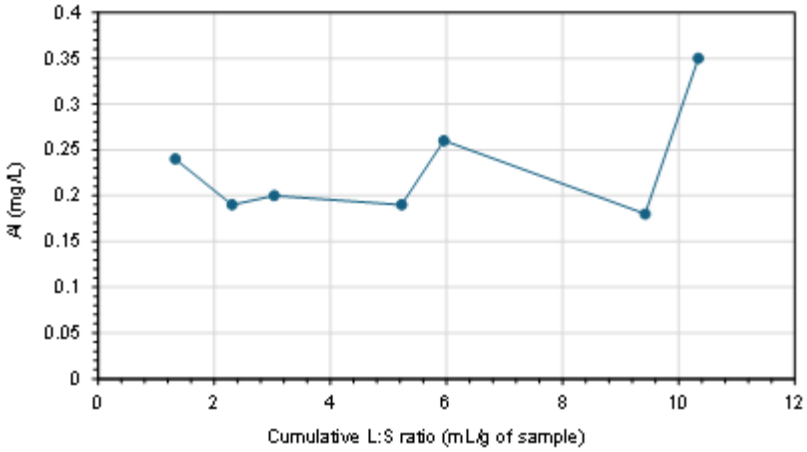

Figure 36: Saturated leach columns Al vs. L/S ratio.

The initial free CN concentration was 0.017 mg/L and decreased to 0.012 mg/L before showing a slight increase to 0.014 mg/L (Figure 37). The next two samples were below a laboratory reporting limit of 0.002 mg/L and the final sample was below a laboratory reporting limit of 0.02 mg/L. The CN(WAD) concentrations similarly were low, initially remaining below 0.02 mg/L (Figure 38). The sample corresponding to a L/S ratio of 5.23 appears to be anomalous and is inconsistent with the CN(T) and free CN concentrations. While the CN(T) (ranging from 3.6 to 1.7 mg/L) generally appear to decrease with increasing L/S contact, the trend is not clear and suggests that the source phase(s) is not readily soluble, and it is not flushed as observed for more readily soluble sulfate and

chloride salts Figure 39). The release of the CN(T) may therefore be either solubility or kinetically controlled.

The solute concentrations for the respective eluate samples were input to PHREEQC to calculate saturation indices for possible solubility controlling phases. However, the CN species present in the MINTEQ database are limited and did not contain some of Fe CN complexes and phases that will influence the CN(T). The speciation results from the modelling were inconsistent with the analytical results. For example, based on the speciation calculations, the results indicate that most of the CN in the eluates would be present as hydrogen cyanide (HCN ~98%), i.e. as free CN. This would be consistent with the observed eluate pH range. However, the analytical results indicate that the free CN represents only approximately 0.6% of the CN(T).

Fe is the only metal present in the eluates at any significant concentration that may complex CN and fall in the CN(T) category. The CN(T) generally correlates with the Fe concentration, except for one assumed outlier (disregarding the outlier, the R^2 value for the correlation is 0.98; including the outlier, it is 0.94). The CN: Fe molar ratio for hexacyanoferrate ($[Fe(CN_6)]^{4-}$), the primary complex that would form, is six – the average molar ratio between CN(T) and Fe in the eluates is 8.6 (with CN(WAD) and free CN included in CN(T) analysis). This would suggest that analytical results may be erroneous for either the CN(T) (too high) or the Fe (too low).

Based on the available data, and keeping in mind that no results were available for the first two samples, it is estimated that more than 12.5 mg of CN(T) was removed from the sample, or more than 23 mg/kg, which equates to more than 16% of the estimated initial mass contained in the sample. The removal occurs over a period equivalent to 26 pore volume displacements.

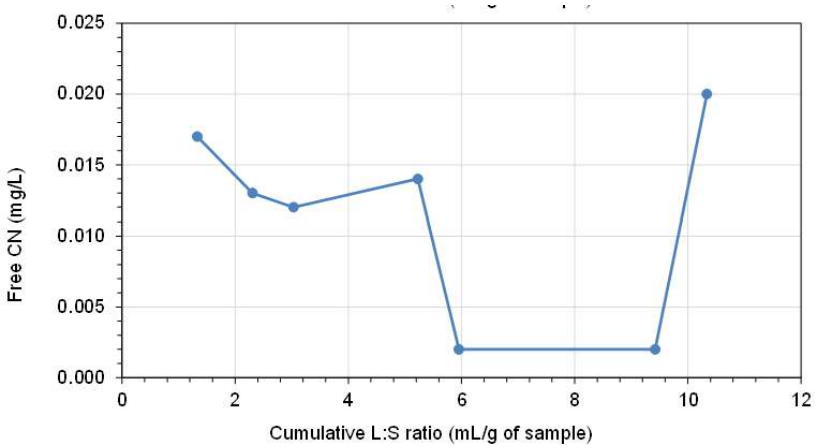

Figure 37: Saturated leach columns Free CN vs. L/S ratio.

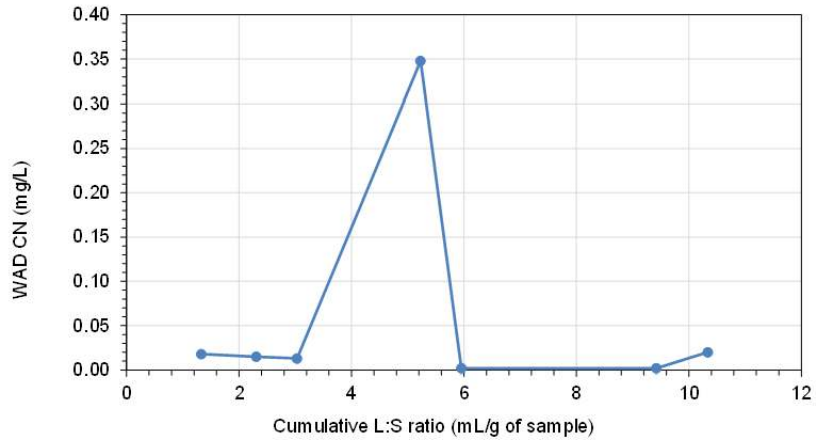

Figure 38: Saturated leach columns WAD CN vs. L/S ratio.

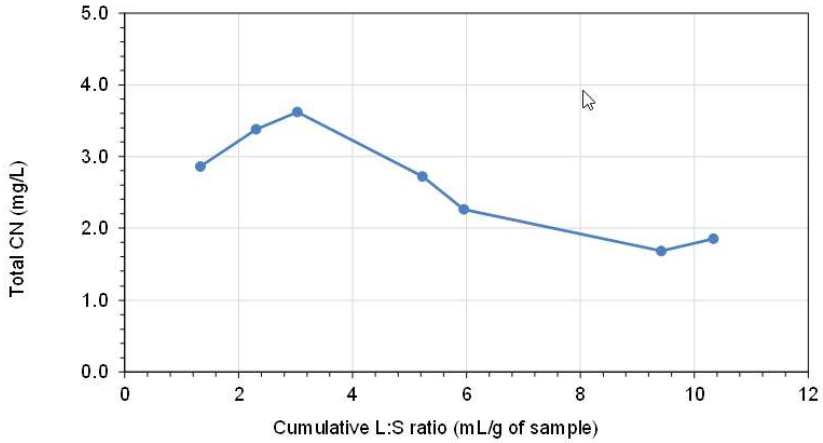

Figure 39: Saturated leach columns Total CN vs. L/S ratio.

The results show a slight flushing trend for NO_3-N, rapidly decreasing to low concentrations (Figure 40). NH_3-N concentrations similarly show a flushing trend (Figure 41). Nitrogen in the tailings is contained only in CN(T) (Nitrite NO_2-N, NO_3-N and NH_3-N were below laboratory reporting limits). Therefore, the presence of NO_3-N and NH_3-N indicate that some degree of CN degradation (by oxidation) had occurred during storage of the sample prior to testing. The results suggest the CN degraded to NH_3 predominantly, with little oxidation to NO_2/NO_3.

Using the cumulative mass of nitrogen (as NO_2, NO_3, NH_3) released, it is estimated that the equivalent of more than 8.8 mg CN(T) or 16 mg CN(T)/kg (> 11%, based on estimated initial content) had been degraded to NO_3 and NH_4. In contrast to the continuous leaching of CN(T) from the sample, the CN equivalent reacted calculated from the N-T release suggests that:

- Most of the CN(T) reacted prior to the sample being tested (during handling and storage) and the accumulated reaction products are flushed.
- The degradation reactions are slow under the anoxic test conditions (as indicated by the almost constant tail-end NH_3-N concentrations).

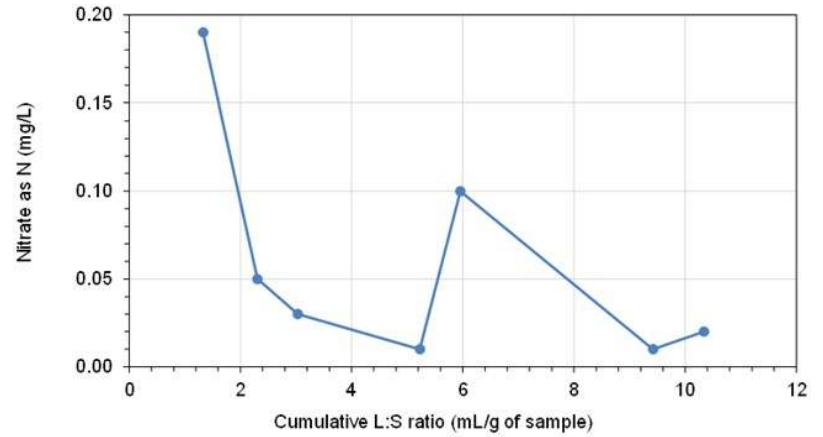

Figure 40: Saturated leach columns NO_3 vs. L/S ratio.

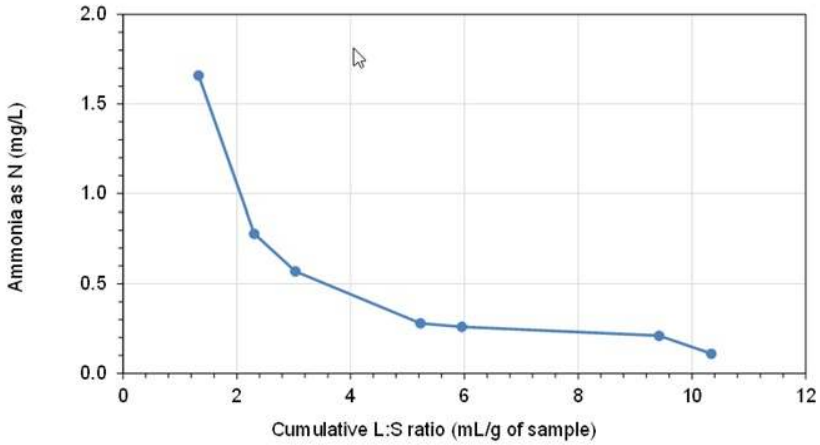

Figure 41: Saturated leach columns NH_3 vs. L/S ratio.

3.5.3. *SUMMARY OF SATURATED LEACH TEST WORK*

LEAF Method 1314 testing, completed under saturated conditions, excluding oxygen, found that:

- Neutral pH was maintained for both LS and HS tails.
- Most trace elements were flushed to very low concentrations (below laboratory reporting limits) over the test period. As porewater is displaced, soluble salts (TDS) concentrations decrease rapidly and will be flushed from the tailings, with porewater concentrations reflecting tailings supernatant concentrations (at the time of deposition).

Under field conditions, considering that the TSF will be lined and will be subject to closure measures, as well as the low rainfall in the area, the test results may overestimate solute release rates but may underestimate solute concentrations.

Furthermore, the test results indicate that residual CN (after detoxification) was degraded while the sample was in storage; consequently, in the TSF environment (where tailings water will be exposed to direct sunlight/UV light), degradation of residual CN would be expected to also occur and is likely to be accelerated above rates indicated by the laboratory test results.

3.6. UNSATURATED KINETICS LEACH COLUMNS

Free-draining leach columns have been run to assess the mobility of constituents in the tailing's under field-relevant conditions that can occur when the tailings are exposed to atmosphere, including successive dry-wet cycles. The following section was adapted from Life Cycle Geo (LCG 2025) and SRK (2024).

3.6.1. *SAMPLE SELECTION*

Kinetic testing (HCTs unless otherwise described as AMIRA columns) included three composite LS tailings samples with sulfur contents near the LOM average 0.2 wt% and representing different types of sulfide sulfur mineralisation (PS feed or SS feed) and processing (post CIL detoxification). A brief description of the samples is provided below:

- ***LS tailings: Median Sulfur (PS feed)*:** LS tailings produced using mineral resource material from the zone of primary sulfide mineralisation (DP1739 cycle 4,5,6) with a total sulfur content of 0.18 wt%, close to the expected median total sulfur content for the overall LS tailings (0.20 wt% S).
- ***LS tailings: Median Sulfur (SS feed)*:** LS tailings produced using mineral resource material from the zone of secondary sulfide mineralisation (DP2728 cycle 4,5,6) with a total sulfur content of 0.19 wt%, close to the expected median total sulfur content for the overall LS tailings (0.20 wt% S).
- **LS tailings: Low Sulfur (PS feed**): LS tailings produced ore from material from the zone of primary sulfide mineralization in a pilot plant using the P80 106 µm grind base case. The total sulfur content was 0.1 wt.%, lower than the expected annual average total sulfur content for the overall LS tailings (0.20 wt% S_t); as such, testing of this sample was terminated after three weekly cycles.
- ***LS tailings: After CIL Detox (PS feed)***: LS tailings (DP1947) produced using mineral resource material from the zone of primary sulfide mineralisation with a total sulfur content of 0.15 wt% that also went through the CIL and CN detoxification processes as a part of pilot testing. The CN detoxification process involved the addition of SO_2, air, sodium metabisulfite ($Na_2S_2O_5$), copper sulfate ($CuSO_4 \cdot 5H_2O$), and $Ca(OH)_2$ reagents.
- ***LS tailings: High Sulfur (PS feed)*:** Higher total sulfur content in LS tailings with a total sulfur content of 0.55 wt%, produced using mineral resource material from the zone of primary sulfide mineralisation (DP1999).
- ***LS tailings: High Sulfur (SS feed)*:** Higher end of range for total sulfur content in LS tailings with a total sulfur content of 0.36 wt%, produced using mineral resource material from the zone of secondary sulfide mineralisation (DP2186).
- ***LS tailings - AMIRA (PS feed)*:** Higher total sulfur content in LS tailings with a total sulfur content of 0.40 wt%, produced using mineral resource material from the zone of primary sulfide mineralisation (A19905, DP1741 RO tail Bucket 4 Wet Cake, also referred to as "rougher tailings").

Finally, a single sample created by mixing LS and HS tailings together was included to represent the theoretical composition of whole tailings:

- ***Whole tailings – AMIRA (PS feed)*:** Combined LS tailings and HS tailings, using mineral resource material from the zone of primary sulfide mineralisation (JAN MC DP1471 RT & DP1554-1560 CT + 3 kg DWE, also referred to as "combined tailings") and meant to represent whole tailings under an alternative, outdated processing scenario.

While the Whole tailings – AMIRA sample is not representative of an expected waste stream under the current TSF management strategy, the results provide helpful information in understanding the reactivity of LS tailings and differences between the different kinetic testing methods.

3.6.2. *ACID BASE ACCOUNTING – FOR KINETIC LEACH SAMPLES*

The total sulfur content for the LS tailings samples ranges from 0.15 to 0.55 wt% (Table 12). The Whole tailings - AMIRA sample has a much higher total sulfur content (1.3 wt%), primarily due to the HS tailings recombined with the LS tailings. Sulfide sulfur in the LS tailings samples ranges from 0.12 to 0.35 wt%, indicating that majority of the total sulfur is in the sulfide form. As such, sulfide sulfur is used in ABA calculations herein.

Most samples have relatively low ANC of between 7.1 and 15.9 kg H_2SO_4/t. It should be noted that different ANC methods were used, as noted in Table 12, to accommodate the presences of siderite in the deposit. However, this can be dependent on availability of the siderite and kinetics of the Fe hydrolysis during the titration[4]. Rio Tinto developed specific protocols for measuring ANC for the Project to limit overestimation of ANC values (Appendix 2), and this was used for the HS tailings samples. Regardless of the method, the ANC values were relatively low (< 20 kg H_2SO_4/t). An exception to the relatively low ANC values is the CIL Detox. sample and Low Sulfur (PS feed) sample, which has an elevated ANC of 30.1 and 29 kg H_2SO_4/t respectively. In the case of the CIL Detox. sample, this was likely due to the addition of $Ca(OH)_2$ during detoxification, a portion of which may remain unreacted and available for neutralisation (SRK 2024).

Based on AMIRA classification using the NAPP and NAG pH results to predict AMD potential, Median Sulfur (PS feed), Low Sulfur (PS feed) and CIL Detox. samples were classified as NAF, Whole tailings - AMIRA (PS feed) were classified as PAF, and the remaining four samples were classified as UNC (Table 12).

Classification by NPR which is generally more applicable for a wider range of sulfur contents and when samples have relatively low sulfur and ANC, ranges from 0.4 to 6.55. Samples with NPR values below one are classified as PAF (e.g., AMIRA 2002, MEND 2009, INAP 2009). By this metric, both High Sulfur samples, as well as the Whole tailings - AMIRA sample, are PAF, while the remaining are NAF or uncertain (Table 12).

The resultant NAG pH ranges from 2.9 to 9 for the nine samples. The Whole tailings - AMIRA, LS tailings – AMIRA, and Median Sulfur (SS feed) samples had NAG pH values that fall below the AMIRA NAG pH guideline of 4.5 (AMIRA 2002). The NAG acidity value of 12 kg H_2SO_4/t (to pH 4.5) for the Whole tailings - AMIRA, combined with the NAG pH of 2.9, confirms the classification as PAF. The remaining samples with NAG pH values less than 4.5 are classified as PAF-LC given low NAG acidity results (< 5 kg H_2SO_4/t).

[4] Siderite availability may be dependent on grain size or grain-size reduction methods used by the laboratory. Titrations undertaken quickly may not allow enough time for complete Fe hydrolysis, resulting in siderite contribution to the ANC. This effect can vary widely depending on the specific laboratory's methods or procedures. Additionally, titration methods with heating may also affect the rate of mineral dissolution and Fe hydrolysis.

Table 12: Summary of ABA results for tailings samples selected for kinetic test work.

Parameter	Units	Median Sulfur (PS feed) HCT	Post-Kinetic Median Sulfur (PS Feed) HCT	Median Sulfur (SS feed) HCT	Low Sulfur (PS feed) HCT	After CIL Detox. (PS feed) HCT	High Sulfur (PS feed) HCT	High Sulfur (SS feed) HCT	LS tailings – AMIRA (PS feed) AMIRA	Whole tailings – AMIRA (PS feed) AMIRA
Total sulfur	wt%	0.18	0.18	0.19	0.1	0.15	0.55	0.36	0.40	1.3
Sulfide sulfur	wt%	0.17	0.16	0.18	0.09	0.12	0.52	0.30	0.35	0.79
MPA (calculated using total sulfur)	kg H_2SO_4/t	5.51	5.51	5.82	3.1	4.59	16.8	11.0	12.3	40.1
	kg $CaCO_3$/t	5.63	5.63	5.94	3.1	4.69	17.2	11.2	12.5	40.9
MPA - Sulfide (calculated using sulfide sulfur)	kg H_2SO_4/t	5.21	4.90	5.51	2.8	3.61	15.9	9.2	10.6	24.2
	kg $CaCO_3$/t	5.31	5.00	5.63	2.8	3.69	16.3	9.4	10.8	24.7
Total carbon	%	0.16	0.18	0.07	0.24	0.30	0.24	<0.02	--	0.18
Total organic carbon	%	0.02	0.03	0.07	0.03	<0.02	0.07	<0.02	<0.02	<0.02
Total Inorganic Carbon (TIC)	%	0.14	0.15	<0.02	0.21	0.30	0.17	<0.02	0.21	0.16
ANC	kg H_2SO_4/t	14.8	17	7.5	22.9	30.1	14.5	7.1	15.9	9.7
	kg $CaCO_3$/t	15.1	17.3	7.7	23.4	30.7	14.8	7.2	16.2	9.9
	% $CaCO_3$	1.5	1.7	0.8	2.3	3.1	1.5	0.7	1.6	1.0
ANC_{TIC}	kg H_2SO_4/t	11.43	12.25	4.08	17.1	24.50	13.88	4.08	17.15	13.1
	kg $CaCO_3$/t	11.7	12.5	4.2	17.5	25.0	14.2	4.2	17.5	13.3
NAG pH	s.u.	6.6	6.90	4.2	9.0	8.2	5.2	5.0	4.3	2.9
NAG acidity to 4.5	kg H_2SO_4/t	<0.1	<0.1	0.40	<0.1	<0.1	<0.1	<0.1	0.20	12.1
NAG acidity to 7.5	kg H_2SO_4/t	0.40	1.90	4.80	0.1	<0.1	1.50	1.50	2.6	21.4
NAPP (MPA $_{sulfide}$ – ANC)	kg H_2SO_4/t	-9.59	-12.10	-1.99	-20.14	-26.49	1.43	2.09	-5.27	14.52
ANC/MPA $_{sulfide}$	--	2.84	3.47	1.36	8.31	8.33	0.91	0.77	1.50	0.40
Classification – AMIRA(2002)	--	NAF	NAF	UNC	NAF	NAF	UNC	UNC	UNC	PAF
Classification – MEND (2009)	--	NAF	NAF	UNC	NAF	NAF	PAF	PAF	UNC	PAF

Note:

- ANC in the high sulfur samples was measured by the Mike Hutton Ash Kenny custom method (Appendix 2)
- ANC in the CIL Detox., LS tailings - AMIRA and Whole tailings - AMIRA samples were measured by the AMIRA ANC method.
- A post leach analysis is provided in this table for the Median Sulfur (PS feed) sample. Some post leach data is available for other samples in Appendix 5.
- Some particle size analysis is provided in Appendix 5.

3.6.3. *KINETIC TESTING RESULTS*

3.6.3.1. Acid Generation and Buffering Capacity

Leachate pH for all of the LS tailings - Median Sulfur samples was initially pH 7 to 8, potentially indicating an initial flush influenced by slightly alkaline process solution associated with tailings processing and slurry (Figure 42).

For the Median Sulfur (PS feed) samples, leachate pH for both the Agitated and Non-Agitated tests has remained circumneutral to alkaline throughout the duration of testing, fluctuating generally between pH 6.3 to 7.8. The total alkalinity for both Median Sulfur (PS feed) samples remained generally low (< 50 mg/L as $CaCO_3$) throughout testing (Figure 43). Total alkalinity in the Agitated sample fluctuated with intermittent periods of stable concentrations. The Non-Agitated sample had a slow but steady decrease in alkalinity throughout testing and had a final concentration of 9 mg/L as $CaCO_3$ when testing was terminated.

For the Median Sulfur (SS feed) samples, leachate pH for the Non-Agitated test initially dropped, and then remained circumneutral through week 21 (pH generally between 6.5 and 7.1). From week 21 to week 38 the pH decreased steadily to near pH 4.5. After week 38, the pH remained relatively steady with fluctuations between pH 4.7 and 5.8. The leachate pH for the Agitated test decreased steadily until week 35, after which the leachate pH has been relatively stable between pH 4.6 and 5.5. The total alkalinity in both samples dropped rapidly to < 10 mg/L $CaCO_3$ and has remained low to date.

The Low Sulfur (PS feed) sample remained circumneutral with no discernible trend throughout the testing period, with pH ranging from 7.3 to 7.6. Total alkalinity started at 65 mg/L $CaCO_3$ and decreased steadily throughout testing to 46 mg/L $CaCO_3$. While the lack of reactivity is expected given the short duration of testing, results are included herein for completeness.

In comparison with previous tests, the leachate pH values for both the High Sulfur (PS feed) and High Sulfur (SS feed) samples tested by HCT remained circumneutral for the first 15 weeks of testing and then steadily decreased over the next 20 to 30 weeks. The minimum pH value in leachate was 4.1 for High Sulfur (PS feed) and 2.9 for High Sulfur (SS feed). After reaching the minimum values between weeks 30 and 40 weeks, pH values rebound slightly over the remainder of the testing period. The High Sulfur (PS feed) and High Sulfur (SS feed) samples leachates had high and variable total alkalinity values during the initial weeks of testing. Alkalinity was not consistently measured in these samples after week 21 due to the onset of acidic conditions. Total alkalinity in CIL Detox leachates were slightly higher, between 40 and 78 mg/L as $CaCO_3$, potentially reflecting alkalinity imparted during the cyanide leaching or destruction processing steps. The pH in the CIL Detox leachates remained above neutral, ranging from 7.2 to 8.2.

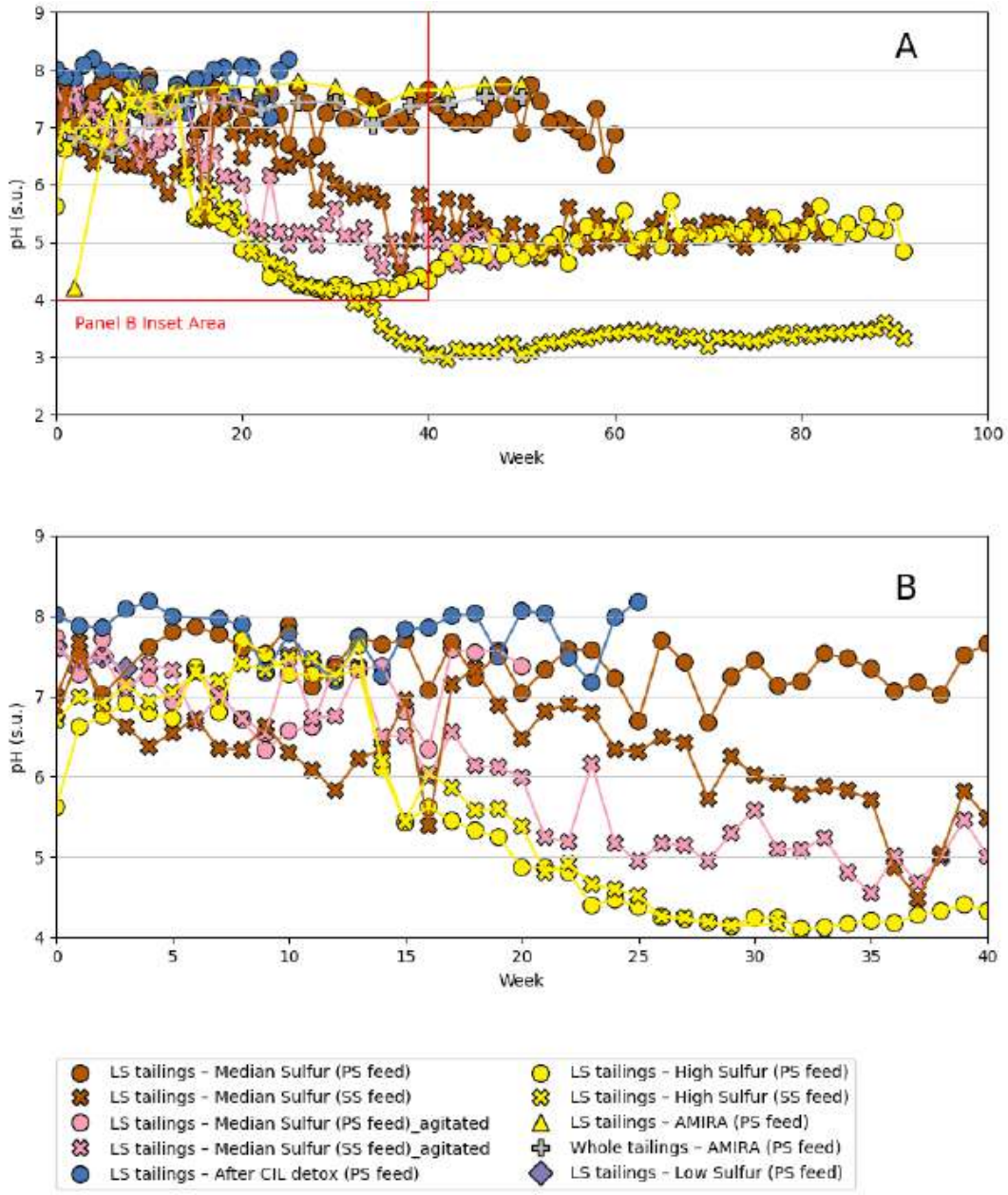

Figure 42: pH in kinetic testing leachates.

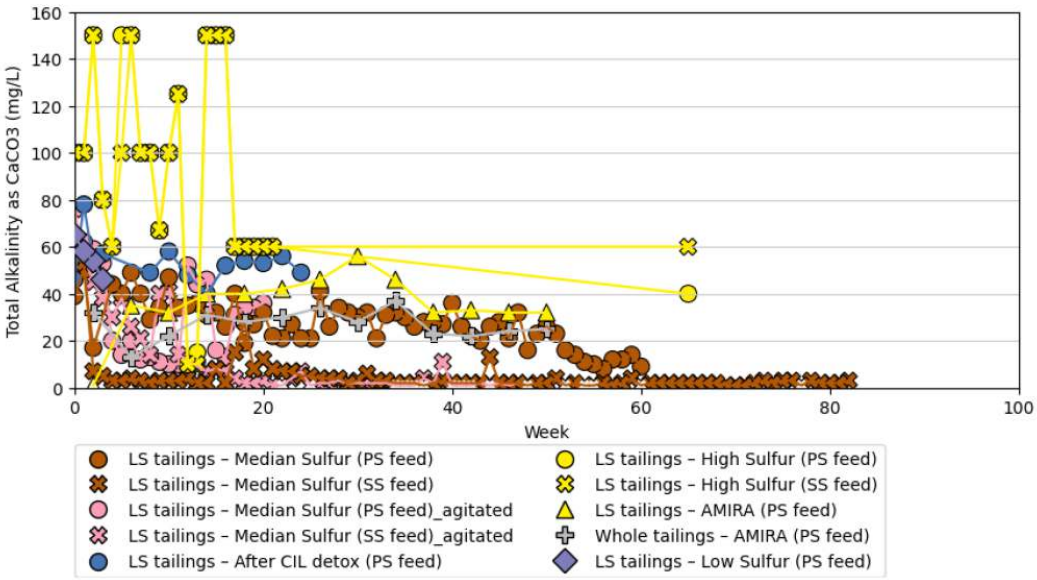

Figure 43: Total alkalinity in kinetic testing leachates.

3.6.3.2. Major Ion Quality

Elevated concentrations of most major ions were observed in the first five weeks of testing, consistent with a typical “first flush” type behaviour observed in kinetic tests. The first flush is generally derived by the flushing of soluble salts that built up prior to testing or flushing of residual process solutions from the tailings (Appendix 4). Following the first flush, K, Ca, and Mg concentrations exhibit generally gradual decreasing trends in the HCT leachates for the Medium Sulfur (PS feed), Medium Sulfur (SS feed), and CIL Detox. samples. Cl and Na concentrations were elevated during the first flush but rapidly decreased to low, stable concentrations, indicating the flushing of saline process solutions from the tailings.

In the High Sulfur (PS feed) and High Sulfur (SS feed) samples, Ca and Mg concentrations increase after the first flush period, as acidic conditions developed. After the column leachates reached stable pH values, the Ca and Mg concentrations decrease to below concentrations observed for the Medium Sulfur samples. Cl concentration in HCT leachates from High Sulfur (SS feed) increased at Week 40 and steadily declined over the remainder of the test.

Si is detected in the leachate for all samples and are generally stable, except for the in High Sulfur (PS feed) and High Sulfur (SS feed) samples, which showed increases in Si coinciding with decreases in pH conditions, consistent with Si buffering of acidity.

3.6.3.3. Sulfate Release

Sulfate release in leachates is an important metric for kinetic tests. Sulfate is generally a major component of first flush leachates in mine wastes, typically due to the dissolution of gypsum that accumulated due to sulfide mineral oxidation prior to testing. Long-term sulfate release is also used to calculate sulfide mineral oxidation rates. Corresponding to this, tracking sulfur depletion, by sulfate release, provides insight into sulfide oxidation behaviour and acid generation potential for a sample.

The Agitated and Non-Agitated Median Sulfur (PS feed) and CIL Detox. samples both exhibit relatively stable, low (< 30 mg/L) leachate sulfate concentrations after the first flush period (Figure 44). These results imply limited sulfide oxidation occurring in these tests, consistent with the measured pH and alkalinity (Figure 42 and Figure 43).

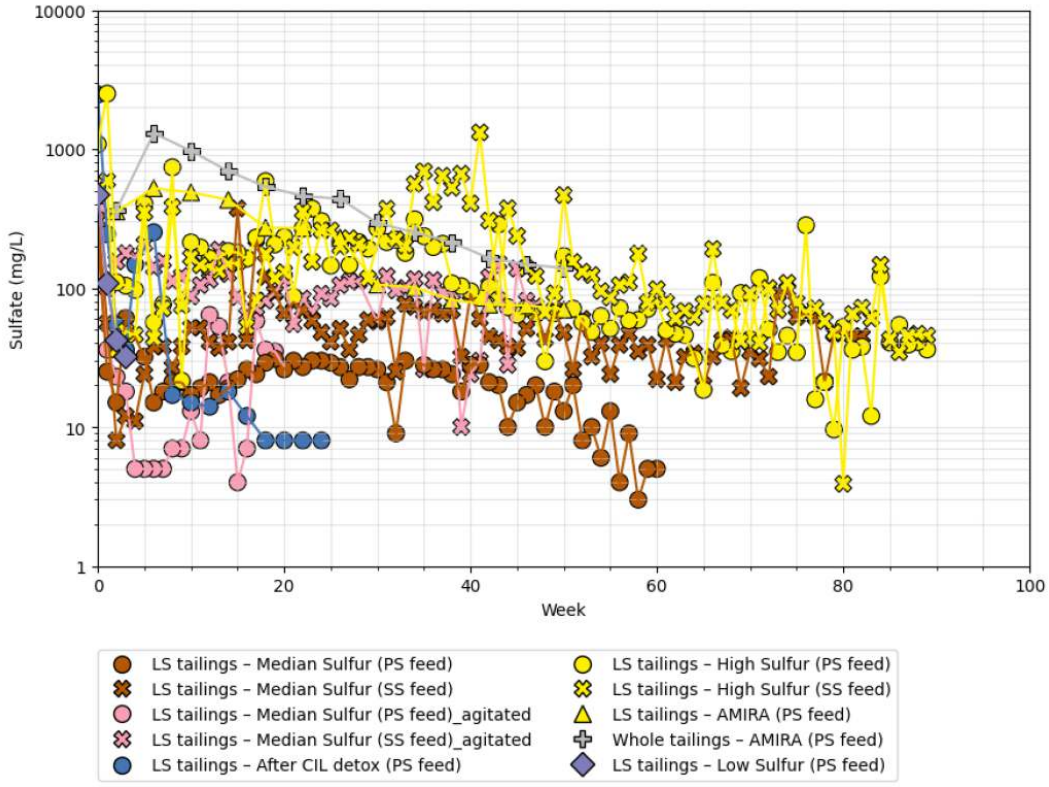

Figure 44: Sulfate concentrations in kinetic testing leachates.

The Non-Agitated Median Sulfur (SS feed) leachate sulfate concentrations demonstrated an initial first flush, following by fluctuations in concentrations between approximately 25 and 50 mg/L through weeks 14. In weeks 15 through 19 fluctuations in sulfate concentrations increased, ranging from 42 to 374 mg/L. This increased variability may be due to:

1) The onset of sulfide oxidation causing an initial spike in sulfate concentration,

2) Increases in leaching volume during this time resulting in contact with material that had not been previously wetted and additional flushing of sulfate salts or

3) A combination of both effects.

After week 20, sulfate concentrations fluctuate between 19 and 97 mg/L with an average of 50 mg/L, and leaching volumes remained consistent in this time period (700 mL per week). The Agitated Median Sulfur (SS feed) leachate sample has similar fluctuations in sulfate concentration, though values are typically higher. Sulfate concentrations after the first flush range from 10 to 189 mg/L with an average of 94 mg/L.

3.6.3.4. Metal Leaching

In leachates from the Non-Agitated and Agitated Median Sulfur (PS feed) samples, the CIL Detox sample, and the Low Sulfur (PS feed) samples, Be, Cr, Pb, and U, were at or below the detection limit for the duration of testing. Low, but detectable, concentrations of Al, As, B, Ba, Co, Cu, Li, Mn, Mo, Ni, Sr, W, and Zn were measured in these samples. These results are expected for the near-neutral pH values of the samples. Overall the Median Sulfur (PS feed) and CIL Detox. tailings are not undergoing significant sulfide oxidation and are not a significant source of leachable metals under non-acidic conditions. Increasing and decreasing trends were not observed for metals concentrations following the first flush.

For the Non-Agitated Median Sulfur (SS feed) sample, an increase in metals (Co, Cu, Mn, Ni, Si, and Zn) is observed after week 16, consistent with the shift in pH for this sample.

Metals concentrations slowly increase with time. Corresponding with similar trends in pH, similar trends in metals concentrations are observed in the Agitated Median Sulfur (SS feed) sample, though increases tend to occur earlier in testing than in the Non-Agitated tests. Additionally, the Agitated test had a large increase in concentration at week 45 in each metal. These metals with increasing trends are consistent with those metals observed to be mobile in previous tests with acidic conditions (i.e., the High Sulfur (PS feed) and High Sulfur (SS feed) samples), though, concentrations are still low in the median sulfur tests. The metals release is related to the change in pH, potentially due to mobilisation of metals by dissolution of oxides, by desorption, or release from sulfide minerals, depending on the metal.

At the onset of acidic conditions observed in the High Sulfur (PS feed) and High Sulfur (SS feed) samples, there was elevated concentrations of Al, Be, Cd, Co, Cu, Cr, Mn, Ni, Pb, U, and Zn. Metal concentrations generally increase for approximately 15 weeks, then decrease and stabilise. Iron concentrations are generally low, but exhibit increases coinciding with increasing concentrations of other metals.

For all kinetic test samples, a significant number of trace elements not associated with the deposit type (e.g., Sb, Bi, Cs, Hg, Re, Se, Ag, Sn, Te, Ti, Tl, and V) were at or below laboratory report limits in leachates for the duration of testing (Appendix 4).

3.6.3.5. Cyanide and Nitrogen Species

Cyanide species in the LS tailings sample following detoxification were analysed in SRK (2024) and the following section summarises the findings. SCN^- concentrations decreased from 1.9 mg/L, showing some variability initially but remaining below 0.7 mg/L, to below laboratory report limits (< 0.1 mg/L) after Cycle eight (Figure 45).

The results indicate that:

- The initial SCN^- leachable content of the tailings was low (~3.5 mg/kg).
- The SCN^- was likely sourced from residual porewater in the tailings.

Similarly, the free CN and CN(WAD) is flushed from the tailings within the first few cycles (Figure 46). The free CN and CN(WAD) concentrations were generally very similar, indicating that little or no CN is complexed to form CN(WAD) under the test conditions. Concentration rapidly decreased to at or below laboratory report limits (0.002 mg/L for both free CN and CN(WAD)). It should be noted that the final sample was subject to a higher detection limit (0.004 mg/L) and does not reflect an increase in either free CN or CN(WAD) concentrations.

The CN(T) concentration similarly shows a flush of readily soluble content, with concentrations decreasing from ~2.2 mg/L in the initial flush, and stabilising within the range of 0.22 to 0.28 mg/L (Cycle six to Cycle 16) (Figure 47). A slight increasing trend occurs from about Cycle 18 onwards, with an average concentration of ~0.41 mg/L for the final few cycles.

The results suggest that CN is unlikely to leach from the tailings at elevated concentrations and that the complexes containing CN in the tailings are relative insoluble under oxidising conditions. This is consistent with the formation of Prussian blue, which is a ferric hexacyanoferrate compound ($Fe^{III}_4[Fe^{II}(CN)_6]_3$); ferrous iron is oxidised rapidly to ferric under neutral oxidising conditions, which ensures the stability of the compound.

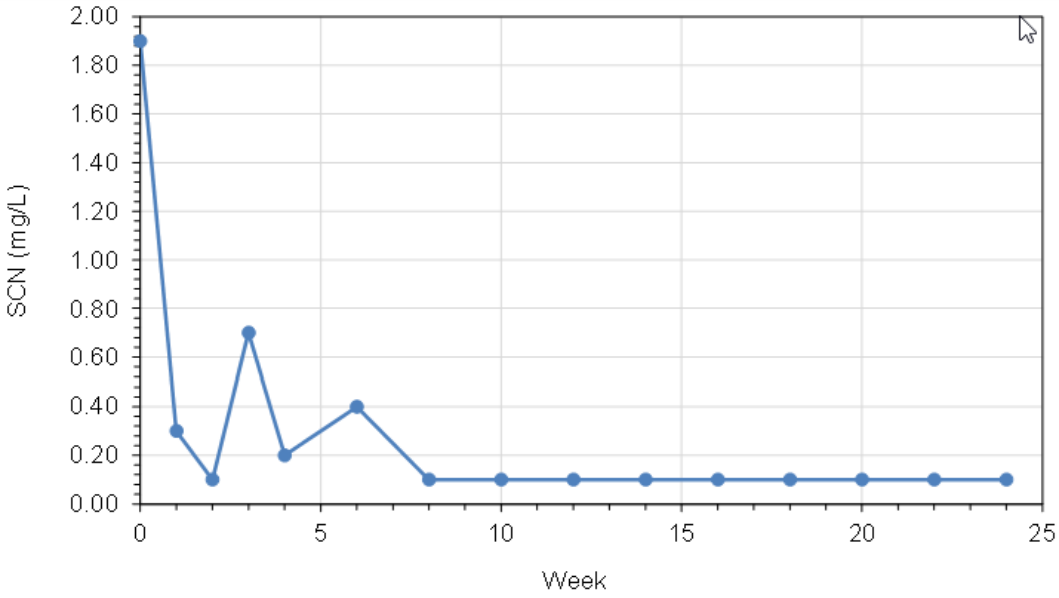

Figure 45: Thiocyanate concentrations in kinetic testing leachates for the sample that underwent CIL and detoxification.

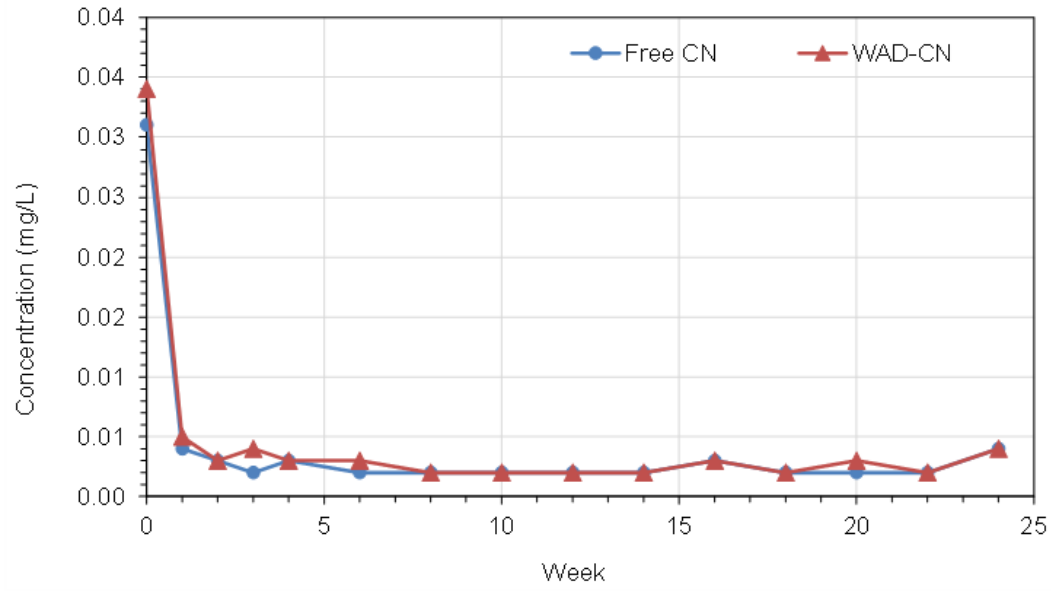

Figure 46: Free CN and CN(WAD) concentrations in kinetic testing leachates for the sample that underwent CIL and detoxification.

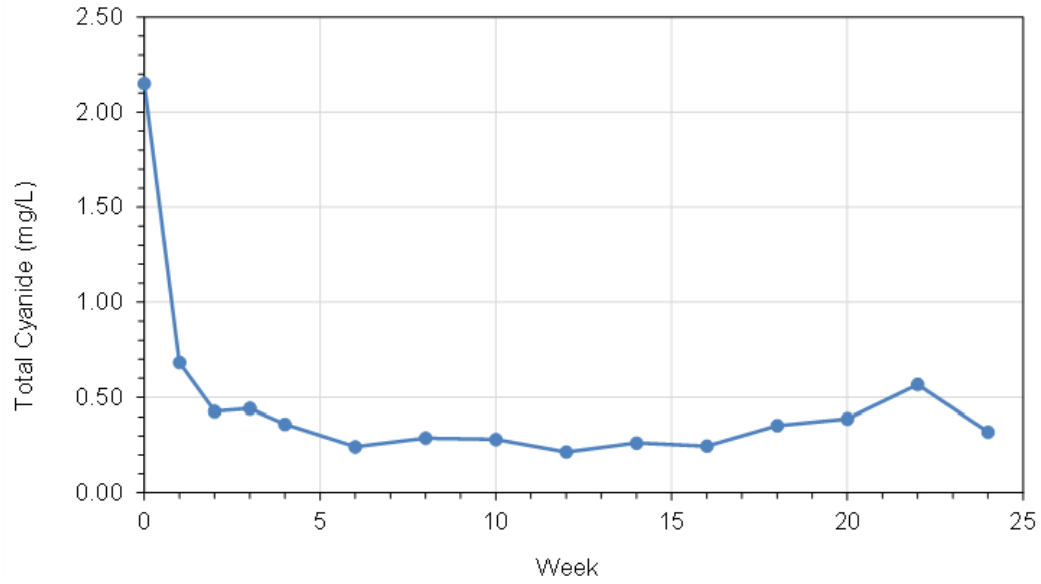

Figure 47: Total CN concentrations in kinetic testing leachates for the sample that underwent CIL and detoxification.

NO_2 concentrations remained below detection for the duration of the HCT period; under oxidising conditions NO_2 rapidly oxidises to NO_3 and is not expected to persist. The NO_3-N, NH_3-N and estimated total nitrogen concentration profiles are shown in Figure 48. The results indicate that the total nitrogen concentration remained relatively constant (in the range of ~0.4 to 0.5 mg/L) between Cycle 4 and Cycle 16, and then showed step decrease to less than 0.2 mg/L. While the reason for this is not apparent, it is noted that the NO_3-N concentration decreases to below laboratory report limits during this period. The absence of NO_3suggests that little or no oxidation of NH_3-N to NO_3 is occurring. However, the redox does not change over this period. The latter stages suggest that less CN(T) is hydrolysed to NH_3-N than during the earlier part of the test.

Assuming that nitrogen released from the HCT was sourced from the hydrolysis of CN to NH_3-N, and the subsequent oxidation of NH_3-N to NO_3-N, the equivalent mass of CN converted can be calculated as ~4.64 mg/kg for the period shown.

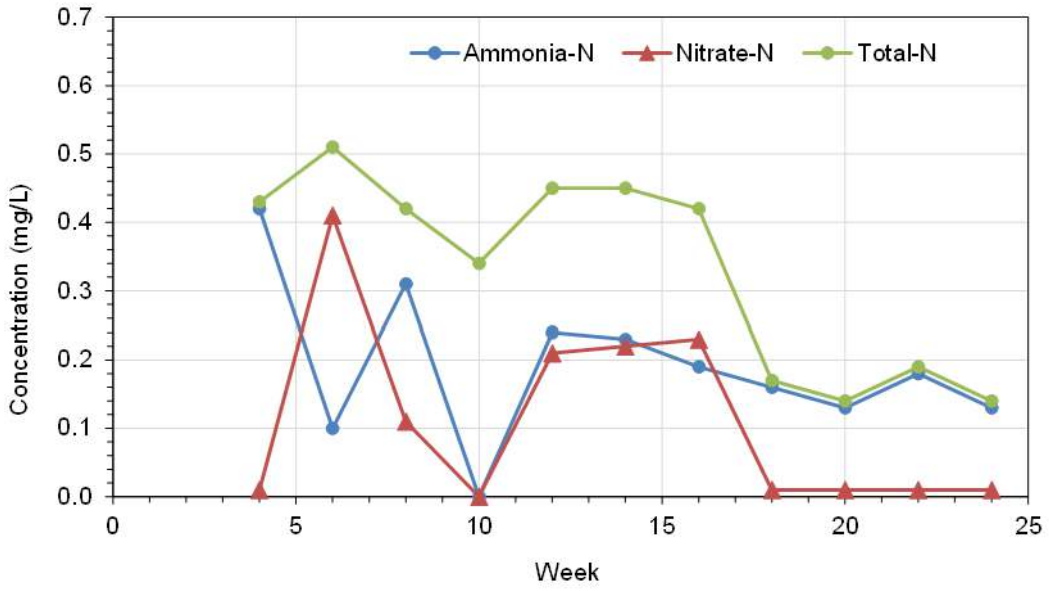

Figure 48: Total NH_3, NO_3 and NO_2 concentrations in kinetic testing leachates for the sample that underwent CIL and detoxification.

Based on the leachate results, the cumulative mass of CN leached from the tailings sample is estimated to be ~6.6 mg/kg for the duration of the test. For the available nitrogen results, the cumulative mass of CN(T) converted to NH_3/NO_3 is estimated to be in excess of 8.6 mg/kg (as CN(T)). Combining these estimates with the HCT final residue CN(T) analysis suggests that the initial CN(T) content of the tailings sample (before testing in the HCT) may have been ~141.2 mg/kg.

On that basis, the results suggest that approximately 4.6% of the initial mass was leached as dissolved CN(T) complexes, and approximately 6.1% was hydrolysed to NH_3, and partially oxidised to NO_3, over a period of 25 weeks. The results suggest that it may take about five years for all the CN to be removed or degraded, assuming that the tailings pore volume displacement rate is equivalent to that of the test (i.e. 1.6 pore volume displacements every week). Under field conditions this is unlikely to occur, and little or no flushing would occur. Therefore, degradation is expected to be the primary mechanism for CN removal. Based on the nitrogen release rate and assuming the degradation rate remains constant, the contained CN may be degraded within a period of between eight years (maximum rate) and approximately 25 years (lowest rate).

3.6.3.6. Comparison to AMIRA Leach Columns

The tailings samples submitted for AMIRA leach column testing had higher sulfur contents (0.4 to 1.3 wt% S) than is expected for the current processing methods and relative to other representative tailings samples tested in this program (0.15 to 0.55 wt% S). While these samples are not representative of the expected processing, the testing conditions of the AMIRA leach columns compared to the HCTs provides additional information about the reactivity of Winu LS tailings.

Despite both samples (LS tailings - AMIRA and Whole tailings - AMIRA) being classified as PAF, neither column went acidic in the 46 weeks of testing (Figure 42). Total alkalinity concentrations in leachates from AMIRA leach columns were similar to the range of LS tailings with Median Sulfur HCT columns, despite having a lower water to tailings ratio (Figure 43). Sulfate concentrations were generally similar to concentrations measured in the High Sulfur HCT, steadily decreasing over the testing period (Figure 44).

The major ion quality in AMIRA leach column leachates was approximately two to ten times higher than the concentrations in HCT leachates (Appendix 4), which may, in part, reflect the less frequent flushing schedule (monthly) and lower water to tailings ratios. Metal leaching rates from the AMIRA leach columns were consistent with the non-acidic leachates observed in Median Sulfur HCTs and slower than rates observed in the acidic, higher sulfur HCTs (High Sulfur (PS feed) and High Sulfur (SS feed)).

Assuming that the different LS tailings samples (median sulfur versus higher sulfur) have similar particle size distributions, amounts of residual process solutions, neutralisation capacity, and sulfide mineralogy, the lower rates of tailings reactivity in the AMIRA leach columns relative to the HCTs suggest a difference in the testing environments.

While an AMIRA leach column is intended to keep the sample well oxygenated, the leachate results leachates indicate that mildly reducing conditions may have been present in the columns. Figure 49 presents time series of concentration of nitrogen-bearing compounds, NO_3, NO_2, and NH_3, for the LS tailings - AMIRA and Whole tailings - AMIRA leach columns. At the start of the column testing, N leaching primarily occurred as NO_3, indicating oxidising conditions in the columns. As the test progressed, the concentrations of NO_3 decreased and concentrations of NO_2 and NH_3 increased, indicating that reducing conditions formed within in the columns. In contrast, N speciation in HCT leachates was dominated by NO_3 throughout the testing periods. Metals mobility in the AMIRA leach columns also indicate that reducing conditions are present. Increasing and/or elevated

concentrations of As and Mo in AMIRA leach column leachates are consistent with reducing redox conditions.

In order to develop reducing conditions, the AMIRA leach columns would require limited ingress of oxygen in the tailings pore space and the consumption of the limited oxygen that does ingress. An evaporative crust formed on the surface of the AMIRA columns. While the weekly wet-dry cycles and heating by lamps are meant to facilitate sulfide oxidation by evaporating water from sample pore spaces, this procedure may result in the formation of secondary salts on the surface of fine-grained tailings sample surfaces. This would limit evaporation from the sample and enhance the retention of moisture within the tailings. The crusts and the additional moisture may limit oxygen ingress, limit sulfide oxidation, and cause an extended lag time to acidity. With a slower sulfide oxidation rate, ANC would be depleted more slowly, and metals associated with the sulfide minerals would also be released more slowly. The precipitated secondary salts may also prevent water in the monthly flushes from interacting with the majority of the tailings in the column, further reducing the replacement of reactants required for sulfide oxidation. This would not be expected to be an issue for coarser grained tailings or waste rock samples. This is also possible in an HCT, though the use of humid and dry air flow is intended to limit this, and the nitrogen species in the HCT data do not reflect this to date.

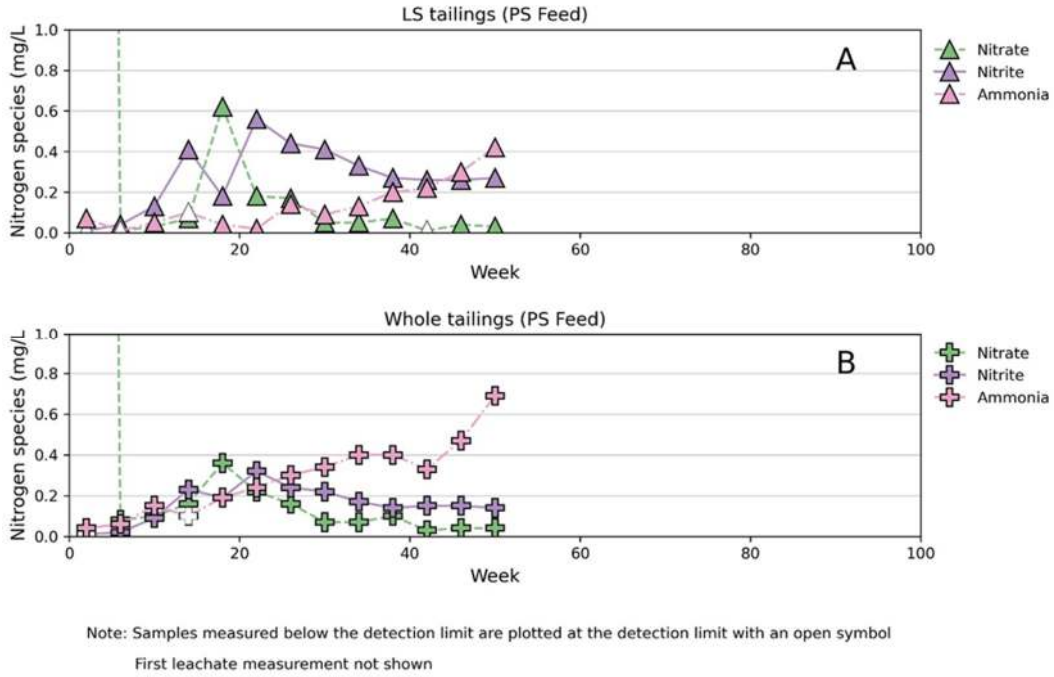

Figure 49: Nitrogen speciation in AMIRA leach column tests.

3.6.3.7. Depletion Calculations

Depletion calculations were applied to the kinetic tests to determine the sulfur and ANC remaining in the samples and have been completed through week 82 for the active Non-Agitated Median Sulfur (SS feed) and week 47 for the active Agitated Median Sulfur (SS feed) sample. The magnitude and pattern of depletion over the course of the test, the rate of the depletion, and comparisons of sulfur and ANC depletion can provide insight as to the expected acid-generation potential and lag time for a sample.

Depletion rates for the current assessment were calculated based on average release rates for the most recent eight weeks of column leachate results. These results are extrapolated forward to determine if ANC will be depleted first (resulting in PAF conditions) or whether the sulfide sulfur will be depleted first (NAF conditions). However, depletion calculations

have several limitations, so sole reliance on depletion calculations is not recommended. Significant limitations of depletion calculations include the fact that rates of depletion can change over time (e.g., rates calculated at any point in a test may not be representative of future behaviour), that non-conservative behaviour of oxidation products used to calculate depletion rates (e.g., precipitation of secondary minerals or ion exchange), and that there are interferences with major parameters used for the depletion calculations (e.g., sulfate release from gypsum dissolution or sulfide oxidation). Additionally, the analytes collected, frequency of collection, and testing methodology can limit information needed for complete depletion calculations (e.g., incomplete flushing of parameters used in the calculations).

Depletion calculations were performed based on methods presented in Morin and Hutt (2001) and MEND (2009). Sulfate release is used to calculate sulfur depletion. While sulfide-sulfur depletion is of greater interest from an acid-base perspective, it is difficult to differentiate contributions to sulfate release between gypsum dissolution and sulfide mineral oxidation. As such, total sulfur is used for the depletion calculations. For ANC depletion, “Empirical Open System NP Consumption around Neutral pH” calculation was utilized. This relies on using sulfate, alkalinity, and acidity release from the sample. However, the acidity measured as a part of the kinetic tests (acidity per titration to a pH of 7.0) is not compatible with the acidity values required by the depletion calculation (acidity per titration to a pH of 4.5). As such, an estimated acidity was calculated for use in the depletion calculation based on pH with the Al, Fe, Mn, and Zn concentrations that would contribute to acidity. The ANC depletion is applied herein to the measured ANC and to calculated ANC contributions from carbonates, based on the concentration of total inorganic carbon.

Results of the depletion calculations for total sulfur and ANC are shown in Figure 50 and time to depletion is shown in Table 13. For the Non-Agitated Median Sulfur (PS feed) sample, depletion rates are relatively low for ANC and sulfur, with approximately 88 to 90% of the ANC remaining and approximately 87% of the total sulfur remaining after the test was terminated at 60 weeks. Total sulfur depletion rate (37 years) is slightly slower when compared to the measured ANC (33.7 years) and the calculated carbonate ANC (25.3 years). The Agitated Median Sulfur (PS feed) sample had 94 to 95% of ANC remaining and 93% sulfur remaining when the test was terminated at 20 weeks. The time to sulfur and ANC depletion was faster than the non-agitated method with rates of 11 years for sulfur and 15 and 12 years for measured ANC and calculated carbonate ANC, respectively. Post-kinetic total sulfur measurements for the Median Sulfur (PS feed) sample 0.18 wt% total sulfur, identical to the results prior to kinetic testing. Post-kinetic NAG pH results (6.9) were also very similar to pre-kinetic testing NAG pH (6.6), while post-kinetic ANC was 17.0 kg H_2SO_4/t, slightly higher than pre-kinetic testing results of 14.80 kg H_2SO_4/t. The ABA results indicate little sulfur or ANC depletion occurred throughout the 60 weeks of testing, highlighting the limitations of the depletion calculations as described earlier in this section.

For the Non-Agitated Median Sulfur (SS feed), depletion rates are higher, with approximately 41% to 67% of the ANC remaining and approximately 62% of the total sulfur remaining after 82 weeks. Based on the depletion times shown in Table 13, the sulfur will deplete prior to the total ANC, but not before the carbonate ANC, again indicating uncertainty with respect to the acid generation potential of the sample. Given the current pH trend, it is likely that carbonate ANC depletion is more accurate for this sample under the test conditions. The Agitated Median Sulfur (SS feed) sample has similar rates of depletion, despite the 35 week difference in testing time. The Agitated sample has 45 to 70% ANC remaining and 65% total sulfur remaining. Estimated depletion times are similar to the Non-Agitated sample.

For the CIL Detox. sample, the effects of the higher ANC imparted by the cyanide destruction process are apparent, with time to depletion of ANC ranging from 9.2 to 12.2

years (carbonate and total ANC, respectively), versus 5.2 years to depletion of the total sulfur, indicating the sample will not become acid generating.

In comparison with previous testing programs with LS tailings HCTs, the higher sulfur samples had faster ANC depletion rates. For the High Sulfur (SS feed) sample, all of the ANC was calculated to be consumed with approximately 23% of the total sulfur remaining, consistent with the acidic conditions achieved during testing (terminal pH of 3.6).

The High Sulfur (PS feed) sample had approximately 38 to 40% of the ANC (carbonate and measured, respectively) remaining at the conclusion of the test (91 weeks), despite achieving acidic conditions. This indicates that not all of the ANC measured, whether as TIC or total, is readily available or available at rates to prevent acidification occurring once sulfide oxidation rates reach a certain point. This may be due to the presence of siderite (which can buffer to moderately acidic conditions [pH 4.8 to 6.3; MEND 2009] and also does not contribute to the overall ANC, but is often included in the ANC measurements or calculation), the presence of slower reacting silicates contributing to the ANC, or due to mineralogical or physical factors limiting ANC availability (e.g., mineral occlusion). It is also noted that for both of the High Sulfur (PS feed) and High Sulfur (SS feed) samples, the pH began to fall in the tests before the ANC was depleted. This further emphasises that:

1) Not all of ANC may be readily available (whether due to ANC present as siderite or silicates or due to physical or mineralogical factors), and
2) That the depletion calculations have significant limitations and interferences, as described previously, that can affect the calculations and interpretation.

Depletion calculations for the AMIRA columns indicate that sulfide sulfur is depleted at a slower rate in the AMIRA leach columns than that of the HCTs, whereas ANC depletion occurred at a similar rate as Median Sulfur (PS feed), Median Sulfur (SS feed) and CIL Detox. samples (Figure 50). Based on the slower depletion of sulfur relative to that of ANC, the AMIRA columns were expected to go acidic but appear to be depleting sulfide sulfur 10 to 50 times slower than the High Sulfur (PS feed) and High Sulfur (SS feed) samples. The long lag time of the AMIRA leach columns (predicted to be PAF by static testing) could be due to several cumulative factors, particularly relative to the other tests. The fine grain-size distribution of the tailings, combined with the evaporative crust and no disturbance or agitation of the materials may be keeping the column saturated and under anaerobic conditions, limiting oxygen contact with the sulfide minerals. The slower oxygen consumption rate in the column may also be allowing greater reactivity of the ANC associated with slowly reacting silicate minerals. This result is consistent with the lower reactivity in these tests as described previously.

Table 13: Predicted depletion calculations and carbonate molar ratios.

Sample Name	Total Sulfur (years)	ANC (TIC NP) (years)	ANC (Titration NP) (years)	Depletion Calculation Class	ABA Class (AMIRA)	ABA Class (MEND 2009)
LS tailings – Median Sulfur (PS feed)	37.3	33.8	25.3	UNC	NAF	NAF
LS tailings – Median Sulfur (PS feed) Agitated	10.9	15.9	12.1	UNC	NAF	NAF
LS tailings – Median Sulfur (SS feed)	2.7	3.7	1.2	UNC	UNC	UNC
LS tailings – Median Sulfur (SS feed) Agitated	1.6	2.2	0.8	UNC	UNC	UNC
LS tailings - After CIL detox (PS feed)	5.2	9.7	12.2	NAF	NAF	NAF

Sample Name	Total Sulfur (years)	ANC (TIC NP) (years)	ANC (Titration NP) (years)	Depletion Calculation Class	ABA Class (AMIRA)	ABA Class (MEND 2009)
LS tailings – High Sulfur (PS feed)	2.7	1.5	1.5	PAF	UNC	PAF
LS tailings – High Sulfur (SS feed)	2.4	0.4	0.9	PAF	UNC	PAF
LS tailings – AMIRA (PS feed)	50.4	47.0	47.0	UNC	UNC	UNC
Whole tailings – AMIRA (PS feed)	66.8	18.0	12.9	PAF	PAF	PAF

Note:

- LS tailings - Low Sulfur (PS feed) excluded due to the limited dataset and that acidification is unlikely.

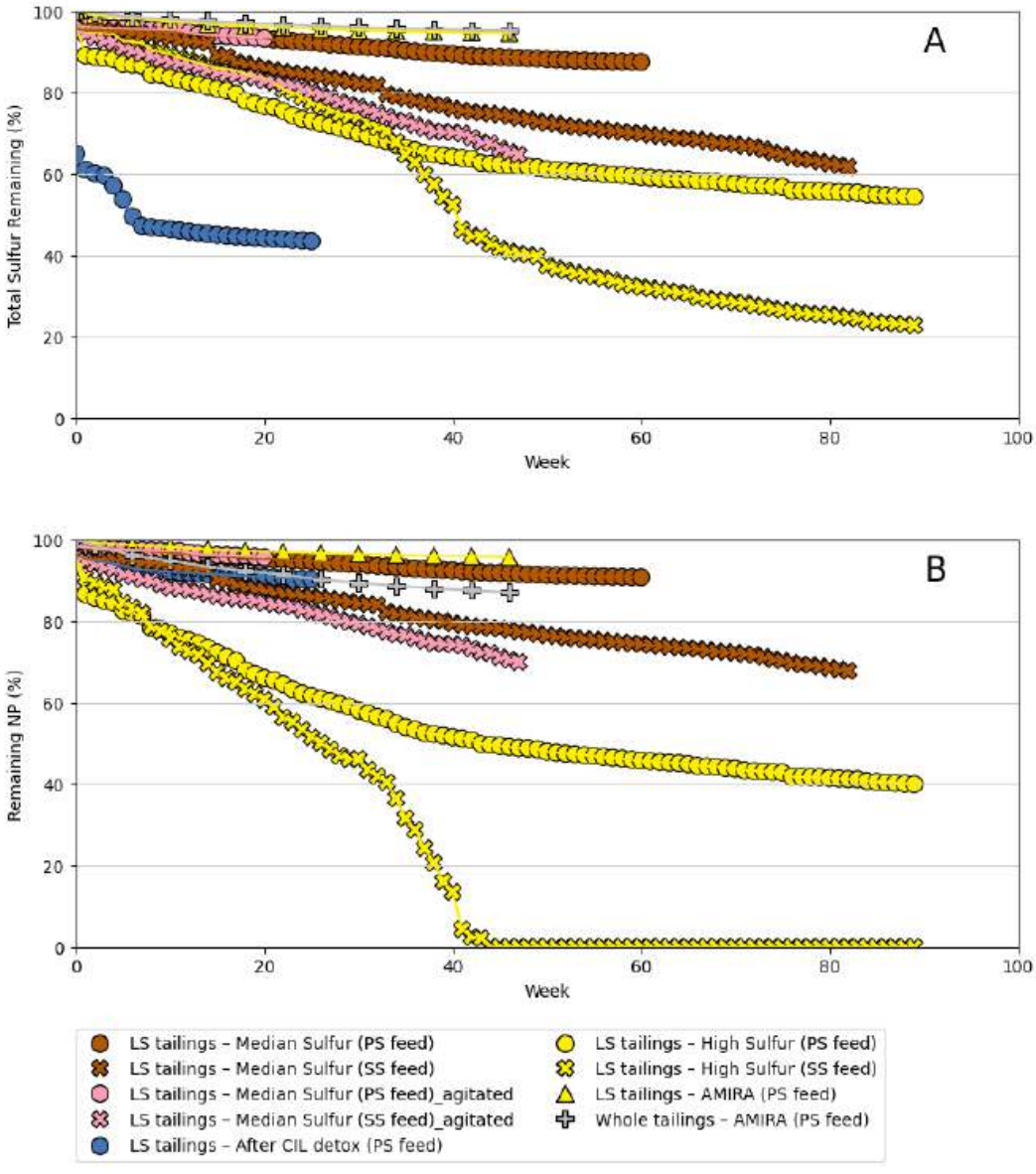

Figure 50: Depletion calculations for total sulfur and measured ANC.

3.6.3.8. Oxygen Consumption Rates

An OCR provides an indication to the rate at which oxidation processes are occurring in a sample. Where sulfide minerals dominate, the OCR can be assumed to represent sulfide oxidation, and can be determined directly by oxidation consumption or indirectly from sulfate production. The OCR will be a function of both the sulfide mineral content of the sample and the reactivity of the sulfides, with the latter dependent on a range of factors. Sample and testing conditions, such as moisture content affecting oxygen diffusion, will also influence the OCR values calculated.

Direct OCR testing was completed on two tailings samples (LS tailings - AMIRA and Whole tailings - AMIRA) and 11 waste rock samples. SRK (2020) noted that the OCR values were relatively low for both the LS tailings - AMIRA (1.4×10^{-10} kg O^2/kg/s) and the Whole tailings - AMIRA (2.1×10^{-10} kg O^2/kg/s) relative to the waste rock samples, but generally consistent with other low sulfide materials.

Calculation of OCR values for the tests in this study was determined indirectly by sulfate released in the final five weeks of kinetic testing and is compared to the laboratory OCR values in Figure 51 (waste rock OCR values, as well as SRK [2020] database values, are included in the figure shown for reference). The variability likely reflects differences in test conditions and sulfur content. Values for OCR calculated indirectly from kinetic testing are an order of magnitude lower than those calculated by the direct OCR testing. Additionally, the lowest tailings oxygen consumption rates were associated with the AMIRA columns and the Median Sulfur (PS feed) samples. These findings are consistent with the low reactivity of these tests. Tailings samples tested by HCT had higher oxygen consumption rates than the AMIRA columns, but still lower than that of the direct laboratory OCR tests, potentially reflecting some moisture retention limiting oxygen ingress. Furthermore, the HCTs that were agitated (LS tailings - High Sulfur (PS feed), LS tailings - High Sulfur (SS feed), Agitated Median Sulfur (PS feed), and Agitated Median Sulfur (SS feed) reflect higher OCR values, also potentially indicating the agitation added to the oxidation. However, it should be noted that the tests for the Agitated Median Sulfur (SS feed) and Non-Agitated Median Sulfur (SS feed) samples are considered in progress and the calculated OCR values may or may not be premature.

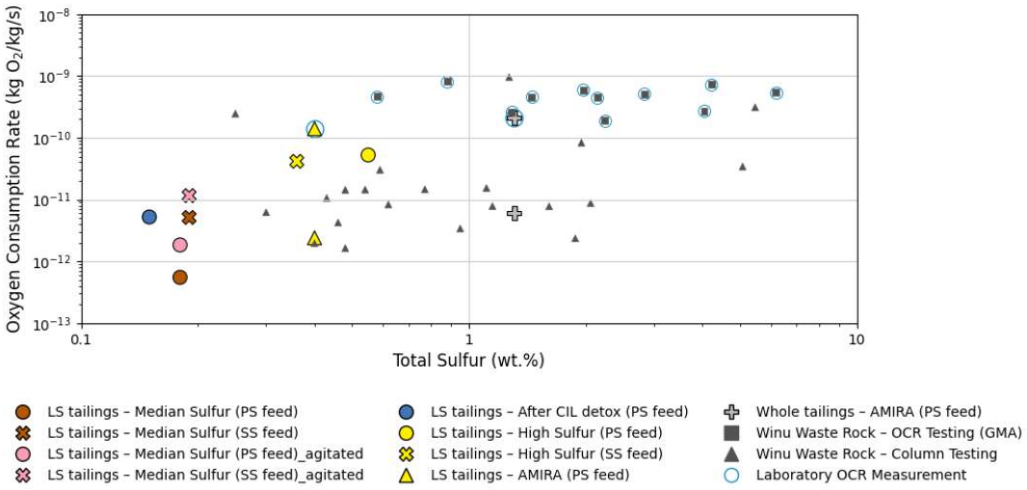

Figure 51: OCR versus total sulfur in Winu tailings and waste rock.

Note:

- Laboratory OCR was determined directly by GCA, Column OCR was determined indirectly based on the sulfate concentration (Figure 41) of last five weeks of testing.

3.6.3.9. Multivariate Analysis

Multivariate analysis such as Principal Component Analysis (PCA), which is an unsupervised machine learning method, reduces dataset dimensionality to its principal, independent components, thereby revealing the inner structure of a dataset that might otherwise be obscured. This technique can reveal the subtle relationships between groups of elements that define the HCTs chemical evolution through progressive leaches. This evolution can be indicative of a cell heading toward acidic conditions and may assist in understanding different laboratory methodologies.

An analysis using PCA was performed on all HCT results, except for the Low Sulfur (PS feed) sample due to the limited dataset, for the weeks with a full analytical suite, to better understand the multivariate evolution of the cells. Performing PCA analysis requires preparation of the dataset because the raw data often contains values in forms unsuitable for advanced analytics, such as:

1) Measurements reported below a method detection limit, referred to as censored data, and
2) Missing values.

To account for censored data, values below the detection limit were converted to half detection limits and any missing values were imputed with a nearest neighbour algorithm[5]. Additionally, analytes where > 80% of the data were below method detection limit were removed from the analysis. Furthermore, the first flush (weeks 0 to 5) were removed from the analysis, so as to remove the influence soluble salts have on the dataset variance. All data was converted into the same units and underwent a cantered log-ratio transformation to account for numeric closure inherent in chemical datasets. This transformation centres the data and eases identification of geochemical domains. Data preparation was conducted using python programming language.

The PCA results are presented in biplot (Figure 52) with principal component 1 (PC1) on the x-axis and principal component 2 (PC2) on the y-axis. PC1 represents 46% of the dataset variance while PC2 represents 14%. The following observations can be made from the multivariate analysis:

- The vectors arrangement suggests PC1 is dominated by total alkalinity on the left and the hydrogen ion (representing pH) and metals vectors on the right. Similarly, the PC2 space is dominated by sulfate at the top and Al at the bottom. This is consistent with conceptual models of HCTs where acid-base reactions as a result of sulfide oxidation drive HCT chemical evolution.
- The CIL Detox. and both the Agitated and Non-Agitated Median Sulfur (PS feed) sample are in the lower left corner near the total alkalinity vector. Each of these samples plots in a relatively small space on the biplot, indicating limited chemical change across datapoints. This is consistent with observations of low reactivity from time series results.
- The two High Sulfur samples both plot primarily on the right of the biplot, near the metals and H+ vectors. This positioning is indicative of acid generation and metal leaching, consistent with the results observed with the acidic leachates from these tests.
- Both the Non-Agitated and Agitated Median Sulfur (SS feed) samples begin near the sulfate vector and move progressively to the right, near the metals and H+

[5] Nearest neighbour algorithms calculate the multi-dimensional distance between all datapoints within a dataset using the available chemical data. It then identifies the “k” closest datapoints (e.g. most chemically similar) to make predictions for missing data. “k” is user defined and in this case equals five.

vectors. This suggests a week to week evolution toward acid generating conditions. Additionally, the agitated samples enter the area indicating acid generation earlier than the non-agitated counterpart.

- The AMIRA columns show a consistent weekly trend beginning from the sulfate vector towards the total alkalinity vector. These samples also track a change in nitrogen species from nitrate variance in the earlier weeks of testing and more ammonia in the later weeks.

The PCA results are consistent with observations from depletion calculations and time series in terms of reactivity of the High Sulfur samples and the non-reactivity of the CIL Detox. and both the Agitated and Non-Agitated Median Sulfur (PS feed). It also clearly demonstrates the trajectory of both the Median Sulfur (SS feed) samples toward acid generation as well as the difference in lag time to acidic conditions due to methodology. Furthermore, the AMIRA columns show a marked difference in chemical trajectory than the HCT samples, supporting conclusions that testing conditions were representative of expected conditions. Future changes in leachate chemistry may be discernible by PCA trends, assisting in analysis of the expected pH and constituent concentrations with time.

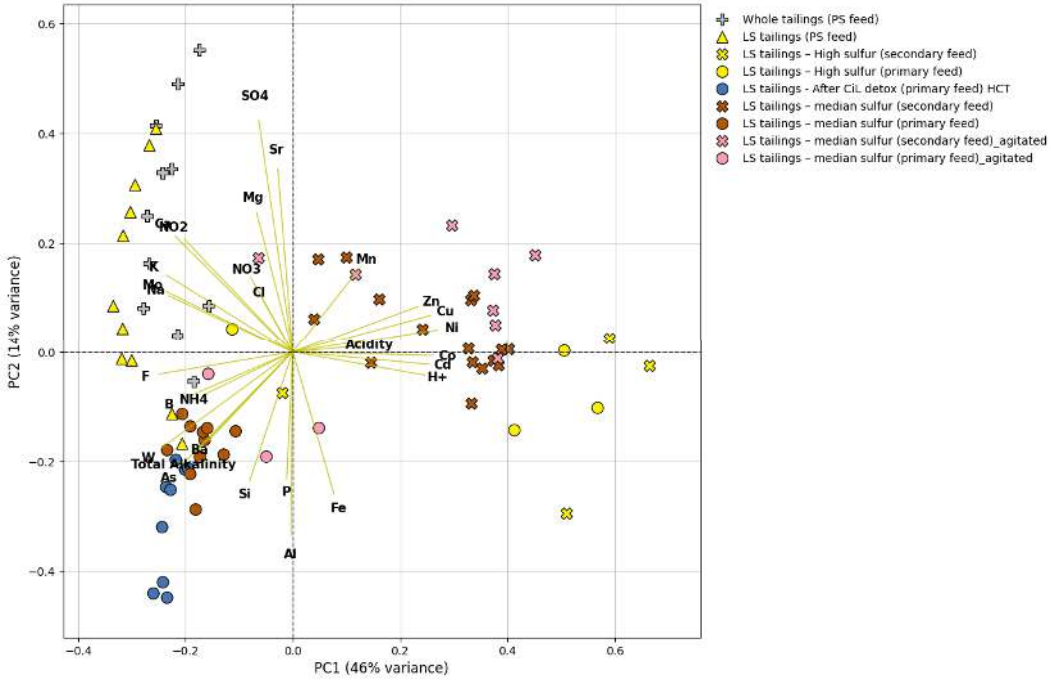

Figure 52: PCA on HCT tailings dataset.

3.6.4. *EVALUATION OF POTENTIAL ENVIRONMENTAL BEHAVIOUR*

3.6.4.1. Acid Generation Potential and Lag Times

The LS tailings will have an overall LoM average of 0.2 wt% sulfur (Figure 4); as such, the three median sulfur samples for kinetic testing (Median Sulfur (PS feed), Median Sulfur (SS feed), and CIL Detox.), which have similar sulfur contents (0.15 to 0.19 wt% sulfur) can be considered representative of the LS tailings. The following provides observations with respect to the expected acid generation potential and lag time for these tailings samples.

Primary Sulfide Mineral Resource Feed:

Geochemical characterisation results to date indicate that NAF behaviour is expected for the PS feed tailings under deposition conditions for the Winu Project and the median sulfur content. Factors contributing to this include:

- ABA results (NAPP and NPR) indicate NAF behaviour based on bulk composition (Table 12), and NAG pH values are greater than 5.5, resulting in a NAF classification.
- Kinetic HCT results to date support the NAF designation for the Non-Agitated Median Sulfur (PS feed), the Agitated Median Sulfur (PS feed), and CIL Detox. samples, with circumneutral leachates generated for 60, 20, and 25 weeks of testing, respectively. The majority of constituent concentrations are relatively stable to decreasing over the testing period, which is consistent with a system well-buffered relative to the minor amounts of acid generated by sulfide oxidation.

Additionally, the deposition, storage, and closure methods of the LS tailings will further support NAF behaviour, with additional neutralisation capacity added as a part of the CIL processing and supernatant, maintaining a high degree of saturation in the tailings during operations, and the installation of a closure cover that will limit oxygen ingress and sulfide mineral oxidation.

Comparison of the neutral LS tailings HCTs with median sulfur (0.15 to 0.19 wt% sulfur) and the acidic LS tailings HCT with high sulfur (0.55 wt% sulfur) indicates that an increase of this magnitude in the sulfur content has the potential to result in acidic conditions.

Secondary Sulfide Mineral Resource Feed:

The geochemical characterisation results to date indicate that Median Sulfur (SS feed) has a potential for acid generating conditions with time under oxidising conditions (i.e., with exposure to atmospheric air and oxygen ingress). The Median Sulfur (SS feed) sample was initially classified as uncertain based on ABA results, though HCT kinetic tests indicate that acidic and metal leaching conditions can develop in both the Agitated and Non-Agitated tests. The High Sulfur (SS feed) kinetic test also reached acidic conditions (terminal testing pH near 3.5). While the sulfur content of these samples is relatively low (0.19 and 0.36 wt%) and consistent with the overall range of the LS tailings for the project, they are more reactive than the primary sulfur; this result is consistent with the higher reactivity observed for the secondary sulfide materials in the waste rock (Rio Tinto 2024c).

For the Median Sulfur (SS feed) samples tested with different methodologies, there is a clear and significant lag time difference to acidification. The Non-Agitated sample began acidification processes around 21 weeks but did not develop stable acidic conditions until week 31. The pH in the Agitated sample began dropping at week 1 and achieved stable acidic conditions by week 20. Similarly, the High Sulfur (SS feed), which was also agitated, had a shorter lag time to acidic conditions. The accelerated lag times in these tests are likely due to additional exposure of oxygen. However, differences in lag times were relatively small to minimal between the Agitated and Non-Agitated Median Sulfur (PS feed) samples, suggesting that methodological differences are more important when samples have higher sulfide content. In the field, the lag time to acidic conditions will likely be governed by sulfide content to some extent, but also the moisture content and extent of exposure to oxygen, as demonstrated by differences between the AMIRA and HCT testing methods

3.6.4.2. Environmental Behaviour and Lag Time – Operations

During operations, the LS tailings will be placed as a slurry (68% solids by weight). With the liner limiting drain down and continual placement of tailings, it is expected that the LS tailings will maintain a relatively high degree of saturation during operations, if not fully saturated.

Geochemical characterisation results to date for LS tailings samples (Median Sulfur (PS feed), Median Sulfur (SS feed), and CIL Detox.) indicate a NAF behaviour under deposition and operational conditions expected for the Winu Project. While tailings derived from the

SS feed have a potential to generate acid conditions based on testing to date, several factors will limit their reactivity during operations. These include:

- Maintaining a high degree of saturation is well understood to limit oxygen ingress and subsequent sulfide oxidation (e.g., INAP 2009, MEND 2009) and testing as a part of this characterisation program has demonstrated this effect can be observed in Winu tailings under the correct conditions.
- A lag time is demonstrated in kinetic tests, which is likely to be extended in the field given that the tailings are expected to be kept saturated and will not be disturbed or agitated after placement.
- Alkaline process solutions used to slurry the tailings will also provide additional neutralisation capacity to extend the lag time.
- The majority of the LS tailings will be derived from the PS feed (85%), which has a lower reactivity based on this testing.

Corresponding with the limited sulfide oxidation and non-acidic conditions, metals leaching is expected to be low during operations.

3.6.4.3. Environmental Behaviour and Lag Time – Closure and Post-Closure

As a part of closure, the LS tailings will undergo drain down, via the TSF underdrains, and a closure cover will be placed. While a lower degree of saturation is expected at closure and post-closure, the cover and fine-grained nature of the tailings are still expected to maintain a degree of saturation that will limit oxygen ingress and subsequent sulfide oxidation. Nonetheless, some oxidation may occur in post closure, for which the SS feed derived tailings are expected to have the greater reactivity and risk of acid generation with associated metals release.

The overall risk for AMD in closure and post closure was qualitatively evaluated to be low based on the following:

- LS tailings will have an overall LoM average of 0.2 wt% sulfur. Based on kinetic testing to date, this sulfur content has not resulted in acidic conditions for the PS feed tailings, which comprise 85% of the total tailings.
- As HCTs are unsaturated tests and likely more aggressive, having higher sulfide oxidation rates than the saturated conditions expected within the TSF, the ANC and sulfur depletion rates may be even slower than that calculated using HCT results. The agitated test had faster depletion rates, but agitation of the tailings will not occur in closure and post-closure, particularly after the cover is placed.
- Even after drain down from completely saturated, the LS tailings are still expected to maintain an elevated degree of saturation, which will limit oxygen ingress. The overall testing program has demonstrated that the Winu tailings acid generating behaviour is sensitive to moisture content (which affects oxygen ingress). AMIRA leach columns with tailings samples containing higher total sulfur concentrations than anticipated LS tailings for the Winu project had lower sulfur and ANC depletion rates (Figure 50). The mildly reducing conditions observed in the AMIRA leach column leachates are consistent with a higher degree of saturation, which is expected for the LS tailings during placement. Maintaining a high degree of saturation is well understood to limit oxygen ingress and subsequent sulfide oxidation (e.g., INAP 2009, MEND 2009) and testing as a part of this characterisation program has demonstrated this effect can be observed in Winu tailings under the correct conditions.
- Simple PHREEQC mixing of HCT leachates was undertaken to evaluate mixing of neutral solutions associated with the Median Sulfur (PS feed) (based on week 55 of the HCT, pH 7.05) and acidic solutions from the LS tailings High Sulfur (SS feed)

(week 85, pH 3.4). The HCT results were mixed in PHREEQC at a ratio considering the expected contribution of the of PS feed (85%) and SS feed (12%) to the LS tailings. The mixing calculations in PHREEQC resulted in a solution with a pH 6.1. A pH of 6.1 is above the AMIRA guideline for NAG pH (4.5) and is considered NAF. This suggests that it is likely the higher proportion of PS feed tailings may be sufficient to buffer acidity generated. However, this is recognised as a simplistic approach and does not consider a range of factors or variability. More detailed modelling with sensitivity analysis would be appropriate to evaluate further and consider conditions in the TSF.

- In evaluating the bulk characteristics of the LS tailings, a weighted average of the ABA results for the expected ratios of PS feed (85%) and SS feed (12%) based on the median sulfur samples results in a weighted NAPP of -9.12 kg H_2SO_4/t. However, this has some uncertainty given the that the depletion calculations indicated that not all of the ANC is available. As such, the blending calculations conservatively considered the following:
    - The ABA results for individual samples indicate that both Median Sulfur (PS feed) and Median Sulfur (SS feed) sample had slightly more ANC than MPA, resulting in NAPP values of -9.59 and -1.99 kg H_2SO_4/t, respectively. This gives a NAF classification for the Median Sulfur (PS feed), though the ANC is low enough in the Median Sulfur (SS feed) sample to result in an uncertain classification. However, acidic conditions and depletion calculations for the Median Sulfur - SS feed HCT suggest that not all of the ANC may be available or kinetically too slow to neutralise the acid that is being generated (e.g., neutralisation by silicate mineral). Depletion calculations for High Sulfur (PS feed) and High Sulfur (SS feed) HCTs show a similar trend, with acidic conditions (less than pH 4.5) forming while there was still 62% and 50% of ANC remaining, respectively.
    - If approximately 55% of ANC is not available in both PS and SS feeds, NAPP values would shift to -2.63 and 1.69 kg H_2SO_4/t, respectively. This means that every tonne of PS feed tailings could neutralise the acid generated by 1.5 tonnes of SS feed tailings. Since it is anticipated that there will be over five times more PS feed tailings than SS feed tailings, there should be sufficient ANC in the PS feed to neutralise acid generated by SS feed tailings. Additionally, the CIL detoxification process is expected to contribute additional ANC to the tailings (NAPP of -26.5 kg H_2SO_4/t). Even if only 55% of this ANC is available (NAPP of -12.0 kg H_2SO_4/t), 1 tonne of CIL Detox. tailings could neutralise the acid generated by 7 tonnes of PS feed tailings.
    - While these calculations imply the bulk LS tailings will be NAF, there are a number of assumptions and a relatively small margin of error for the NAF calculations.
- In addition, alkaline slurry water generated during the tailings processing, including the CIL and CN destruction processes, will be present in the TSF during operations. This will preserve a portion of the ANC of the tailings by neutralising generated acid without consuming carbonate minerals.

3.6.5. *SUMMARY OF UNSATURATED KINETIC LEACH TEST WORK*

While the LS tailings are expected to be overall NAF, their behaviour is expected to be sensitive to processing and operational changes. The following factors may be critical to limiting acidic conditions:

- Sulfide content: Comparison of the LS tailings HCTs with median sulfur (0.15 to 0.19 wt% sulfur) and high sulfur (0.36 to 0.55 wt% sulfur) indicates that a relatively

small increase in sulfur may drive acidic conditions. While the current LoM indicates a maximum for the LS tailings of between 0.4 and 0.5% wt% sulfur (quarterly average), monitoring should be undertaken to make sure that mineral resource feed or operational changes do not result in significant changes to the LS tailings sulfur content.

- Reduced moisture content: The overall testing program has demonstrated that the Winu tailings acid generating behaviour is sensitive to moisture content (which affects oxygen ingress). If the mine plan changes or operational conditions develop such that allow significant drying and oxygen ingress to the tailings there may a be a potential for localised or general AMD development.

While overall acidic conditions may not develop, develop, more reactive tailings (i.e., the SS feed tailings) may oxidise in localised zones or at the micro scale, releasing metals even if the localised or micro-scale acidification is neutralised by the overall tailings mass. For example, this is observed in the zinc trends in both Median Sulfur (SS feed) samples, where zinc is consistently detected and concentrations have increased in the last 30 weeks for the Non-Agitated sample, though concentrations are still relatively low (maximum concentration of 0.44 mg/L at week 87). Manganese is also consistently detected in all Median Sulfur samples, though concentrations are also relatively low (< 0.1 mg/L). Additionally, some first flush behaviour will be possible for the tailings in closure and the earlier stages of post-closure.

Concentrations of dissolved CN (free CN) and CN complexes (CN(WAD), CN(T)) remained low, and well below values detected in the supernatant. The cumulative mass of CN(T) leached from the tailings sample is estimated to be ~6.6 mg/kg (or ~4.6% of the initial mass) for the duration of the test. The generation of nitrogen from the HCT (sourced from the hydrolysis of CN to NH_3-N, and the subsequent oxidation of NH_3-N to NO_3-N) indicated that the equivalent mass of CN converted was ~4.64 mg/kg for the test period.

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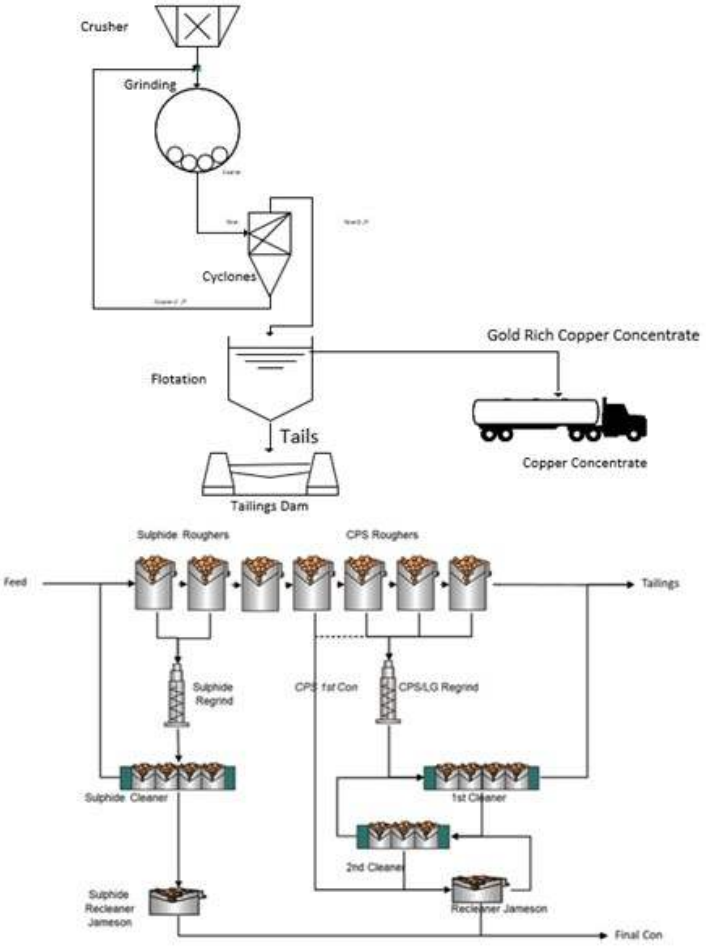
Analytical and supporting laboratory reports are within Appendix 5.

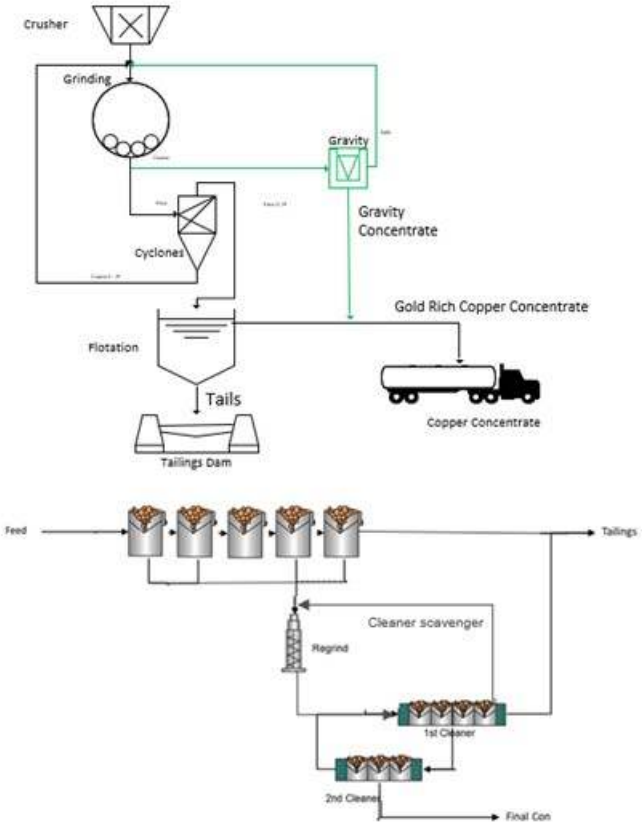
APPENDIX 1 – WINU PROCESSING FLOWSHEETS

The processing flow sheets were continually refined during the study. Tailings were collected during this metallurgical development process, with Flowsheet 4 being the most relevant.

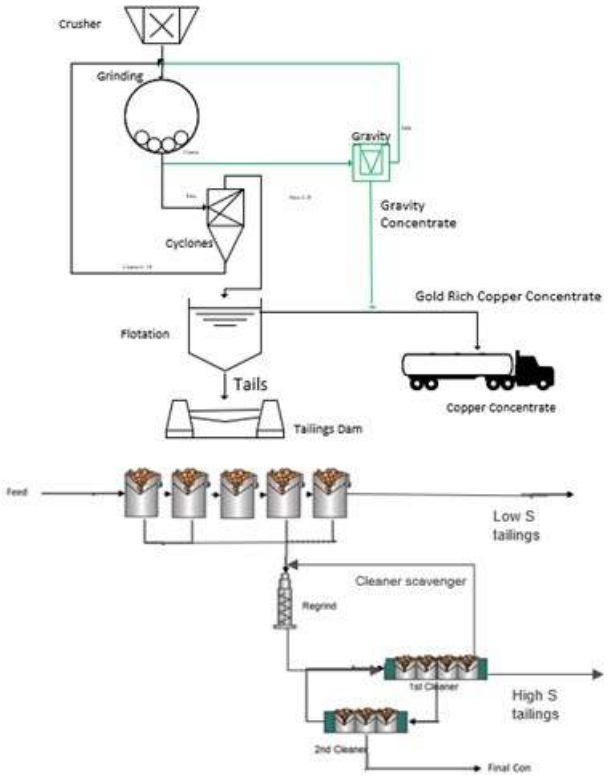
Winu Flowsheet 1 (September 2019 – February 2020)



Winu Flowsheet 2 (March 2020- October 2020)

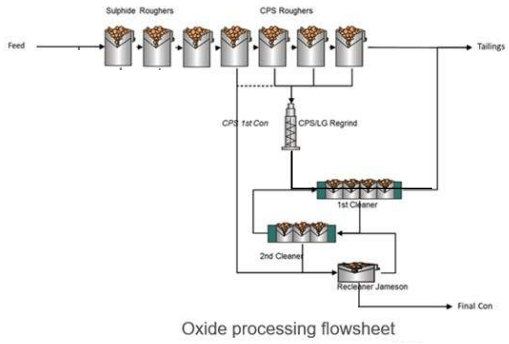


Winu Flowsheet 3 (November 2020- March 2021)

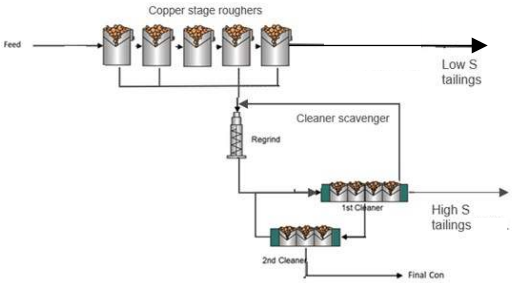


Winu Flowsheet 4 (April 2021, viability of CIL being assessed)

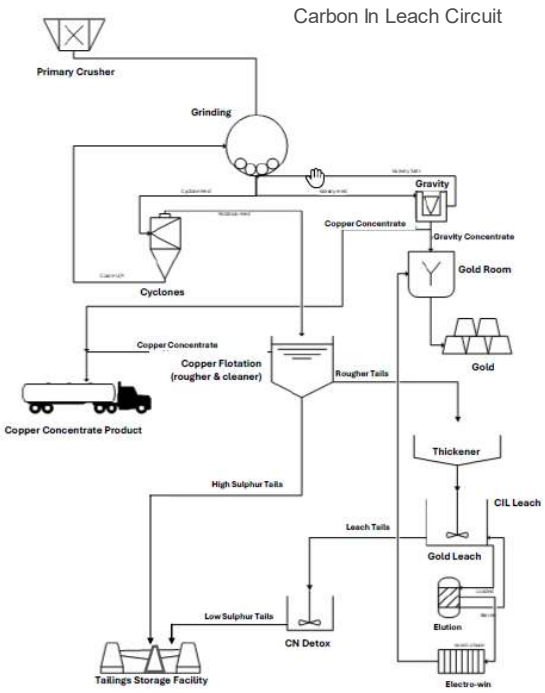
CIL is shown in the diagram as 'Gold Leach';
SO_2/air detoxification is shown as 'Detox.'.



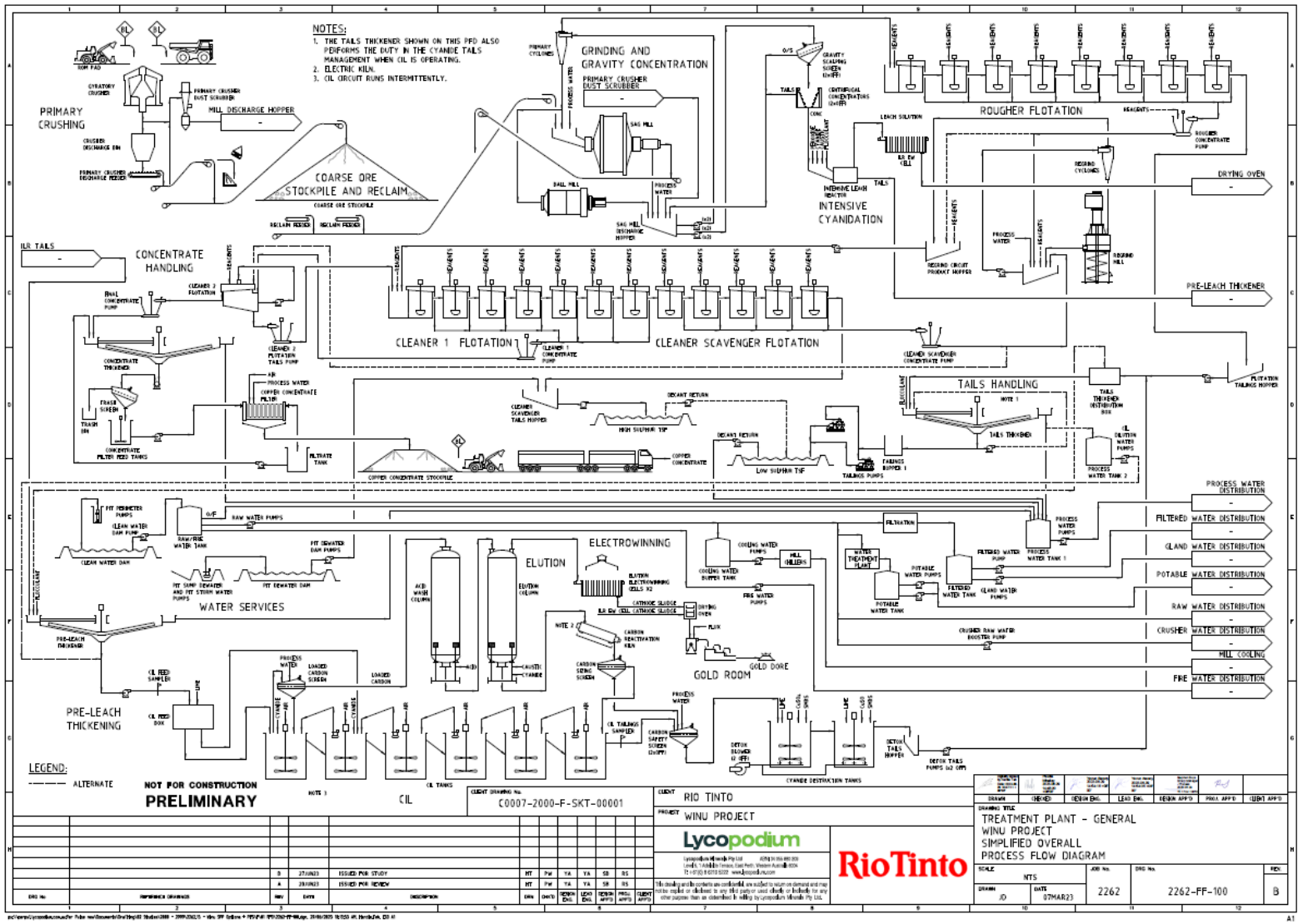
Oxide processing flowsheet



Sulfide processing flowsheet



Overall Winu Process Flow Diagram (Current)



APPENDIX 2 – CUSTOM ANC METHOD

From	Mike Hutton-Ashkenny (G&I)
Department	Bundoora Technical Development Centre
To	Ros Green (RTCD), Paul Brown (G&I), Matt Wickham (RTCD)
CC	Paul Weber, Roger Smart, Andrea Gerson, Anita Parbhakar-Fox, Nathan Fox, Louisa O'Connor, Jake Waples, Yuan Tian, Steven Lee
Date	10 September 2020
Number of pages	5

Review of ANC Test Methodologies: Rio Tinto Winu Study

Background and Summary

There have been inconsistencies noted in the acid neutralisation capacity (ANC) results received from testing Winu mineral waste samples at ALS via the Australian standard AMIRA method[6] and a variation of this method developed to correct for the presence of siderite.[7] Notably, the method used to correct the measured ANC for the presence of siderite (a non-net acid consuming carbonate) returned ANC values on average 10% higher than where no correction for siderite was undertaken (Figure 1), when the values from siderite correction should be lower than, or at least equivalent to, that for the standard ANC test.

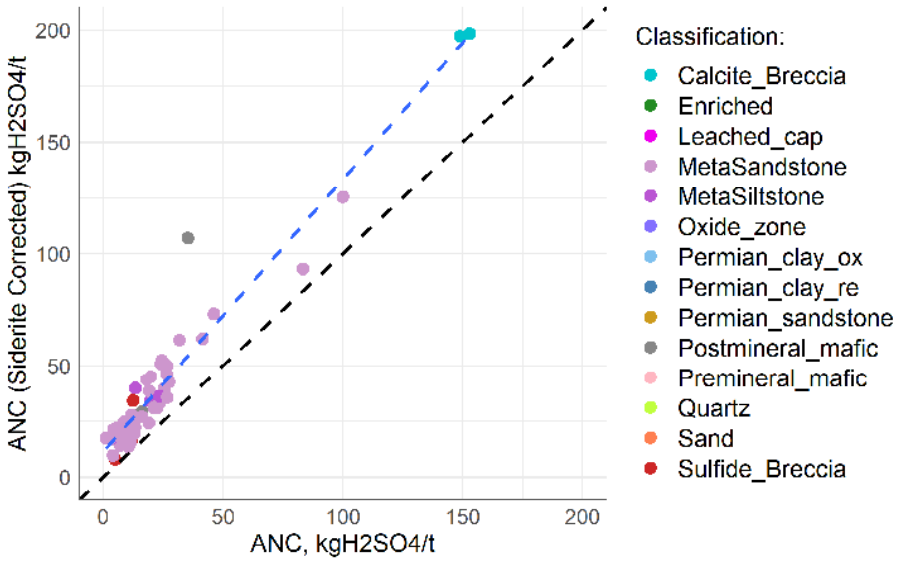


Figure 1: Relationship between the AMIRA ANC method and ANC conducted to correct for siderite (EGi method) for Winu samples, showing a 1:1 relationship (black) and the line of best-fit (blue).

A review of the data and test methods used has suggested that there are several potential issues with both the AMIRA ANC method and the EGi Siderite Correction method as

[6] AMIRA International, ARD test handbook, 2002, Project P387A: Prediction & Kinetic Control of Acid Mine Drainage, Melbourne

[7] Environmental Geochemistry International (EGi), Modified hydrogen peroxide acid neutralising capacity procedure, 2009, EGi, Balmain

applied to samples from Winu, mostly related to the high level of mica and other silicate minerals in the samples:

1. Pulverising the sample increases the surface area of silicate minerals and allows them to over-dissolve.
2. The AMIRA method causes silicate minerals to over-react by targeting a too-low pH based on over addition of acid to the samples as a result of using the AMIRA fizz-rating table.
    a. The method for determining acid addition to Winu samples should be changed.
    b. The digestion pH before back-titration should be reported to help in understanding potential silicate dissolution.
3. For the EGi Siderite Correction method used by ALS, filtration of the pulp after digestion means that adsorbed acidity on mica and other aluminosilicate minerals does not get accounted for during the back-titration.
    a. The amount of peroxide (2 – 3 drops of 30% H_2O_2 for 15 minutes) added to a slurry for the standard AMIRA ANC method to oxidise residual ferrous iron is sufficient for typical Winu samples, and hence, the EGi Siderite Correction method over-estimates ANC.

In response to the above, different methods for determining ANC were reviewed to develop an ANC determination method applicable for Winu. The review and developed method are presented here.

Review of ANC Methods

An ANC test estimates the capacity of a sample to neutralise acid by first digesting a known mass of the sample in hydrochloric acid and then back-titrating to a neutral pH using sodium hydroxide to calculate the moles of acid consumed per unit mass of sample during digestion. The initial ANC method accepted by the mining industry (the Sobek method)[8] is based on this principle. Since this method was published in 1978, there have been many variations adopted – including the AMIRA ANC test. Several of these methods aim to deal with the problem of siderite dissolution.

Siderite ($FeCO_3$) is not net-acid neutralising as any ferrous iron dissolved during reaction of the carbonate with acid will eventually oxidise to ferric iron, releasing acidity equal to that neutralised by the dissolution. Under short-term laboratory testing, however, ferrous oxidation can be incomplete, and thus, the measured ANC is over-estimated. The AMIRA ANC method uses a few drops of 30% H_2O_2 to oxidise any residual ferrous iron, but it is generally believed that at high ferrous loadings the amount of peroxide added is insufficient. The EGi Siderite Correction method therefore adds a large excess of peroxide, over 24 hours or more, to ensure complete oxidation. To avoid oxidation of sulfide minerals under this regime, however, the digest slurry is first filtered before peroxide is added and the back-titration completed.

Other methods to correct for potential siderite anomalies include the Lawrence[9] and the Skousen[10] methods. The Lawrence method relies on less intense digestion conditions, which aim to avoid dissolution of siderite. This includes lower acid additions (higher digestion pH) and lower temperatures. Most ANC tests estimate the amount of acid required by first conducting a qualitative 'fizz test' where the intensity of reaction between

[8] Sobek, A.A. et al., Field and laboratory methods applicable to overburdens and minesolis, EPA-600/2-78-054, 1978

[9] Lawrence, R.W., Prediction of the behaviour of mining and processing wastes in the environment. In: Proc. Western Regional Symp. On Mining and Mineral Processing Wastes, ed. F. Doyle, Berkeley, California, 1990, 115 – 122.

[10] Skousen J., Neutralisation potential of overburden samples containing siderite, Journal Environmental Quality, 26, 1997, 673 – 681

a sample and concentrated HCl is ranked between 1 and 5. The volume and molarity of acid added based on the fizz rating, however, can vary between methods (Table 1).

A method developed by Graeme Campbell Associates (GCA) similarly reduces siderite digestion by adding the minimal requirement of acid by first calculating addition of acid to slightly above stoichiometric requirements.[11] The method also aims to reduce dissolution of mica and other aluminosilicate minerals that would typically offer no neturalising capacity to acid drainage, due to slow reaction kinetics at moderate pH (> pH 2).

Commentary from Graeme Campbell elaborates on the differences between the GCA method and the standard AMIRA procedure (Table 2):

- Testing is performed on −2 mm fractions (rather than pulps) where available to avoid over-exposing slow reacting minerals (such as aluminosilicate minerals) and causing unrealistic reaction extents. *Note that a −2 mm and 50 g sample would be required to provide a statistically representative sample (approximately 15% standard deviation).*
- Acid addition is calculated based on the TIC content of a sample to target a slight excess of stoichiometric acid addition (3 kg H_2SO_4/t excess).
- Slurry pH is recorded and reported after digestion to ensure low pH values, where appreciable silicate digestion can occur, are not obtained. Although this is measured in the AMIRA method, the acceptable minimum pH is very low (pH 0.8) and typically not reported.

Table 1: Acid additions for various ANC methods normalised to 1 N HCl and 2 g of sample.

	Fizz Rating 0 ~ ANC 5 kg/t			Fizz Rating 1 ~ ANC 25 kg/t			Fizz Rating 2 ~ ANC 70 kg/t		
	mL	N	mL of 1 N eq	mL	N	mL of 1 N eq	mL	N	mL of 1 N eq
Kennecott*	18	0.1	1.8	18	0.5	9	18	0.5	9
GCA (approx.)	3	0.1	0.3	10	0.1	1	6	0.5	3
Skousen (SobPer)	20	0.1	2	40	0.1	4	40	0.5	20
Lawrence	2	1	2	3	1	3	4	1	4
AMIRA / EGi**	4	0.5	2	8	0.5	4	20	0.5	10

* The method used at Kennecott applies a blanket 18 mL of 0.1 / 0.5 M HCl for all samples, potentially over-digesting silicates for low-moderate ANC samples.

** Includes Siderite Correction method from EGi.

Table 2: Summary and comparison of key method parameters for various ANC methods.

	Size Fraction	Temperature C	Time h	End pH	30% H_2O_2	Notes
Kennecott	Pulp	Boil	Until bubbling stops	NA	NA	Based on Skousen
GCA	−2 mm	75 – 85	1	1.5 – 2.5	3 drops	Boil for 1 min after digest. Non-publisehd method
Skousen (SobPer)	Pulp	90 – 95	Until bubbling stops	NA	5 mL	Boil for 1 min after digest.
Lawrence	Pulp	Ambient	24	2.0 – 2.5	None	Acid added in 2 stages
AMIRA	Pulp	80 – 90	1 – 2	0.8 – 1.5	2 – 3 drops	Year 2000 revision
EGi*	Pulp	80 – 90	1 – 2	0.8 – 1.5	5 mL, rest 24 h then 8 drops.	Slurry filtered before peroxide addition

* EGi method for Siderite Correction

[11] Cambpell, G., Acid neutralisation capacity (ANC) testwork: based on AMIRA (2002) with variations to constrain dissolution of non-carbonate minerals unrelated to circum-neutral buffering save for vanishingly small rates of pyrite oxidation, Bridgetown, 2020

Proposed ANC Procedure for Winu

In response to the above considerations, an alternative method to determine ANC of Winu samples has been developed based on a Modified Sobek (modified Lawrence Method)[12] ANC. A detailed method for the determination of ANC from Winu waste rock samples based on this method is provided here:

1. The sample will be provided either as a pulverised sample, or 100% passing 2 mm sample.
    a. If the sample is not pulverised, take a small 5 g sub-sample and pulverise (either mechanically or by hand) for determination of the fizz rating.
2. Place approximately 0.5 g of pulverised sample on a piece of aluminium foil or in a shallow dish. Add 1 or 2 drops of 25 wt.% HCl to the sample. The presence of carbonate minerals will be indicated by a bubbling or an audible 'fizz'. Rate the 'fizz' as per Table 3.

Table 3: Volume and normality of standardised HCl for use in ANC determination on basis of Fizz Rating (based on a 2 g sample).

Fizz Rating	Standardised HCl	
	mL	N
None - 0	20	0.1
Slight - 1	40	0.1
Moderate - 2	40	0.5
Strong - 3	80	0.5
Very Strong - 4	80	0.5

3. For pulverised samples, weigh 2.00 g of sample into a 250 mL Erlenmeyer flask and, as a first approximation, add the volume and normality of HCl as indicated by the fizz rating in Table 3.
    a. For un-pulverised samples at −2 mm, use 10.00 g of sample and increase volumes of HCl in Table 3 by a factor of 5. For example, use 100 mL of 0.1 N HCl for a fizz rating of 0. For samples with a higher ANC, a larger Erlenmeyer flask may be required.
4. Agitate the contents of the flask for 24 hours at ambient temperature by placing on a shaking apparatus. At least once in the treatment period, and preferably after approximately 6 hours of reaction, check the pH of the pulp. If the pH is above 2, add an appropriate volume of HCl at the same strength as originally added to reduce the pH to between 1.5 – 2.
5. At the end of the shaking period, check the pulp pH. If the total volume and strength of acid was appropriate the **end pH will be in the range of 1.5 – 2**. If the pH is above this range, the amount of acid added was too low. If the pH is below this range, the amount of acid added was too high. In either case, repeat the test with the next lower or higher volume or strength of HCl, as required.
    a. In some cases for samples with very low ANC (~ 1 kg H_2SO_4 /t) a lower volume of 0.1 N HCl may be required and DI water used to make up the additional volume. For example, 15 mL of 0.1 N HCl and 5 mL of DI water.
6. **Record and report the end pH** for the sample if proceeding to the next step.
7. Titrate the contents of the flask using standardised 0.1 N or 0.5 N NaOH (corresponding to the normality of HCl used in Step 3) to a pH of 4.5 and add 2 – 3 drops of 30% H_2O_2 to oxidise any residual ferrous iron.
8. Following addition of H_2O_2, continue to titrate the contents of the flask until a pH end-point of 8.3 is reached and remains stable for at least 30 seconds.

[12] Lawrence R.W., Marchant P.B., "A Manual of Chemical Evaluation Procedures for the Prediction of Acid Generation from Mine Wastes", Coastech Research, 6.2-11 to 6.2-14

The ANC is then to be reported as:

ANC kg H_2SO_4/t = 49 x ([HCl N] x 'HCl mL' – [NaOH N] x 'NaOH mL') / 'Sample mass g'

Results and Recommendations

The ANC of 5 samples of Winu waste rock were analysed using 4 laboratory methods (one sample was omitted for the EGi method) and compared to the calculated ANC based on total inorganic carbon (TIC). For 4 of 5 samples, the AMIRA ANC was actually higher than that calculated from available inorganic carbon (Table 4). This result suggests significant dissolution of non-carbonate minerals, which is unlikely to occur under field conditions in the short to medium term. Conversely, the results from the GCA test method were always lower than the calculated ANC, and therefore, aligned with realistic expectations for field performance.

In most cases, the Winu ANC gave realistic results based on the ANC calculated from the TIC. The exception was for a sulfide breccia sample (10722335) where only the GCA method appeared to give a realistic result. For this sample, the GCA digest pH was 3.0 – outside the accepted Winu method range – whereas the Winu method digest pH was 1.6. In addition, the GCA test method was performed on –2 mm chips rather than pulverised material. At this size range, to achieve a statistically representative sub-sample, a mass of at least 50 g would be required – GCA only used 5 g for this test, which makes direct comparison difficult. **It is therefore recommended that the test method presented here (ANC_Winu) is used for determining the ANC of mineral waste at Winu.**

For all 4 samples using the EGi method, the ANC corrected for siderite was higher than the standard ANC not correcting for siderite, as predicted in Figure 1. It is believed that this anomaly is a result of high levels of mica and other silicate minerals in the Winu samples. Under acidic digestion, acid bearing species adsorb onto the solid silicate minerals. During back-titration of a pulp sample, these acid species will desorb and consume base. In the EGi Siderite Correction method, however, the acid-bearing solids are filtered away from the liquor before back-titration, removing a portion of the acidity. **It is therefore not recommended to use the EGi ANC method for siderite correction in general, particularly for high mica and other silicate samples.**

Table 4: Comparison of ANC (in kg H_2SO_4 / t) calculated from inorganic carbon and measured using 4 laboratory methods. Numbers in blue italics are below detection.

Sample_ID	Description	ANC_TIC	ANC_AMIRA	ANC_EGi	ANC_GCA	ANC_Winu
10808364	OX_premin_mafic	58.8	13.1	NA	16	7.6
10722187	MetaSandstone	*1.6*	4.2	7.1	0.4	2.7
10722335	Sulfide Breccia	18.0	30.1	39.9	15	28.2
10721817	WE	4.9	10.1	21.7	2.3	3.9
10722153	WE_mineral resource	*1.6*	2.1	3.7	*0.1*	1.5

APPENDIX 3 – SAMPLE INFORMATION

Description	Total S%	Sulfide %	MPA kg H_2SO_4/t	MPA (Sulfide) kg H_2SO_4/t	Total C%	TIC %	ANC kg H_2SO_4/t	ANC(TIC) kg H_2SO_4/t	NPR	NAPP kg H_2SO_4/t	NAF/PAF
Representative Processing Scheme:											
LS tails											
DP1471 LS tail #3	0.16	0.15	4.9	4.6	0.19	0.16	10.0	13.1	2.19	-5.4	NAF
DP1471 LS tail #4	0.40	0.35	12.2	10.6	0.21	0.21	12.9	17.2	1.21	-2.3	UNC
DP1648 LS tail	0.72	0.68	22.0	20.8	0.20	0.18	8.3	14.7	0.40	12.5	PAF
DP1649 LS tail	1.17	1.13	35.8	34.6	0.19	0.16	7.8	13.1	0.23	26.8	PAF
DP1745 LS tail	0.08	0.09	2.4	2.7	0.17	0.13	0.5	10.6	0.19	2.2	PAF-LC
DP1750 LS tail	0.32	0.29	9.8	8.9	0.28	0.24	0.5	19.6	0.06	8.4	PAF-LC
DP1802 LS tail	0.69	0.59	21.1	17.9	0.14	0.14	3.8	11.4	0.21	14.1	PAF
DP1803 LS tail	0.24	0.21	7.3	6.4	0.02	0.02	0.5	1.6	0.08	5.9	PAF-LC
DP1804 LS tail	0.08	0.06	2.4	2.0	0.26	0.26	10.6	21.2	5.41	-8.6	NAF
DP1855 LS tail	0.40	0.42	12.2	12.8	0.02	0.02	0.7	1.6	0.05	12.1	PAF
DP1931 LS tail	0.18	0.15	5.5	4.5	0.25	0.25	9.5	20.4	2.13	-5.0	NAF
DP1970 LS tail	0.14	0.11	4.3	3.4	0.02	0.02	0.5	1.6	0.15	2.9	PAF-LC
DP1971 LS tail	0.19	0.16	5.8	4.7	0.29	0.26	9.1	21.2	1.92	-4.4	NAF
DP1972 LS tail	0.16	0.13	4.9	3.8	0.13	0.13	3.1	10.6	0.81	0.7	UNC
DP1975 LS tail	0.08	0.08	2.4	2.5	0.06	0.02	3.2	1.6	1.29	-0.7	Barren
DP1976 LS tail	0.18	0.15	5.5	4.7	0.06	0.04	4.0	3.3	0.86	0.7	PAF-LC
DP2003 LS tail	1.02	0.41	31.2	12.5	0.20	0.16	6.5	13.1	0.52	6.0	PAF
IMAPS LS tail	0.18	0.08	5.5	2.4	0.23	0.19	9.3	15.5	3.85	-6.9	NAF
DP2001 LS tail	0.10	0.14	3.1	4.3	0.28	0.26	21.2	21.2	4.89	-16.9	NAF
DP2002 LS tail	0.89	0.29	27.2	9.0	0.31	0.29	23.7	23.7	2.64	-14.7	UNC
DP2004 LS tail	1.51	0.62	46.2	18.9	0.16	0.16	13.1	13.1	0.69	5.8	PAF
DP2042r LS tail	0.23	0.31	7.0	9.6	0.23	0.23	18.8	18.8	1.96	-9.2	NAF
DP2043 LS tail	0.05	0.09	1.5	2.9	0.02	0.02	1.6	1.6	0.57	1.2	Barren
DP2044 LS tail	0.17	0.10	5.2	3.1	0.22	0.22	18.0	18.0	5.76	-14.9	NAF
DP2045 LS tail	1.96	0.10	60.0	3.1	0.02	0.02	1.6	1.6	0.53	1.5	PAF
DP2046 LS tail	1.07	0.11	32.7	3.2	0.30	0.30	24.5	24.5	7.63	-21.3	UNC

Description	Total S%	Sulfide %	MPA kg H_2SO_4/t	MPA (Sulfide) kg H_2SO_4/t	Total C%	TIC %	ANC kg H_2SO_4/t	ANC(TIC) kg H_2SO_4/t	NPR	NAPP kg H_2SO_4/t	NAF/PAF
DP2047 LS tail	0.17	0.13	5.2	3.9	0.18	0.18	14.7	14.7	3.81	-10.9	NAF
DP2048 LS tail	0.88	0.55	26.9	16.8	0.29	0.29	23.7	23.7	1.41	-6.9	NAF
IMASS LS tail	0.06	0.05	1.8	1.4	0.04	0.02	6.6	1.6	4.79	-5.2	NAF
DP1999 LS tail	0.55	0.52	16.8	15.8	0.24	0.17	14.5	13.9	0.92	1.3	UNC
DP2186 LS tail	0.36	0.30	11.0	9.2	0.02	0.02	7.1	1.6	0.77	2.1	UNC
CC18 LS tail	0.02	0.01	0.6	0.4	0.02	0.02	4.5	1.6	12.3	-4.1	Barren
HS tail											
DP1555-1560 HS tail	30.5	25.0	933.3	765.0	0.3	0.3	5.2	23.7	0.01	759.8	PAF
DP1745 HS tail	32.4	25.0	991.4	765.0	0.5	0.5	0.5	37.6	0.00	764.5	PAF
DP1802 HS tail	34.2	25.0	1046.5	765.0	0.2	0.1	0.5	10.6	0.00	764.5	PAF
DP1804 HS tail	14.3		437.6								
DP1855 HS tail	12.6	11.3	385.6	345.8	0.1	0.0	3.1	1.6	0.01	342.7	PAF
DP1931 HS tail	28.7	25.3	878.2	774.2			9.2		0.01	765.0	
DP1970 HS tail	20.4	16.2	624.2	495.7			2.7		0.01	493.0	
DP1971 HS tail	24.5	23.0	749.7	703.8			6.7		0.01	697.1	
DP1972 HS tail	26.3	25.1	804.8	768.1			3.7		0.00	764.4	
DP1975 HS tail	18.9	17.2	578.3	526.3			3.2		0.01	523.1	
DP1976 HS tail	33.1	23.1	1012.9	706.9			7.4		0.01	699.5	
DP2003 HS tail	38.7	29.2	1184.2	893.5			3.3		0.00	890.2	
IMAPS HS tail	32.7	23.4	1000.6	716.0	0.4	0.3	18.4	27.8	0.03	697.6	PAF
IMASS HS tail	27.7	19.8	847.6	605.9	0.2	0.1	6.1	9.8	0.01	599.8	PAF
CC18 HS tail	0.05	0.04	1.5	1.1	0.06	0.02	2.8	1.6	2.47	-1.7	Barren
Unrepresentative Processing Scheme:											
DP1471 LS tail & DP1554-1560 HS tail							15.9				
DP1471 LS tail #4 rpt							16.9				
DP1471 LS tail & DP1554-1560 HS tail	1.3	0.8	40.1	24.2	0.2	0.2	9.7	13.1	0.40	14.5	PAF
DP1648 HS tail	19.6		600		0.4	0.3	23.5	25.3			
DP1649 HS tail	19.4		594		0.4	0.3	24.4	24.5			

Description	Total S%	Sulfide %	MPA kg H_2SO_4/t	MPA (Sulfide) kg H_2SO_4/t	Total C%	TIC %	ANC kg H_2SO_4/t	ANC(TIC) kg H_2SO_4/t	NPR	NAPP kg H_2SO_4/t	NAF/PAF
DP1655 HS tail	3.9		120		0.5	0.5	29.8	36.8			
DP1655 LS tail	1.8	1.8	56.0	55.1	0.2	0.2	6.7	13.1	0.12	48.4	PAF

Full Whole Rock Digest Results

	Al (%)	Ba (mg/kg)	Be (mg/kg)	Ca (%)	Cd (mg/kg)	Ce (mg/kg)	Cr (mg/kg)	Cs (mg/kg)	Fe (%)	Ga (mg/kg)	Ge (mg/kg)	Hf (mg/kg)	In (mg/kg)	K (%)	La (mg/kg)	Li (mg/kg)
Average abundance	*8.2*	*425*	*2.8*	*4.1*	*0.15*	*67*	*102*	*3*	*5.6*	*19*	*1.5*	*3*	*0.25*	*2.1*	*39*	*20*
Primary Sulfides																
DP1471 LS Tail #3	5.4	820	1.6	1.0	0.5		364		2.8					3.3		
DP1745 LS Tail	3.5	540	1.1	0.1	0.5		460		2.0					2.4		
DP1750 LS Tail	5.5	800	1.7	0.5	0.5		486		4.1					3.3		
DP1802 LS Tail	5.9	650	1.8	0.7	0.5		522		4.4					3.4		
DP1804 LS Tail	5.6	720	1.8	0.6	0.5		481		2.6					3.4		
DP1931 LS Tail	5.4	760	1.6	0.6	0.5		524		3.1					3.5		
DP1970 LS Tail	5.7	830	1.2	0.0	0.5		276		0.6					3.3		
DP1971 LS Tail	6.8	800	2.1	0.5	0.5		392		3.7					4.0		
DP1972 LS Tail	4.7	660	1.2	0.3	0.5		476		2.4					3.3		
DP1975 LS Tail	3.9	530	0.8	0.1	0.3	50.2	416	5.3	1.7	10.0	0.1	3.4	0.1	2.3	24.4	18.8
DP2003 LS Tail	5.5	1360	0.8	1.0	0.6	69.8	388	53.3	7.1	23.2	0.2	4.3	0.1	5.1	29.5	81.2
IMAPS LS Tail	5.4	820	1.6	0.6	0.1	62.6	746	10.6	3.3	14.5	0.1	3.4	0.1	3.6	33	38.9
DP1999 LS Tail	5.5	650	1.7	0.7	0.3	57.1	446	13	4.2	15.7	0.1	3	0.1	3.5	30	44.7
DP1555-1560 HS Tail	2.5	10	0.7	0.5	0.5		1210		30.3					1.5		
IMAPS HS Tail	3.1	20	1.2	0.9	0.9	67	780	5.2	27.5	8.5	0.3	8.3	0.3	1.8	31.9	22.1
DP1803 LS Tail	8.3	810	2.1	0.0	0.5		208		0.8					3.2		
DP1855 LS Tail	7.7	340	2.1	0.0	0.5		223		1.7					2.7		
Secondary Sulfides																
DP1976 LS Tail	5.6	860	1.4	0.2	0.3	51.7	447	16.7	3.2	16.1	0.1	3.9	0.1	3.9	24.9	41.7
IMASS LS Tail	5.8	650	1.3	0.1	1.0	73.7	375	8.6	1.7	15.3	0.1	3.9	0.2	3.2	37	30.1
DP2186 LS Tail	6.6	940	1.9	0.1	0.7	61.4	291	10.2	2.3	16.4	0.1	3.7	0.1	3.9	31.2	45.9
IMASS HS Tail	3.8	200	1.0	0.5	3.0	96.4	971	3.9	28.7	10.9	0.2	6.7	0.6	1.3	49.1	16.7
Oxides																
CC18 HS Tail	12.3	440	3.2	0.1	0.5		555		2.3					2.2		
CC18 LS Tail	10.8	470	2.8	0.1	0.5		520		2.2					2.5		

	Mg (%)	Mn (mg/kg)	Na (%)	Nb (mg/kg)	Pb (mg/kg)	Rb (mg/kg)	Sc (mg/kg)	Sr (mg/kg)	Ta (mg/kg)	Te (mg/kg)	Th (mg/kg)	Ti (%)	Tl (mg/kg)	U (mg/kg)	V (mg/kg)	Y (mg/kg)	Zn (mg/kg)	Zr (mg/kg)
Average abundance	*2.3*	*950*	*2.4*	*20*	*14*	*90*	*22*	*370*	*2*	*0.001*	*9.6*	*0.56*	*0.85*	*2.7*	*120*	*33*	*70*	*165*
Primary Sulfides																		
DP1471 LS Tail #3	0.9	394	0.7		13			75		10	20		<10	<10	57		57	
DP1745 LS Tail	0.5	312	0.2		7			38		10	10		<10	<10	37		47	
DP1750 LS Tail	1.4	549	0.4		13			64		10	10		<10	<10	63		74	
DP1802 LS Tail	1.4	414	0.7		12			76		10	20		<10	<10	67		59	
DP1804 LS Tail	0.7	394	0.7		4			57		10	20		<10	<10	64		66	
DP1931 LS Tail	1.0	445	0.4		11			54		10	20		<10	<10	60		88	
DP1970 LS Tail	0.2	67	0.1		11			46		10	20		<10	<10	62		42	
DP1971 LS Tail	1.1	453	0.4		12			43		10	20		<10	<10	73		109	
DP1972 LS Tail	0.7	362	0.4		13			47		10	20		<10	<10	54		169	
DP1975 LS Tail	0.3	234	0.1	6.4	7.3	177.5	7	28.9	0.6	0.6	10.3	0.2	1.1	2.5	44	16.7	56	112
DP2003 LS Tail	3.2	1080	0.1	27.5	5.4	734	34.4	72	1.7	3.8	4.5	1.8	4.5	2.4	306	54.2	243	159
IMAPS LS Tail	1.0	492	0.4	8.7	8	284	10	56.9	0.8	1.3	13.2	0.3	1.5	2.6	63	18.8	71	116
DP1999 LS Tail	1.2	463	0.5	9.1	16.6	317	10.4	69.7	0.9	4.8	13.8	0.3	1.5	2.8	58	25.7	90	111
DP1555-1560 HS Tail	0.5	341	0.3		154			31		10.0	20.0		10.0	10	34		158	
IMAPS HS Tail	0.6	389	0.2	5.7	127	146.5	5.9	33.3	0.5	11.0	16.7	0.2	8.4	3.6	34	34.2	226	348
DP1803 LS Tail	0.2	72	0.1		32			30		10.0	20.0		10.0	10	89		25	
DP1855 LS Tail	0.6	160	0.0		9			14		10.0	20.0		10.0	10	82		92	
Secondary Sulfides																		
DP1976 LS Tail	1.0	429	0.1	11.1	9.2	344	11.7	49.6	0.9	1.2	14.1	0.4	2.0	2.8	78	24.6	113	128.5
IMASS LS Tail	0.5	194	0.1	9.8	25.6	266	11.6	41.5	0.9	1.7	14.5	0.3	1.4	3.4	65	27.1	73	130.5
DP2186 LS Tail	0.9	270	0.1	11.4	9.7	325	12	47	1.0	3.3	17.2	0.3	1.8	3.3	66	31.5	171	129
IMASS HS Tail	0.2	172	0.1	6.6	157.5	117.5	7.5	27.1	0.6	7.5	20	0.2	10.6	4.5	49	48.5	110	268
Oxides																		
CC18 HS Tail	0.4	167	0.1		108			42		10	40		10	10	129		107	
CC18 LS Tail	0.3	142	0.1		69			31		10	30		10	10	119		84	

Full Static Leach Results

Description	Matrix	Notes	Batch Date	pH Value_pH Unit	Sulfate as SO4 - Turbidimetric_mg/L	Bicarbonate Alkalinity as CaCO3_mg/L	Carbonate Alkalinity as CaCO3_mg/L	Total Alkalinity as CaCO3_mg/L	Acidity as CaCO3_mg/L	Aluminium_mg/L	Ammonia as N_mg/L	Antimony_mg/L	Arsenic_mg/L	Barium_mg/L
Representative Processing Scheme:														
Low Sulfur Tails														
DP1471 LS Tail #3	DI Leach	Jan Master Composite	2020/04/22	7.88	92	56	<1	56	6	0.09	0.02	0.003	<0.001	0.025
DP1471 LS Tail #3	Saline Leach (10g/L)	Jan Master Composite	2020/04/22	7.77	81	54	<1	54	1	0.02	<0.01	<0.001	<0.001	0.18
DP1471 LS Tail #3	Saline Leach (2g/L)	Jan Master Composite	2020/04/22	7.87	78	52	<1	52	1	0.1	0.03	<0.001	<0.001	0.158
DP1471 LS Tail #3	Filtrate	Jan Master Composite	2020/04/22	8.01	149	74	<1	74	2	0.08	<0.01	0.0028	0.0024	0.0953
DP1471 LS Tail #3	NAG Liquor	Jan Master Composite	2020/04/22	7.13						105		0.001	0.015	0.746
DP1471 LS Tail #4	DI Leach	Jan Master Composite	2020/04/22	7.92	86	49	<1	49	5	0.08	0.03	0.002	<0.001	0.023
DP1471 LS Tail #4	Filtrate	Jan Master Composite	2020/04/22	7.99	151	85	<1	85	3	0.042	0.02	0.0026	0.0025	0.111
DP1648 LS Tail	NAG Liquor	Jan Master Composite	2020/05/26	3.12						50.7		<0.001	0.012	0.239
DP1649 LS Tail	NAG Liquor	Jan Master Composite	2020/05/26	2.81						49.3		0.002	0.012	0.265
DP1745 LS Tail	DI Leach	W338 Primary Quartz Sandstone	2020/08/07	6.81	42	8	<1	8	3	0.03	0.01	<0.001	<0.001	0.029
DP1745 LS Tail	NAG Liquor	W338 Primary Quartz Sandstone	2020/08/07	4.16						0.08		<0.001	<0.001	0.076
DP1750 LS Tail	DI Leach	W338 Primary Sulfide Intermediate Gold	2020/08/07	7.07	154	11	<1	11	2	0.01	0.05	<0.001	<0.001	0.034
DP1750 LS Tail	NAG Liquor	W338 Primary Sulfide Intermediate Gold	2020/08/07	3.97						0.14		<0.001	<0.001	0.09
DP1802 LS Tail	DI Leach	W332 Primary Sulfides 2	2020/09/30	7.46	149	64	<1	64	1	0.02	0.03	<0.001	<0.001	0.032
DP1802 LS Tail	NAG Liquor	W332 Primary Sulfides 2	2020/09/30	3.34						1.68		<0.001	0.001	0.107
DP1803 LS Tail	DI Leach	W83 Secondary Sulfides	2020/09/30	7.32	26	55	<1	55	<1	0.01	0.08	<0.001	<0.001	0.074
DP1803 LS Tail	NAG Liquor	W83 Secondary Sulfides	2020/09/30	3.62						0.12		<0.001	<0.001	0.165
DP1804 LS Tail	DI Leach	W37 Sulfide Zone	2020/09/30	7.75	126	39	<1	39	1	0.07	0.04	0.001	<0.001	0.045
DP1804 LS Tail	NAG Liquor	W37 Sulfide Zone	2020/09/30	7.42						0.11		<0.001	<0.001	0.014
DP1855 LS Tail	DI Leach	W335 Small Secondary Sulfide	2020/09/30	7.53	70	59	<1	59	1	<0.01	0.05	<0.001	<0.001	0.014
DP1855 LS Tail	NAG Liquor	W335 Small Secondary Sulfide	2020/09/30	3.13						0.25		<0.001	<0.001	0.038
DP1931 LS Tail	NAG Liquor	Initial Mining Area Primary Sulfide	2020/11/24	7.33	52					34.8		<0.001	0.008	0.182
DP1931 LS Tail	DI Leach	Initial Mining Area Primary Sulfide	2020/11/24	7.81	66	60	<1	60	1	0.03	0.02	<0.001	<0.001	0.023
DP1971 LS Tail	NAG Liquor	W332 Primary Sulfide - Siderite	2020/11/24	6.79	51					35.7		<0.001	0.018	0.196
DP1971 LS Tail	DI Leach	W332 Primary Sulfide - Siderite	2020/11/24	7.82	87	48	<1	48	2	0.03	0.03	0.001	<0.001	0.018
DP1976 LS Tail	NAG Liquor	W337 Mixed Sulfides	2020/12/17	3.76	56					0.66		<0.001	<0.001	0.355
DP1976 LS Tail	DI Leach	W337 Mixed Sulfides	2020/12/17	7.63	78	22	<1	22	2	<0.05	<0.01	<0.005	<0.005	0.697
DP2003 LS Tail	NAG Liquor	W333 Primary Upper Mafic	2020/12/17	3.04	314					3.9		<0.001	<0.001	0.326
DP2003 LS Tail	DI Leach	W333 Primary Upper Mafic	2020/12/17	7.22	236	15	<1	15		<0.05	<0.01	<0.005	<0.005	0.742
DP2007 IMAPS LS Tail	Filtrate	Initial Mining Area Primary Sulfide	2020/12/16	7.99	171	178	<1	178	2	0.033	<0.01	0.002	0.001	0.167
DP2007 IMAPS LS Tail	NAG Liquor	Initial Mining Area Primary Sulfide	2020/12/16	6.08	52					0.1		<0.001	<0.001	0.034
DP2007 IMAPS LS Tail	Saline Leach (10g/L)	Initial Mining Area Primary Sulfide	2020/12/16	7.83	80	45	<1	45	1	0.1	0.03	<0.001	<0.001	0.396
DP2007 IMAPS LS Tail	Saline Leach (2g/L)	Initial Mining Area Primary Sulfide	2020/12/16	7.79	76	45	<1	45	1	0.18	0.03	<0.001	<0.001	0.139
DP2007 IMAPS LS Tail	DI Leach	Initial Mining Area Primary Sulfide	2020/12/16	7.75	70	33	<1	33	10	<0.01	0.05	<0.001	<0.001	0.393
DP2226 LS Tail	Filtrate		2021/03/03	8.34	120	114	2	116	<1	0.078	0.05	0.003	0.0094	0.0682
DP2226 LS Tail-2	Filtrate		2021/03/03	8.34	120	115	1	117	<1	0.077	0.1	0.003	0.0097	0.0678
DP1999 LS Tail	NAG Liquor	W339 Primary Sulfides High Copper	2020/10/22	3.03	156					1.06		<0.001	<0.001	0.095
DP2186 LS Tail	NAG Liquor	W338 Secondary Sulfides 2	2021/02/16	3.02	87					0.69		<0.001	<0.001	0.073
IMASS LS Tail	DI Leach	Initial Mining Area Secondary Sulfide	23/08/2021	7.48	44	39	<1	39	3	<0.01	<0.01	<0.001	0.001	0.479
IMASS LS Tail	NAG Liquor	Initial Mining Area Secondary Sulfide	23/08/2021	6.74	15					0.03		0.001	0.002	0.011
IMASS LS Tail	Saline Leach (2g/L)	Initial Mining Area Secondary Sulfide	23/08/2021	7.74	57	44	<1	44	4	0.03	<0.01	<0.001	<0.001	0.113
IMASS LS Tail	Saline Leach (10g/L)	Initial Mining Area Secondary Sulfide	23/08/2021	7.75	45	44	<1	44	6	0.03	0.02	<0.001	<0.001	0.358
IMASS LS Tail	Filtrate_tot	Initial Mining Area Secondary Sulfide	23/08/2021	8.06	297	85	<1	85	3	0.064	<0.01	0.0014	0.0028	0.218
IMASS LS Tail	Filtrate	Initial Mining Area Secondary Sulfide	23/08/2021	7.85	314	84	<1	84	4	0.036	0.01	0.0014	0.0026	0.142
CC18 LS Tail	DI Leach	Oxide Pilot Plant Feed	23/08/2021	7.6	26	36	<1	36	5	0.02	<0.01	<0.001	<0.001	0.942
CC18 LS Tail	NAG Liquor	Oxide Pilot Plant Feed	23/08/2021	7	3					0.02		<0.001	0.003	0.132
CC18 LS Tail	Saline Leach (2g/L)	Oxide Pilot Plant Feed	23/08/2021	7.44	26	34	<1	34	6	<0.01	<0.01	<0.001	<0.001	1.31
CC18 LS Tail	Saline Leach (10g/L)	Oxide Pilot Plant Feed	23/08/2021	7.37	17	34	<1	34	10	0.01	<0.01	<0.001	<0.001	1.97
CC18 LS Tail	Filtrate	Oxide Pilot Plant Feed	23/08/2021	8.05	42	126	<1	126	4	0.064	<0.01	0.0006	0.002	0.122

Description	Matrix	Notes	Batch Date	Beryllium_mg/L	Bismuth_mg/L	Boron_mg/L	Cadmium_mg/L	Calcium_mg/L	Chloride_mg/L	Chromium_mg/L	Cobalt_mg/L	Copper_mg/L	Electrical Conductivity @ 25°C_µS/cm	Fluoride_mg/L
Representative Processing Scheme:														
Low Sulfur Tails														
DP1471 LS Tail #3	DI Leach	Jan Master Composite	2020/04/22	<0.001	<0.001	<0.05	<1e-04	35	28	<0.001	<0.001	0.002	366	1.1
DP1471 LS Tail #3	Saline Leach (10g/L)	Jan Master Composite	2020/04/22	<0.001	<0.001	0.09	<1e-04	45		<0.001	0.001	0.002	2030	0.9
DP1471 LS Tail #3	Saline Leach (2g/L)	Jan Master Composite	2020/04/22	<0.001	<0.001	<0.05	<1e-04	63		<0.001	0.001	0.002	7910	0.8
DP1471 LS Tail #3	Filtrate	Jan Master Composite	2020/04/22	<1e-04	0.00006	0.132	0.00019	36	213	<2e-04	0.004	0.0204	1090	2.2
DP1471 LS Tail #3	NAG Liquor	Jan Master Composite	2020/04/22	0.004	0.31	0.05	0.0006	34		0.414	0.189	0.564		
DP1471 LS Tail #4	DI Leach	Jan Master Composite	2020/04/22	<0.001	<0.001	<0.05	<1e-04	32	24	0.002	<0.001	0.001	337	1.1
DP1471 LS Tail #4	Filtrate	Jan Master Composite	2020/04/22	<1e-04	<5e-05	0.132	0.00025	38	214	<2e-04	0.0029	0.0127	1090	2.2
DP1648 LS Tail	NAG Liquor	Jan Master Composite	2020/05/26	0.002	0.089	0.1	0.0028	30		0.309	0.374	0.806		
DP1649 LS Tail	NAG Liquor	Jan Master Composite	2020/05/26	0.002	0.105	0.1	0.0038	28		0.369	0.559	1.02		
DP1745 LS Tail	DI Leach	W338 Primary Quartz Sandstone	2020/08/07	<0.001	<0.001	<0.05	<1e-04	10	18	<0.001	0.001	0.004	186	0.4
DP1745 LS Tail	NAG Liquor	W338 Primary Quartz Sandstone	2020/08/07	<0.001	<0.001	0.21	0.0008	2		0.026	0.078	0.413		
DP1750 LS Tail	DI Leach	W338 Primary Sulfide Intermediate Gold	2020/08/07	<0.001	<0.001	<0.05	<1e-04	33	27	<0.001	0.011	0.017	465	0.5
DP1750 LS Tail	NAG Liquor	W338 Primary Sulfide Intermediate Gold	2020/08/07	<0.001	<0.001	0.2	0.0011	5		0.001	0.22	1.22		
DP1802 LS Tail	DI Leach	W332 Primary Sulfides 2	2020/09/30	<0.001	<0.001	0.07	<1e-04	47	35	<0.001	0.002	0.002	533	0.7
DP1802 LS Tail	NAG Liquor	W332 Primary Sulfides 2	2020/09/30	0.001	<0.001	0.14	0.0018	9		0.004	0.404	0.756		
DP1803 LS Tail	DI Leach	W83 Secondary Sulfides	2020/09/30	<0.001	<0.001	0.07	<1e-04	6	24	<0.001	0.002	0.086	174	0.7
DP1803 LS Tail	NAG Liquor	W83 Secondary Sulfides	2020/09/30	<0.001	<0.001	0.11	0.0032	3		0.017	0.096	8.23		
DP1804 LS Tail	DI Leach	W37 Sulfide Zone	2020/09/30	<0.001	<0.001	<0.05	<1e-04	40	28	<0.001	<0.001	0.002	429	0.6
DP1804 LS Tail	NAG Liquor	W37 Sulfide Zone	2020/09/30	<0.001	<0.001	0.08	<1e-04	14		0.059	<0.001	<0.001		
DP1855 LS Tail	DI Leach	W335 Small Secondary Sulfide	2020/09/30	<0.001	<0.001	0.08	0.0006	13	28	<0.001	0.005	0.104	315	0.5
DP1855 LS Tail	NAG Liquor	W335 Small Secondary Sulfide	2020/09/30	<0.001	<0.001	0.12	0.0055	5		0.009	0.219	12.4		
DP1931 LS Tail	NAG Liquor	Initial Mining Area Primary Sulfide	2020/11/24	<0.001	0.136	0.07	0.0007	17	1	0.192	0.122	1.24		<0.1
DP1931 LS Tail	DI Leach	Initial Mining Area Primary Sulfide	2020/11/24	<0.001	<0.001	<0.05	<1e-04	31	34	<0.001	<0.001	0.003	407	0.7
DP1971 LS Tail	NAG Liquor	W332 Primary Sulfide - Siderite	2020/11/24	<0.001	0.08	0.07	0.0013	13	2	0.169	0.145	1.23		<0.1
DP1971 LS Tail	DI Leach	W332 Primary Sulfide - Siderite	2020/11/24	<0.001	<0.001	<0.05	<1e-04	31	24	<0.001	0.002	0.002	392	0.6
DP1976 LS Tail	NAG Liquor	W337 Mixed Sulfides	2020/12/17	<0.001	<0.001	0.29	0.0029	4	2	0.026	0.225	1.07		0.2
DP1976 LS Tail	DI Leach	W337 Mixed Sulfides	2020/12/17	<0.005	<0.005	0.35	<5e-04	19	51	<0.005	0.01	0.016	403	1.1
DP2003 LS Tail	NAG Liquor	W333 Primary Upper Mafic	2020/12/17	<0.001	<0.001	0.17	0.0079	16	<1	0.004	0.5	4.15		1.4
DP2003 LS Tail	DI Leach	W333 Primary Upper Mafic	2020/12/17	<0.005	<0.005	0.73	0.0093	47	55	<0.005	0.479	0.115	714	2.9
DP2007 IMAPS LS Tail	Filtrate	Initial Mining Area Primary Sulfide	2020/12/16	<1e-04	<5e-05	0.174	0.00066	40	227	<2e-04	0.0089	0.0535	1210	2.1
DP2007 IMAPS LS Tail	NAG Liquor	Initial Mining Area Primary Sulfide	2020/12/16	<0.001	<0.001	0.08	<1e-04	14	1	0.047	<0.001	0.008		0.2
DP2007 IMAPS LS Tail	Saline Leach (10g/L)	Initial Mining Area Primary Sulfide	2020/12/16	<0.001	<0.001	<0.05	0.0003	86		<0.001	0.002	0.006	16400	0.8
DP2007 IMAPS LS Tail	Saline Leach (2g/L)	Initial Mining Area Primary Sulfide	2020/12/16	<0.001	<0.001	0.06	<1e-04	51		<0.001	0.001	0.006	3750	0.8
DP2007 IMAPS LS Tail	DI Leach	Initial Mining Area Primary Sulfide	2020/12/16	<0.001	<0.001	0.31	<1e-04	25	20	<0.001	<0.001	0.002	305	0.9
DP2226 LS Tail	Filtrate		2021/03/03	<1e-04	<5e-05	0.138	0.00019	29	244	<2e-04	0.0052	0.0116	1190	1.5
DP2226 LS Tail-2	Filtrate		2021/03/03	<1e-04	<5e-05	0.137	0.00021	27	247	<2e-04	0.0053	0.0121	1200	1.6
DP1999 LS Tail	NAG Liquor	W339 Primary Sulfides High Copper	2020/10/22	<0.001	<0.001	0.09	0.0031	7	<1	0.002	0.377	5.04		0.2
DP2186 LS Tail	NAG Liquor	W338 Secondary Sulfides 2	2021/02/16	0.002	<0.001	0.07	0.0072	5	<1	0.017	0.322	5.53		<0.1
IMASS LS Tail	DI Leach	Initial Mining Area Secondary Sulfide	23/08/2021	<0.001	<0.001	0.07	<1e-04	21	20	<0.001	0.002	0.014	256	0.5
IMASS LS Tail	NAG Liquor	Initial Mining Area Secondary Sulfide	23/08/2021	<0.001	<0.001	<0.05	0.0001	2	2	0.049	0.001	0.003		<0.1
IMASS LS Tail	Saline Leach (2g/L)	Initial Mining Area Secondary Sulfide	23/08/2021	<0.001	<0.001	<0.05	0.0022	51		0.001	0.006	0.024	3820	0.5
IMASS LS Tail	Saline Leach (10g/L)	Initial Mining Area Secondary Sulfide	23/08/2021	<0.001	<0.001	<0.05	0.0075	76		0.001	0.007	0.026	16000	0.4
IMASS LS Tail	Filtrate_tot	Initial Mining Area Secondary Sulfide	23/08/2021	<1e-04	0.0002	0.055	0.00103	84	233	0.0004	0.0119	0.124	1420	0.9
IMASS LS Tail	Filtrate	Initial Mining Area Secondary Sulfide	23/08/2021	<1e-04	<5e-05	0.085	0.00103	78	216	<2e-04	0.0109	0.117	1420	1
CC18 LS Tail	DI Leach	Oxide Pilot Plant Feed	23/08/2021	<0.001	<0.001	0.23	0.0001	6	25	<0.001	<0.001	0.043	212	0.6
CC18 LS Tail	NAG Liquor	Oxide Pilot Plant Feed	23/08/2021	<0.001	<0.001	<0.05	<1e-04	<1	<1	0.045	<0.001	0.005		<0.1
CC18 LS Tail	Saline Leach (2g/L)	Oxide Pilot Plant Feed	23/08/2021	<0.001	<0.001	0.18	0.0004	29		<0.001	0.004	0.041	3720	0.5
CC18 LS Tail	Saline Leach (10g/L)	Oxide Pilot Plant Feed	23/08/2021	<0.001	<0.001	0.17	0.0006	44		<0.001	0.004	0.041	16100	0.4
CC18 LS Tail	Filtrate	Oxide Pilot Plant Feed	23/08/2021	<1e-04	<5e-05	0.082	0.00007	16	253	0.0005	0.0051	0.216	1070	1

Description	Matrix	Notes	Batch Date	Free Cyanide_mg/L	Gold_mg/L	Hydroxide Alkalinity as CaCO3_mg/L	Iron_mg/L	Lead_mg/L	Magnesium_mg/L	Manganese_mg/L	Mercury_mg/L	Molybdenum_mg/L	Nickel_mg/L	Nitrate as N_mg/L
Representative Processing Scheme:														
Low Sulfur Tails														
DP1471 LS Tail #3	DI Leach	Jan Master Composite	2020/04/22		*<0.001*	*<1*	*<0.05*	*<0.001*	5	0.095	*<1e-04*	0.018	0.002	0.03
DP1471 LS Tail #3	Saline Leach (10g/L)	Jan Master Composite	2020/04/22		*<0.001*	*<1*	*<0.05*	*<0.001*	7	0.131	*<1e-04*	0.021	0.003	0.23
DP1471 LS Tail #3	Saline Leach (2g/L)	Jan Master Composite	2020/04/22		*<0.001*	*<1*	*<0.05*	*<0.001*	9	0.246	*<1e-04*	0.018	0.004	1.19
DP1471 LS Tail #3	Filtrate	Jan Master Composite	2020/04/22		*<0.001*	*<1*	0.004	0.0109	9	0.0865	*<4e-05*	0.157	0.0092	0.02
DP1471 LS Tail #3	NAG Liquor	Jan Master Composite	2020/04/22		*<0.001*		179	0.095	54	2.15	*<1e-04*	0.014	0.19	
DP1471 LS Tail #4	DI Leach	Jan Master Composite	2020/04/22		*<0.001*	*<1*	*<0.05*	*<0.001*	4	0.121	*<1e-04*	0.013	0.002	0.02
DP1471 LS Tail #4	Filtrate	Jan Master Composite	2020/04/22		*<0.001*	*<1*	0.003	0.0083	10	0.0987	*<4e-05*	0.165	0.0099	0.03
DP1648 LS Tail	NAG Liquor	Jan Master Composite	2020/05/26		*<0.001*		135	0.071	47	1.62	*<1e-04*	0.012	0.294	
DP1649 LS Tail	NAG Liquor	Jan Master Composite	2020/05/26		*<0.001*		177	0.289	45	1.74	0.0003	0.034	0.399	
DP1745 LS Tail	DI Leach	W338 Primary Quartz Sandstone	2020/08/07	*<0.004*	*<0.001*	*<1*	*<0.05*	*<0.001*	3	0.047	0.0353	0.027	0.004	0.02
DP1745 LS Tail	NAG Liquor	W338 Primary Quartz Sandstone	2020/08/07		*<0.001*		0.06	0.002	1	0.493	*<1e-04*	*<0.001*	0.071	
DP1750 LS Tail	DI Leach	W338 Primary Sulfide Intermediate Gold	2020/08/07		*<0.001*	*<1*	*<0.05*	*<0.001*	12	0.123	*<1e-04*	0.008	0.02	0.02
DP1750 LS Tail	NAG Liquor	W338 Primary Sulfide Intermediate Gold	2020/08/07		*<0.001*		19.3	0.004	6	1.31	*<1e-04*	*<0.001*	0.149	
DP1802 LS Tail	DI Leach	W332 Primary Sulfides 2	2020/09/30		*<0.001*	*<1*	*<0.05*	*<0.001*	12	0.106	0.0006	0.013	0.007	0.02
DP1802 LS Tail	NAG Liquor	W332 Primary Sulfides 2	2020/09/30		*<0.001*		37.1	0.017	11	0.543	*<1e-04*	*<0.001*	0.338	
DP1803 LS Tail	DI Leach	W83 Secondary Sulfides	2020/09/30		*<0.001*	*<1*	*<0.05*	*<0.001*	2	0.01	0.0228	0.006	0.006	0.03
DP1803 LS Tail	NAG Liquor	W83 Secondary Sulfides	2020/09/30		*<0.001*		0.06	0.013	1	0.041	*<1e-04*	*<0.001*	0.08	
DP1804 LS Tail	DI Leach	W37 Sulfide Zone	2020/09/30		*<0.001*	*<1*	*<0.05*	*<0.001*	9	0.053	0.0026	0.016	0.002	0.02
DP1804 LS Tail	NAG Liquor	W37 Sulfide Zone	2020/09/30		*<0.001*		*<0.05*	*<0.001*	*<1*	*<0.001*	*<1e-04*	0.007	*<0.001*	
DP1855 LS Tail	DI Leach	W335 Small Secondary Sulfide	2020/09/30		*<0.001*	*<1*	*<0.05*	*<0.001*	4	0.025	*<1e-04*	0.016	0.002	0.02
DP1855 LS Tail	NAG Liquor	W335 Small Secondary Sulfide	2020/09/30		*<0.001*		0.23	0.021	2	0.039	*<1e-04*	*<0.001*	0.136	
DP1931 LS Tail	NAG Liquor	Initial Mining Area Primary Sulfide	2020/11/24		*<0.001*		73.1	0.05	27	0.962	*<1e-04*	0.014	0.125	
DP1931 LS Tail	DI Leach	Initial Mining Area Primary Sulfide	2020/11/24		*<0.001*	*<1*	*<0.05*	*<0.001*	6	0.026	0.0009	0.023	0.002	0.04
DP1971 LS Tail	NAG Liquor	W332 Primary Sulfide - Siderite	2020/11/24		*<0.001*		76.3	0.056	24	0.996	*<1e-04*	0.012	0.137	
DP1971 LS Tail	DI Leach	W332 Primary Sulfide - Siderite	2020/11/24		*<0.001*	*<1*	*<0.05*	*<0.001*	9	0.041	0.0018	0.018	0.004	0.04
DP1976 LS Tail	NAG Liquor	W337 Mixed Sulfides	2020/12/17		*<0.001*		*<0.05*	0.013	3	0.329	*<1e-04*	*<0.001*	0.14	
DP1976 LS Tail	DI Leach	W337 Mixed Sulfides	2020/12/17		*<0.005*	*<1*	*<0.05*	*<0.005*	6	0.09	0.0031	0.017	0.012	0.07
DP2003 LS Tail	NAG Liquor	W333 Primary Upper Mafic	2020/12/17		*<0.001*		22.9	0.008	16	1.59	*<1e-04*	*<0.001*	0.267	
DP2003 LS Tail	DI Leach	W333 Primary Upper Mafic	2020/12/17		*<0.005*	*<1*	0.1	*<0.005*	21	0.938	*<5e-04*	*<0.005*	0.307	0.04
DP2007 IMAPS LS Tail	Filtrate	Initial Mining Area Primary Sulfide	2020/12/16		*<0.001*	*<1*	0.063	0.0024	18	0.134	*<4e-05*	0.163	0.0213	*<0.01*
DP2007 IMAPS LS Tail	NAG Liquor	Initial Mining Area Primary Sulfide	2020/12/16		*<0.001*		*<0.05*	*<0.001*	3	0.002	*<1e-04*	0.006	*<0.001*	
DP2007 IMAPS LS Tail	Saline Leach (10g/L)	Initial Mining Area Primary Sulfide	2020/12/16		*<0.001*	*<1*	*<0.05*	*<0.001*	20	0.202	*<1e-04*	0.02	0.004	*<0.01*
DP2007 IMAPS LS Tail	Saline Leach (2g/L)	Initial Mining Area Primary Sulfide	2020/12/16		*<0.001*	*<1*	0.09	*<0.001*	12	0.106	*<1e-04*	0.019	0.002	*<0.01*
DP2007 IMAPS LS Tail	DI Leach	Initial Mining Area Primary Sulfide	2020/12/16		*<0.001*	*<1*	*<0.05*	*<0.001*	6	0.046	*<1e-04*	0.015	0.002	*<0.01*
DP2226 LS Tail	Filtrate		2021/03/03		*<0.001*	*<1*	0.005	0.0016	12	0.0363	0.00025	0.159	0.0487	0.47
DP2226 LS Tail-2	Filtrate		2021/03/03		*<0.001*	*<1*	0.004	0.0016	12	0.0366	0.00023	0.162	0.0506	0.48
DP1999 LS Tail	NAG Liquor	W339 Primary Sulfides High Copper	2020/10/22		*<0.001*		17.7	0.017	7	0.705	*<1e-04*	*<0.001*	0.247	
DP2186 LS Tail	NAG Liquor	W338 Secondary Sulfides 2	2021/02/16		*<0.001*		0.22	0.007	2	0.073	*<1e-04*	*<0.001*	0.249	
IMASS LS Tail	DI Leach	Initial Mining Area Secondary Sulfide	23/08/2021	*<0.004*	*<0.001*	*<1*	*<0.05*	*<0.001*	3	0.013	*<1e-04*	0.009	0.001	*<0.01*
IMASS LS Tail	NAG Liquor	Initial Mining Area Secondary Sulfide	23/08/2021		*<0.001*		*<0.05*	*<0.001*	*<1*	0.002	*<1e-04*	0.004	*<0.001*	
IMASS LS Tail	Saline Leach (2g/L)	Initial Mining Area Secondary Sulfide	23/08/2021		*<0.001*	*<1*	*<0.05*	*<0.001*	7	0.037	*<1e-04*	0.01	0.005	*<0.01*
IMASS LS Tail	Saline Leach (10g/L)	Initial Mining Area Secondary Sulfide	23/08/2021		*<0.001*	*<1*	*<0.05*	*<0.001*	9	0.057	*<1e-04*	0.011	0.006	*<0.01*
IMASS LS Tail	Filtrate_tot	Initial Mining Area Secondary Sulfide	23/08/2021	*<0.004*	*<0.001*	*<1*	0.056	0.002	16	0.151	*<4e-05*	0.126	0.0459	0.01
IMASS LS Tail	Filtrate	Initial Mining Area Secondary Sulfide	23/08/2021	*<0.004*	*<0.001*	*<1*	*<0.002*	0.0006	14	0.152	*<4e-05*	0.0987	0.0459	*<0.01*
CC18 LS Tail	DI Leach	Oxide Pilot Plant Feed	23/08/2021		*<0.001*	*<1*	*<0.05*	*<0.001*	2	0.028	*<1e-04*	0.011	0.004	*<0.01*
CC18 LS Tail	NAG Liquor	Oxide Pilot Plant Feed	23/08/2021		*<0.001*		*<0.05*	*<0.001*	*<1*	0.005	*<1e-04*	0.005	*<0.001*	
CC18 LS Tail	Saline Leach (2g/L)	Oxide Pilot Plant Feed	23/08/2021		*<0.001*	*<1*	*<0.05*	*<0.001*	9	0.169	*<1e-04*	0.012	0.008	*<0.01*
CC18 LS Tail	Saline Leach (10g/L)	Oxide Pilot Plant Feed	23/08/2021		*<0.001*	*<1*	*<0.05*	*<0.001*	12	0.305	*<1e-04*	0.013	0.009	*<0.01*
CC18 LS Tail	Filtrate	Oxide Pilot Plant Feed	23/08/2021		*<0.001*	*<1*	0.002	0.0003	6	0.038	*<4e-05*	0.0948	0.0204	*<0.01*

Description	Matrix	Notes	Batch Date	Nitrate as NO3_mg/L	Nitrite + Nitrate as N_mg/L	Nitrite as N_mg/L	Potassium_mg/L	Reactive Phosphorus as P_mg/L	Selenium_mg/L	Silicon_mg/L	Silver_mg/L	Sodium_mg/L	Strontium_mg/L	Tellurium_mg/L
Representative Processing Scheme:														
Low Sulfur Tails														
DP1471 LS Tail #3	DI Leach	Jan Master Composite	2020/04/22	0.13	0.03	<0.01	17	<0.01	<0.01	3.18	0.001	21	0.092	<0.005
DP1471 LS Tail #3	Saline Leach (10g/L)	Jan Master Composite	2020/04/22	1.02	0.23	<0.01	21	<0.01	<0.01	2.38	<0.001		0.15	<0.005
DP1471 LS Tail #3	Saline Leach (2g/L)	Jan Master Composite	2020/04/22	5.27	1.19	<0.01	28	<0.01	<0.01	2.19	<0.001		0.245	<0.005
DP1471 LS Tail #3	Filtrate	Jan Master Composite	2020/04/22	0.09	0.02	<0.01	47	<0.01	0.0021	5.36	<1e-04	130	0.203	<2e-04
DP1471 LS Tail #3	NAG Liquor	Jan Master Composite	2020/04/22				41		<0.01	87.8	0.005	27	0.095	0.023
DP1471 LS Tail #4	DI Leach	Jan Master Composite	2020/04/22	0.09	0.02	<0.01	16	<0.01	<0.01	2.73	<0.001	20	0.082	<0.005
DP1471 LS Tail #4	Filtrate	Jan Master Composite	2020/04/22	0.13	0.03	<0.01	48	<0.01	0.0013	5.37	<1e-04	131	0.206	<2e-04
DP1648 LS Tail	NAG Liquor	Jan Master Composite	2020/05/26				29		<0.01	71	0.005	21	0.05	<0.005
DP1649 LS Tail	NAG Liquor	Jan Master Composite	2020/05/26				28		<0.01	70	0.008	20	0.048	0.005
DP1745 LS Tail	DI Leach	W338 Primary Quartz Sandstone	2020/08/07	0.09	0.02	<0.01	5	<0.01	<0.01	4.6	<0.001	16	0.064	<0.005
DP1745 LS Tail	NAG Liquor	W338 Primary Quartz Sandstone	2020/08/07				2		<0.01	1.97	0.002	17	0.014	<0.005
DP1750 LS Tail	DI Leach	W338 Primary Sulfide Intermediate Gold	2020/08/07	0.09	0.02	<0.01	12	<0.01	<0.01	5.98	<0.001	36	0.248	<0.005
DP1750 LS Tail	NAG Liquor	W338 Primary Sulfide Intermediate Gold	2020/08/07				9		<0.01	4.92	<0.001	18	0.035	<0.005
DP1802 LS Tail	DI Leach	W332 Primary Sulfides 2	2020/09/30	0.09	0.02	<0.01	16	<0.01	<0.01	4.79	<0.001	32	0.148	<0.005
DP1802 LS Tail	NAG Liquor	W332 Primary Sulfides 2	2020/09/30				8		<0.01	6.78	<0.001	24	0.029	<0.005
DP1803 LS Tail	DI Leach	W83 Secondary Sulfides	2020/09/30	0.13	0.03	<0.01	6	0.07	0.05	4.85	<0.001	19	0.041	<0.005
DP1803 LS Tail	NAG Liquor	W83 Secondary Sulfides	2020/09/30				1		0.01	1.72	<0.001	23	0.019	<0.005
DP1804 LS Tail	DI Leach	W37 Sulfide Zone	2020/09/30	0.09	0.02	<0.01	12	0.02	<0.01	4.04	<0.001	26	0.136	<0.005
DP1804 LS Tail	NAG Liquor	W37 Sulfide Zone	2020/09/30				4		<0.01	4.2	<0.001	23	0.019	<0.005
DP1855 LS Tail	DI Leach	W335 Small Secondary Sulfide	2020/09/30	0.09	0.02	<0.01	12	0.02	<0.01	4.91	<0.001	36	0.098	<0.005
DP1855 LS Tail	NAG Liquor	W335 Small Secondary Sulfide	2020/09/30				2		<0.01	2.49	0.002	24	0.04	0.01
DP1931 LS Tail	NAG Liquor	Initial Mining Area Primary Sulfide	2020/11/24				15		<0.01	49	0.002	25	0.037	<0.005
DP1931 LS Tail	DI Leach	Initial Mining Area Primary Sulfide	2020/11/24	0.18	0.04	<0.01	12	<0.01	<0.01	3.96	<0.001	40	0.107	<0.005
DP1971 LS Tail	NAG Liquor	W332 Primary Sulfide - Siderite	2020/11/24				13		<0.01	45	0.001	26	0.042	<0.005
DP1971 LS Tail	DI Leach	W332 Primary Sulfide - Siderite	2020/11/24	0.18	0.04	<0.01	14	<0.01	<0.01	3.43	<0.001	25	0.123	<0.005
DP1976 LS Tail	NAG Liquor	W337 Mixed Sulfides	2020/12/17				8		<0.01	8.68	0.001	22	0.038	<0.005
DP1976 LS Tail	DI Leach	W337 Mixed Sulfides	2020/12/17	0.31	0.07	<0.01	8	<0.01	<0.05	6.81	<0.005	38	0.153	<0.026
DP2003 LS Tail	NAG Liquor	W333 Primary Upper Mafic	2020/12/17				45		<0.01	26.4	0.003	23	0.053	<0.005
DP2003 LS Tail	DI Leach	W333 Primary Upper Mafic	2020/12/17	0.18	0.04	<0.01	25	<0.01	<0.05	10.6	<0.005	41	0.415	<0.026
DP2007 IMAPS LS Tail	Filtrate	Initial Mining Area Primary Sulfide	2020/12/16	<0.01	<0.01	<0.01	53	<0.01	0.0044	5.48	<1e-04	150	0.304	<2e-04
DP2007 IMAPS LS Tail	NAG Liquor	Initial Mining Area Primary Sulfide	2020/12/16				9		<0.01	8.02	0.002	15	0.018	<0.005
DP2007 IMAPS LS Tail	Saline Leach (10g/L)	Initial Mining Area Primary Sulfide	2020/12/16	<0.01	<0.01	<0.01	28	<0.01	<0.01	2.93	<0.001		0.462	<0.005
DP2007 IMAPS LS Tail	Saline Leach (2g/L)	Initial Mining Area Primary Sulfide	2020/12/16	<0.01	<0.01	<0.01	16	<0.01	<0.01	3.56	<0.001		0.229	<0.005
DP2007 IMAPS LS Tail	DI Leach	Initial Mining Area Primary Sulfide	2020/12/16	<0.01	<0.01	<0.01	7	<0.01	<0.01	3.28	<0.001	24	0.092	<0.005
DP2226 LS Tail	Filtrate		2021/03/03	2.08	0.48	0.01	50	<0.01	0.0069	5.03	<1e-04	149	0.25	<2e-04
DP2226 LS Tail-2	Filtrate		2021/03/03	2.12	0.49	0.01	46	<0.01	0.0069	4.76	<1e-04	141	0.256	<2e-04
DP1999 LS Tail	NAG Liquor	W339 Primary Sulfides High Copper	2020/10/22				6		<0.01	5.88	<0.001	17	0.028	<0.005
DP2186 LS Tail	NAG Liquor	W338 Secondary Sulfides 2	2021/02/16				3		<0.01	3.39	<0.001	16	0.033	<0.005
IMASS LS Tail	DI Leach	Initial Mining Area Secondary Sulfide	23/08/2021	<0.01	<0.01	<0.01	5	<0.01	<0.01	3.5	<0.001	19	0.081	<0.005
IMASS LS Tail	NAG Liquor	Initial Mining Area Secondary Sulfide	23/08/2021				4		<0.01	5.77	<0.001	18	0.008	<0.005
IMASS LS Tail	Saline Leach (2g/L)	Initial Mining Area Secondary Sulfide	23/08/2021	<0.01	<0.01	<0.01	12	<0.01	<0.01	3.13	<0.001		0.218	<0.005
IMASS LS Tail	Saline Leach (10g/L)	Initial Mining Area Secondary Sulfide	23/08/2021	<0.01	<0.01	<0.01	23	<0.01	<0.01	2.76	<0.001		0.366	<0.005
IMASS LS Tail	Filtrate_tot	Initial Mining Area Secondary Sulfide	23/08/2021	0.04	0.01	<0.01	38	<0.01	0.0116	6.24	<1e-04	167	0.477	0.0002
IMASS LS Tail	Filtrate	Initial Mining Area Secondary Sulfide	23/08/2021	<0.01	<0.01	<0.01	35	<0.01	0.0104	5.26	<1e-04	157	0.533	<2e-04
CC18 LS Tail	DI Leach	Oxide Pilot Plant Feed	23/08/2021	<0.01	<0.01	<0.01	4	<0.01	<0.01	8.93	<0.001	30	0.062	<0.005
CC18 LS Tail	NAG Liquor	Oxide Pilot Plant Feed	23/08/2021				2		<0.01	6.38	<0.001	17	0.006	<0.005
CC18 LS Tail	Saline Leach (2g/L)	Oxide Pilot Plant Feed	23/08/2021	<0.01	<0.01	<0.01	10	<0.01	<0.01	7.86	<0.001		0.305	<0.005
CC18 LS Tail	Saline Leach (10g/L)	Oxide Pilot Plant Feed	23/08/2021	<0.01	<0.01	<0.01	13	<0.01	<0.01	6.36	<0.001		0.465	<0.005
CC18 LS Tail	Filtrate	Oxide Pilot Plant Feed	23/08/2021	<0.01	<0.01	<0.01	20	<0.01	0.0065	11.1	<1e-04	167	0.141	<2e-04

Description	Matrix	Notes	Batch Date	Thallium_mg/L	Thorium_mg/L	Total Cyanide_mg/L	Total Kjeldahl Nitrogen as N_mg/L	Total Nitrogen as N_mg/L	Tungsten_mg/L	Uranium_mg/L	Vanadium_mg/L	Weak Acid Dissociable Cyanide_mg/L	Zinc_mg/L
Representative Processing Scheme:													
Low Sulfur Tails													
DP1471 LS Tail #3	DI Leach	Jan Master Composite	2020/04/22	*<0.001*	0.001		*<0.1*	*<0.1*	0.011	0.001	*<0.01*		*<0.005*
DP1471 LS Tail #3	Saline Leach (10g/L)	Jan Master Composite	2020/04/22	*<0.001*	*<0.001*		*<0.1*	0.2	0.015	0.001	*<0.01*		0.035
DP1471 LS Tail #3	Saline Leach (2g/L)	Jan Master Composite	2020/04/22	*<0.001*	*<0.001*		*<0.1*	1.2	0.039	*<0.001*	*<0.01*		*<0.005*
DP1471 LS Tail #3	Filtrate	Jan Master Composite	2020/04/22	0.00018	*<1e-04*		0.2	0.2	0.065	0.0024	0.0009		0.041
DP1471 LS Tail #3	NAG Liquor	Jan Master Composite	2020/04/22	0.005	0.104				0.849	0.017	0.27		0.44
DP1471 LS Tail #4	DI Leach	Jan Master Composite	2020/04/22	*<0.001*	*<0.001*		0.1	0.1	0.01	*<0.001*	*<0.01*		*<0.005*
DP1471 LS Tail #4	Filtrate	Jan Master Composite	2020/04/22	0.00047	*<1e-04*		0.2	0.2	0.065	0.00283	0.0008		0.026
DP1648 LS Tail	NAG Liquor	Jan Master Composite	2020/05/26	0.003	0.066				0.223	0.011	0.15		1.03
DP1649 LS Tail	NAG Liquor	Jan Master Composite	2020/05/26	0.004	0.074				0.108	0.012	0.15		1.22
DP1745 LS Tail	DI Leach	W338 Primary Quartz Sandstone	2020/08/07	*<0.001*	*<0.001*	*<0.004*	*<0.1*	*<0.1*	0.014	*<0.001*	*<0.01*	*<0.004*	*<0.005*
DP1745 LS Tail	NAG Liquor	W338 Primary Quartz Sandstone	2020/08/07	*<0.001*	*<0.001*				*<0.001*	*<0.001*	*<0.01*		0.24
DP1750 LS Tail	DI Leach	W338 Primary Sulfide Intermediate Gold	2020/08/07	*<0.001*	*<0.001*		0.2	0.2	0.003	*<0.001*	*<0.01*		0.005
DP1750 LS Tail	NAG Liquor	W338 Primary Sulfide Intermediate Gold	2020/08/07	0.002	*<0.001*				*<0.001*	0.002	*<0.01*		0.298
DP1802 LS Tail	DI Leach	W332 Primary Sulfides 2	2020/09/30	*<0.001*	*<0.001*		0.1	0.1	0.005	*<0.001*	*<0.01*		*<0.005*
DP1802 LS Tail	NAG Liquor	W332 Primary Sulfides 2	2020/09/30	*<0.001*	*<0.001*				*<0.001*	0.006	*<0.01*		0.285
DP1803 LS Tail	DI Leach	W83 Secondary Sulfides	2020/09/30	*<0.001*	*<0.001*		0.2	0.2	0.03	*<0.001*	*<0.01*		*<0.005*
DP1803 LS Tail	NAG Liquor	W83 Secondary Sulfides	2020/09/30	*<0.001*	*<0.001*				*<0.001*	0.004	*<0.01*		0.123
DP1804 LS Tail	DI Leach	W37 Sulfide Zone	2020/09/30	*<0.001*	*<0.001*		*<0.1*	*<0.1*	0.057	0.004	*<0.01*		*<0.005*
DP1804 LS Tail	NAG Liquor	W37 Sulfide Zone	2020/09/30	*<0.001*	*<0.001*				0.042	*<0.001*	*<0.01*		*<0.005*
DP1855 LS Tail	DI Leach	W335 Small Secondary Sulfide	2020/09/30	*<0.001*	*<0.001*		0.1	0.1	0.044	*<0.001*	*<0.01*		0.007
DP1855 LS Tail	NAG Liquor	W335 Small Secondary Sulfide	2020/09/30	0.002	*<0.001*				*<0.001*	0.014	*<0.01*		0.543
DP1931 LS Tail	NAG Liquor	Initial Mining Area Primary Sulfide	2020/11/24	0.002	0.038				0.402	0.005	0.08		0.384
DP1931 LS Tail	DI Leach	Initial Mining Area Primary Sulfide	2020/11/24	*<0.001*	*<0.001*		*<0.1*	*<0.1*	0.089	*<0.001*	*<0.01*		*<0.005*
DP1971 LS Tail	NAG Liquor	W332 Primary Sulfide - Siderite	2020/11/24	0.002	0.042				0.115	0.005	0.06		0.495
DP1971 LS Tail	DI Leach	W332 Primary Sulfide - Siderite	2020/11/24	*<0.001*	*<0.001*		*<0.1*	*<0.1*	0.024	0.001	*<0.01*		*<0.005*
DP1976 LS Tail	NAG Liquor	W337 Mixed Sulfides	2020/12/17	0.001	*<0.001*				*<0.001*	0.002	*<0.01*		0.488
DP1976 LS Tail	DI Leach	W337 Mixed Sulfides	2020/12/17	*<0.005*	*<0.005*		0.1	0.2	0.018	*<0.005*	*<0.05*		0.054
DP2003 LS Tail	NAG Liquor	W333 Primary Upper Mafic	2020/12/17	0.005	*<0.001*				*<0.001*	0.002	*<0.01*		1.2
DP2003 LS Tail	DI Leach	W333 Primary Upper Mafic	2020/12/17	*<0.005*	*<0.005*		0.1	0.1	*<0.005*	*<0.005*	*<0.05*		1.56
DP2007 IMAPS LS Tail	Filtrate	Initial Mining Area Primary Sulfide	2020/12/16	0.00064	*<1e-04*		0.1	0.1	0.057	0.00311	0.0004		0.051
DP2007 IMAPS LS Tail	NAG Liquor	Initial Mining Area Primary Sulfide	2020/12/16	*<0.001*	*<0.001*				0.209	*<0.001*	0.01		0.026
DP2007 IMAPS LS Tail	Saline Leach (10g/L)	Initial Mining Area Primary Sulfide	2020/12/16	*<0.001*	*<0.001*		*<0.5*	*<0.5*	0.126	0.001	*<0.01*		0.015
DP2007 IMAPS LS Tail	Saline Leach (2g/L)	Initial Mining Area Primary Sulfide	2020/12/16	*<0.001*	*<0.001*		*<0.1*	*<0.1*	0.088	0.001	*<0.01*		0.027
DP2007 IMAPS LS Tail	DI Leach	Initial Mining Area Primary Sulfide	2020/12/16	*<0.001*	*<0.001*		*<0.1*	*<0.1*	0.025	*<0.001*	*<0.01*		0.046
DP2226 LS Tail	Filtrate		2021/03/03	0.00043	*<1e-04*		0.4	0.9	0.119	0.00099	0.0011		0.021
DP2226 LS Tail-2	Filtrate		2021/03/03	0.00043	*<1e-04*		0.5	1	0.118	0.001	0.0011		0.034
DP1999 LS Tail	NAG Liquor	W339 Primary Sulfides High Copper	2020/10/22	*<0.001*	*<0.001*				*<0.001*	0.005	*<0.01*		0.514
DP2186 LS Tail	NAG Liquor	W338 Secondary Sulfides 2	2021/02/16	0.001	*<0.001*				*<0.001*	0.004	*<0.01*		0.874
IMASS LS Tail	DI Leach	Initial Mining Area Secondary Sulfide	23/08/2021	*<0.001*	*<0.001*	*<0.004*	*<0.1*	*<0.1*	0.034	*<0.001*	*<0.01*	*<0.004*	0.011
IMASS LS Tail	NAG Liquor	Initial Mining Area Secondary Sulfide	23/08/2021	*<0.001*	*<0.001*				0.084	*<0.001*	0.02		0.008
IMASS LS Tail	Saline Leach (2g/L)	Initial Mining Area Secondary Sulfide	23/08/2021	*<0.001*	*<0.001*		*<0.1*	*<0.1*	0.022	*<0.001*	*<0.01*		*<0.005*
IMASS LS Tail	Saline Leach (10g/L)	Initial Mining Area Secondary Sulfide	23/08/2021	0.002	*<0.001*		*<0.5*	*<0.5*	0.036	*<0.001*	*<0.01*		*<0.005*
IMASS LS Tail	Filtrate_tot	Initial Mining Area Secondary Sulfide	23/08/2021	0.00037	0.0002	*<0.004*	0.1	0.1	0.065	0.00222	0.0009	*<0.004*	0.01
IMASS LS Tail	Filtrate	Initial Mining Area Secondary Sulfide	23/08/2021	0.00034	*<1e-04*	*<0.004*	0.1	0.1	0.068	0.0024	0.0009	*<0.004*	0.01
CC18 LS Tail	DI Leach	Oxide Pilot Plant Feed	23/08/2021	*<0.001*	*<0.001*		*<0.1*	*<0.1*	0.038	*<0.001*	*<0.01*		0.046
CC18 LS Tail	NAG Liquor	Oxide Pilot Plant Feed	23/08/2021	*<0.001*	*<0.001*				0.061	*<0.001*	*<0.01*		*<0.005*
CC18 LS Tail	Saline Leach (2g/L)	Oxide Pilot Plant Feed	23/08/2021	*<0.001*	*<0.001*		*<0.1*	*<0.1*	0.027	*<0.001*	*<0.01*		0.168
CC18 LS Tail	Saline Leach (10g/L)	Oxide Pilot Plant Feed	23/08/2021	*<0.001*	*<0.001*		*<0.5*	*<0.5*	0.034	*<0.001*	*<0.01*		0.206
CC18 LS Tail	Filtrate	Oxide Pilot Plant Feed	23/08/2021	0.00013	*<1e-04*		0.2	0.2	0.133	0.00151	0.0018		0.006

Description	Matrix	Notes	Batch Date	pH Value_pH Unit	Sulfate as SO4 - Turbidimetric_mg/L	Bicarbonate Alkalinity as CaCO3_mg/L	Carbonate Alkalinity as CaCO3_mg/L	Total Alkalinity as CaCO3_mg/L	Acidity as CaCO3_mg/L	Aluminium_mg/L	Ammonia as N_mg/L	Antimony_mg/L	Arsenic_mg/L	Barium_mg/L
Representative Processing Scheme:														
High Sulfur Tails														
DP1554-1560 HS Tail	Filtrate	DP1471 Ro con	2020/04/22	7.87	189	75	*<1*	75	3	0.072	0.02	0.0024	0.0009	0.133
DP1555-1560 HS Tail	NAG Liquor	DP1471 Ro con	2020/04/22	1.97	0	0	0	0	0	94	0	0.016	0.176	0.96
DP1855 HS Tail	DI Leach	DP1855 Ro Con	2020/09/30											
DP2007 IMAPS HS Tail	Filtrate	Initial Mining Area Primary Sulfide	2020/12/16	7.49	109	26	*<1*	26	*<1*	0.142	0.04	0.0063	0.0065	0.0406
DP2007 IMAPS HS Tail	NAG Liquor	Initial Mining Area Primary Sulfide	2020/12/16	1.84	3050	0	0	0	0	21.3	0	*<0.001*	0.024	0.241
DP2007 IMAPS HS Tail	Saline Leach (10g/L)	Initial Mining Area Primary Sulfide	2020/12/16	7.61	585	165	*<1*	165	14	0.02	0.49	0.002	*<0.001*	0.238
DP2007 IMAPS HS Tail	Saline Leach (2g/L)	Initial Mining Area Primary Sulfide	2020/12/16	7.5	568	134	*<1*	134	11	*<0.01*	0.35	0.002	*<0.001*	0.101
DP2007 IMAPS HS Tail	DI Leach	Initial Mining Area Primary Sulfide	2020/12/16	7.48	429	106	*<1*	106	9	*<0.01*	0.2	0.002	*<0.001*	0.448
DP2099 HS Tail	Filtrate	10 g/t NaCN in cleaner circuit	2020/12/10											
DP2100 HS Tail	Filtrate	20 g/t NaCN in cleaner circuit	2020/12/10											
IMASS HS Tail	DI Leach	Initial Mining Area Secondary Sulfide	23/08/2021	8	919	200	*<1*	200	4	0.03	*<0.05*	*<0.001*	*<0.001*	0.457
IMASS HS Tail	NAG Liquor	Initial Mining Area Secondary Sulfide	23/08/2021	2.07	1490					10.2		*<0.001*	0.008	0.127
IMASS HS Tail	Saline Leach (2g/L)	Initial Mining Area Secondary Sulfide	23/08/2021	7.92	926	198	*<1*	198	8	0.02	0.01	*<0.001*	*<0.001*	0.153
IMASS HS Tail	Saline Leach (10g/L)	Initial Mining Area Secondary Sulfide	23/08/2021	8.03	898	203	*<1*	203	9	0.02	*<0.01*	*<0.001*	*<0.001*	0.551
IMASS HS Tail	Filtrate_tot	Initial Mining Area Secondary Sulfide	23/08/2021	7.6	329	22	*<1*	22	2	0.058	0.01	0.0028	0.001	0.0904
IMASS HS Tail	Filtrate	Initial Mining Area Secondary Sulfide	23/08/2021	7.35	328	21	*<1*	21	3	0.035	*<0.01*	0.003	0.001	0.0906
CC18 HS Tail	DI Leach	Oxide Pilot Plant Feed	23/08/2021	7.82	26	56	*<1*	56	4	0.02	*<0.01*	*<0.001*	0.001	0.94
CC18 HS Tail	NAG Liquor	Oxide Pilot Plant Feed	23/08/2021	6.49	17					*<0.01*		*<0.001*	0.001	0.04
CC18 HS Tail	Saline Leach (2g/L)	Oxide Pilot Plant Feed	23/08/2021	7.57	22	45	*<1*	45	7	0.02	*<0.01*	*<0.001*	*<0.001*	1.52
CC18 HS Tail	Saline Leach (10g/L)	Oxide Pilot Plant Feed	23/08/2021	7.41	21	38	*<1*	38	8	*<0.01*	0.06	*<0.001*	*<0.001*	3.48
CC18 HS Tail	Filtrate	Oxide Pilot Plant Feed	23/08/2021	8.04	44	130	*<1*	130	4	0.079	*<0.01*	0.0008	0.0024	0.119
Unrepresentative Processing Scheme:														
DP1471 LS Tail & DP1554-1560 HS Tail	Filtrate	Jan MC	2020/04/30	7.9	290	86	*<1*	86	*<1*	0.071	0.03	0.0023	0.0012	0.115
DP1655 LS Tail	NAG Liquor	Jan MC	2020/05/26	2.56	0	0	0	0	0	47.6	0	0.003	0.015	0.266

Description	Matrix	Notes	Batch Date	Beryllium_mg/L	Bismuth_mg/L	Boron_mg/L	Cadmium_mg/L	Calcium_mg/L	Chloride_mg/L	Chromium_mg/L	Cobalt_mg/L	Copper_mg/L	Electrical Conductivity @ 25°C_µS/cm	Fluoride_mg/L
Representative Processing Scheme:														
High Sulfur Tails														
DP1554-1560 HS Tail	Filtrate	DP1471 Ro con	2020/04/22	*<1e-04*	*<5e-05*	0.098	0.00041	94	230	*<2e-04*	0.0078	0.0099	1170	1.2
DP1555-1560 HS Tail	NAG Liquor	DP1471 Ro con	2020/04/22	0.004	1.42	0.11	0.0099	46		1.28	14.2	17.7		
DP1855 HS Tail	DI Leach	DP1855 Ro Con	2020/09/30											
DP2007 IMAPS HS Tail	Filtrate	Initial Mining Area Primary Sulfide	2020/12/16	*<1e-04*	0.00132	0.125	0.00006	20	250	0.0008	0.0097	2.04	906	1.1
DP2007 IMAPS HS Tail	NAG Liquor	Initial Mining Area Primary Sulfide	2020/12/16	0.003	0.069	0.14	0.0064	67	*<1*	0.243	4.22	11.5	0	*<0.1*
DP2007 IMAPS HS Tail	Saline Leach (10g/L)	Initial Mining Area Primary Sulfide	2020/12/16	*<0.001*	*<0.001*	0.09	0.0017	334		*<0.001*	0.086	0.052	17100	0.5
DP2007 IMAPS HS Tail	Saline Leach (2g/L)	Initial Mining Area Primary Sulfide	2020/12/16	*<0.001*	*<0.001*	0.1	0.0005	306		*<0.001*	0.079	0.024	4830	0.4
DP2007 IMAPS HS Tail	DI Leach	Initial Mining Area Primary Sulfide	2020/12/16	*<0.001*	*<0.001*	0.33	0.0003	183	129	*<0.001*	0.044	0.019	1150	0.5
DP2099 HS Tail	Filtrate	10 g/t NaCN in cleaner circuit	2020/12/10											
DP2100 HS Tail	Filtrate	20 g/t NaCN in cleaner circuit	2020/12/10											
IMASS HS Tail	DI Leach	Initial Mining Area Secondary Sulfide	23/08/2021	*<0.001*	*<0.001*	0.23	0.0052	532	456	*<0.001*	0.598	0.236	2380	0.5
IMASS HS Tail	NAG Liquor	Initial Mining Area Secondary Sulfide	23/08/2021	*<0.001*	0.02	0.13	0.0275	48	*<1*	0.187	2.92	22.6		0.3
IMASS HS Tail	Saline Leach (2g/L)	Initial Mining Area Secondary Sulfide	23/08/2021	*<0.001*	*<0.001*	0.19	0.0096	546		*<0.001*	0.616	0.236	5860	0.6
IMASS HS Tail	Saline Leach (10g/L)	Initial Mining Area Secondary Sulfide	23/08/2021	*<0.001*	*<0.001*	0.1	0.022	566		*<0.001*	0.612	0.35	17500	0.5
IMASS HS Tail	Filtrate_tot	Initial Mining Area Secondary Sulfide	23/08/2021	*<1e-04*	0.00022	0.019	0.00048	73	253	0.0007	0.0038	0.124	1380	0.5
IMASS HS Tail	Filtrate	Initial Mining Area Secondary Sulfide	23/08/2021	*<1e-04*	*<5e-05*	0.058	0.0005	71	231	0.0004	0.0035	0.121	1380	0.6
CC18 HS Tail	DI Leach	Oxide Pilot Plant Feed	23/08/2021	*<0.001*	*<0.001*	0.28	0.0001	3	54	*<0.001*	0.002	0.097	310	0.8
CC18 HS Tail	NAG Liquor	Oxide Pilot Plant Feed	23/08/2021	*<0.001*	*<0.001*	*<0.05*	*<1e-04*	2	*<1*	0.075	0.004	0.085		*<0.1*
CC18 HS Tail	Saline Leach (2g/L)	Oxide Pilot Plant Feed	23/08/2021	*<0.001*	*<0.001*	0.24	0.0004	36		*<0.001*	0.009	0.107	3620	0.6
CC18 HS Tail	Saline Leach (10g/L)	Oxide Pilot Plant Feed	23/08/2021	*<0.001*	*<0.001*	0.38	0.0013	88		0.016	0.022	0.152	15200	0.7
CC18 HS Tail	Filtrate	Oxide Pilot Plant Feed	23/08/2021	*<1e-04*	*<5e-05*	0.077	0.00006	16	250	0.0008	0.0042	0.244	1120	1
Unrepresentative Processing Scheme:														
DP1471 LS Tail & DP1554-1560 HS Tail	Filtrate	Jan MC	2020/04/30	*<1e-04*	*<5e-05*	0.235	0.00024	84	545	0.0008	0.0031	0.0424	2300	1.7
DP1655 LS Tail	NAG Liquor	Jan MC	2020/05/26	0.002	0.105	0.12	0.0044	29		0.272	0.736	1.14		

Description	Matrix	Notes	Batch Date	Free Cyanide_mg/L	Gold_mg/L	Hydroxide Alkalinity as CaCO3_mg/L	Iron_mg/L	Lead_mg/L	Magnesium_mg/L	Manganese_mg/L	Mercury_mg/L	Molybdenum_mg/L	Nickel_mg/L	Nitrate as N_mg/L
Representative Processing Scheme:														
High Sulfur Tails														
DP1554-1560 HS Tail	Filtrate	DP1471 Ro con	2020/04/22		*<0.001*	*<1*	*<0.002*	0.0024	7	0.0932	*<4e-05*	0.0418	0.0085	0.04
DP1555-1560 HS Tail	NAG Liquor	DP1471 Ro con	2020/04/22		*<0.001*		2860	1.42	51	2.33	0.0006	0.145	5.37	
DP1855 HS Tail	DI Leach	DP1855 Ro Con	2020/09/30											
DP2007 IMAPS HS Tail	Filtrate	Initial Mining Area Primary Sulfide	2020/12/16	0.626	0.003	*<1*	0.078	0.0003	*<1*	0.0036	0.00009	0.0656	0.0058	0.1
DP2007 IMAPS HS Tail	NAG Liquor	Initial Mining Area Primary Sulfide	2020/12/16		*<0.001*		826	0.37	26	2.24	*<1e-04*	*<0.001*	2.5	
DP2007 IMAPS HS Tail	Saline Leach (10g/L)	Initial Mining Area Primary Sulfide	2020/12/16		*<0.001*	*<1*	*<0.05*	*<0.001*	46	0.294	*<1e-04*	0.008	0.077	0.01
DP2007 IMAPS HS Tail	Saline Leach (2g/L)	Initial Mining Area Primary Sulfide	2020/12/16		*<0.001*	*<1*	*<0.05*	*<0.001*	43	0.253	*<1e-04*	0.006	0.072	0.01
DP2007 IMAPS HS Tail	DI Leach	Initial Mining Area Primary Sulfide	2020/12/16	*<0.004*	*<0.001*	*<1*	*<0.05*	*<0.001*	30	0.132	*<1e-04*	0.006	0.038	0.01
DP2099 HS Tail	Filtrate	10 g/t NaCN in cleaner circuit	2020/12/10											
DP2100 HS Tail	Filtrate	20 g/t NaCN in cleaner circuit	2020/12/10											
IMASS HS Tail	DI Leach	Initial Mining Area Secondary Sulfide	23/08/2021	*<0.004*	*<0.001*	*<1*	*<0.05*	*<0.001*	25	0.271	*<1e-04*	0.004	0.26	*<0.01*
IMASS HS Tail	NAG Liquor	Initial Mining Area Secondary Sulfide	23/08/2021		*<0.001*		387	0.26	8	0.377	*<1e-04*	*<0.001*	1.87	
IMASS HS Tail	Saline Leach (2g/L)	Initial Mining Area Secondary Sulfide	23/08/2021		*<0.001*	*<1*	*<0.05*	*<0.001*	22	0.245	*<1e-04*	0.005	0.27	*<0.01*
IMASS HS Tail	Saline Leach (10g/L)	Initial Mining Area Secondary Sulfide	23/08/2021		*<0.001*	*<1*	*<0.05*	*<0.001*	22	0.242	*<1e-04*	0.007	0.262	*<0.01*
IMASS HS Tail	Filtrate_tot	Initial Mining Area Secondary Sulfide	23/08/2021	*<0.004*	*<0.001*	*<1*	0.048	0.0092	2	0.0682	0.00014	0.0652	0.0184	0.29
IMASS HS Tail	Filtrate	Initial Mining Area Secondary Sulfide	23/08/2021	*<0.004*	*<0.001*	*<1*	0.002	0.0053	2	0.0674	*<4e-05*	0.0661	0.0179	0.27
CC18 HS Tail	DI Leach	Oxide Pilot Plant Feed	23/08/2021		*<0.001*	*<1*	*<0.05*	*<0.001*	1	0.025	*<1e-04*	0.025	0.008	*<0.01*
CC18 HS Tail	NAG Liquor	Oxide Pilot Plant Feed	23/08/2021		*<0.001*		*<0.05*	*<0.001*	*<1*	0.029	*<1e-04*	0.009	0.001	
CC18 HS Tail	Saline Leach (2g/L)	Oxide Pilot Plant Feed	23/08/2021		*<0.001*	*<1*	*<0.05*	*<0.001*	13	0.227	*<1e-04*	0.022	0.017	*<0.01*
CC18 HS Tail	Saline Leach (10g/L)	Oxide Pilot Plant Feed	23/08/2021		*<0.001*	*<1*	*<0.05*	*<0.001*	30	0.615	*<1e-04*	0.023	0.032	*<0.01*
CC18 HS Tail	Filtrate	Oxide Pilot Plant Feed	23/08/2021		*<0.001*	*<1*	*<0.002*	0.0005	6	0.0477	*<4e-05*	0.102	0.0222	*<0.01*
Unrepresentative Processing Scheme:														
DP1471 LS Tail & DP1554-1560 HS Tail	Filtrate	Jan MC	2020/04/30		*<0.001*	*<1*	0.004	0.0017	26	0.274	*<4e-05*	0.282	0.0118	0.09
DP1655 LS Tail	NAG Liquor	Jan MC	2020/05/26		*<0.001*	0	207	0.101	52	1.6	0.005	0.009	0.415	

Description	Matrix	Notes	Batch Date	Nitrate as NO3_mg/L	Nitrite + Nitrate as N_mg/L	Nitrite as N_mg/L	Potassium_mg/L	Reactive Phosphorus as P_mg/L	Selenium_mg/L	Silicon_mg/L	Silver_mg/L	Sodium_mg/L	Strontium_mg/L	Tellurium_mg/L
Representative Processing Scheme:														
High Sulfur Tails														
DP1554-1560 HS Tail	Filtrate	DP1471 Ro con	2020/04/22	0.18	0.06	0.02	24	*<0.01*	0.0044	4.15	*<1e-04*	130	0.203	*<2e-04*
DP1555-1560 HS Tail	NAG Liquor	DP1471 Ro con	2020/04/22			0	46	0	0.23	128	0.256	30	0.114	0.184
DP1855 HS Tail	DI Leach	DP1855 Ro Con	2020/09/30											
DP2007 IMAPS HS Tail	Filtrate	Initial Mining Area Primary Sulfide	2020/12/16	0.44	0.12	0.02	26	*<0.01*	0.0115	5.25	0.0018	141	0.071	0.0004
DP2007 IMAPS HS Tail	NAG Liquor	Initial Mining Area Primary Sulfide	2020/12/16			0	8	0	0.04	34.2	0.017	16	0.092	0.021
DP2007 IMAPS HS Tail	Saline Leach (10g/L)	Initial Mining Area Primary Sulfide	2020/12/16	0.04	0.01	*<0.01*	25	*<0.01*	0.03	4.76	*<0.001*	0	0.782	*<0.005*
DP2007 IMAPS HS Tail	Saline Leach (2g/L)	Initial Mining Area Primary Sulfide	2020/12/16	0.04	0.01	*<0.01*	18	*<0.01*	0.02	5.29	*<0.001*	0	0.614	*<0.005*
DP2007 IMAPS HS Tail	DI Leach	Initial Mining Area Primary Sulfide	2020/12/16	0.04	0.02	0.01	12	*<0.01*	0.01	4.43	*<0.001*	33	0.404	*<0.005*
DP2099 HS Tail	Filtrate	10 g/t NaCN in cleaner circuit	2020/12/10											
DP2100 HS Tail	Filtrate	20 g/t NaCN in cleaner circuit	2020/12/10											
IMASS HS Tail	DI Leach	Initial Mining Area Secondary Sulfide	23/08/2021	*<0.01*	0.02	0.02	9	*<0.01*	0.01	3.56	*<0.001*	32	0.677	*<0.005*
IMASS HS Tail	NAG Liquor	Initial Mining Area Secondary Sulfide	23/08/2021				5		0.01	18.6	*<0.001*	13	0.07	0.016
IMASS HS Tail	Saline Leach (2g/L)	Initial Mining Area Secondary Sulfide	23/08/2021	*<0.01*	0.02	0.02	13	*<0.01*	0.02	2.99	*<0.001*		0.679	*<0.005*
IMASS HS Tail	Saline Leach (10g/L)	Initial Mining Area Secondary Sulfide	23/08/2021	*<0.01*	0.01	0.02	22	*<0.01*	0.02	2.6	*<0.001*		0.772	*<0.005*
IMASS HS Tail	Filtrate_tot	Initial Mining Area Secondary Sulfide	23/08/2021	1.28	0.35	0.06	20	*<0.01*	0.023	2.98	0.001	189	0.155	*<2e-04*
IMASS HS Tail	Filtrate	Initial Mining Area Secondary Sulfide	23/08/2021	1.2	0.33	0.06	19	*<0.01*	0.0213	2.67	0.001	185	0.164	*<2e-04*
CC18 HS Tail	DI Leach	Oxide Pilot Plant Feed	23/08/2021	*<0.01*	*<0.01*	*<0.01*	8	*<0.01*	*<0.01*	11.3	*<0.001*	53	0.041	*<0.005*
CC18 HS Tail	NAG Liquor	Oxide Pilot Plant Feed	23/08/2021				2		*<0.01*	12.1	*<0.001*	20	0.018	*<0.005*
CC18 HS Tail	Saline Leach (2g/L)	Oxide Pilot Plant Feed	23/08/2021	*<0.01*	*<0.01*	*<0.01*	18	*<0.01*	*<0.01*	9.81	*<0.001*		0.426	*<0.005*
CC18 HS Tail	Saline Leach (10g/L)	Oxide Pilot Plant Feed	23/08/2021	*<0.01*	*<0.01*	*<0.01*	26	*<0.01*	*<0.01*	9.06	*<0.001*		1.08	*<0.005*
CC18 HS Tail	Filtrate	Oxide Pilot Plant Feed	23/08/2021	*<0.01*	*<0.01*	*<0.01*	21	*<0.01*	0.0085	11.2	*<1e-04*	176	0.152	*<2e-04*
Unrepresentative Processing Scheme:														
DP1471 LS Tail & DP1554-1560 HS Tail	Filtrate	Jan MC	2020/04/30	0.4	0.11	0.02	49	*<0.01*	0.0098	6.05	*<1e-04*	293	0.777	*<2e-04*
DP1655 LS Tail	NAG Liquor	Jan MC	2020/05/26			0	32	0	0.01	73.5	0.011	21	0.048	0.008

Description	Matrix	Notes	Batch Date	Thallium_mg/L	Thorium_mg/L	Total Cyanide_mg/L	Total Kjeldahl Nitrogen as N_mg/L	Total Nitrogen as N_mg/L	Tungsten_mg/L	Uranium_mg/L	Vanadium_mg/L	Weak Acid Dissociable Cyanide_mg/L	Zinc_mg/L
Representative Processing Scheme:													
High Sulfur Tails													
DP1554-1560 HS Tail	Filtrate	DP1471 Ro con	2020/04/22	0.0004	*<1e-04*	0	0.3	0.4	0.009	0.00102	*<2e-04*		0.008
DP1555-1560 HS Tail	NAG Liquor	DP1471 Ro con	2020/04/22	0.029	0.122	0	0	0	0.749	0.026	0.19		1.84
DP1855 HS Tail	DI Leach	DP1855 Ro Con	2020/09/30										
DP2007 IMAPS HS Tail	Filtrate	Initial Mining Area Primary Sulfide	2020/12/16	0.00011	*<1e-04*	1.28	5	5.1	0.062	0.00013	0.002	1.27	0.004
DP2007 IMAPS HS Tail	NAG Liquor	Initial Mining Area Primary Sulfide	2020/12/16	0.025	0.057	0	0	0	0.002	0.012	0.03		1.9
DP2007 IMAPS HS Tail	Saline Leach (10g/L)	Initial Mining Area Primary Sulfide	2020/12/16	0.003	*<0.001*	0	1.5	1.5	0.003	0.003	*<0.01*		0.072
DP2007 IMAPS HS Tail	Saline Leach (2g/L)	Initial Mining Area Primary Sulfide	2020/12/16	0.002	*<0.001*	0	1.5	1.5	0.001	0.003	*<0.01*		0.05
DP2007 IMAPS HS Tail	DI Leach	Initial Mining Area Primary Sulfide	2020/12/16	*<0.001*	*<0.001*	0.006	1.8	1.8	0.001	0.002	*<0.01*	*<0.004*	0.261
DP2099 HS Tail	Filtrate	10 g/t NaCN in cleaner circuit	2020/12/10										
DP2100 HS Tail	Filtrate	20 g/t NaCN in cleaner circuit	2020/12/10										
IMASS HS Tail	DI Leach	Initial Mining Area Secondary Sulfide	23/08/2021	*<0.001*	*<0.001*	*<0.004*	*<0.1*	*<0.1*	*<0.001*	0.004	*<0.01*	*<0.004*	0.418
IMASS HS Tail	NAG Liquor	Initial Mining Area Secondary Sulfide	23/08/2021	0.021	0.024				0.001	0.007	0.02		0.737
IMASS HS Tail	Saline Leach (2g/L)	Initial Mining Area Secondary Sulfide	23/08/2021	0.005	*<0.001*		0.1	0.1	*<0.001*	0.003	*<0.01*		0.413
IMASS HS Tail	Saline Leach (10g/L)	Initial Mining Area Secondary Sulfide	23/08/2021	0.012	*<0.001*		0.6	0.6	*<0.001*	0.002	*<0.01*		0.412
IMASS HS Tail	Filtrate_tot	Initial Mining Area Secondary Sulfide	23/08/2021	0.00076	*<1e-04*	*<0.004*	0.3	0.6	0.048	0.00008	0.0006	*<0.004*	0.039
IMASS HS Tail	Filtrate	Initial Mining Area Secondary Sulfide	23/08/2021	0.00071	*<1e-04*	*<0.004*	0.2	0.5	0.05	0.00009	0.0005	*<0.004*	0.041
CC18 HS Tail	DI Leach	Oxide Pilot Plant Feed	23/08/2021	*<0.001*	*<0.001*		*<0.1*	*<0.1*	0.044	*<0.001*	*<0.01*		0.067
CC18 HS Tail	NAG Liquor	Oxide Pilot Plant Feed	23/08/2021	*<0.001*	*<0.001*				0.029	*<0.001*	*<0.01*		0.008
CC18 HS Tail	Saline Leach (2g/L)	Oxide Pilot Plant Feed	23/08/2021	*<0.001*	*<0.001*		*<0.1*	*<0.1*	0.025	*<0.001*	*<0.01*		0.254
CC18 HS Tail	Saline Leach (10g/L)	Oxide Pilot Plant Feed	23/08/2021	*<0.001*	*<0.001*		*<0.5*	*<0.5*	0.022	*<0.001*	*<0.01*		0.324
CC18 HS Tail	Filtrate	Oxide Pilot Plant Feed	23/08/2021	0.00013	*<1e-04*		0.2	0.2	0.113	0.00188	0.0017		0.011
Unrepresentative Processing Scheme:													
DP1471 LS Tail & DP1554-1560 HS Tail	Filtrate	Jan MC	2020/04/30	0.00029	*<1e-04*	0	0.4	0.5	0.035	0.00628	0.0007		0.067
DP1655 LS Tail	NAG Liquor	Jan MC	2020/05/26	0.004	0.075	0	0	0	0.159	0.012	0.13		1.37

Oxygen Consumption Rate Tests

	Rougher-Tailings		
	EB2003185003 (0.40%S; 0.21%C)		
Cell No.	K		
Test Specifications and Conditions			
Damp-Solids (kg)	2.44		
GWC (%)	**4.2**		
Dry-Solids [DS] (kg)	2.34		
Solids-SG	2.69		
Dry-Solids Volume (L)	0.87		
Pore-Fluid Volume (L)	0.10		
Cell-Volume (L)	4.65		
Inert-Spacer-Volume (L)	1.30		
Gas Volume [GV] (L)	2.32		
GV/DS Ratio (L/kg)	0.99		
Temperature (oC) [+/- 0.1]	**30.0**		
Measurement with Quantek Q2			
Reaction-Time (days)	**3.0**		
Reaction-Time (hrs)	73		
Measured O2-Conc. (%) [+/- 0.1]	**19.1**	**Measured CO2-Conc. (%) [+/- 0.01]**	**0.43**
O2-Consumption (%) [+/- 0.2]	1.8	CO2 Concentration (mg CO2/L)	9.03
O2-Consumption (mg O2)	55.6	CO2-Released (mg CO2)	21.0
OCR (kg O2/kg/s)	**9.0E-11**	**CDRR (kg CO2/kg/s)**	**3.4E-11**
Measurement with Nova 309			
GV + Ext.-Dead-Vol. (L)	2.46		
N2-Dilution Factor	0.943		
Measured O2-Conc. (%) [+/- 0.1]	**17.1**		
O2-Conc. (corrected) [%] (+/- 0.1)	18.1		
O2-Consumption (%) [+/- 0.2]	2.8		
O2-Consumption (mg O2)	85.5		
OCR (kg O2/kg/s)	**1.4E-10**		

Notes:
GWC = Gravimetric-Water Content; SG = Specific-Gravity.
Submitted dry tailings-solids sample initially moistened using high-purity-deionised-water (HPDW).
HPDW added incrementally via a spray-bottle, and the tailings mass 'hand-mixed' until the consistency reached a 'just clumpy' state.
Following moistening, the tailings-solids were stored in a plastic-bag in a CT-room at 20-22 oC for *ca.* 2-3 days to equilibrate. The equilibrated moist tailings-solids were then packed into the Oxygen-Consumption Cell (OCC) which was then placed in incubator at 30.0 oC.
GWC determined via o'night drying a subsample of equilibrated tailings-solids at 105 oC.
SG value provided by Rio.
The relative-error for the OCR and CDRR values is estimated to be *ca.* 10-20 %.

After completing testing, *ca.* 10 grams of reacted-tailings was mixed with *ca.* 5 mL of HPDW, and the 'Mud-pH' value determined. **'Mud-pH' = 7.1.**

	Combined-Rougher-Tailings
	EB2010398001 (1.31%S; 0.18%C)
Test Specifications and Conditions	
Moist-Solids (kg)	1.26
GWC (%)	**4.7**
Dry-Solids [DS] (kg)	1.20
Solids-SG	2.89
Dry-Solids Volume (L)	0.42
Pore-Fluid Volume (L)	0.06
Cell Volume (L)	1.15
Gas Volume [GV] (L)	0.68
GV/DS Ratio (L/kg)	0.56
Temperature (oC) [+/- 0.1]	**30.0**
Measurement with Quantek O2	
Reaction-Time (days)	**1.0**
Reaction-Time (hrs)	24
Measured O2-Conc. (%) [+/- 0.1]	**18.4**
O2-Consumption (%) [+/- 0.2]	2.5
O2-Consumption (mg O2)	22.1
OCR (kg O2/kg/s)	2.1E-10
Measured CO2-Conc. (%) [+/- 0.01]	**0.51**
CO2 Concentration (mg CO2/L)	10.71
CO2-Release (mg CO2)	7.25
CDRR (kg CO2/kg/s)	7.0E-11

Notes:

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

Submitted dry tailings-solids sample initially moistened using high-purity-deionised-water (HPDW). HPDW added incrementally via a spray-bottle, and the tailings mass 'hand-mixed' until the consistency reached a 'just clumpy' state.

Following moistening, the tailings-solids were stored in a plastic-bag in a CT-room at 20-22 oC for *ca.* 2-3 days to equilibrate. The equilibrated moist tailings-solids were then packed into the Oxygen-Consumption Cell (OCC) which was then placed in incubator at 30.0 oC.

GWC determined via o'night drying a subsample of equilibrated tailings-solids at 105 oC.

SG value provided by Rio.

The relative-error for the OCR and CDRR values is estimated to be *ca.* 10-20 %.

After completing testing, *ca.* 10 grams of reacted-tailings was mixed with *ca.* 5 mL of HPDW, and the 'Mud-pH' value determined. **'Mud-pH' = 7.5.**

APPENDIX 4 – UNSATURATED LEACH RESULTS

Note: Samples measured below the detection limit are plotted at the detection limit with an open symbol.

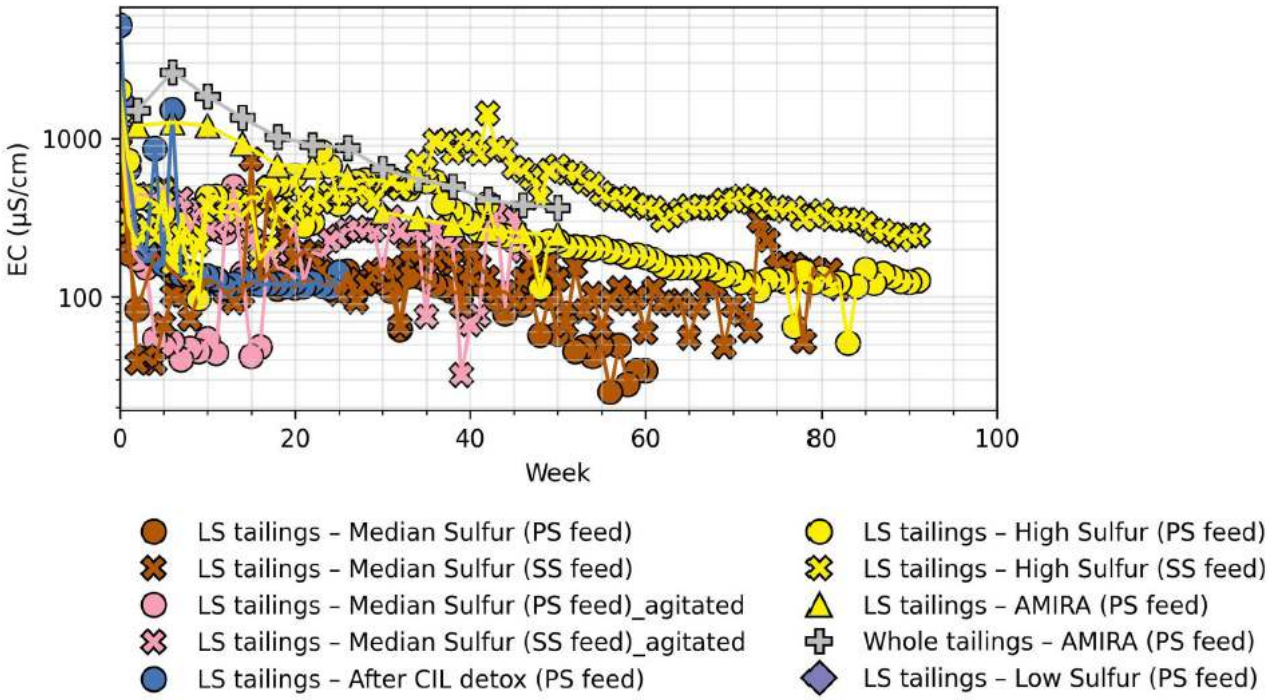


Figure 53: EC in kinetic testing leachates.

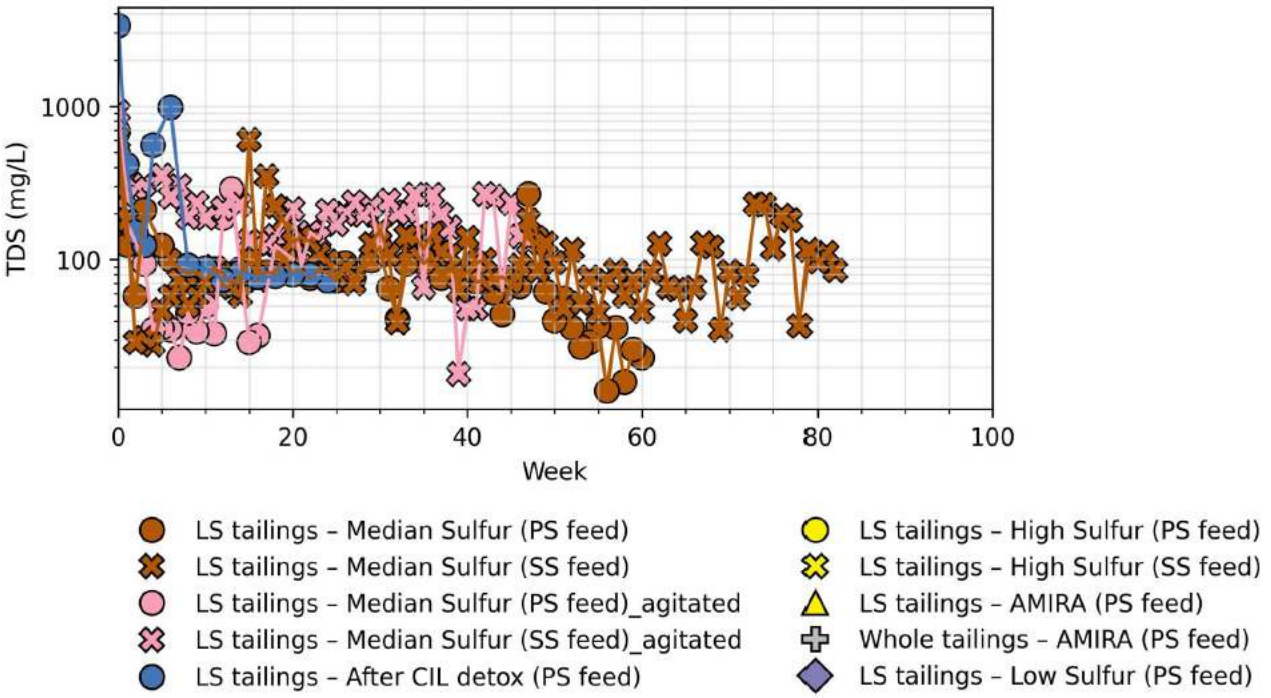


Figure 54: TDS concentrations in kinetic testing leachates.

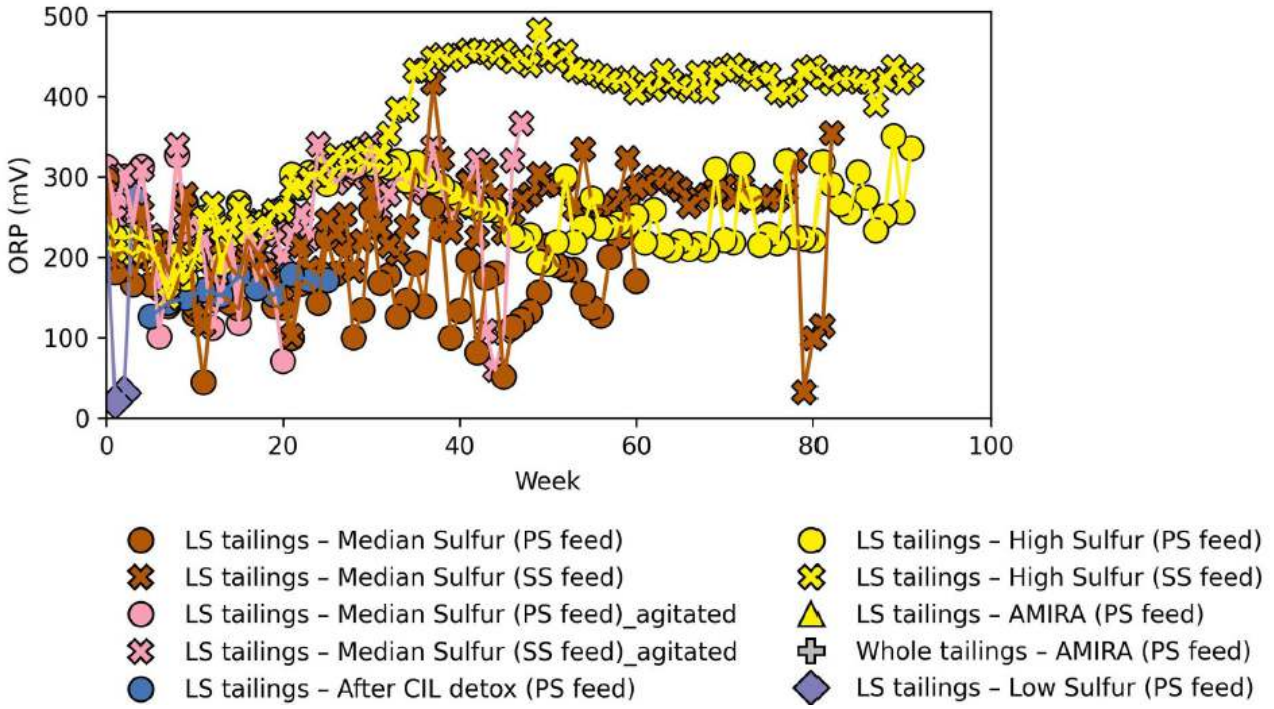


Figure 55: ORP concentrations in kinetic testing leachates.

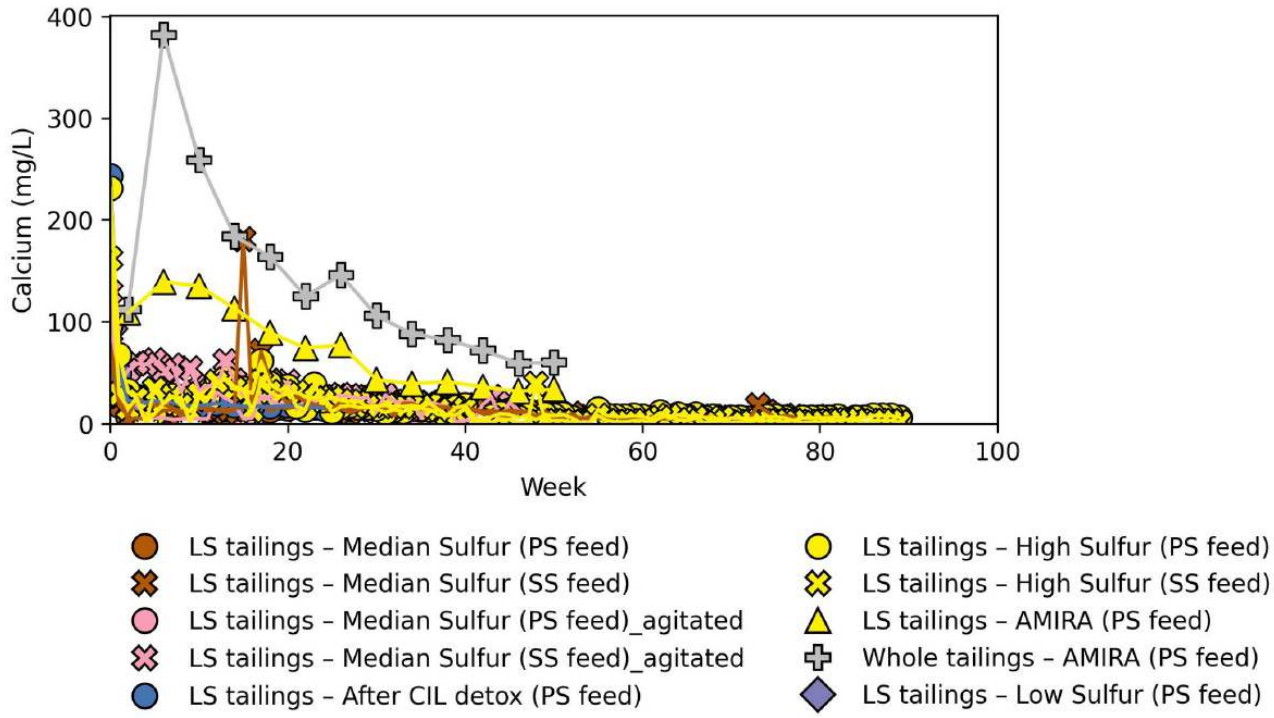


Figure 56: Ca concentrations in kinetic testing leachates.

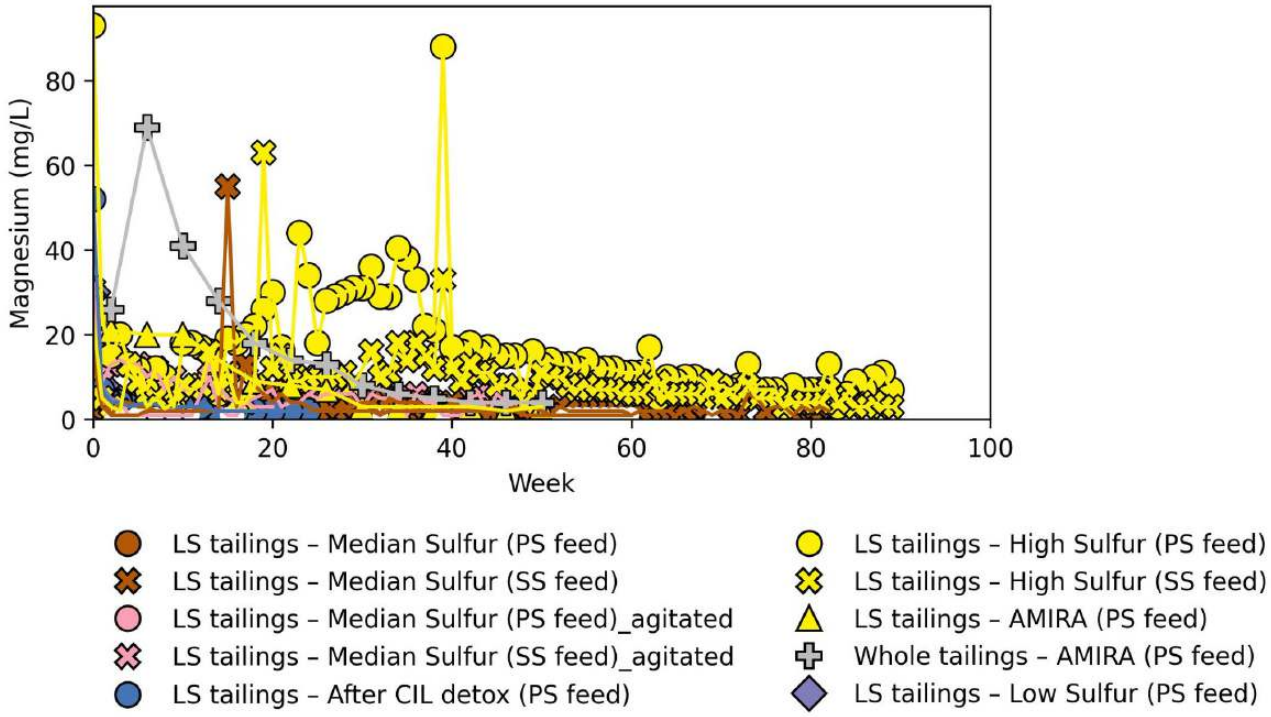


Figure 57: Mg concentrations in kinetic testing leachates.

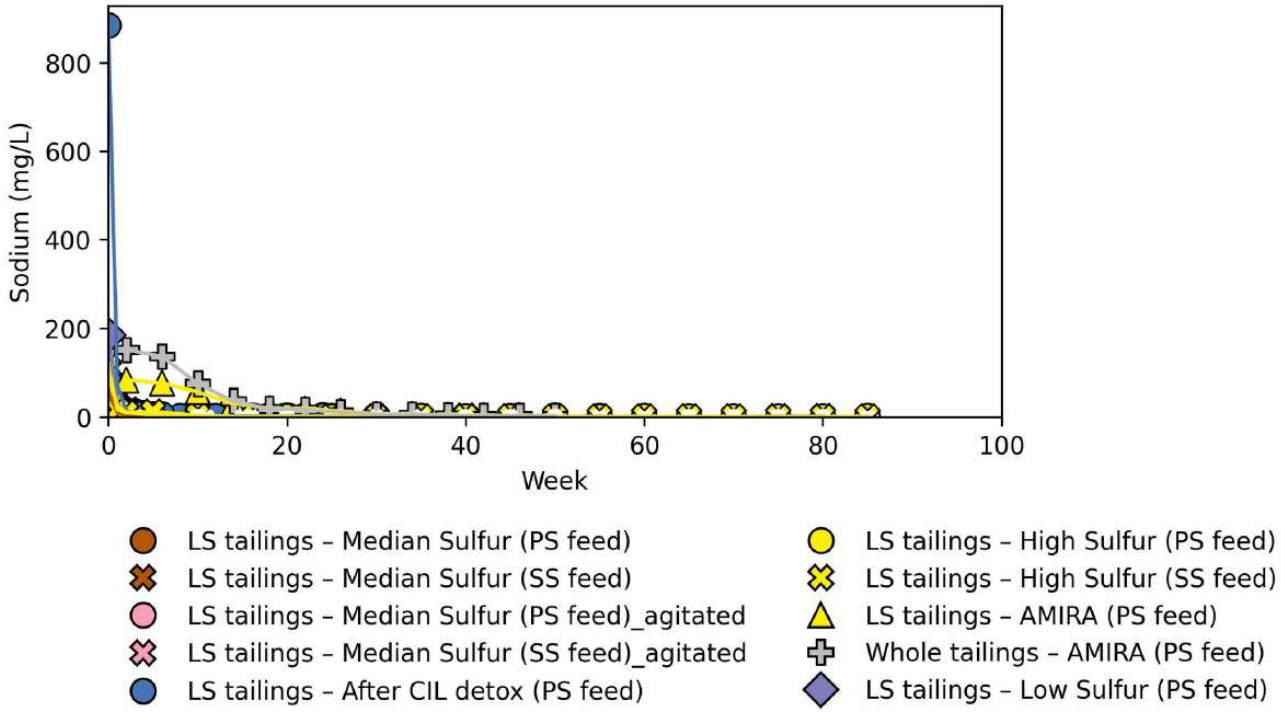


Figure 58: Na concentrations in kinetic testing leachates.

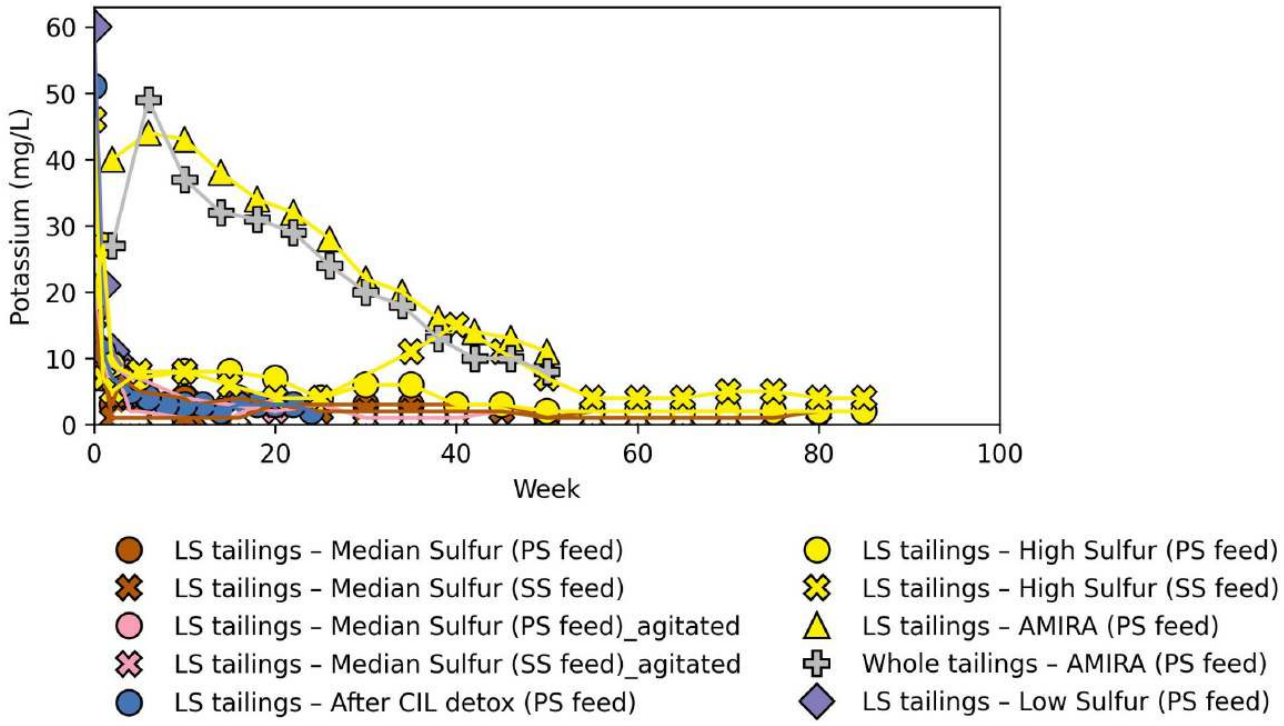


Figure 59: K concentrations in kinetic testing leachates.

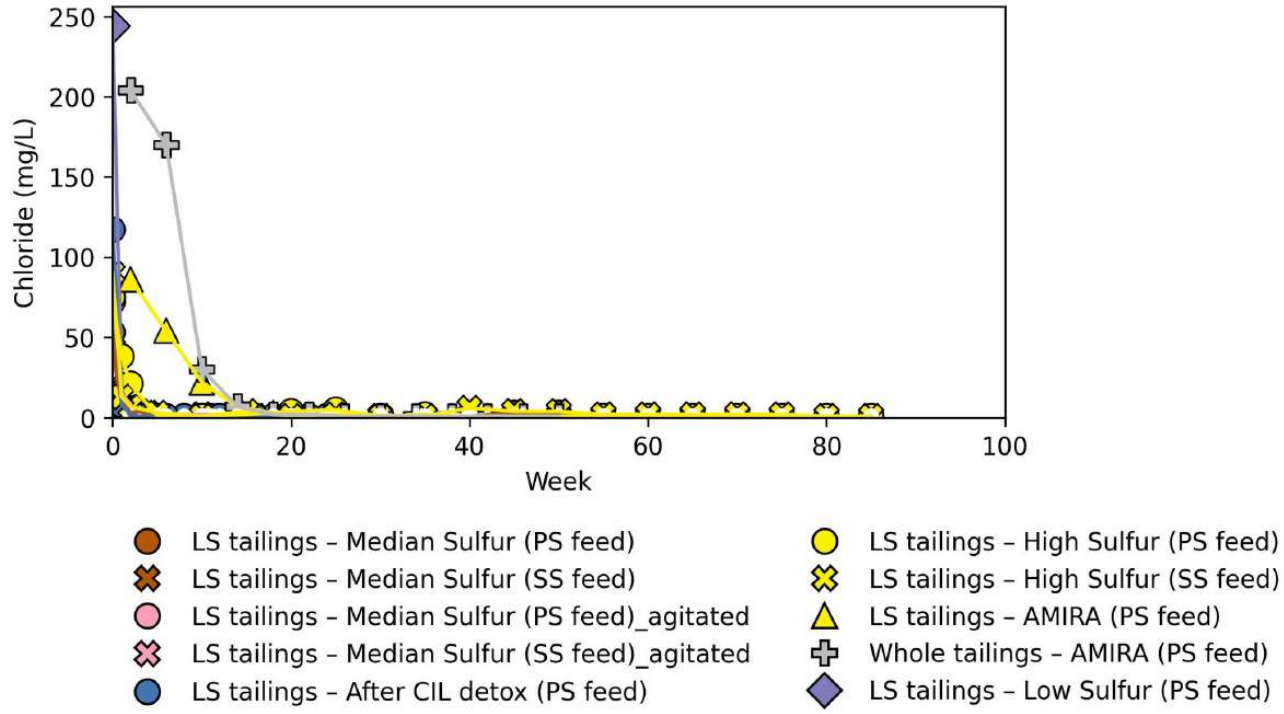


Figure 60: Cl concentrations in kinetic testing leachates.

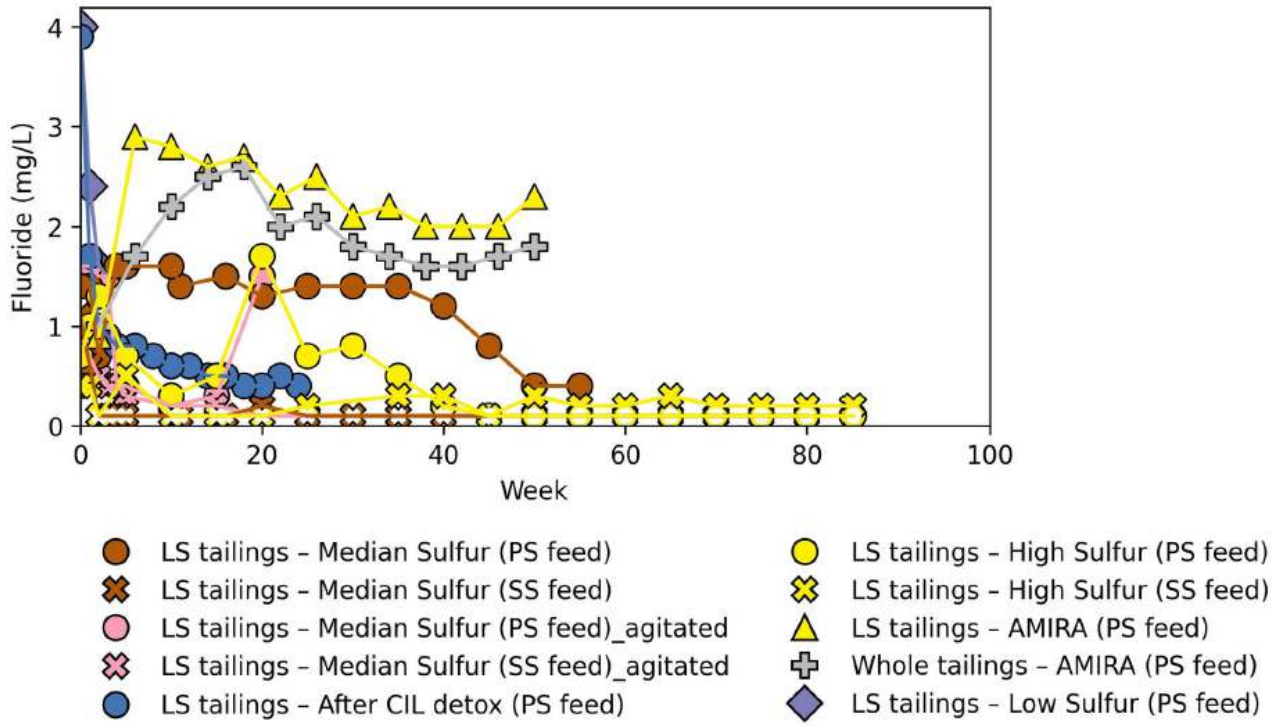


Figure 61: F concentrations in kinetic testing leachates.

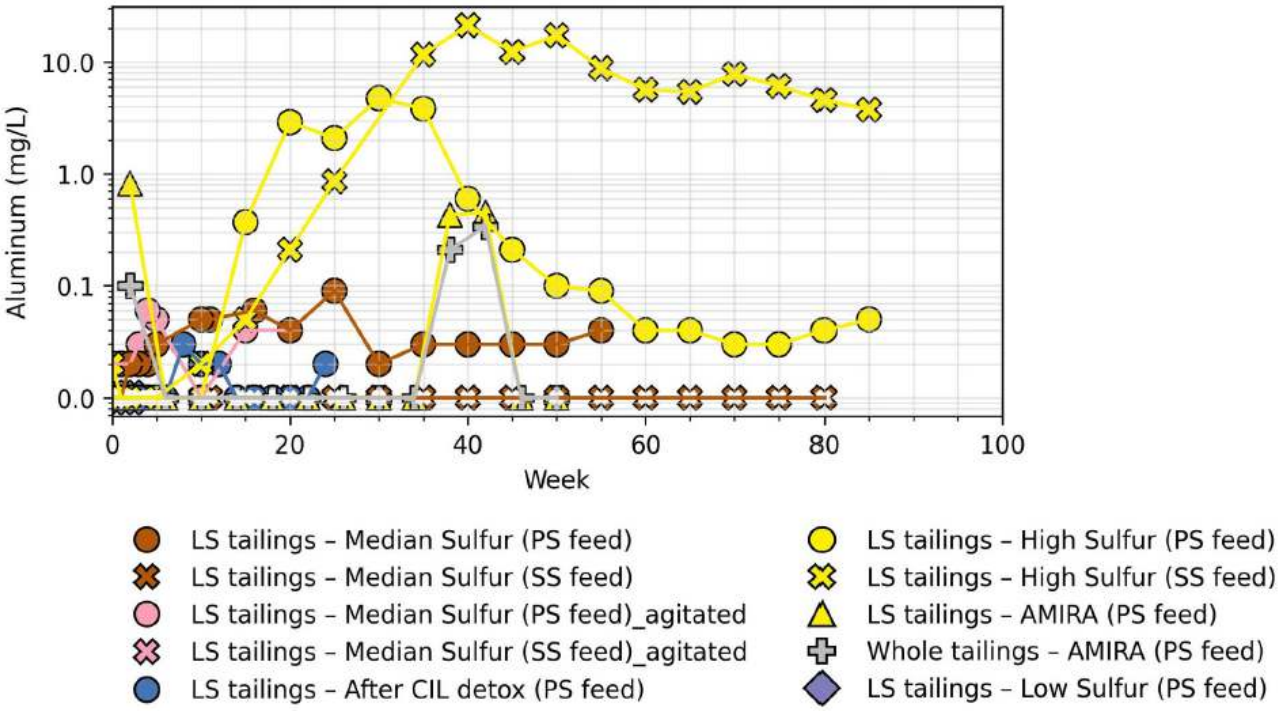


Figure 62: Al concentrations in kinetic testing leachates.

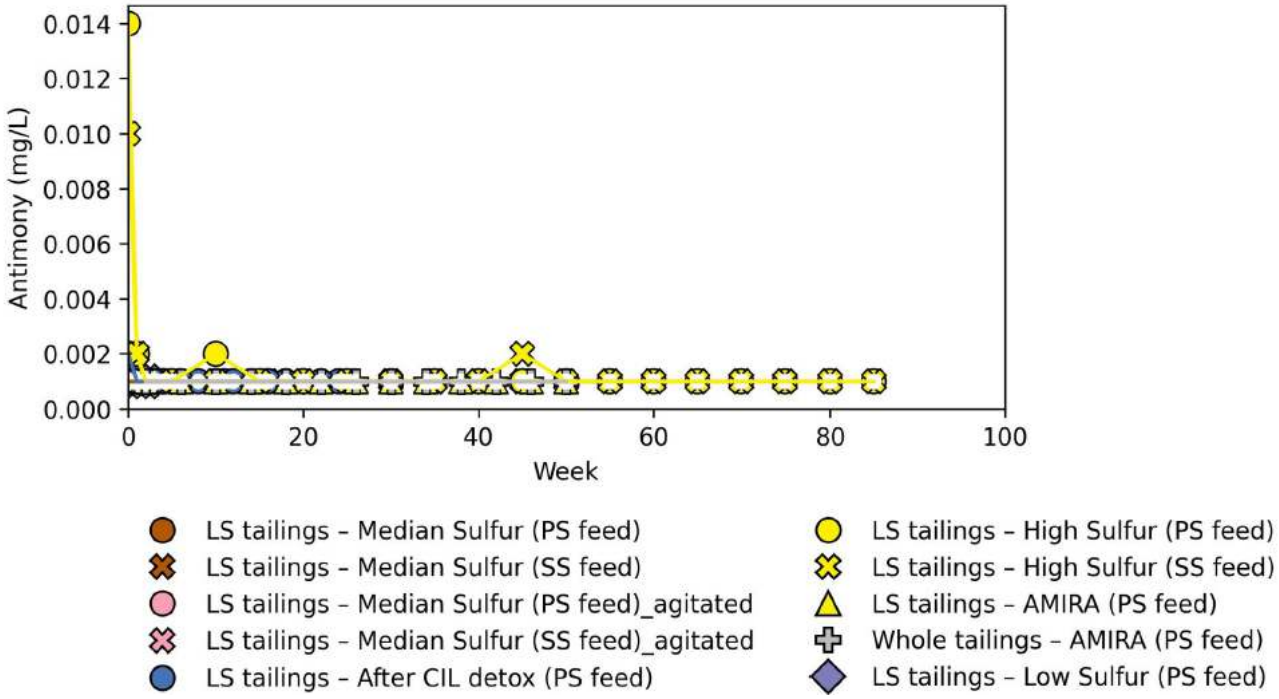


Figure 63: Sb concentrations in kinetic testing leachates.

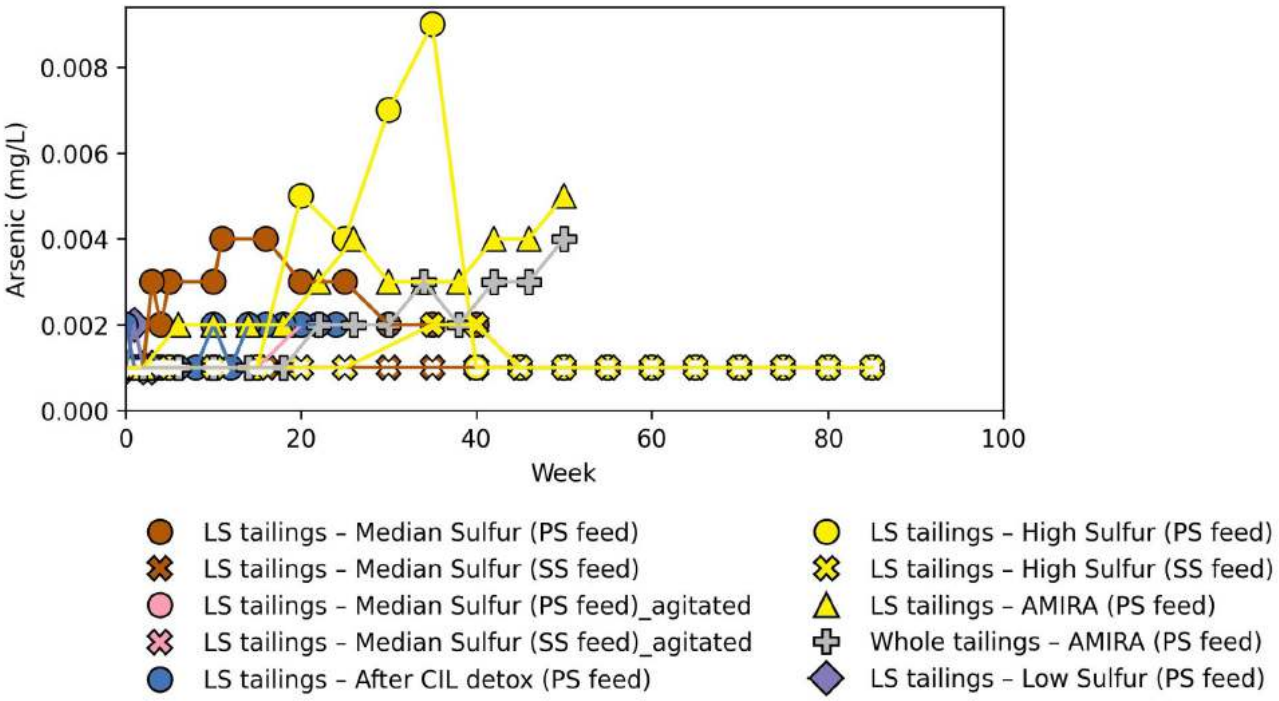


Figure 64: As concentrations in kinetic testing leachates.

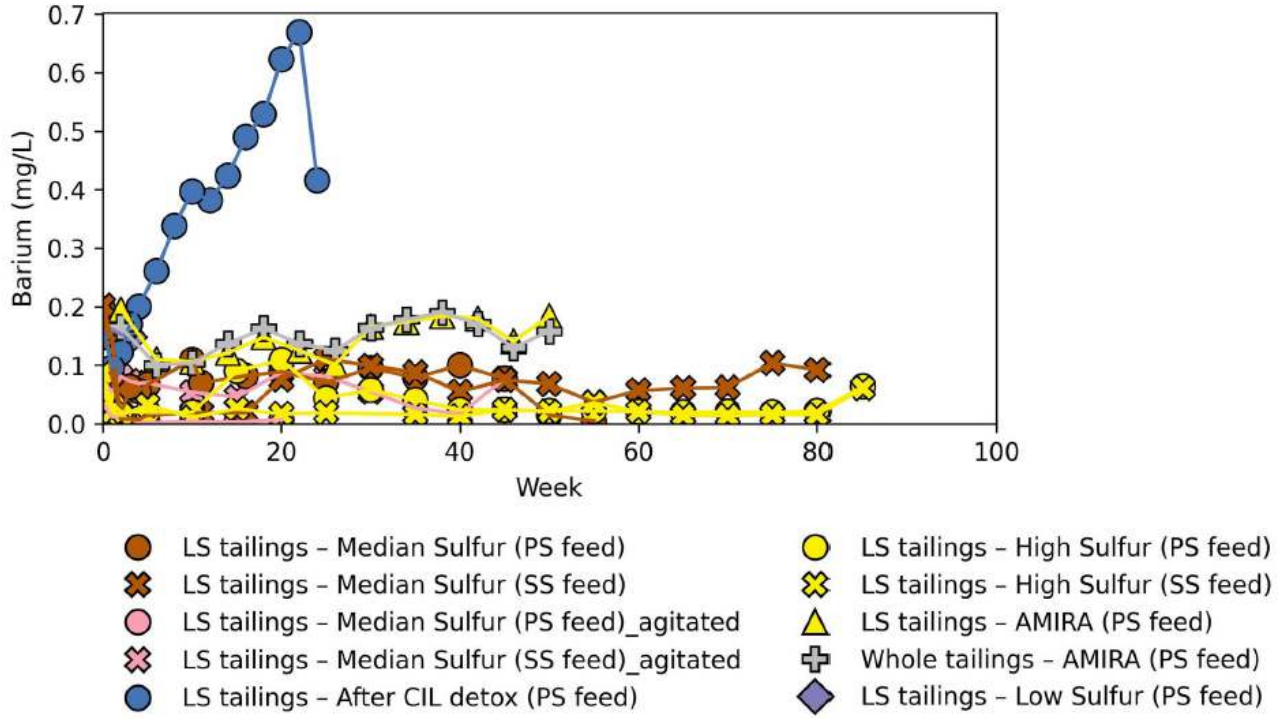


Figure 65: Ba concentrations in kinetic testing leachates.

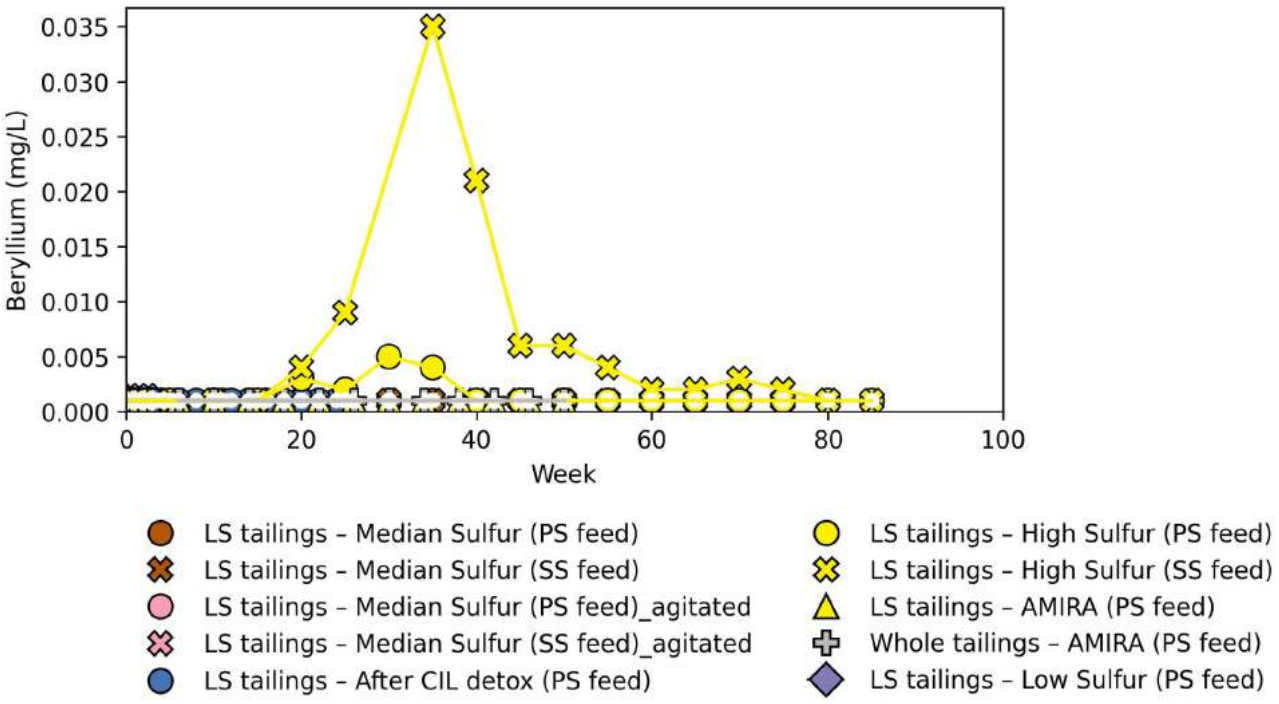


Figure 66: Be concentrations in kinetic testing leachates.

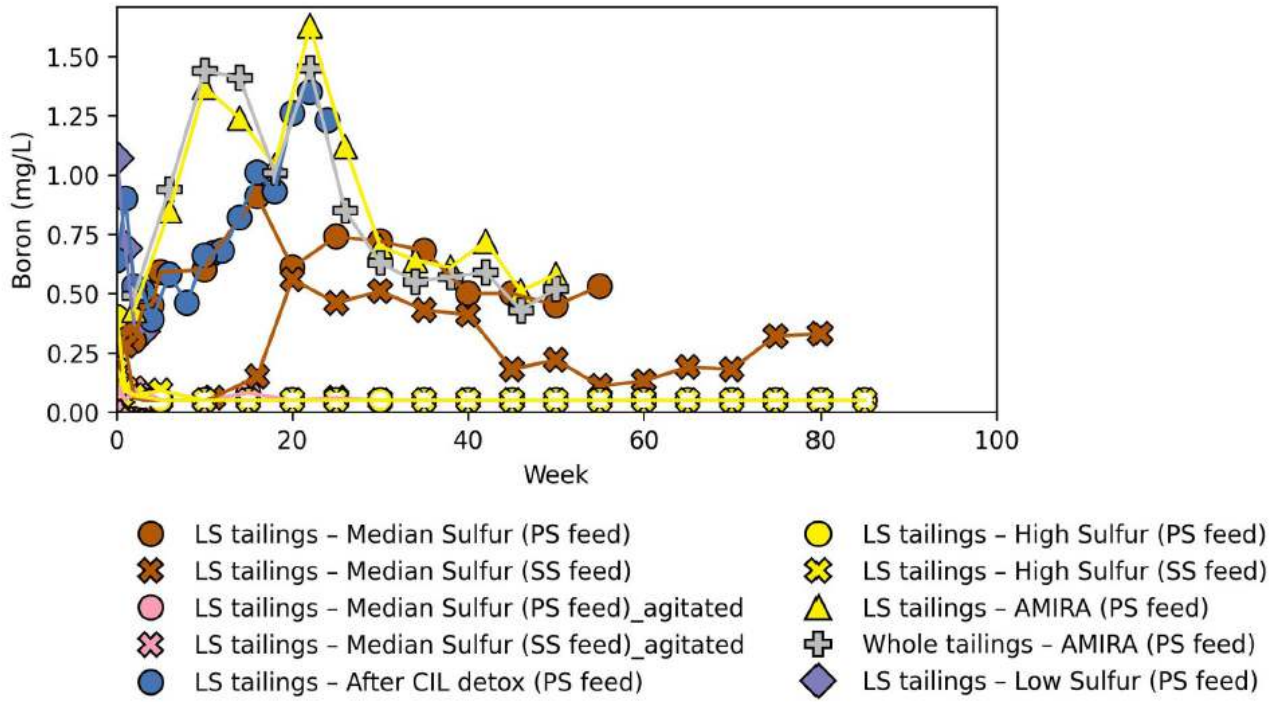


Figure 67: B concentrations in kinetic testing leachates.

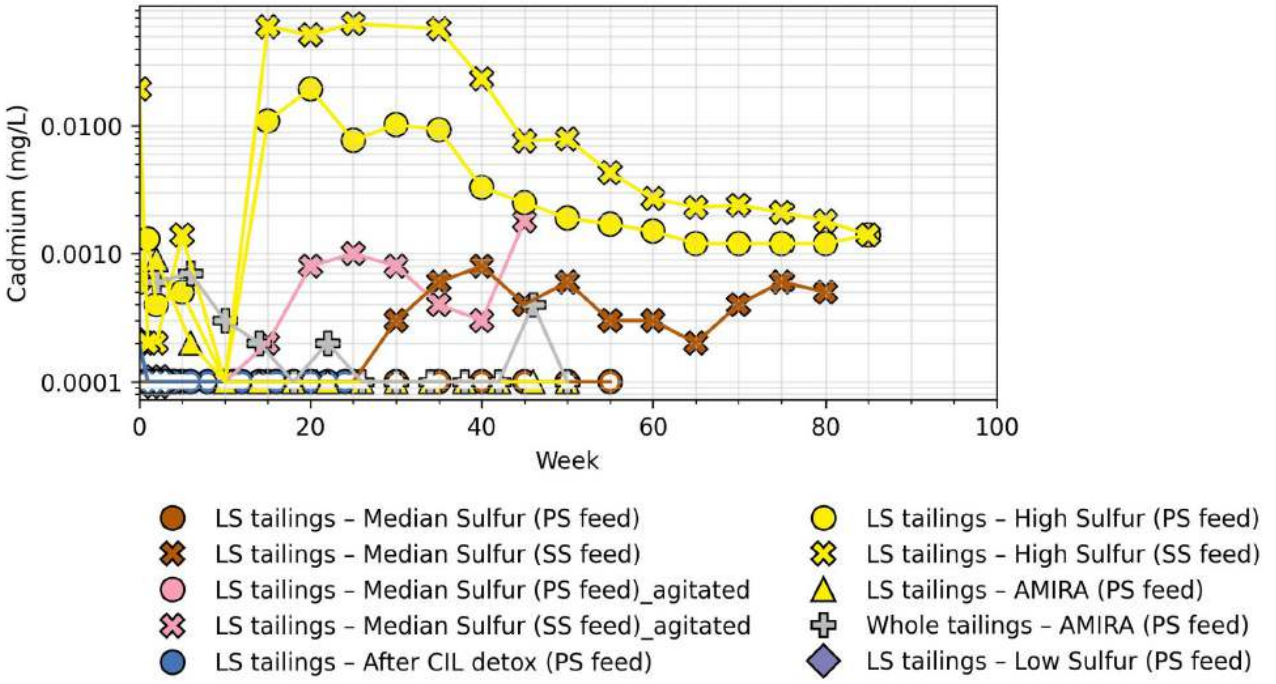


Figure 68: Cd concentrations in kinetic testing leachates.

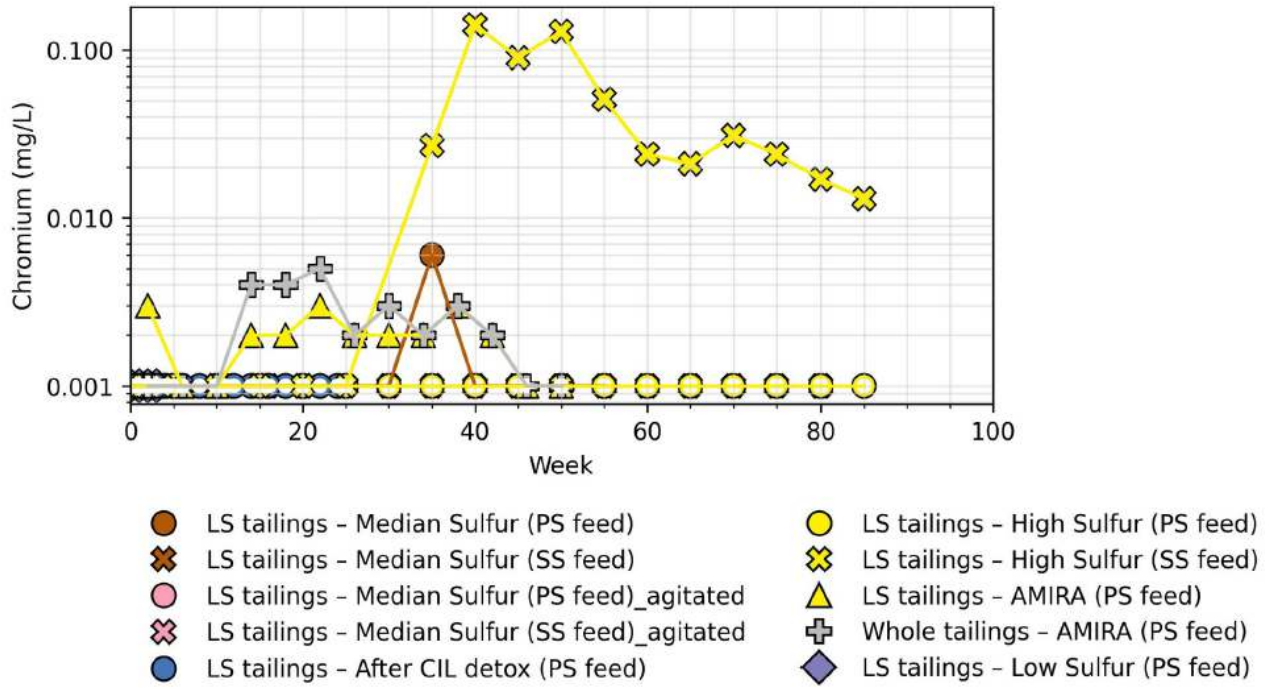


Figure 69: Cr concentrations in kinetic testing leachates.

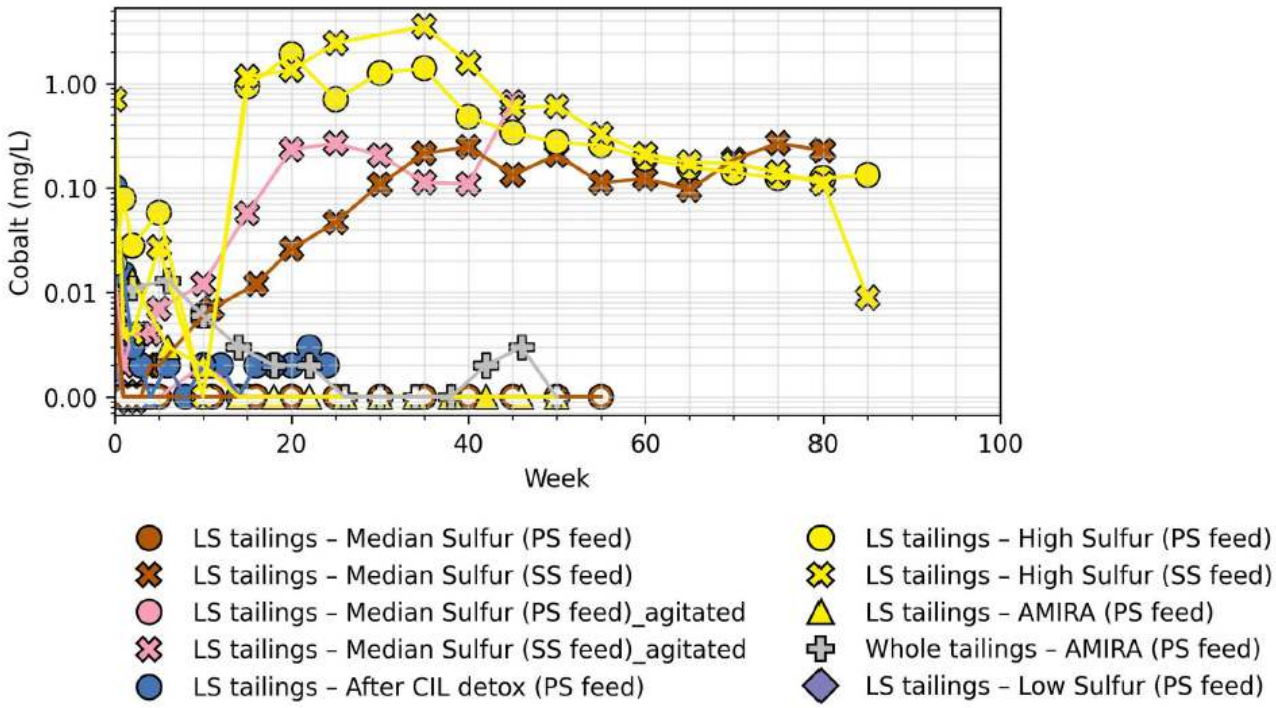


Figure 70: Co concentrations in kinetic testing leachates.

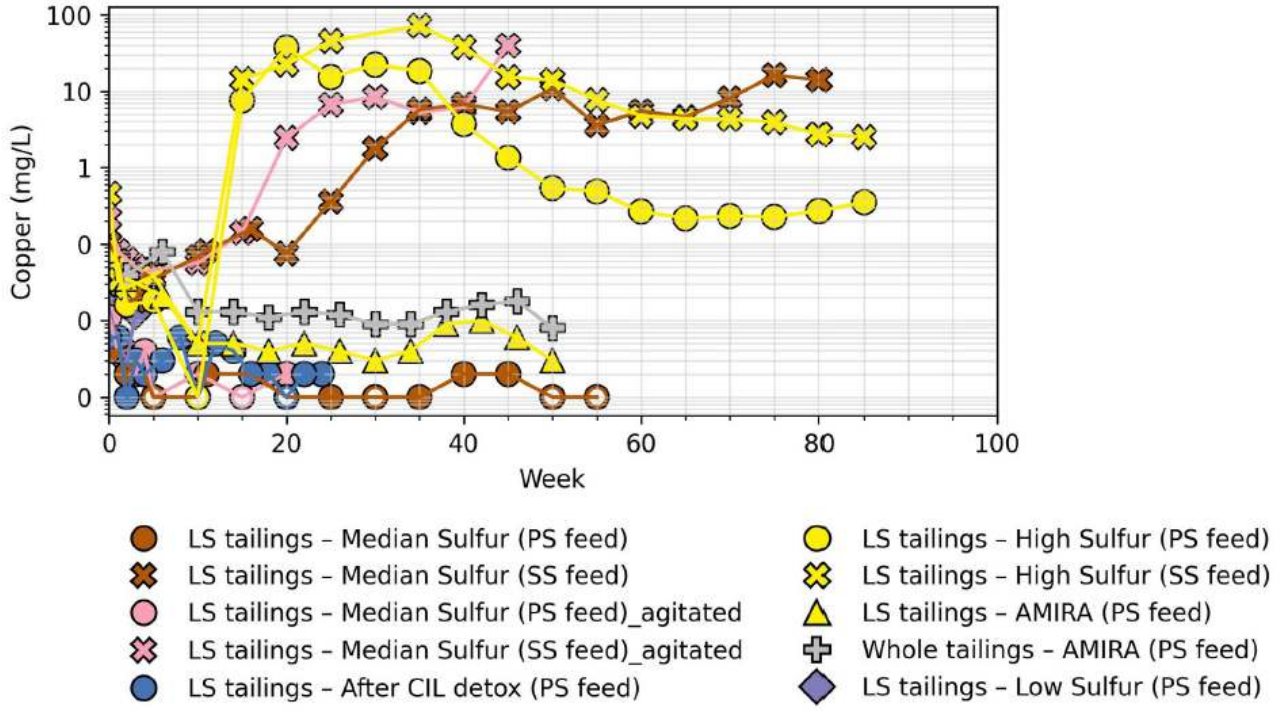


Figure 71: Cu concentrations in kinetic testing leachates.

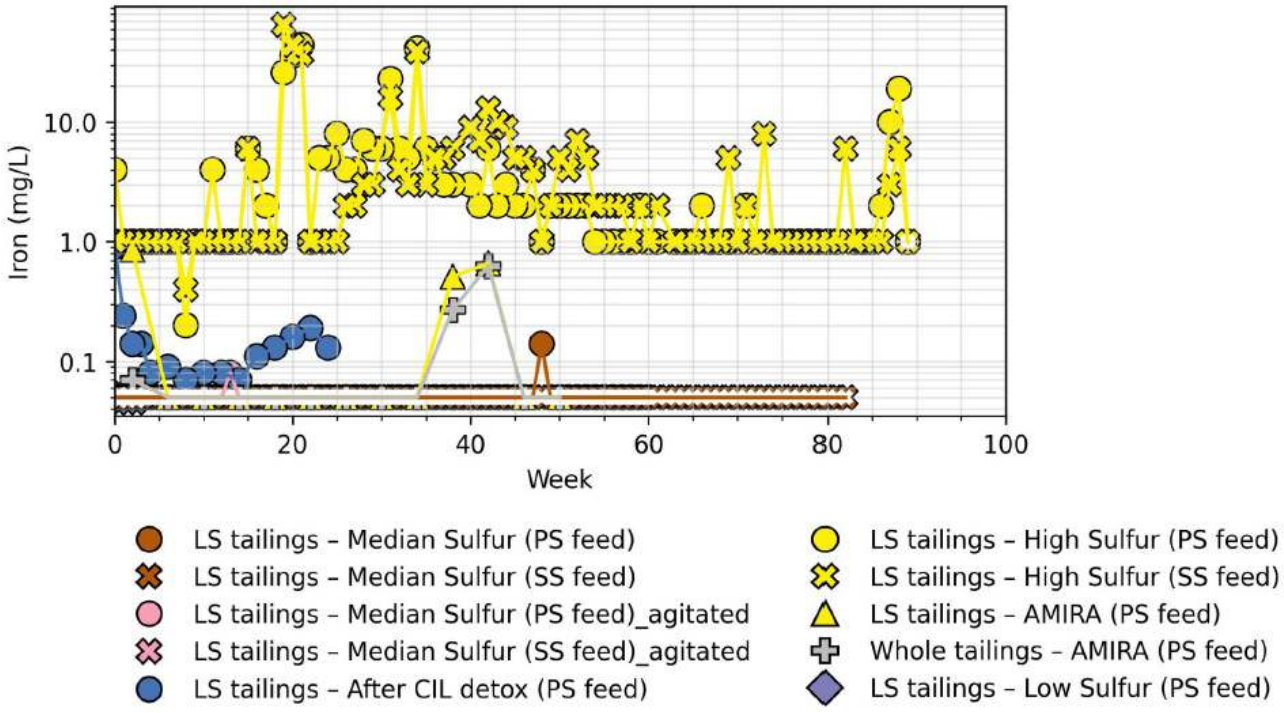


Figure 72: Fe concentrations in kinetic testing leachates.

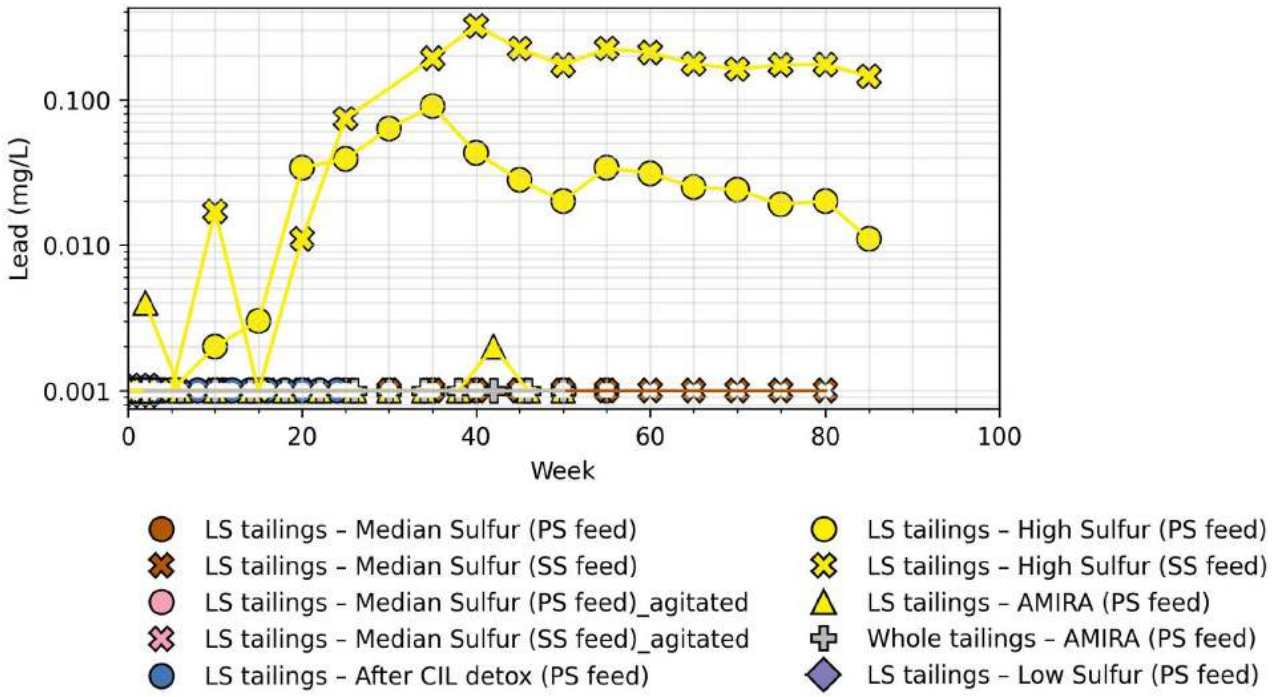


Figure 73: Pb concentrations in kinetic testing leachates.

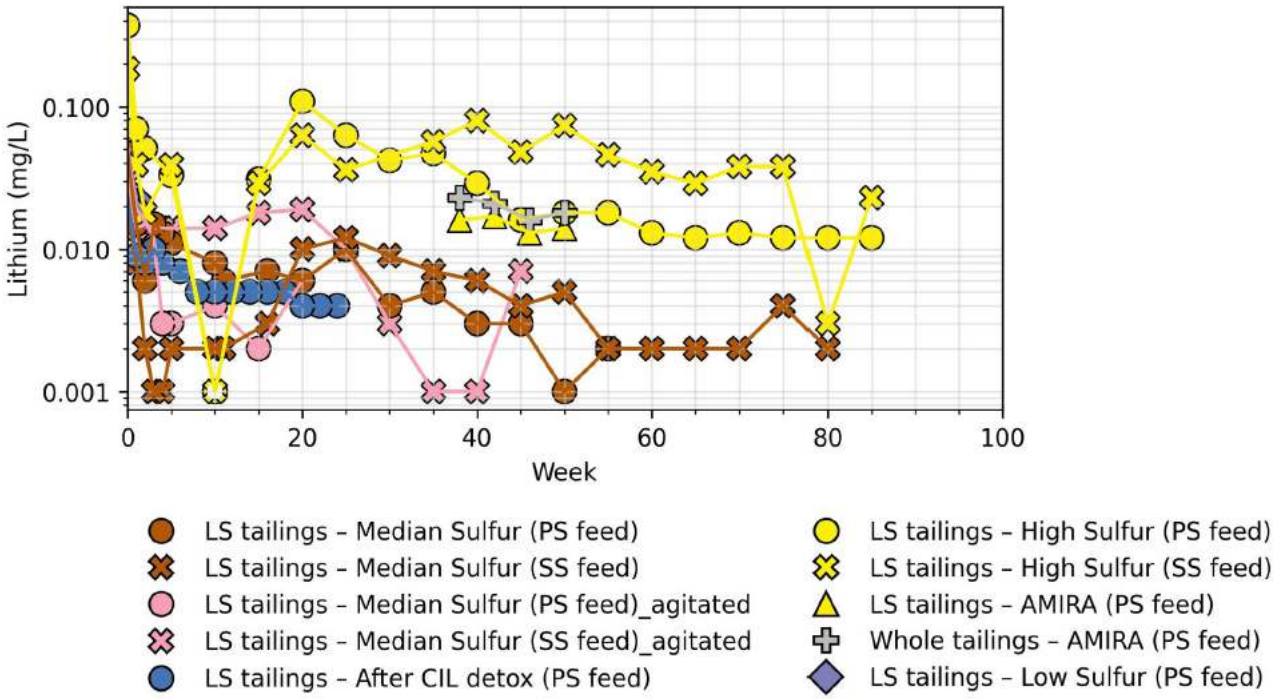


Figure 74: Li concentrations in kinetic testing leachates.

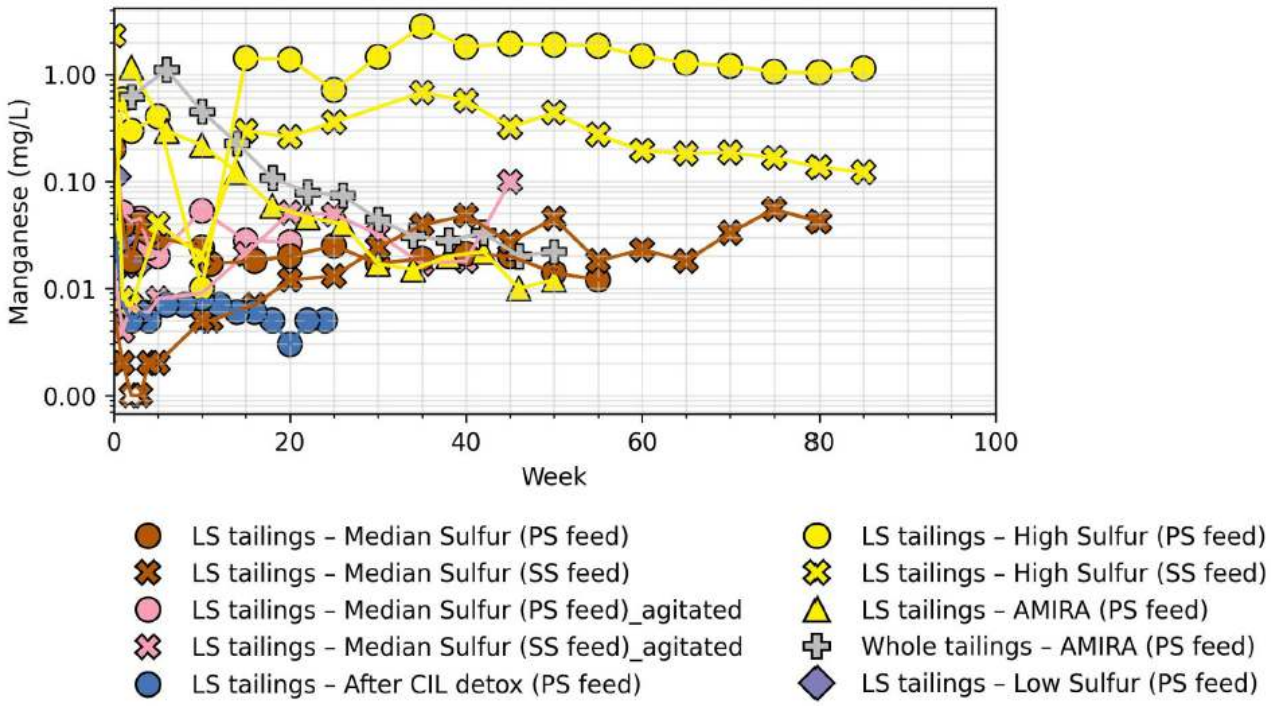


Figure 75: Mn concentrations in kinetic testing leachates.

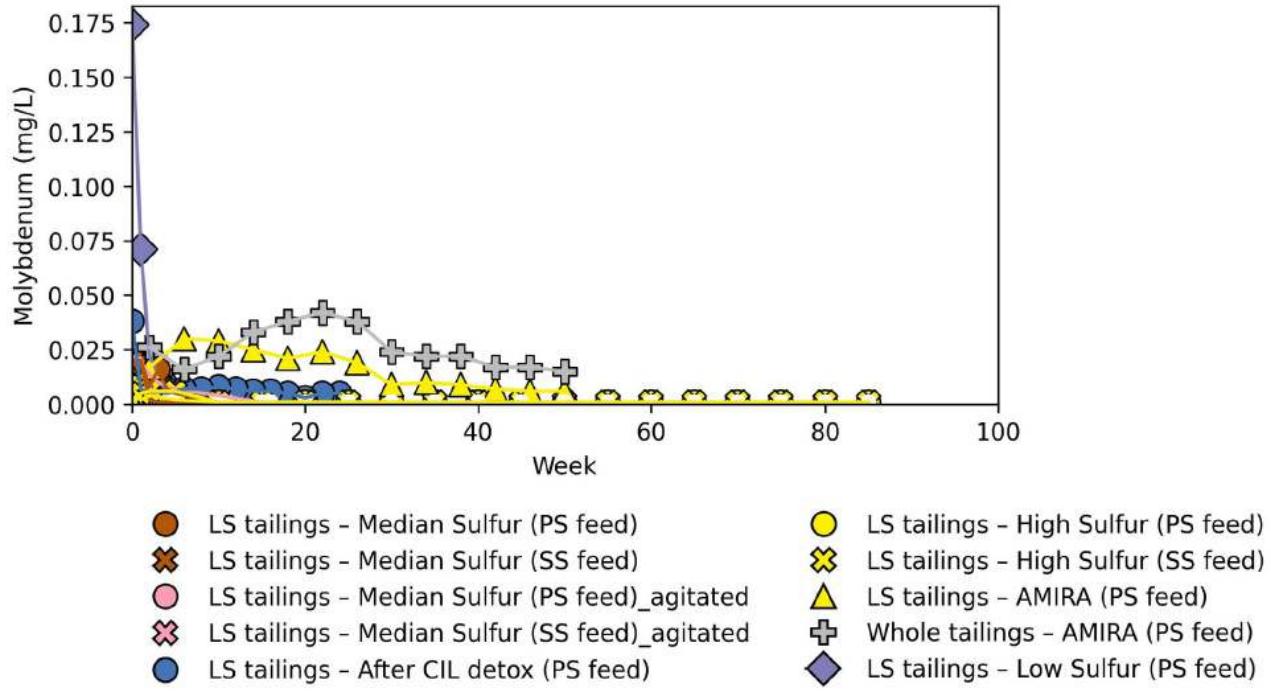


Figure 76: Mo concentrations in kinetic testing leachates.

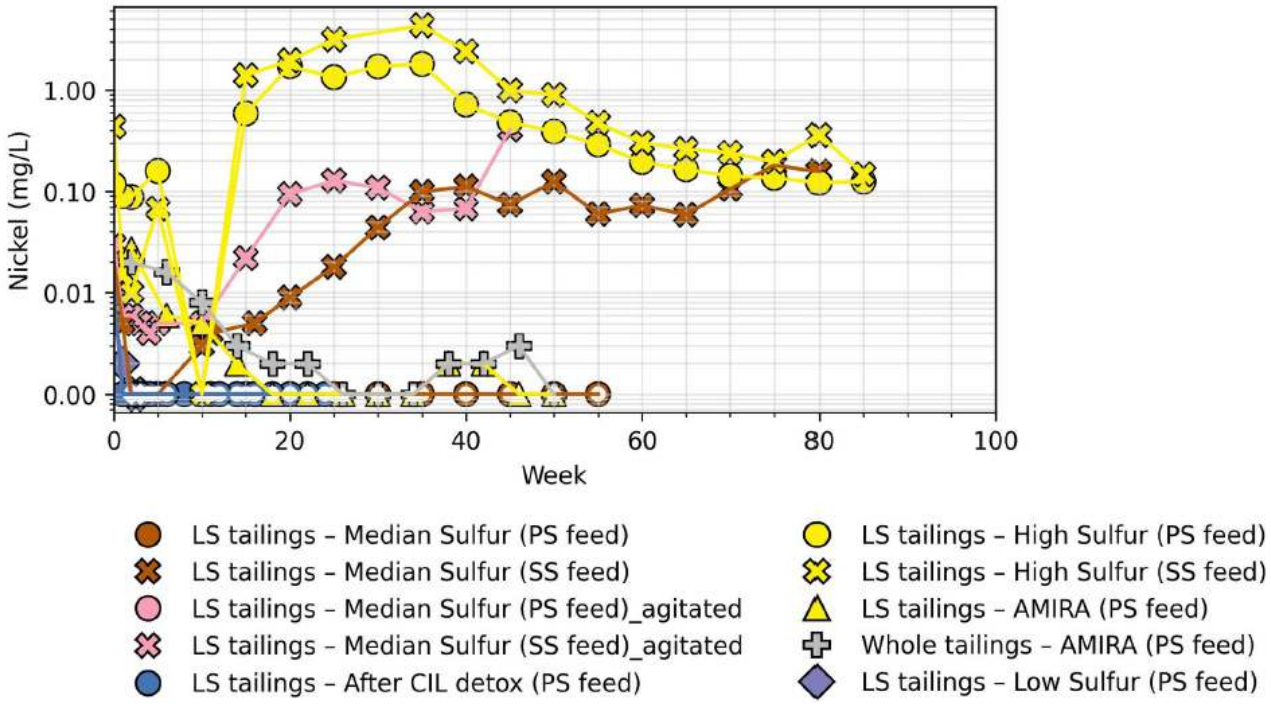


Figure 77: Ni concentrations in kinetic testing leachates.

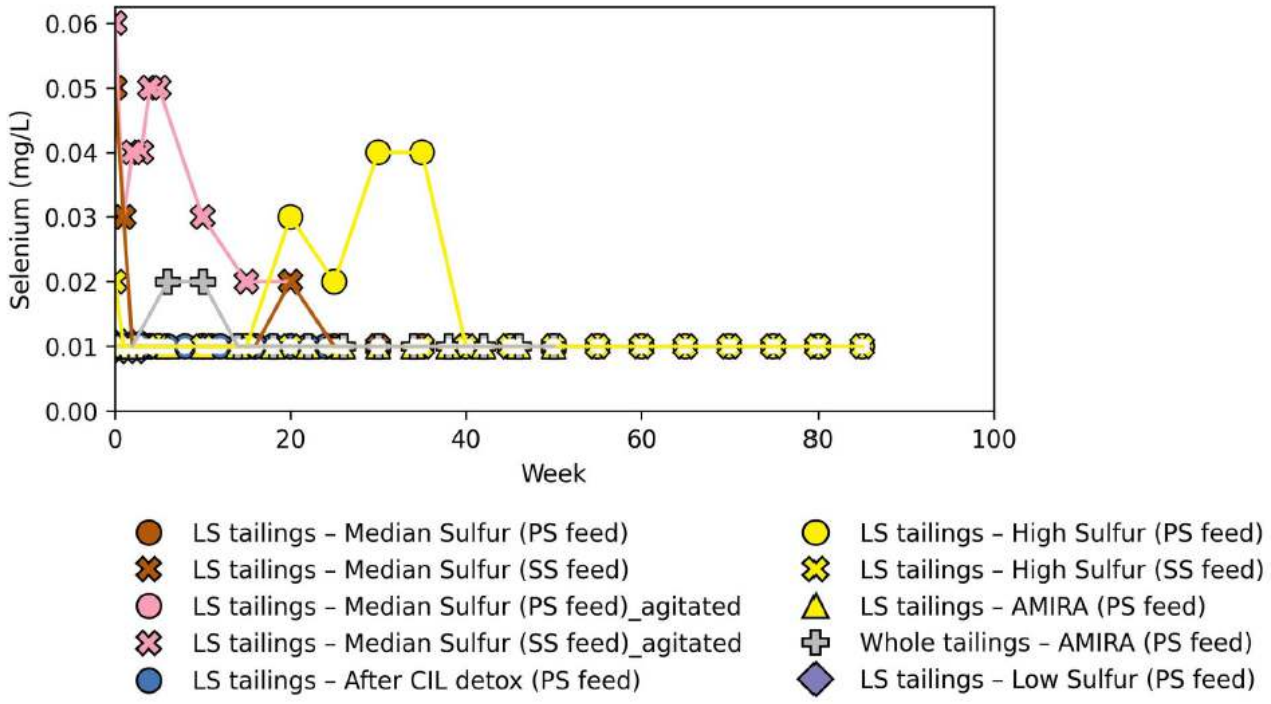


Figure 78: Se concentrations in kinetic testing leachates.

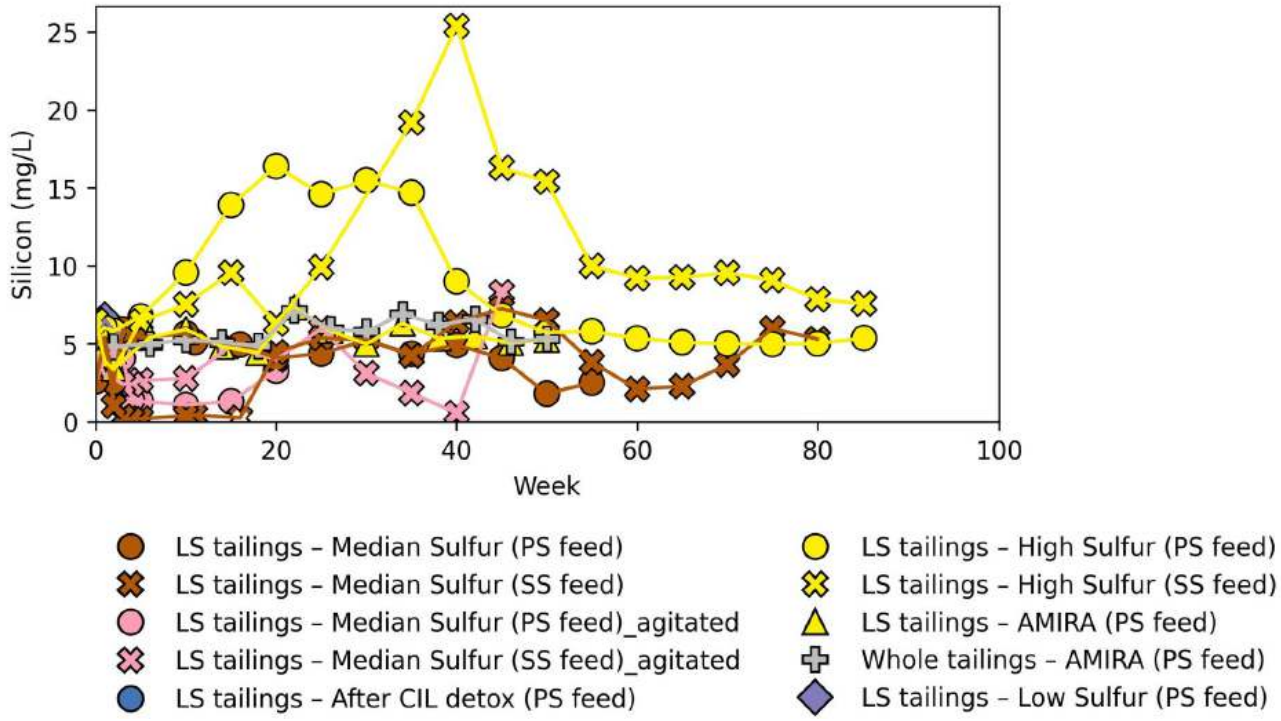


Figure 79: Si concentrations in kinetic testing leachates.

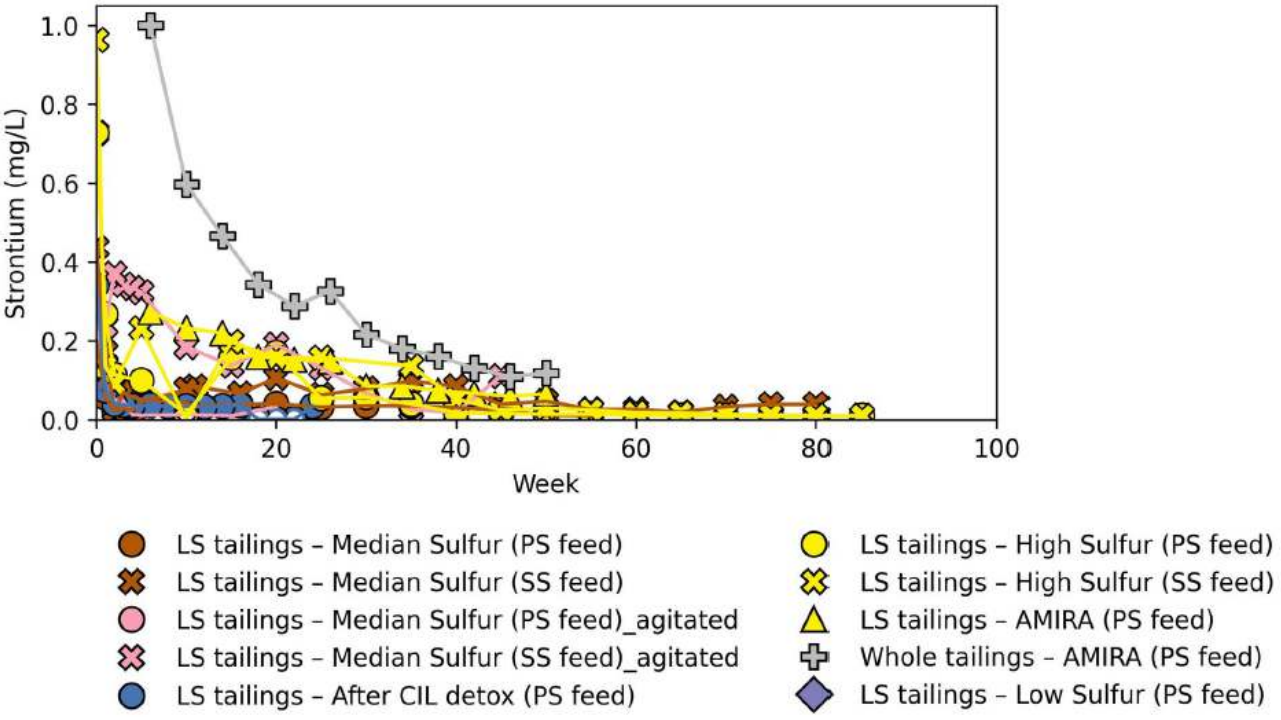


Figure 80: Sr concentrations in kinetic testing leachates.

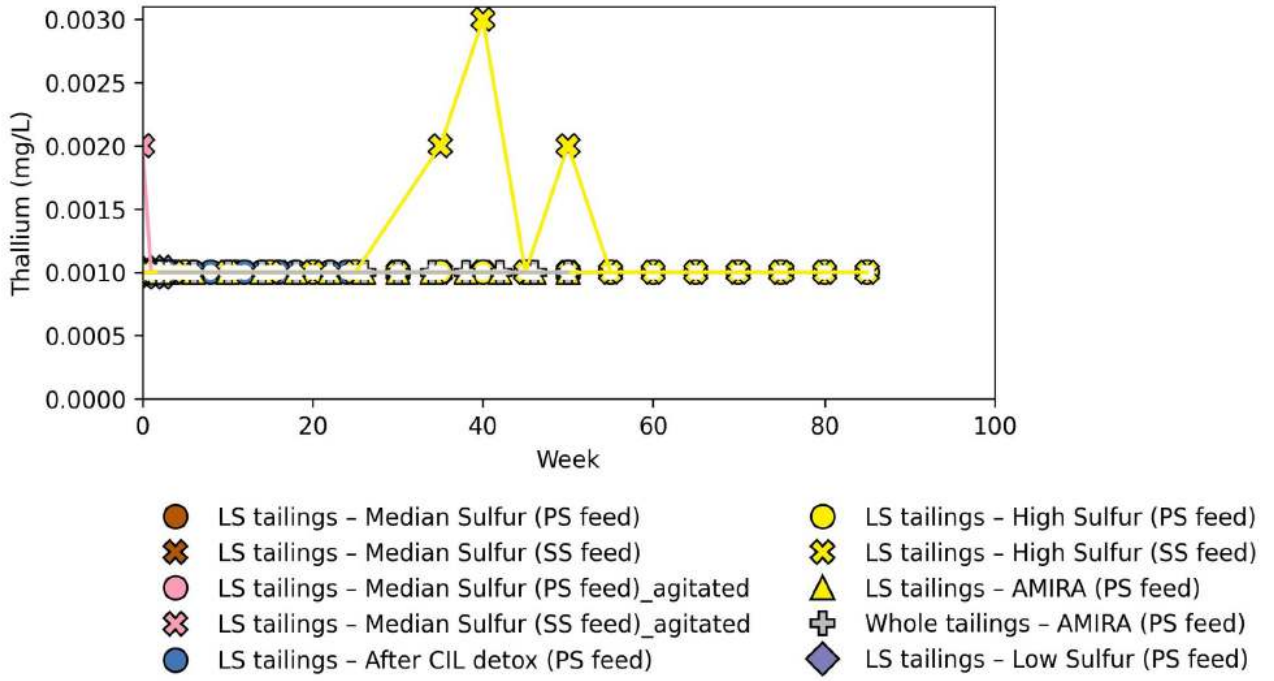


Figure 81: Tl concentrations in kinetic testing leachates.

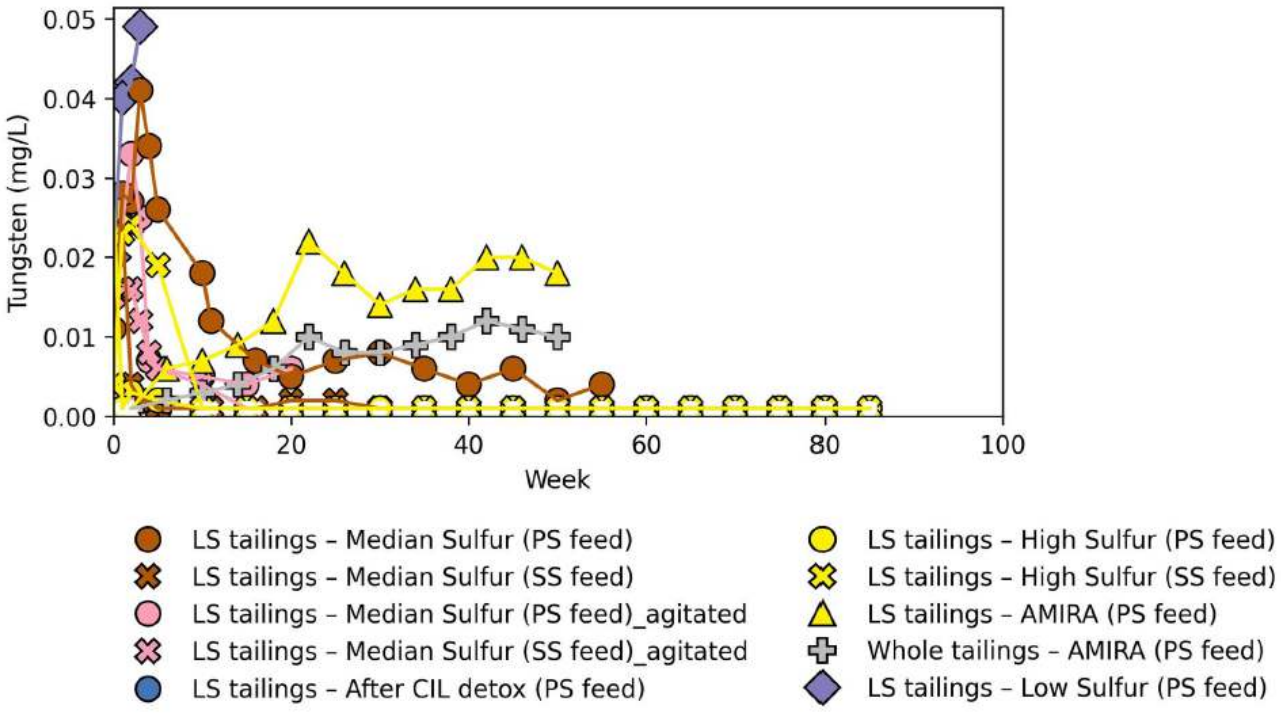


Figure 82: W concentrations in kinetic testing leachates.

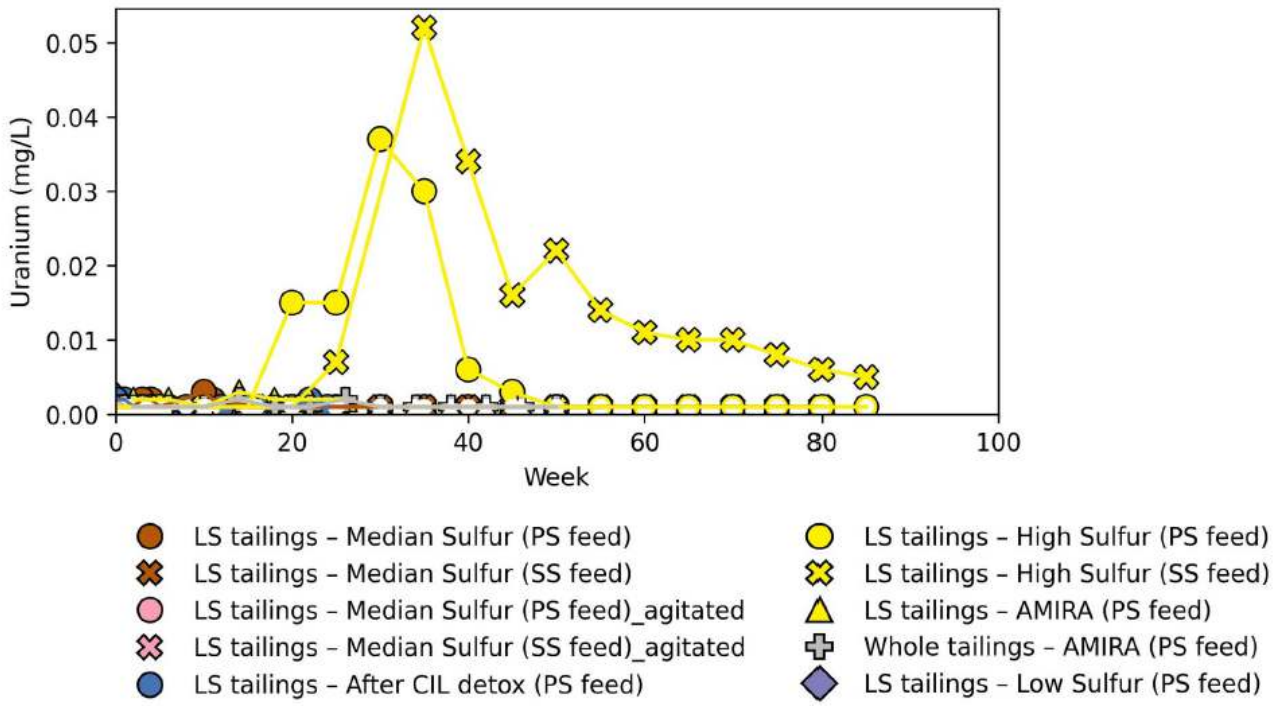


Figure 83: U concentrations in kinetic testing leachates.

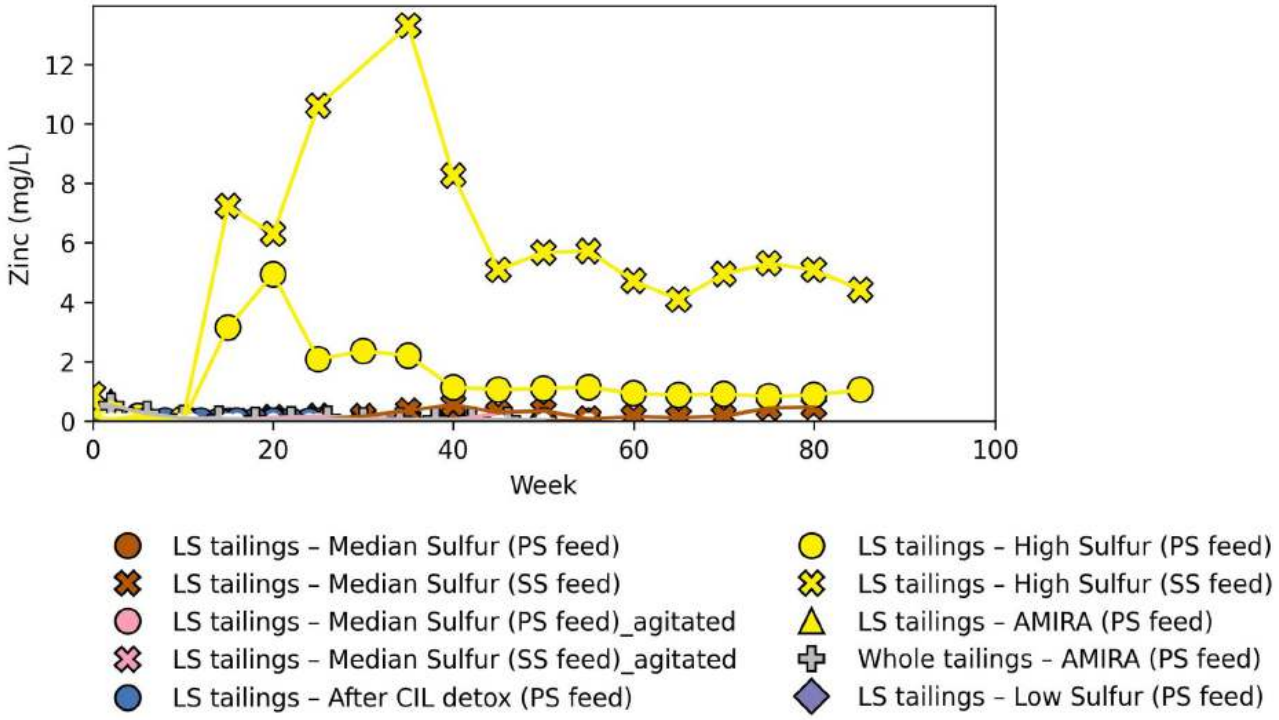


Figure 84: Zn concentrations in kinetic testing leachates.

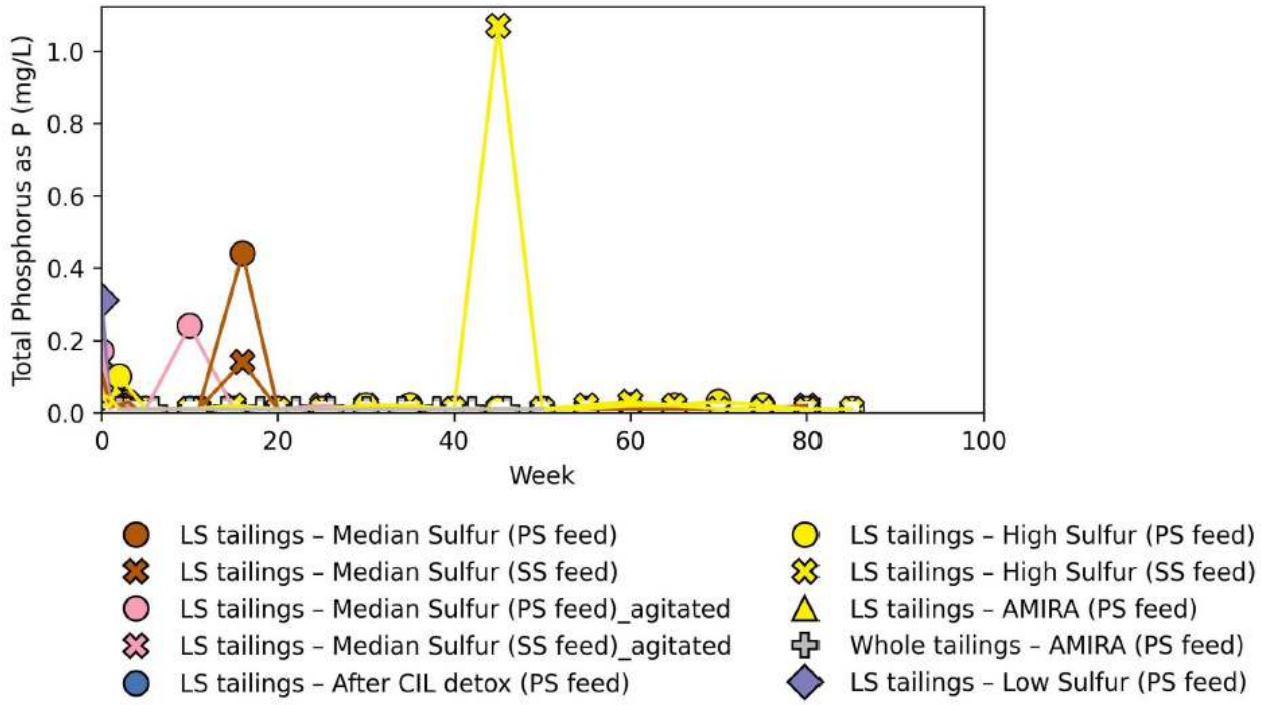


Figure 85: Total P concentrations in kinetic testing leachates.

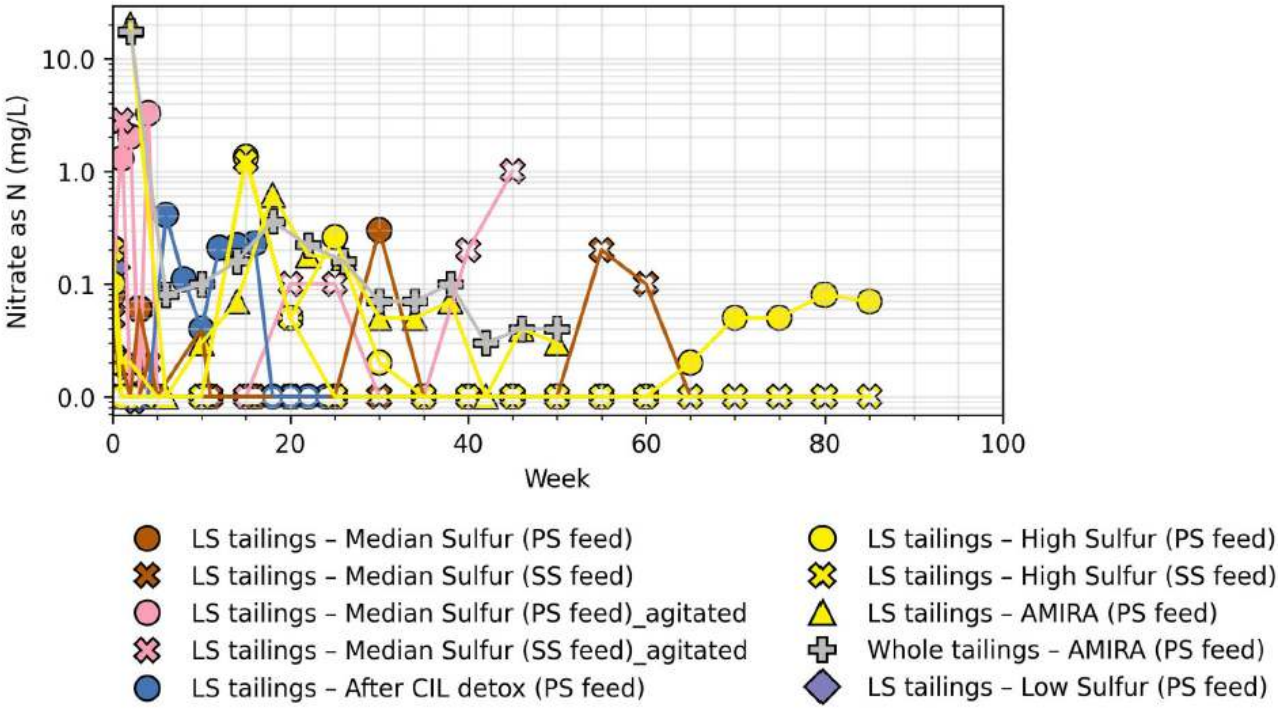


Figure 86: NO_3 concentrations in kinetic testing leachates.

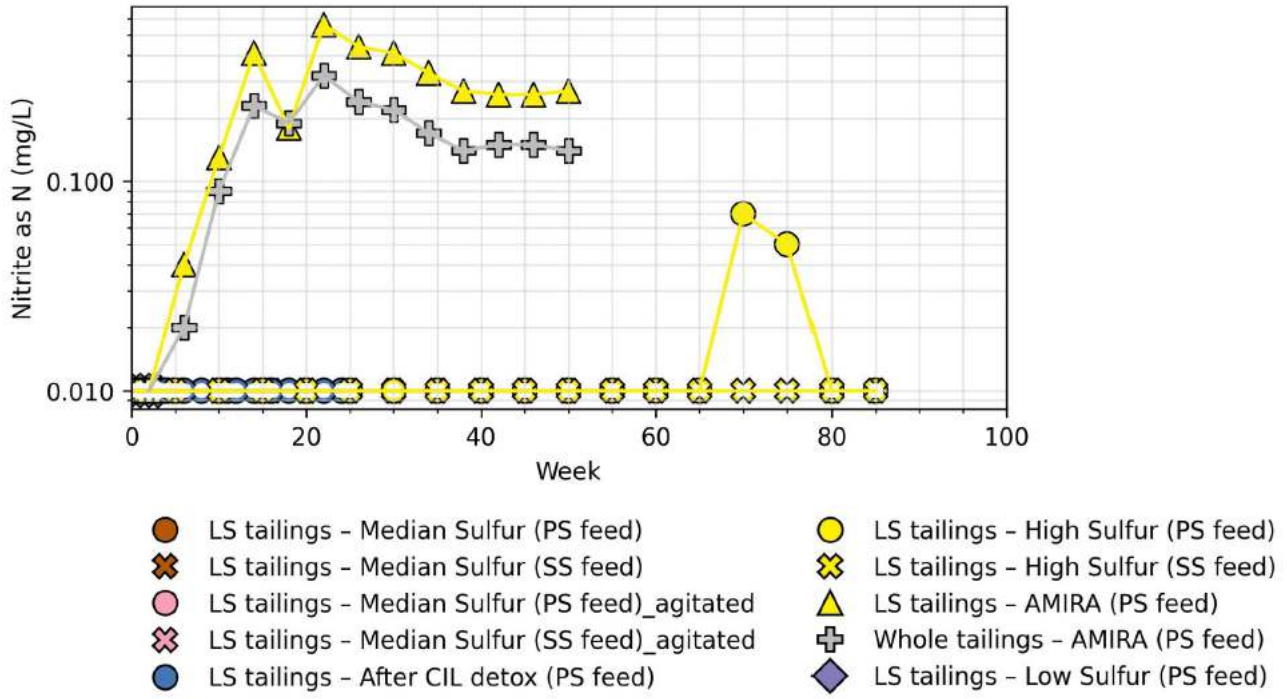


Figure 87: NO_2 concentrations in kinetic testing leachates.

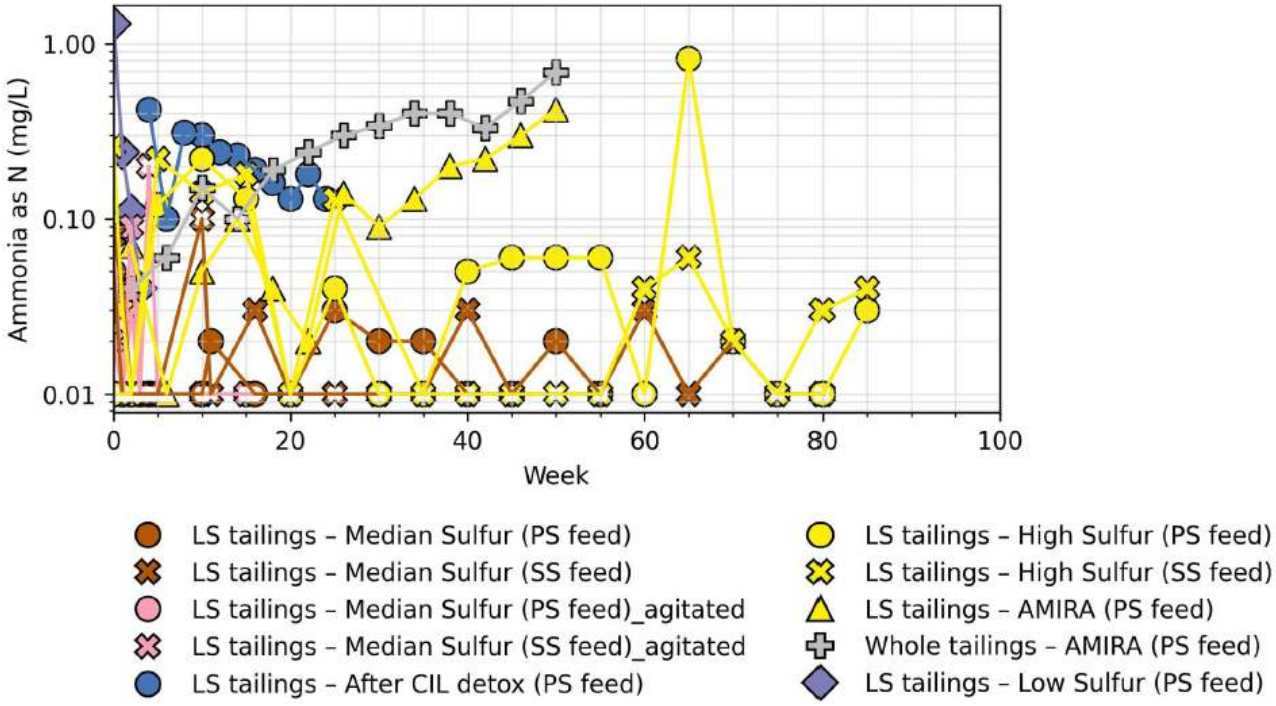


Figure 88: NH_3 concentrations in kinetic testing leachates.

APPENDIX 5 – ANALYTICAL AND SUPPORTING REPORTS

Solids


CC18LS_CC18HS_EP2111119_4.pdf


DP1471_EP2003185.pdf


DP1975_DP1976_DP1976_EP2013352.pdf


DP1999_DP2185_EP2114620.pdf


IMPASS LS_IMPASS HS_EP2012987.pdf


210217 Rio.pdf


Winu Tailings PSD_2.xlsx


EP2110581_QXRD.pdf


EP2114620_XRD.pdf


EP2114620_4acid digest.pdf


EP2111119_4 acid digest.pdf


EP2110581_4A Multielement.pdf


EP2110581_0_COA.pdf


EP2110581 Custom ANC.pdf


EP2111119 Custom ANC.pdf


EP2111119_0_COA.pdf


EP2113582_0_COA.pdf


EP2114620 Custom ANC.pdf


EP2114620_0_COA.pdf


EP2200917_0_COA.pdf


Decommission AMIRA column 10689


Winu Columns Residues.ESDAT_EP21

Liquids


DP_1745_EP2007616_0.pdf


DP1471_EP2003185_0.pdf


DP1802_DP1803_DP1804_DP1855_EP20093


DP1931_DP1971_EP2011981_0.pdf


DP2003_DP1976_EP2013338_0.pdf


IMPASS LS Tail_IMPASS HS Tail_E