

Appendix A Australian Drinking Water Guidelines

Table A1-1 Water Quality Regulatory Limits

Test Analyte/Parameter	Units	Recreational Water Quality Guidelines (2000)	Australian Drinking Water Guidelines (2004)
BULK PROPERTIES			
pH	pH Units	6.5-8.5	6.5-8.5 ^[1]
Total Dissolved Solids (TDS)	mg/L	1000	500 ^[1]
Hardness (as CaCO ₃)	mg/L	500	200 ^[1]
MAJOR/MINOR CATIONS AND ANIONS			
Sodium, Na ⁺	mg/L	300	180 ^[1]
Iron, Fe	mg/L	0.3	0.3 ^[1]
Chloride, Cl ⁻	mg/L	400	250 ^[1]
Sulfate, SO ₄ ²⁻	mg/L	400	500, 250 ^[1]
Fluoride, F ⁻	mg/L	-	1.5
Iodide, I ⁻	mg/L	-	0.1
Cyanide	mg/L	0.1	0.08
Nitrate-N	mg/L	10	50 (as nitrate)
Nitrite-N	mg/L	1	3 (as nitrite)
Ammonia (as N)	mg/L	0.01	0.5 ^[1] (as NH ₃)
Total Phosphate	mg/L	-	-
TRACE METALS			
Aluminum, Al	mg/L	0.2	0.2 ^[1]
Antimony, Sb	mg/L	-	0.003
Arsenic, As	mg/L	0.05	0.007
Barium, Ba	mg/L	1	0.7
Beryllium, Be	mg/L	-	-
Boron, B	mg/L	1	4
Cadmium, Cd	mg/L	0.005	0.002
Chromium, Cr	mg/L	0.05	0.05 (as Cr(VI))
Cobalt, Co	mg/L	-	-
Copper, Cu	mg/L	1	2, 1 ^[1]
Lead, Pb	mg/L	0.05	0.01
Manganese, Mn	mg/L	0.1	0.5, 0.1 ^[1]
Mercury, Hg	mg/L	0.001	0.001
Molybdenum, Mo	mg/L	-	0.05
Nickel, Ni	mg/L	0.1	0.02
Selenium, Se	mg/L	0.01	0.01
Silver, Ag	mg/L	0.05	0.1
Thallium, Tl	mg/L	-	-
Uranium, U	mg/L	-	0.02
Zinc, Zn	mg/L	5	3 ^[1]

Notes: [1] aesthetic-related guideline value; - No known regulatory limit

NHMRC and NRMMC (2004) *Australian Drinking Water Guidelines 2004, National Water Quality Management Strategy*, National Health and Medical Research Council and the Natural Resource Management Ministerial Council.

Geochemical Characterisation of the Cameco Kintyre Uranium Project- Prefeasibility Study

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EXECUTIVE SUMMARY

Tetra Tech was commissioned by Cameco Australian Pty Ltd (Cameco) to assess the geochemical character of the Kintyre Uranium property as part of the Pre-Feasibility Study (PFS). The goal was to determine the potential for acid rock drainage and metal leaching (ARD/ML) associated with the geochemical weathering of waste rock materials, below ore grade materials (BOGUM), and tailings derived from an alkali leach process of ore materials. This report contains the results of that assessment.

Lithologies present in the proposed pit are predominantly metamorphic schist, meta-carbonates and skarns, with some unconformable overlying tillites and sediments. Overall assessment of the system indicates that any localised ARD/ML situations will be compensated by the benign and/or neutralizing character of the system. To support this, samples utilised in the study showed an overall relatively low (< 0.3 weight percent) sulphur content which minimizes the ARD potential of the material. Further, most heavy metals did not show long-term metal leaching characteristics although lead, zinc, and aluminum did appear to increase in the effluents derived from kinetic test after week 25, suggesting that longer term monitoring may be appropriate. Static and kinetic effluents pH values were circum-neutral to slightly alkaline, such that ARD should not be an issue in the system. Further, sulphate, conductivity, and most of the other metals, when present in detectable quantities, showed an asymptotic decay curve. This indicated a flushing of residual metallic salts in the waste rock that once exhausted rapidly approached detection limit quantities. With the exception of aluminum in four waste rock samples and lead in one of the waste rock samples, no waste rock sample exceeded the Australian drinking water standards. The alkali tailings sample exceeded drinking water standards for aluminum and uranium.

1.0 INTRODUCTION

This memorandum summarises the geochemical findings for select number of waste rock, below ore grade uranium material (BOGUM), and tailings samples from the Kintyre Project as part of the overall PFS for the property. A total of 273 drill holes were available with up to 1644 individual data points for several key analytes. Using spatial, compositional and representative estimates of proposed mining volumes criteria, a subset of 15 samples were selected (12 waste rock and 3 BOGUM for more detailed and inclusive chemical tests). A uranium cutoff of 200 mg/kg was used to distinguish between waste rock and BOGUM with BOGUM samples defined as material with an uranium content between 200 and 1000 mg/kg. The majority of the waste rock samples did not have associated uranium assay data. One tailings sample plus a duplicate was also sent in for analysis.

Preliminary results from a subset of the initial samples are presented illustrating the availability of certain metals of concern that have the potential to leach and mobilize. The primary elemental constituents of interest include S, Fe, Cu, Sr, As, Cd, Bi, Pb, Hg, Sb, and U. This memorandum also reports humidity cell kinetic results on six waste rock/bogum samples and one alkali tailings sample. Results and discussion of the above mentioned analytical tests are presented below.

1.1 Project Location

The Kintyre Project is located in Northwestern Australia just south of the Great Sandy Desert and 260 km northeast of the town of Newman. A generalised location map appears in Figure 1-1.

1.2 Deposit Type

The Kintyre Uranium deposits are unconformity-related vein-type deposits that occur near major unconformities in faulted and brecciated metasedimentary rocks. The deposit is “world-class” and contains at between 28,000 and 36,000 tonnes of U_3O_8 with a reported grade of 0.3 – 0.4 wt% U_3O_8 , (Redport, 2005, Environ, 2011). There are five major deposits delineated at Kintyre Project. These are:

- 1) Kintyre
- 2) Whale
- 3) Whale East
- 4) Pioneer
- 5) Pioneer East

In addition to these five major deposits, a smaller deposit, named Little Pioneer is shown. It is situated between the Pioneer and the Pioneer East deposits. Figure 1-2 shows the relative location of the five major Kintyre deposits.

Subsequent mine plans, which occurred after the initiation of this project, have restricted the areas to be developed to 1) Kintyre, 2) Whale, and 4) Pioneer from the above list.

1.3 Geology

The Kintyre Project and corresponding properties are situated in metamorphic sedimentary skarn deposits. The dominant rock-types are gneiss and schist with varying degrees of ancillary minerals such as

hornblende, chlorite, muscovite, garnet, epidote, and calcite. Of the original 65 individual rock-types defined in the area, it is feasible to consolidate these based on mineralogy and overall chemistry into six major rock-type categories which build upon the CSA (2011) report:

- 1) Hanging Wall Schists (Plgi, Pt, Ptl)
- 2) Carbonate Rocks (Pk, Pkl)
- 3) Tillite (Pgc, Pgg)
- 4) Ore Host (Pl, Pli, Plki, Plig, Plik, Plk, Plg)
- 5) Fault/Breccia (Ft, Bxx, Fb, FT, Pb)
- 6) Other Schists (Pcg, Pga, Pka, Pkt, Pla, Plc, Pls, Ps, Psi, Psik, Psk, Ptg, Pti, Ptk)

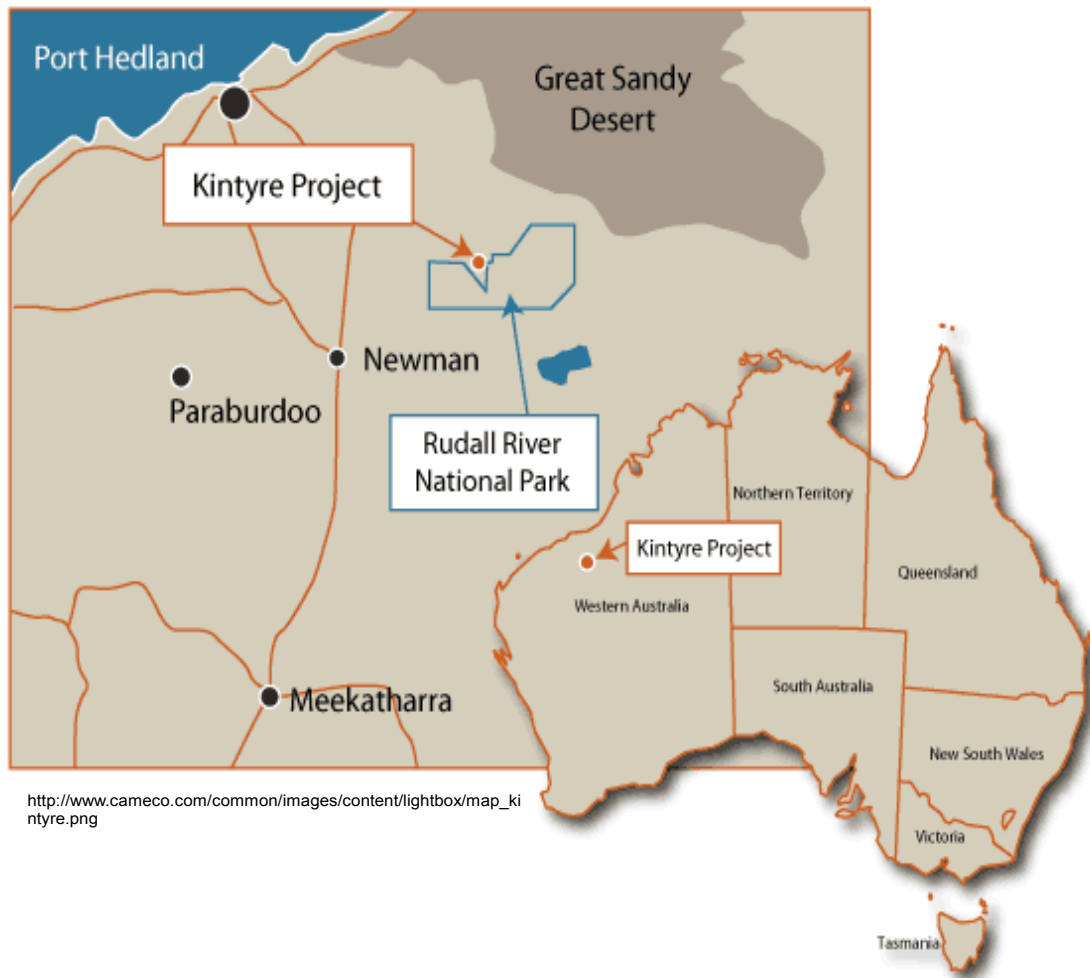


Figure 1-1. Generalized location map of Kintyre Project

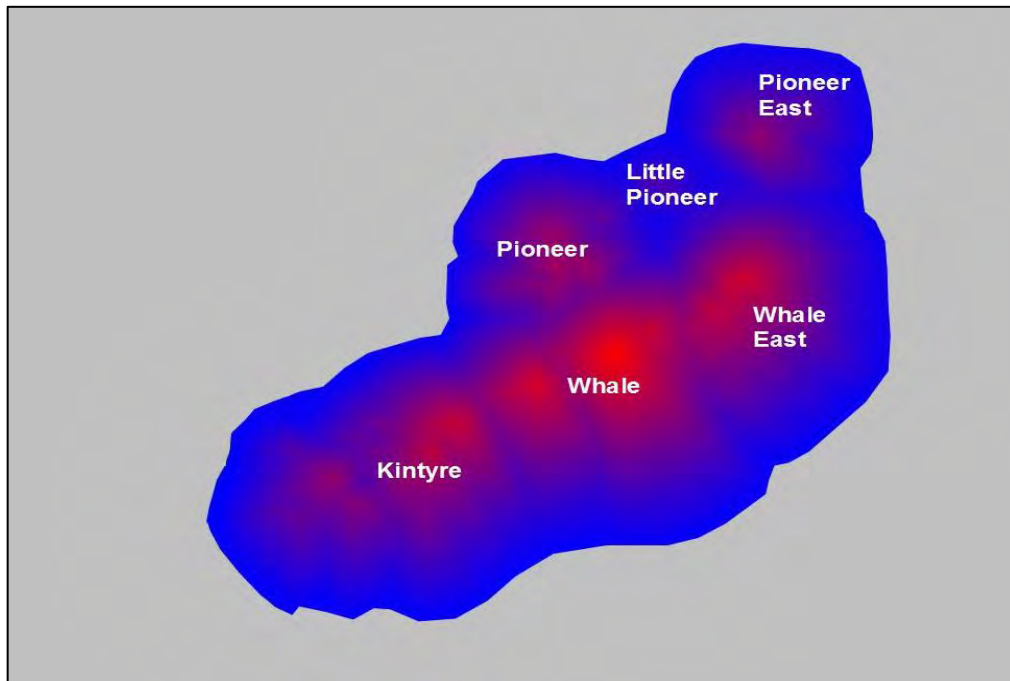


Figure 2-2. Original Kintyre Deposit Locations

Figure 1-3 depicts the general geologic makeup of the area. The uranium mineralisation is present in the Paleoproterozoic Yandagooge Formation (Belyk et al, 2011) with an approximate age between 1.6 and 2.5 Ga. This is the younger of two metasedimentary rock suites in the Rudall River Metamorphic Complex. Unconformably over-lying the Yandagooge Formation are the Neoproterozoic beds of the Yeneena Group (1.0 – 0.54 Ga). The dominant member of this group is the Coolbro Sandstone Formation. Permian glacial tills also are present as extensive valley fill. Mineralised veins in the region typically contain pitchblende along with calcite, dolomite, chlorite, hematite, and trace sulphides.

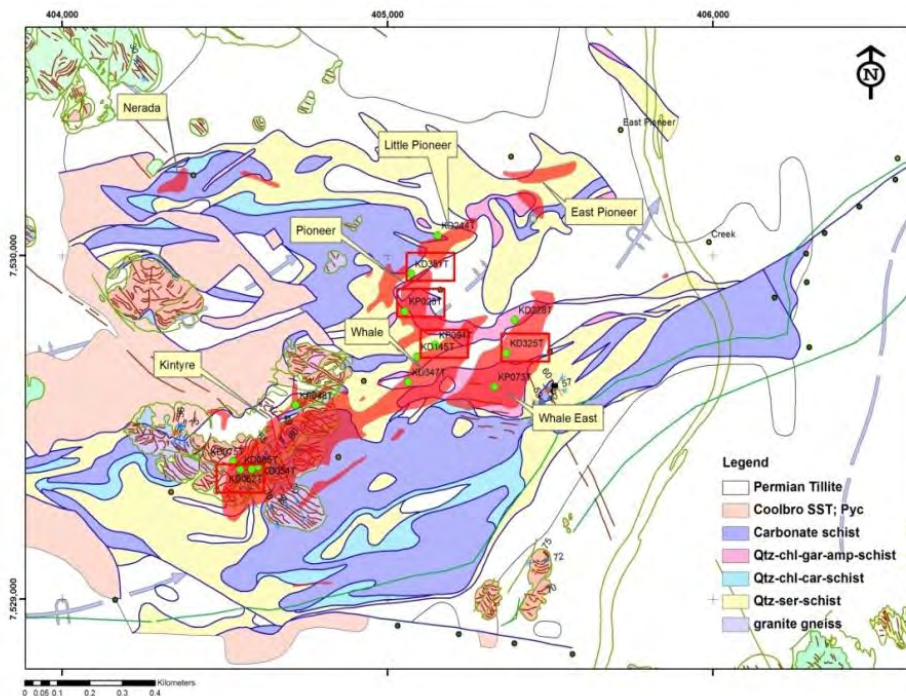


Figure 3-3. Generalized Geologic Map of Kintyre Project Area

1.4 Climate

The Kintyre region is situated in an arid region, with extremely hot summers and winters. Average annual temperature in the region is 35.3°C, with temperatures often exceeding 40°C for a majority of summer days. Although precipitation is sparse, the region can receive extreme precipitation events during the monsoonal months between December and March.

Table 1.1, shows pertinent climate information from Marble bar, which is the nearest weather recording station to the Kintyre project area.

Table 1.1 Climate data for Marble Bar, Western Australia

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Record High °C	49.2	48.3	48.7	45.0	39.5	35.8	35.0	37.2	42.6	45.6	47.2	48.3	49.2
Average High °C	41.0	39.8	39.0	36.0	30.7	27.1	26.8	29.6	33.9	37.6	40.5	41.6	35.3
Average Low °C	26.1	25.7	24.8	21.4	16.6	13.2	11.7	13.3	16.7	20.3	23.6	25.5	19.9
Record Low °C	18.9	13.9	15.0	10.0	5.6	1.1	2.2	3.9	5.6	10.0	14.4	17.0	1.1
Precip mm	76.3	87.8	56.7	21.9	23.0	23.0	12.6	6.4	0.9	3.8	9.1	39.6	361.7

The availability of seasonal precipitation as well as the presence of groundwater is relevant when considering ARD/ML release issues from the mined waste rock and UPS wall rock surfaces.

2.0 SAMPLING AND ANALYSIS

In performing a geochemical characterisation it is necessary to determine the chemical makeup of the rocks found within and adjacent to the proposed pit. An aggressive drill coring program has resulted in several thousands of meters of material being available to assist in this characterisation. A depiction of a large portion of these drill samples in spatial relation to the original proposed ultimate pit surface (UPS) of the deposits along with the dominant rock-type appears in Figure 2-1. Selection of the waste rock, BOGUM, and tailings samples were based on the geologic model and the available assay data provided by Cameco. The 273 drill holes with available multi-element assay data were considered during the selection process. The data were taken into customize scripts and visualized in 3D space using GIS software based on collar, survey and deviation information. The following criteria were used to select samples:

- 1) Spatially and vertically distributed within and around the proposed \$200 USD UPS provided by Cameco (email from Jason Bishop on 17-May-2011).
- 2) Representative of the major lithologic rock types that will comprise the waste rock and BOGUM. Lithological rock types are given presented in the previous section.
- 3) Availability of the selected lithology over continuous three meters intervals (approximate).

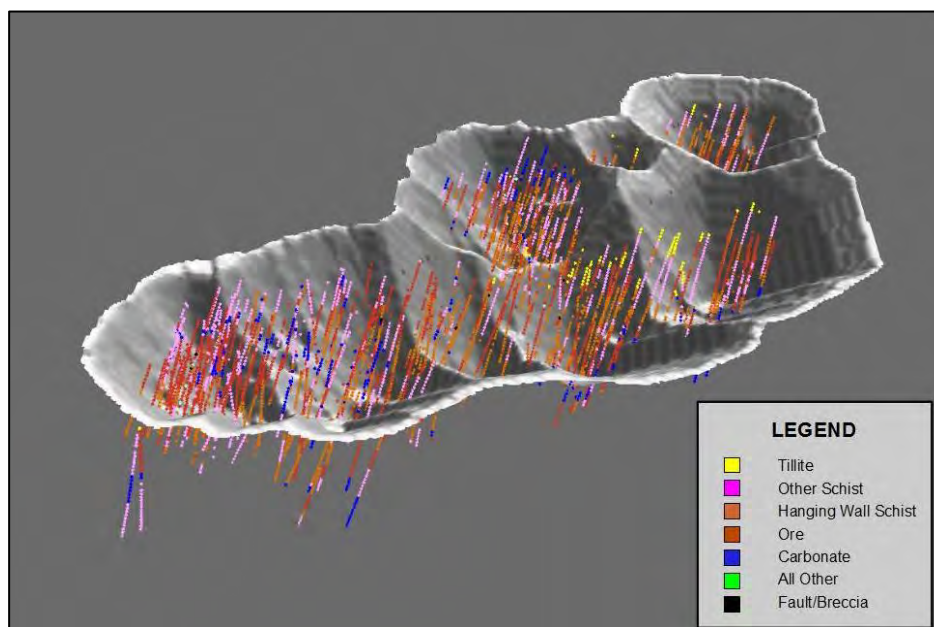


Figure 4-1. Borehole Locations Relative to Original Proposed Min UPS.

Interval spacing was chosen to provide sufficient mass to conduct all analysis outlined in the geochemical characterization program and to archive samples for future analysis if needed. A total of 15 samples (12 waste rock and three BOGUM samples) were chosen for geochemical characterisation from the proposed UPS (Table 2.1). These samples were distributed across the primary rock types based on approximate

volumes to be excavated and the rock types most likely to be problematic, a breakdown of the samples in regards to their rock type shows:

- 1) Hanging Wall Schists - 4 samples including 2 waste rock and 2 BOGUM.
- 2) Carbonate Rocks – 2 waste rock samples.
- 3) Tillite – 3 waste rock samples.
- 4) Ore Host – 3 BOGUM.
- 5) Fault/Breccia – 1 waste rock sample.
- 6) Other Schists – 2 waste rock samples.

The geospatial distribution of the samples selected for this study is shown in Figure 2-2.

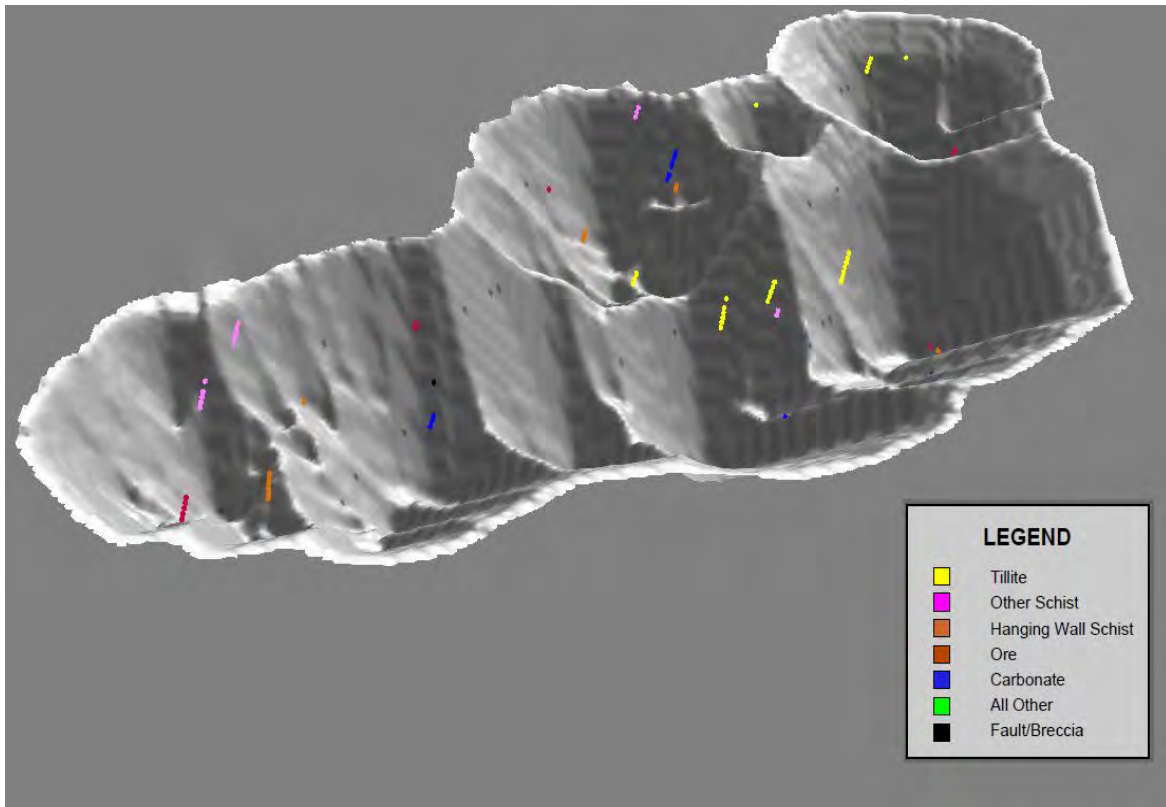


Figure 5-2 Select Waste Rock and BOGUM Samples for detailed Geochemical Assessment.

Table 2.2 Sample Interval for Selected Geochemical Characterization

Sample #	HOLE-ID	From (m)	To (m)	Interval (m)	Lithologic Code	Deposit
Hanging Wall Schists						
1*	KDH004	117	123	6	Pt	Whale East Zone
2	KDH155	87	102	15	Plgi	Pioneer Zone
3*	KDH033	350	359	9	Plgi	Whale Zone
4	KDH081	121	126	5	Plgi	Kintyre
Carbonate Rocks						
5	KDH137	159	171	12	Pk	Kintyre
6	KDH174	78	84	6	PKl	Pioneer Zone
Tillite						
7	KDH034	60	75	15	Pgc	Whale Zone
8	KDH058	27	39	12	Pgc	Kintyre Zone
9	KDH167	0	15	15	Pgg	Pioneer Zone
Ore Host						
10	KDH221	49	79	30	Pli	Kintyre Zone
11	KDH202	117	123	6	Plik	Pioneer East Zone
12*	KDH009	193	197	4	PI	Whale East Zone
Fault/Breccia						
13	KDH073	48	54	6	Fb	Kintyre Zone
Other Schists						
14*	KDH037	148	159	11	Ptg	Whale Zone
15	KDH124	0	36	36	Plc	Kintyre Zone
Tailings Samples						
ALK01-A						Alkali Tailings
ALK01-B						Alkali Tailings-Dup

Samples in italics represent BOGUM samples.

*Note: Samples #1 and #14 replaced samples #3 and #12 for kinetic testing due to insufficient sample quantity.

2.1 Analytical Methods

A variety of chemical tests were applied to the samples. All samples were subjected to static tests and a subset was analysed using kinetic testing. Static and kinetic results were compared to the Australian Drinking Water Guidelines (Appendix A). A detailed listing of all analytical results can be found in the Appendix B.

Static test results are used to evaluate the potential for acid formation and short-term release of solutes whereas long-term kinetic test results are used to estimate rates of oxidation and dissolution and temporal variation of acid generation and leachate quality. The following are static tests were performed on the Kintyre Project samples:

- 1) Acid-base Accounting
- 2) Water Leach Test
- 3) Elemental Analysis
- 4) Mineralogy
- 5) Net Acid Generation Testing

2.1.1 Acid-Base Accounting

Acid-base accounting (ABA) is a relatively fast and low cost method to assess the potential of a sample to either produce or neutralize acid. Such methods compare the maximum potential Acidity (MPA) with acid neutralizing capacity (ANC), these values are depend on either the total sulfur or sulfide sulfur (depending upon the sulfur species and the mineralogy of the samples.

Acquired values from ABA were to determine the neutralization potential ratio ($NPR = ANC/MPA$) and net acid neutralization potential ($NAPP = MPA - ANC$). These criteria are often used to categorize material in potentially acid-producing and non-acid-producing material. Australian industry standard values, based on Price (2009) categorize samples with an $NPR \geq 2$ and a $NAPP < 0$ tons H_2SO_4 /kton of material as non-acid-producing (non-PAG). Contrary, materials with $NPR < 1$ and a $NAPP > 5$ tons H_2SO_4 /kton of material are labeled potentially acid-generating (PAG).

The primary ABA method used for this geochemical characterization program was the modified Sobek method included ANC and past pH (Sobek et al., 1978) with sulphur speciation (total, sulphide, and sulphate) by LECO furnace. Samples were underwent siderite ($FeCO_3$)-corrected ANC. Siderite-corrected method is used to assess whether the presence of siderite overstates ANC due to lack of inclusion of iron generated acidity.

2.1.2 Water Leach Tests

As mentioned above, the Kintyre region does get monsoonal rains during the summer months. Thus single-step static water leach tests will provide an assessment of the potential for metal leaching due to short-term exposure to meteoric precipitation. The modified B.C. SWEP method will be employed, this method uses a 3:1 water to sample ratio; this ratio is deemed sufficient to estimate runoff concentrations. The leachates will be analyzed for bulk parameters, anions and inorganic elements. A subset of eight waste rock/BOGUM one alkaline leach and on acid leach circuit tailings should be selected for the water leaching tests.

A multi-step water leach testing of tailings using 96-hour extraction periods and increasing water to sample ratios will provide an indication of the number of pore volumes needed to flush soluble constituents from the tailings.

2.1.3 Elemental Analysis

Elemental analysis provides the near-total solid phase elemental concentration of selected elements of concern. Elemental concentrations can be compared to crustal abundance and background values to assess potential leaching. Subsamples from each sample was pulverized and subjected to Four-acid

digestion (hydrofluoric, hydrochloric, nitric and perchloric acids) and quantified using inductively coupled plasma-mass spectrometry (ICP-MS).

A subset of samples from the boreholes was submitted to the laboratory for total metal analyses. Total metals on the portions selected for static and kinetic testing were subjected to ICP-MS as a means to determine the potential supply of certain metals of concern that would be available for leaching and possible mobilization.

2.1.4 Mineralogy

Mineralogical analysis will be completed using semi-quantitative x-ray diffraction (XRD) instrumentation coupled with optical analysis. These methods provide a source and identity of potential metals/acidity, sources of neutralization, the occurrence of minerals that contribute to laboratory-based neutralization potential but behave differently under field conditions, soluble and insoluble constituents of earth materials, textures and grain size that may affect weathering kinetics and association with other minerals. A subset of samples was sent to the laboratory for mineralogical determinations.

2.1.5 Net Acid Generation Testing

Net acid generation (NAG) pH testing uses hydrogen peroxide to oxidize sulphidic minerals to determine the capacity of the samples to neutralize acidity. These tests assist to characterize the excess neutralizing potential of the samples. NAG pH levels below 4.5 are usually characterized as acid generating while values above 6 are characterized as non-acid generating. Approximately eight sulfide-bearing waste rock should (were) be subject to NAG pH testing. Results of NAG pH are shown in the Appendix.

2.1.6 Kinetic-Humidity Cell Testing

Kinetic test are mid- to long-term accelerate weathering test method used to simulate optimal sulphide weathering conditions by exposing the samples to abundant water and oxygen. Kinetic test determine the rate of consumption and the potential of the sample to turn acidic. In that there are viable groundwater aquifers and seasonal precipitation in the Kintyre area, kinetic tests will afford a means to estimate long-term wetting/drying cycles and the effect of such activity on the formation and release of ARD/ML. Six samples were chosen to undergo kinetic testing and characterise the long-term leachate quality of the samples. These samples will represent waste rock to be stored on the surface and within pit walls. Representative samples chosen include two from the HWS, two ore hosts, and one sample each of alkaline and tillite sample.

Initial humidity cell test (HCT) results have been received for the first two flush cycles. Of note, the samples had to be restarted in new cells, thus this data is more representative of static tests since the new cell data cannot be accurately compared and merged with future results. Due to insufficient sample being available, sample numbers #3 and #12 had to be dismissed for HCT analysis. These two samples were replaced with samples # 1 and #14. Kinetic tests reported in this report are for 30 weeks for waste rock and bogum samples and for 34 weeks for the alkaline tailings sample.

2.1.7 Radionuclide Analysis

Workers at the project site and mill run the chance of being exposed to radiation due to the nature of the materials present in the pit, the ore, and or the resulting tailings after processing. The three main factors to ALARA (As Low As Reasonably Achievable) include time, dose, and distance. By minimising time of exposure, reducing dose (i.e. use of proper shielding), and maintaining the maximum reasonable distance

for workers from a radioactive source, ALARA can be reached. To this end, samples of the alkali tailings were submitted to determine gross alpha and gross beta levels. These data appear in Appendix B-6.

3.0 RESULTS AND DISCUSSION

3.1 Acid-Base Accounting

ABA chemistry was performed on a select number of boreholes and on two tailings samples. As shown in Table 3.1, the total sulphide sulphur for the Kintyre samples typically fall well below 0.12 wt. %. The highest observed sulphur concentration is from a hanging wall schist. Also one tillite sample was reported to have sulphur wt. % greater than or near reported values found in the hanging wall schist and ore host (BOGUM) samples. Based on the fact that values observed fell well under 0.3 wt. % sulphur concentration, the acid rock drainage (ARD) potential is considered minimal.

Calculated values of NAPP and NPR are shown in Table 3.1. NAPP values of from all the samples range from -8 to -690 kg H₂SO₄/kton. NPR ratios of the samples show a distribution of 3 to 3600. Australian guidelines characterize NAPP of < 0 kg H₂SO₄/kton and an NPR ratio > 2 to be classified as non-PAG. Thus all samples are given a non-PAG classification and ARD/ML potential should be minimal.

Table 3.3 Acid- Base Accounting Summary.

Sample ID	Rock Type	Total Sulphur	Sulphate	Sulphide	MPA	ANC	NAPP	NPR
		wt. %	wt. %	wt. %	kg H ₂ SO ₄ /T	kg H ₂ SO ₄ /T	kg H ₂ SO ₄ /T	ANC/MPA
1	Hanging Wall Schist	0.005	<i>0.0025</i>	0.009	0.2	55	-55	275
2	Hanging Wall Schist	0.04	<i>0.0025</i>	0.037	1.2	79	-78	66
3*	Hanging Wall Schist	0.005	<i>0.0025</i>	<i>0.0025</i>	<i>0.05</i>	62	-62	1240
4b	Hanging Wall Schist	0.274	<i>0.0025</i>	0.27	8.4	26	-17	3
5b	Carbonate	0.018	<i>0.0025</i>	0.013	0.6	690	-690	1150
6	Carbonate	0.005	<i>0.0025</i>	0.009	0.3	530	-530	1767
7	Tillite	0.089	<i>0.0025</i>	0.086	2.7	18	-15	7
8	Tillite	0.013	<i>0.0025</i>	0.012	0.4	36	-35	90
9	Tillite	0.025	0.037	<i>0.0025</i>	0.8	26	-26	33
10	Ore Host	0.005	<i>0.0025</i>	<i>0.0025</i>	<i>0.05</i>	180	-180	3600
11	Ore Host	0.005	<i>0.0025</i>	<i>0.0025</i>	<i>0.05</i>	170	-170	3400
12*	Ore Host	0.11	<i>0.0025</i>	0.11	3.4	44	-41	13
13	Fault/Breccia	0.005	<i>0.0025</i>	<i>0.0025</i>	<i>0.05</i>	390	-390	7800
14	Other Schist	0.113	0.009	0.1	3.5	24	-21	7
15	Other Schist	0.005	<i>0.0025</i>	<i>0.0025</i>	<i>0.05</i>	8.2	-8	164
ALK01-A	Tailings	0.033	-	-	-	86	-85	-

Values in italics represent 1/2 the reporting limit

Figure 3-1 is a standard Sulphur (wt %) to NPR plot. Typically, sufficient sulphur needs to be available to classify a sample as being PAG. Similarly, even if adequate sulphur is available, if sufficient neutralising

material is present as well, the rock may not necessarily be classified as PAG, but could enter into an “uncertain” classification and may not be considered as PAG.

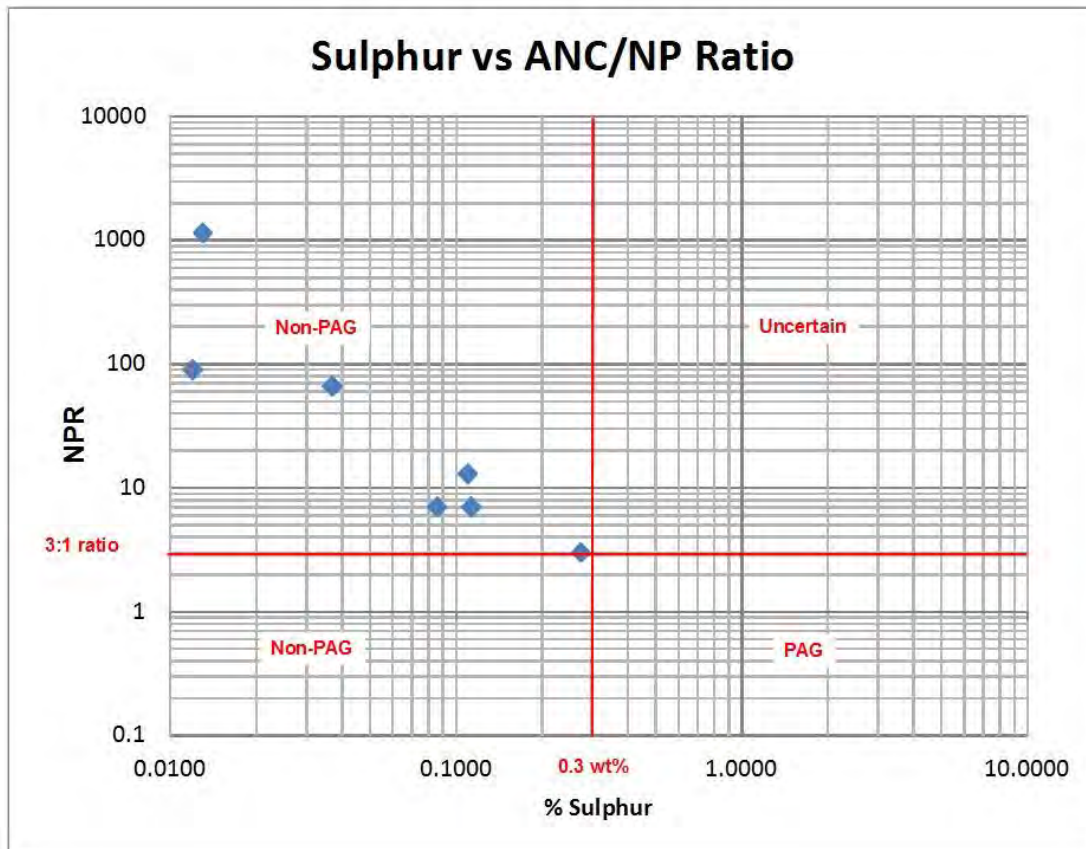


Figure 6-1. Sulphur wt % vs NPR Plot

3.2 Elemental Analysis

As shown in Table 3.2 the total metals available to the system is highly variable. Included in this table is the average crustal abundance of these metals and the “trigger” value (typically 9-10x) that would indicate scrutiny on whether the metals are available to release via normal weathering or leaching processes. Naturally the mineral species containing the metal will determine the likelihood of release. For example, barium as a halogen is more likely to be an issue than barium as a sulphate such as barite. So while a total metal content is a good first screen on potentially available metals, static and kinetic tests will demonstrate the likelihood of release. In the case of arsenic as shown in these samples, values in excess of 300 ppm are mainly restricted to portions of the hanging wall schist, other schist, and ore host (BOGUM) samples. Typically arsenic values are relatively low in most lithological units, except for in a few ore host (BOGUM) samples, tillite (similar to sulphur concentrations), and hanging wall schist. Tillites are considered an allochthonous rock type, the source of sulphur and arsenic in these samples could be due

to indigenous minerals being present in the samples, as opposed to late-stage fluid being associated with the rocks. A subset of samples from the boreholes based on lithology was chosen for static and kinetic testing. In addition to these tests, 17 samples (15 cores plus one duplicate and one tailings sample) were subject to ICP-MS elemental analysis to determine the potential supply of certain metals that may be available for leaching and possible mobilization.

Table 3.2 Selected total metals from all boreholes

Metal	Max	Min	Median	Crustal	Trigger
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
As	886.8	0.7	83.5	2.1	13.0
Bi	23147	1	35	0.025	-
Cu	187.4	0.5	2.2	68.0	424.0
Cd	678.2	0.7	2.8	0.15	0.93
Fe	133	6	30.5	63000	-
Hg	127.4	1.7	25.4	0.067	0.42
Sb	4.5	0.2	1.1	0.2	1.7
U	383	1	3	1.8	20.0
N = 1689					

3.3 Mineralogy

Determination of major minerals by X-ray diffraction were made on eight sections of the core samples as well as on the alkali tailings sample. These data appear in Table 3.3.

As shown, muscovite and clinocllore were dominant minerals in the samples. Quartz was present in moderate to low amounts in all samples. One sample contained 48% dolomite. Calcite was present, was only a minor constituent in five samples. Dolomite was by far the most common reported carbonate mineral. The various feldspars were also fairly sparse.

Table 3.3 Semi-quantitative XRD mineralogical determinations.

Mineral	Ideal Formula	KDH004 120-123	KDH033 355.5- 369	KDH160 126-129	KDH174 80-83	KDH058 32-35	KDH221 69-72	KDH009 193-197	KDH037 148-159	Tailings ALK01
Quartz	SiO ₂	17	38	21	8	20	25	20	26	18.0
Clinochlore	(Mg,Fe ²⁺) ₅ Al(Si ₃ Al)O ₁₀ (OH) ₈	3	26	3	16	47	47	53	5	55.0
Muscovite	KAl ₂ (AlSi ₃ O ₁₀)(OH) ₂	59	23	69	23	9	16	21	63	7
K-feldspar	KAlSi ₃ O ₈									
Albite	NaAlSi ₃ O ₈	3	0.2	0.5				0.2	0.4	
Anorthite	Ca ₂ Al ₂ Si ₂ O ₈	0.6		0.6					0.7	
Calcite	CaCO ₃	5	2	0.5					1	0.3
Anandite	(BaFe ₃ (Si,Fe) ₄ (O,OH) ₁₀ (OH)S)	12		5	0.8				0.7	
Dolomite	CaMg(CO ₃) ₂		6		48	11	10	3	1	9
Talc	(Mg ₃ Si ₄ O ₁₀ (OH) ₂)		5			12	2			11
Magnesianhornblende	Ca ₂ (Mg ₄ (Al,Fe)) Si ₇ AlO ₂₂ (OH) ₂		0.4							0.4
Microcline	KAlSi ₃ O ₈		0.2				0.1	0.4		
Olivine	(Mg _{0.893} Fe _{0.107}) ₂ SiO ₄		1							0.3
Grunerite	Fe ₇ Si ₈ O ₂₂ (OH) ₂					1				
Magnetite	Fe ₂ O ₃						0.7	1		
Cumingtonite	(Fe,Mg) ₇ Si ₈ O ₂₂ (OH) ₂								2	
Beidellite	Na _{0.3} Al ₂ (Si,Al) ₄ O ₁₀ (OH) ₂ ·2H ₂ O									0.3
Total		99.6	101.8	99.6	95.8	100	100.8	98.6	99.8	101.3

3.4 Net Acid Generation Testing

Net Acid Generating (NAG) data for the 15 original core samples appears in Appendix B. While NAPP (See Table 3.1) is for the most part negative, indicating a low acid generating potential. The total amount of sulphur is so low in the rocks that this result is misleading and may not reflect a high neutralising (calcite-rich) character in the samples. Generally a NAPP > 20 reflects a high ARD potential whereas < -20 is a non-PAG classification.

3.5 Kinetic Testing-Column Leach Testing

3.5.1 Kinetic Testing-Waste Rock

Six representative samples were selected based on elemental analysis for kinetic HCT. Initial HCT data for the first two flush cycles and is presented in Table 3.3. At this point in time, the lab decided that the cell geometry was not quite correct, so a new set of cells was constructed and kinetic tests were re-initiated (with substitution of 2 of the samples) for 30 weeks at the time of this report. In addition, the alkali tailings sample was tested for 34 weeks at the time of this report.

Certain elutant, such as sulphate-rich salts are expected to be removed from the samples during the initial flush by deionized water. Values between the first and second flush indicate that loss of the sulphate oxyanion in the second flush. Likewise, conductivity, which is a function of ionic concentration, also decreases between the flushes. This decrease is due to insipient salts being flushed from the system. The subsequent humidity cell samples initiated after cycle 2 showed the same behavior. Figure 3-2 through 3-15 shows the results for the second generation of HCT. Where relevant, a red line is drawn on each plot to show the Australian Drinking Water Guideline MCL (see Appendix A). Laboratory data listings for these and all other humidity cells can be found in the Appendix B.

The pH of the waste rock and alkali tailings sample over the HCT flush cycles is shown in Figure 3-2. With the exception of one spurious result for KDH004 in cycle 8, all data shows that the rocks are near neutral to strongly alkaline. Generally pH values for the waste rock and bogum range between pH 6.5 to 9.8. The majority of the samples were between pH 7 and 9.

As expected, the alkali tailings sample is initially highly basic with a slight but persistent drop off between to pH 8 and 7 with subsequent flush cycles.

Figure 3-3 shows the sulphate contentment of the HCT effluent. While the MCL for sulphate is only an aesthetic limit, no cycles exceeded it. As SO₄ reflects salt, the levels drop off asymptotically with subsequent flushes indicating that now new salts are being generated from the breakdown of minerals during the HCT cycle.

In general agreement with SO₄, Conductivity (Figure 3-4) shows a similar decrease over subsequent flush cycles. This too reflects the depletion of salts from the sample matrix with no new TDS or salts being generated.

Table 3.4 Original waste rock kinetic testing summary for cycles 1 and 2.

Cycle 1							
Sample #		3	4b	12	10	6	8
Description		H Wall Schist	H Wall Schist	Ore Host	Ore Host	Carbonate	Tillite
pH	-	8.3	8.1	8.4	8.5	8	8.2
Cond.	mg/L	370	660	860	410	470	530
Alkalinity (CaCO ₃)	mg/L	50	84	210	47	55	90
Alkalinity (HCO ₃)	mg/L	5	36	44	36	32	33
Sulphate	mg/L	36	110	84	25	110	54
Antimony, Sb	µg/L	2	9	47	3	16	2
Arsenic, As	µg/L	0.5	8	2	2	1	0.5
Cadmium, Cd	µg/L	0.5	0.6	0.4	0.2	0.2	0.5
Copper, Cu	µg/L	1	3	25	21	4	7
Iron, Fe	µg/L	74	2.5	15	2.5	6	2.5
Strontium, Sr	µg/L	46	230	60	61	58	110
Uranium, U	µg/L	1	-	-	8	7	0.5
Cycle 2							
Sample #		1*	4b	14*	10	6	8
Description		H Wall Schist	H Wall Schist	Other Schist	Ore Host	Carbonate	Tillite
pH	-	7.8	8.3	8.5	9.3	8	9.1
Cond.	mg/L	390	140	130	150	240	140
Alkalinity (CaCO ₃)	mg/L	2.5	30	42	38	26	27
Alkalinity (HCO ₃)	mg/L	5	36	44	36	32	33
Sulphate	mg/L	23	20	10	7	63	10

Values in italics represent 1/2 the reporting limit

*Note: Samples #1 and #14 replaced samples #3 and #12 for kinetic testing due to insufficient sample quantity

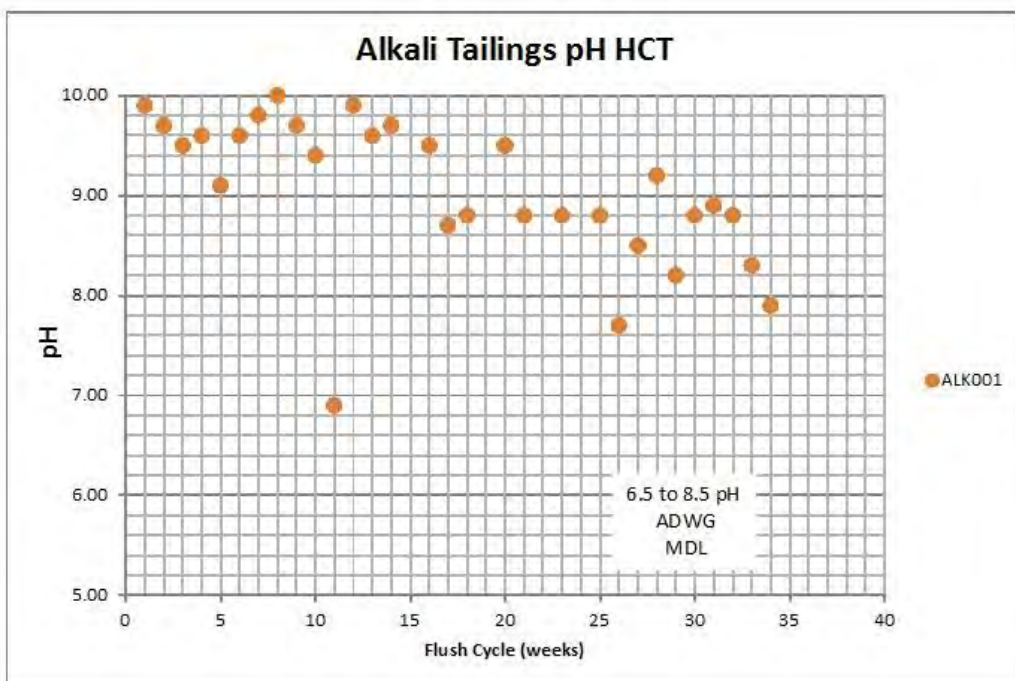
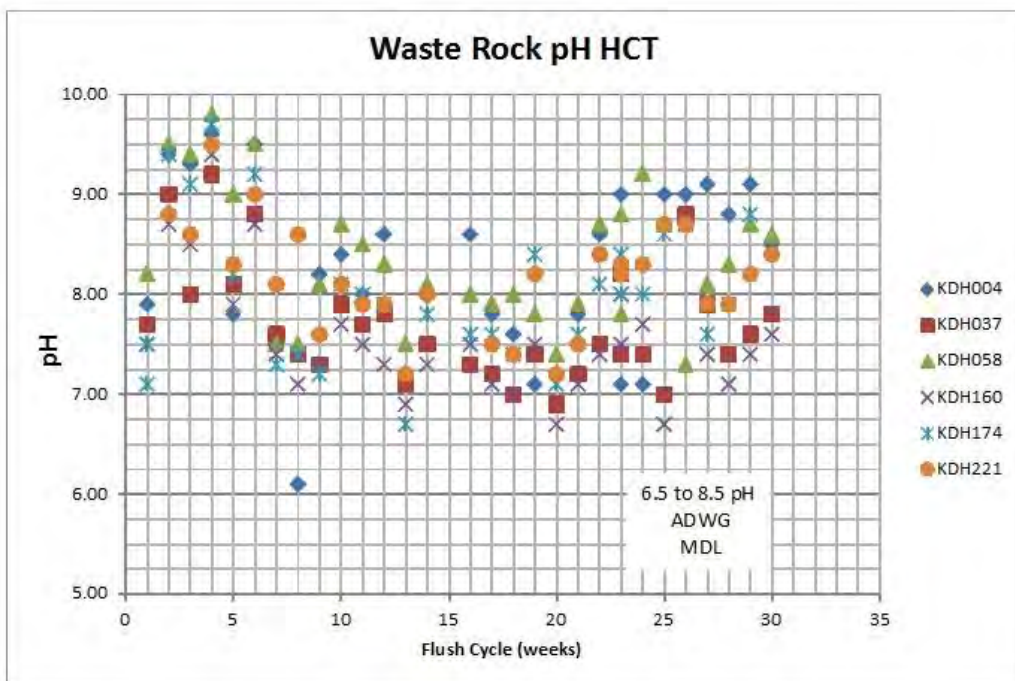


Figure 7-2. Humidity Cell pH Plot.

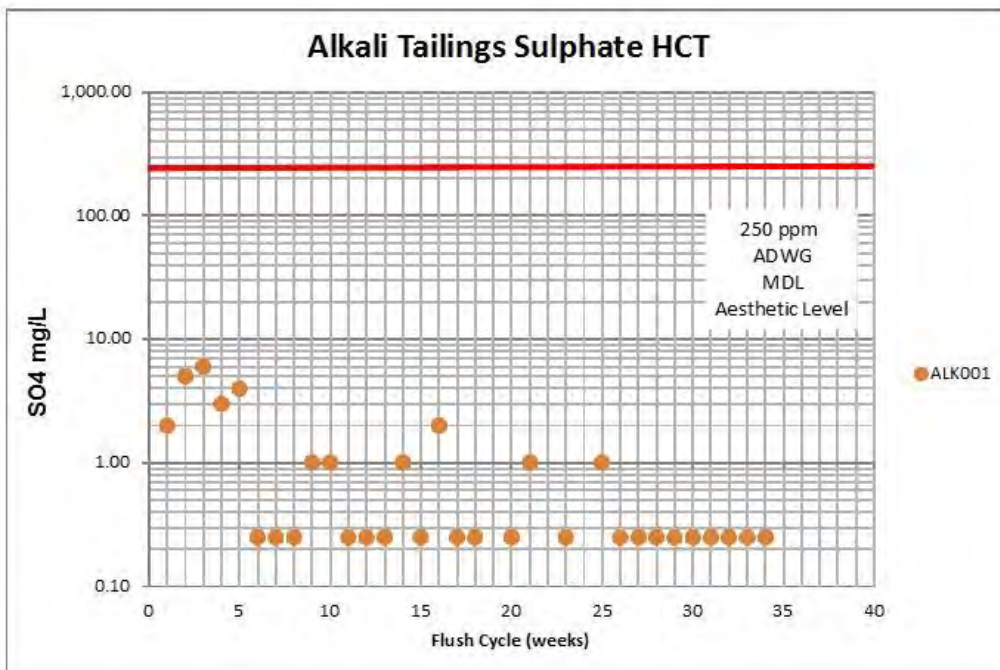
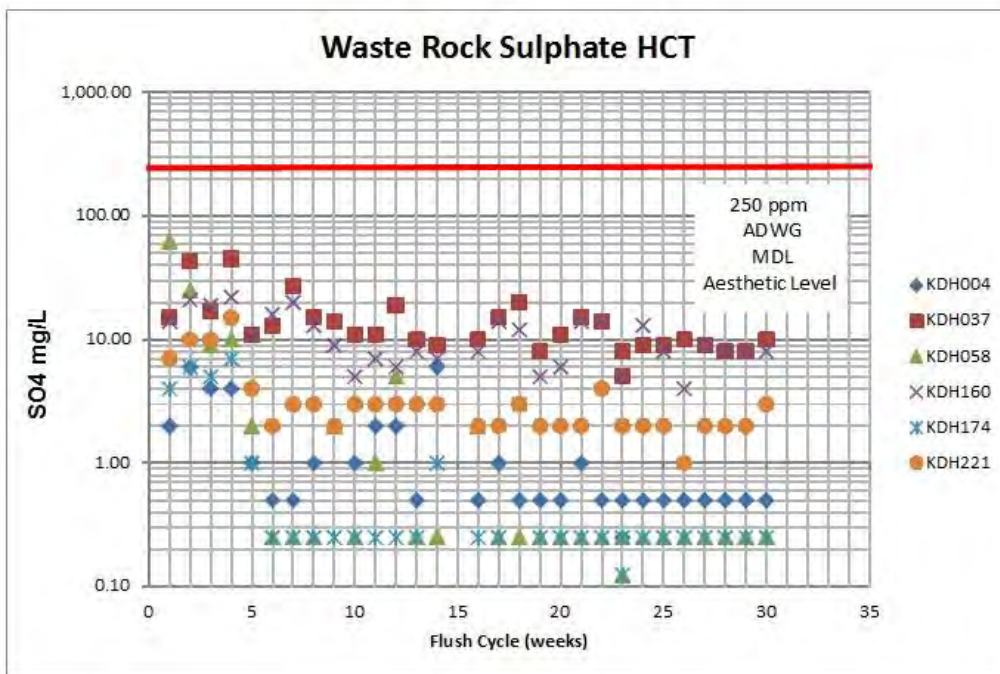


Figure 8-3. Humidity Cell Sulphate Plot.

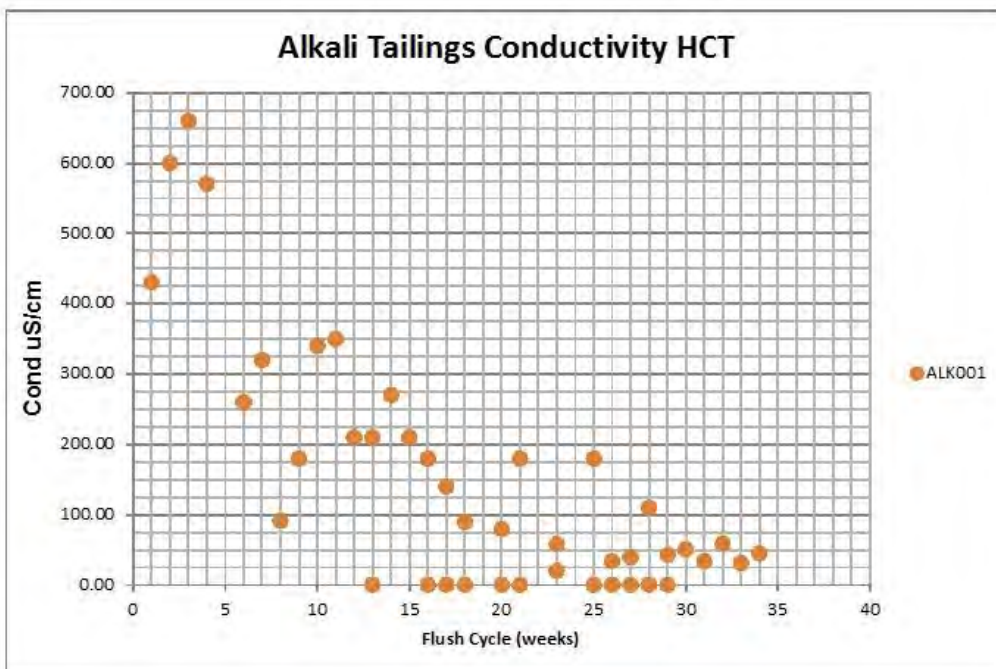
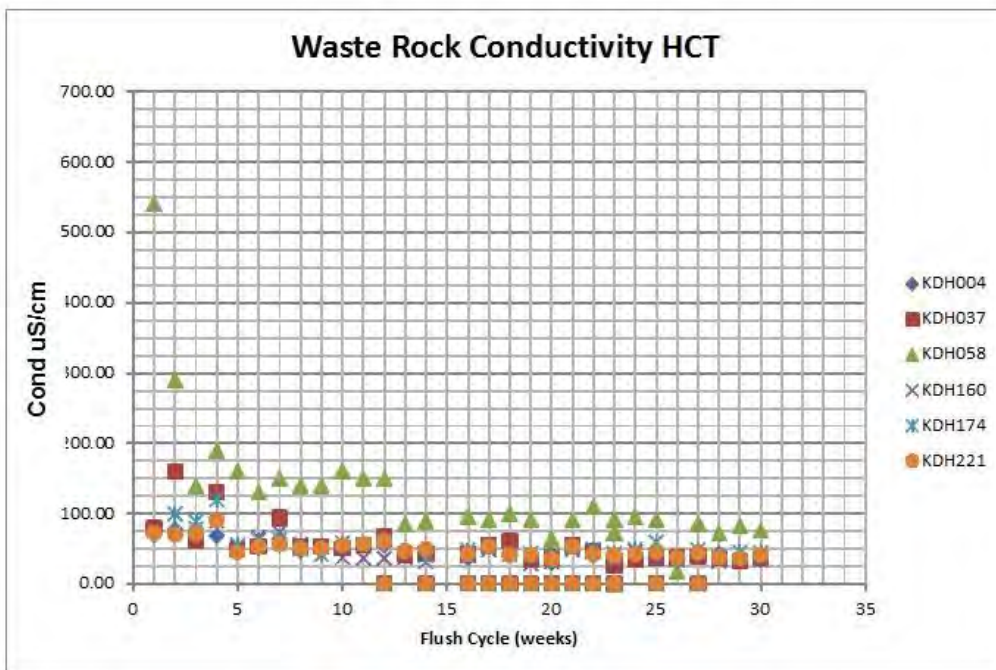


Figure 9-4. Humidity Cell Conductivity Plot.

Weekly metal leachate concentrations are relatively low. However, several metals did exceed the Australian MCL. For the most part, Al was at or below the MCL for the waste sample, however at cycle 25, a notable and consistent increase is noted in the effluent. This may represent a breakdown of minerals in the matrix (possibly clays and/or feldspars). Figure 3-5 shows Al for both the waste rocks and the tailings. The tailings sample was consistently above the MCL.

Figures 3-5, 3-6, 3-7 and 3-8 represent As, Sb, Ba and Cd weekly leachate concentration, respectively. For waste rock samples, none of the flush cycles are above the MCL, and for the tailings sample, As, Sb, and Cd showed some initial flush cycles above the limits, dropping off rapidly to acceptable limits. Ba is consistently below the MCL for the tailings sample.

Figure 3-9 displays Pb values. Like aluminum, this analyte shows a dramatic increase for sample KDH0037 and a slight rise in three of the other samples (KDH221, KDH160, and KDH058) at week 25. Again this could be the result of mineral dissolution and might warrant continuation of the humidity cells for a few more weekly cycles.

Molybdenum is consistently below the MCL and shows a slight but discernible asymptotic trend in the samples with increased time (Figure 3-10).

Nickel appears in Figure 3-11 and shows a slight drop off in the tailing sample. The waste rock samples are fairly consistent and well below the MCL. There is a slight increase again in sample KDH037 in week 25.

Selenium is below MCL in both the waste rock samples and the tailings sample (Figure 3-12). Uranium which also is below MCL in the waste rock, is consistently higher than the guideline limit in the tailings (Figure 3-12). The total U content for the tailings sample was unusually high (> 200 ppm U) and most likely represents an inefficient extraction in the alkali processing method.

Finally, Zn effluent for the humidity cells is shown in Figure 3-14. While consistently below the MCL in both the tailings and waste rock samples, there does appear to be a steady rise for several samples over time.

3.5.2 Radionuclide Analysis - Alkali Tailings Sample

At the time that this PFS was commissioned, it was Cameco's intent to utilise an alkali leaching process to extract uranium from the ore. Due to several factors including extraction efficiencies and Cameco's experience with acid extraction methods, alkaline extraction is not likely to be part of the overall processing scheme. The radiochemistry results of the alkali tailings also showed that the levels for gross alpha and beta were as follows:

- gross alpha was 480 Bq/L
- gross beta was 190 Bq/L.
- Radium-226 was recorded at 73 Bq/L

The Australian MCL for gross alpha, gross beta (K40 corrected), and radium-226 is 0.5 Bq/L, so in all cases, these limits were exceeded. This implies that if this process was utilised, there could be potential adverse health effects. As such, adequate ventilation would be required to minimize Ra-226 exposure and dust abatement processes would need to be in place to reduce any inhalation exposure from radioactive-laden dust particles.

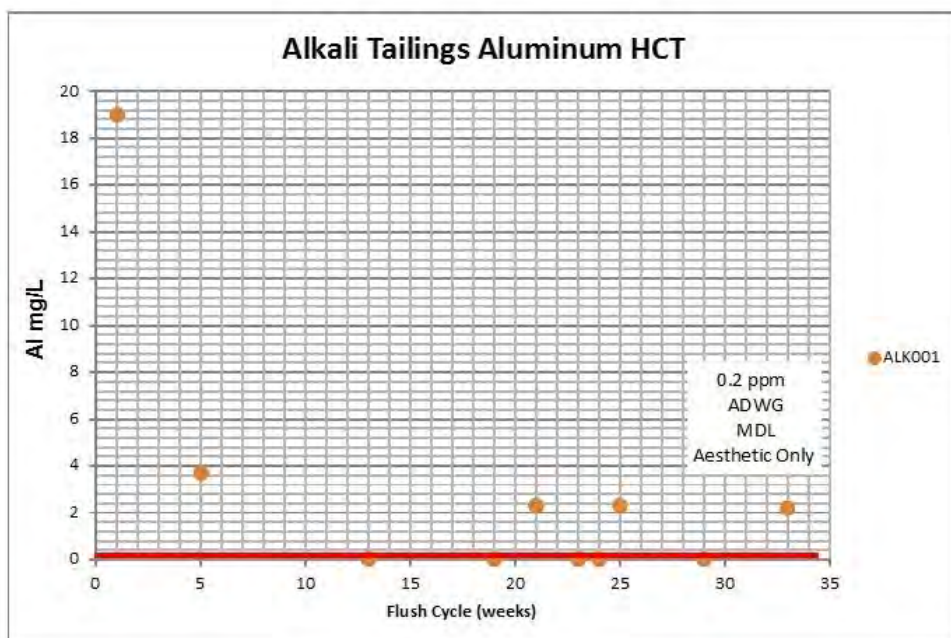
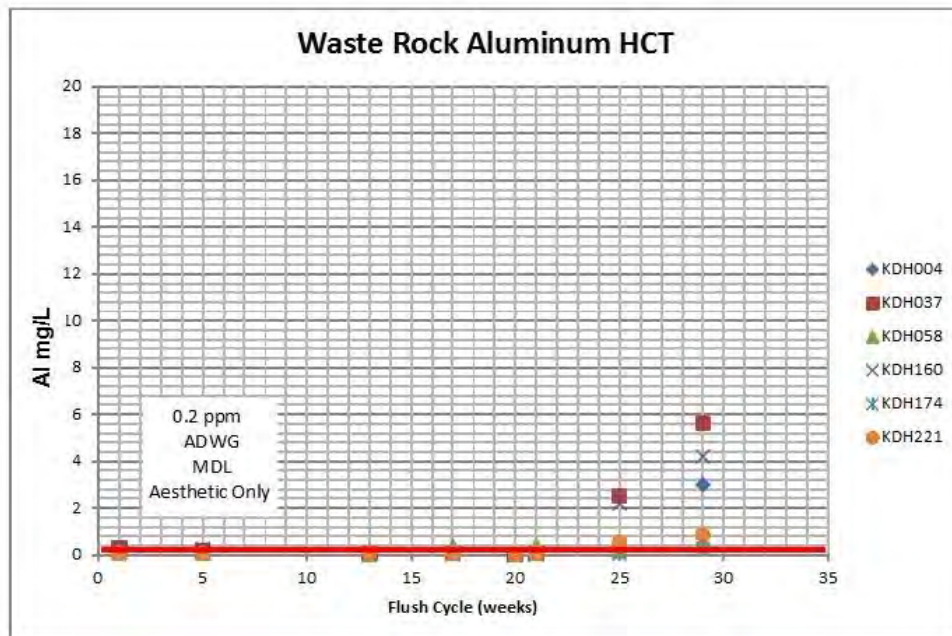


Figure 10-5. Humidity Cell Aluminum Plot.

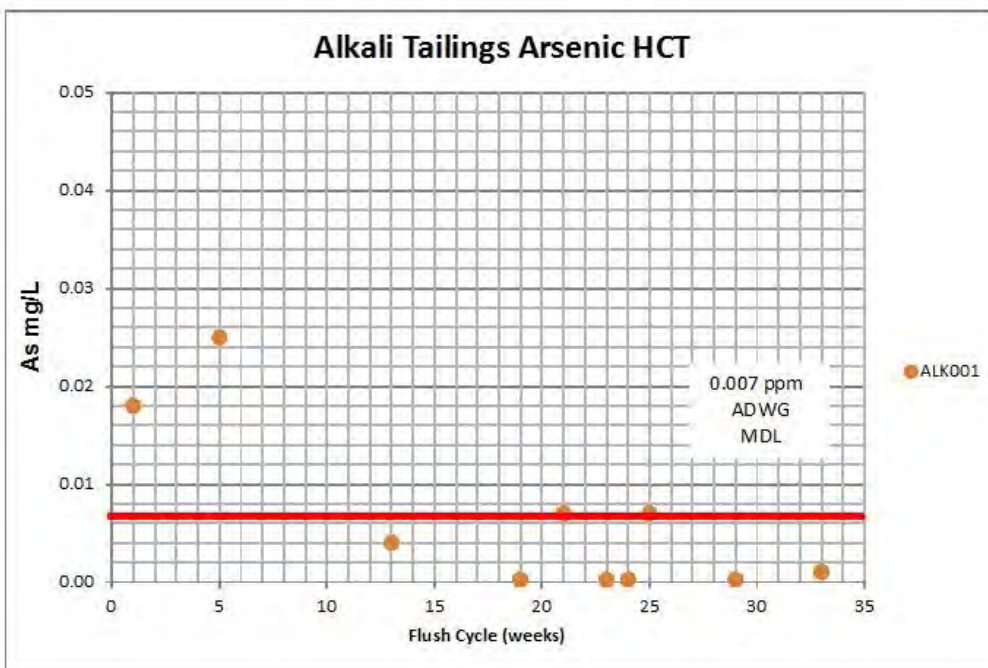
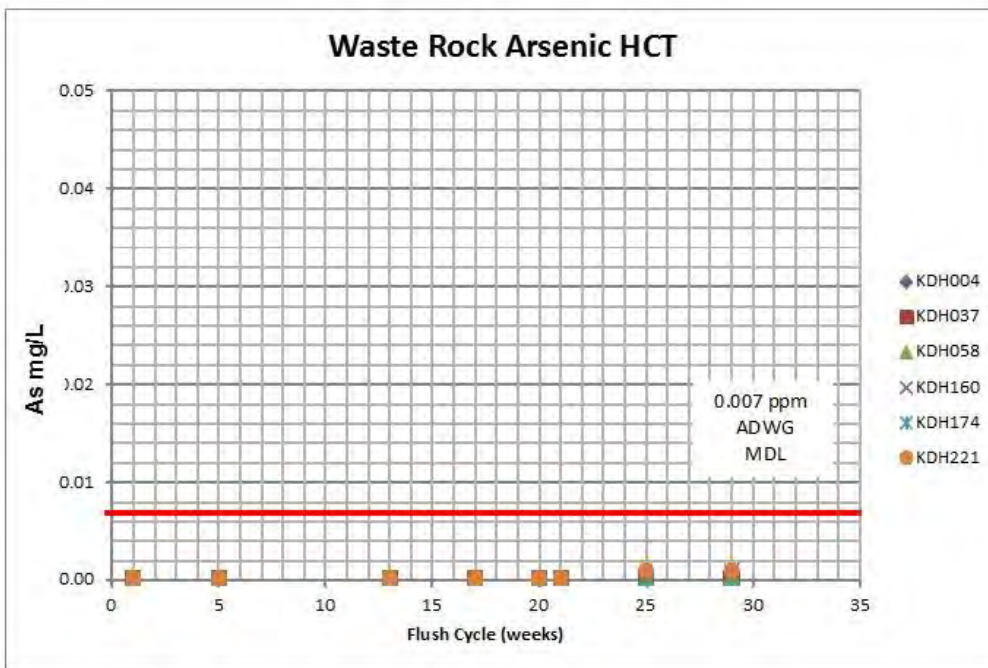


Figure 11-6 Humidity Cell As Plot.

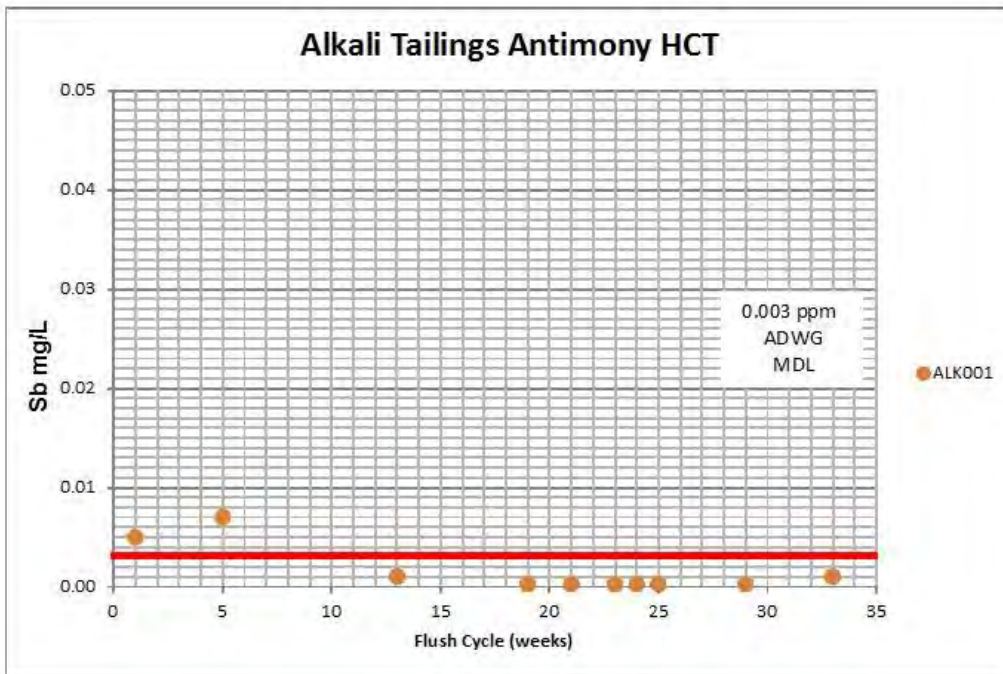
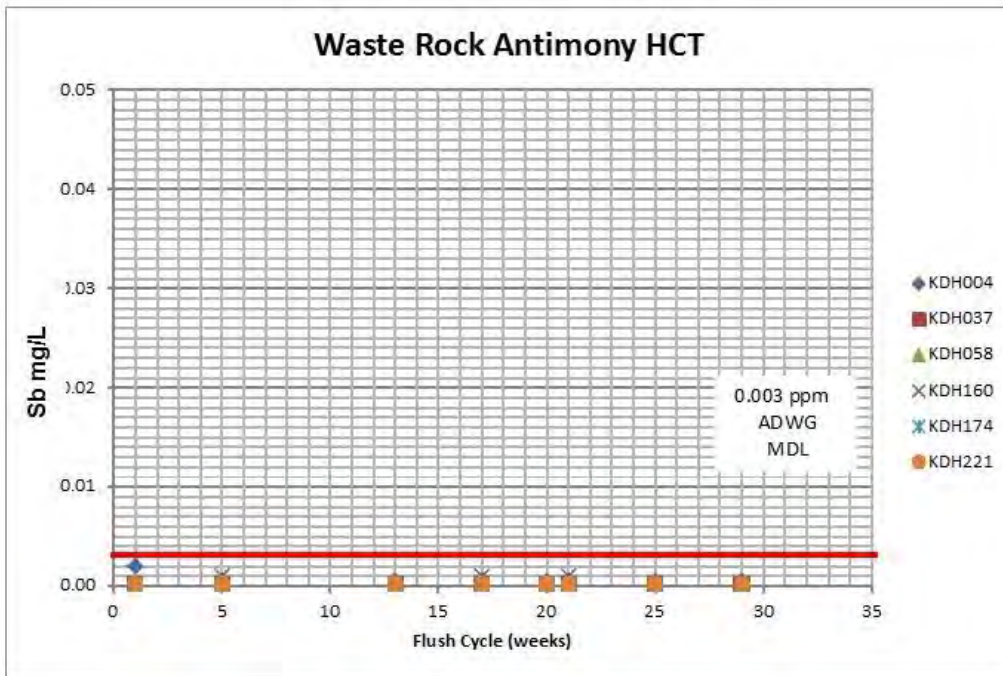


Figure 12-7 Humidity Cell Sb Plot.

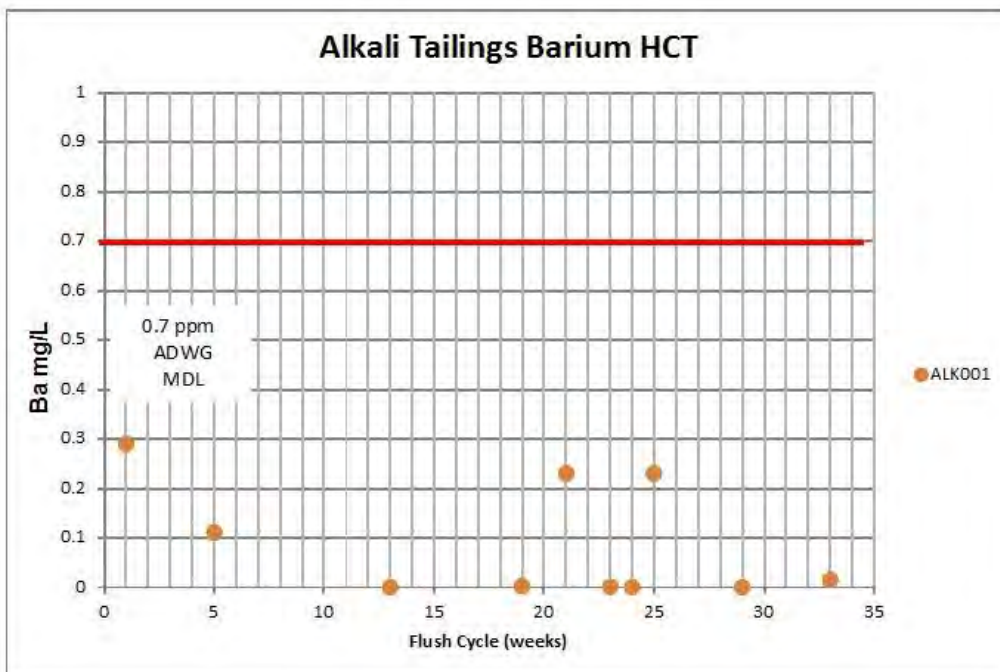
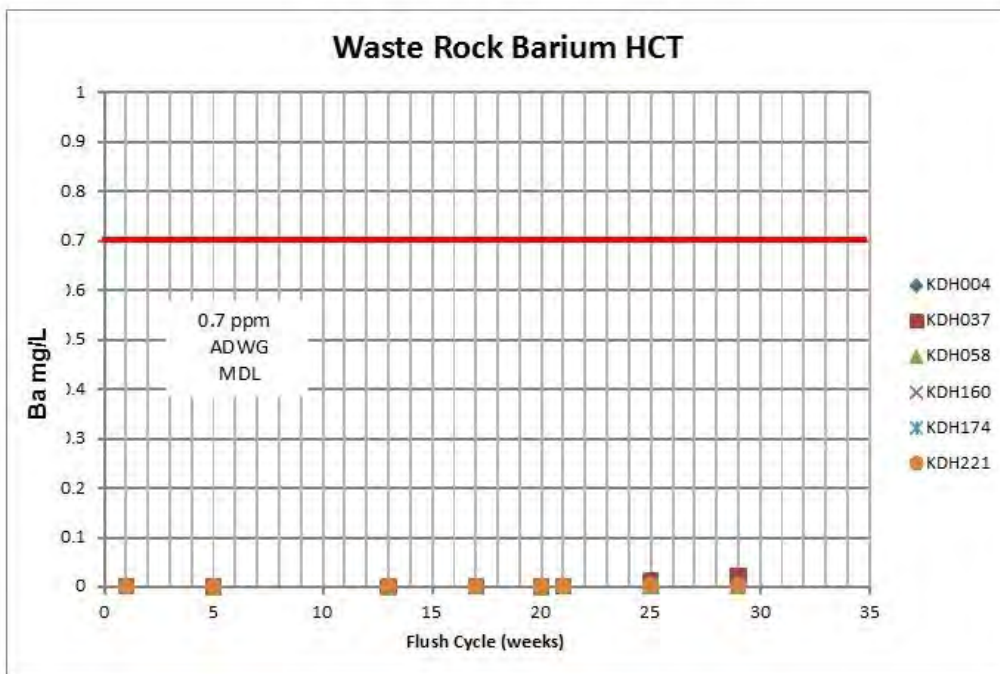


Figure 13-8 Humidity Cell Ba Plot.

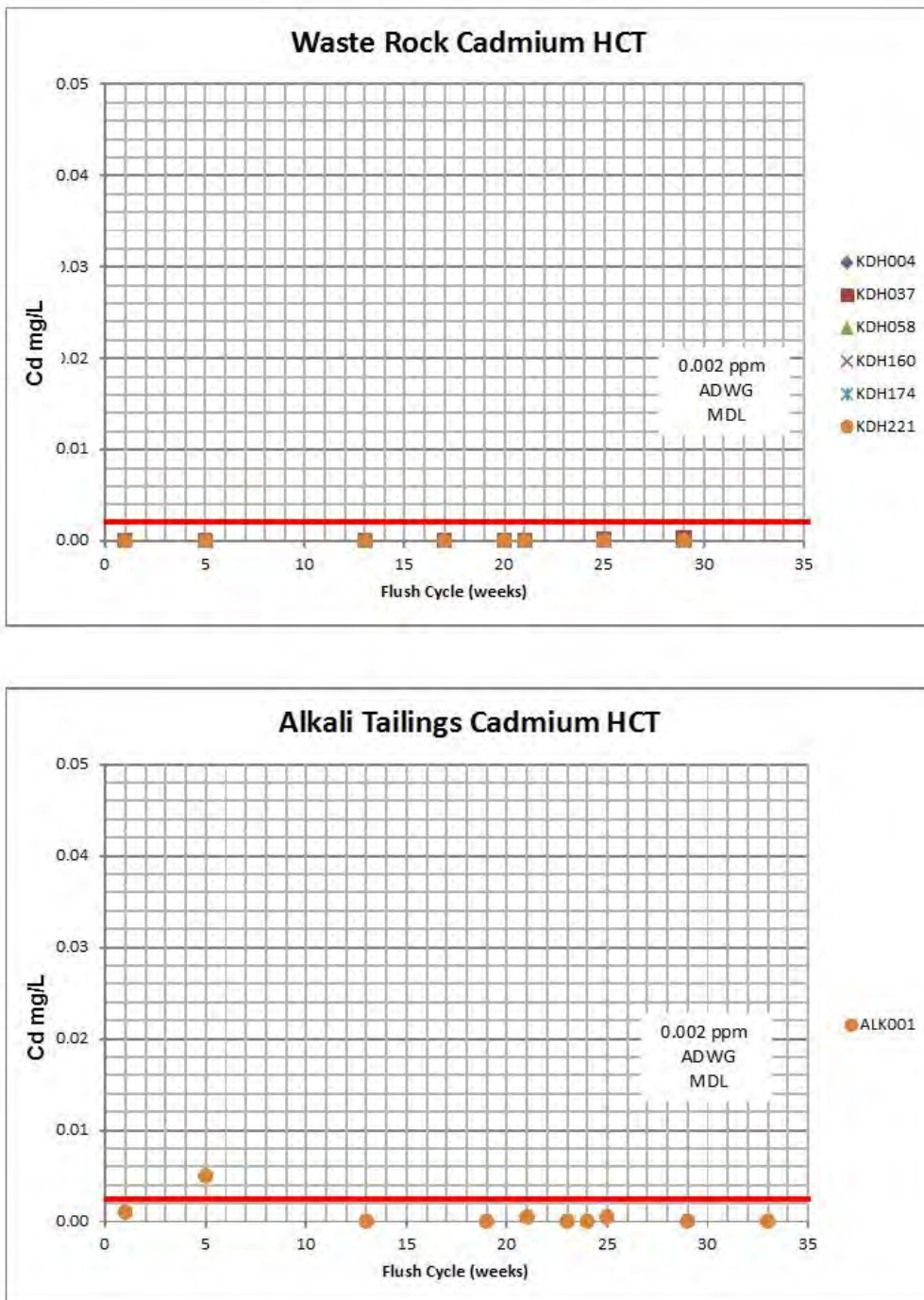


Figure 14-9. Humidity Cell Cd Plot.

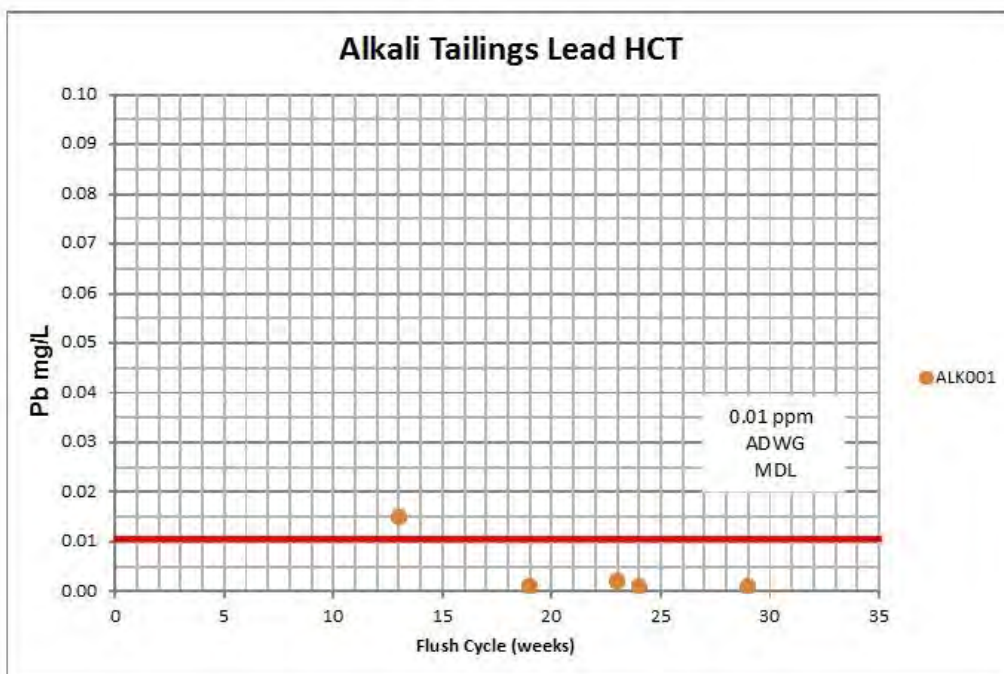
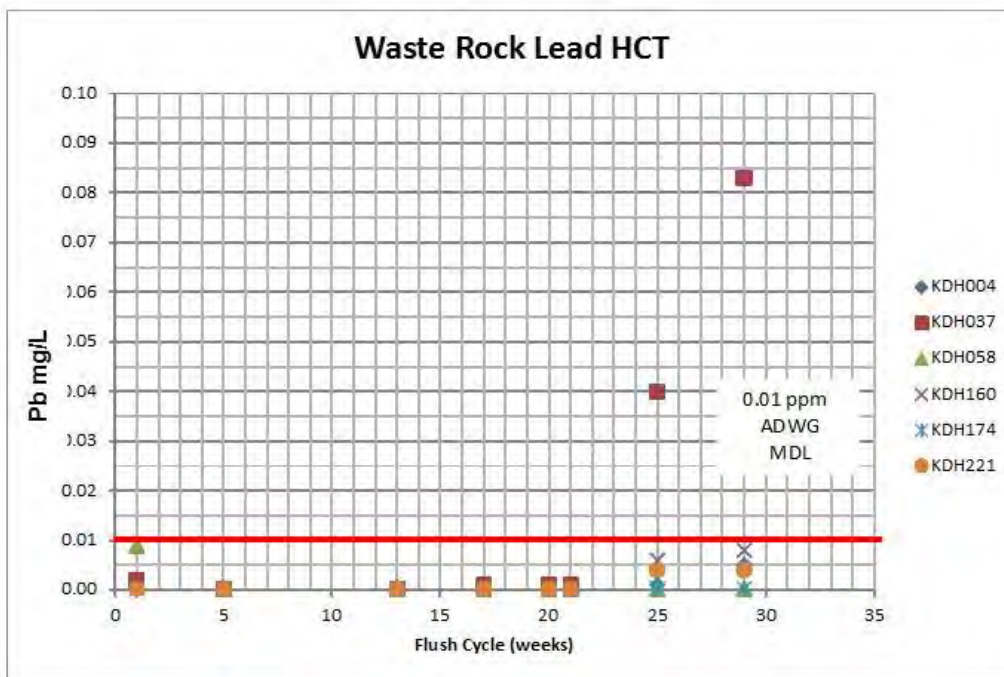


Figure 15-10. Humidity Cell Pb Plot.

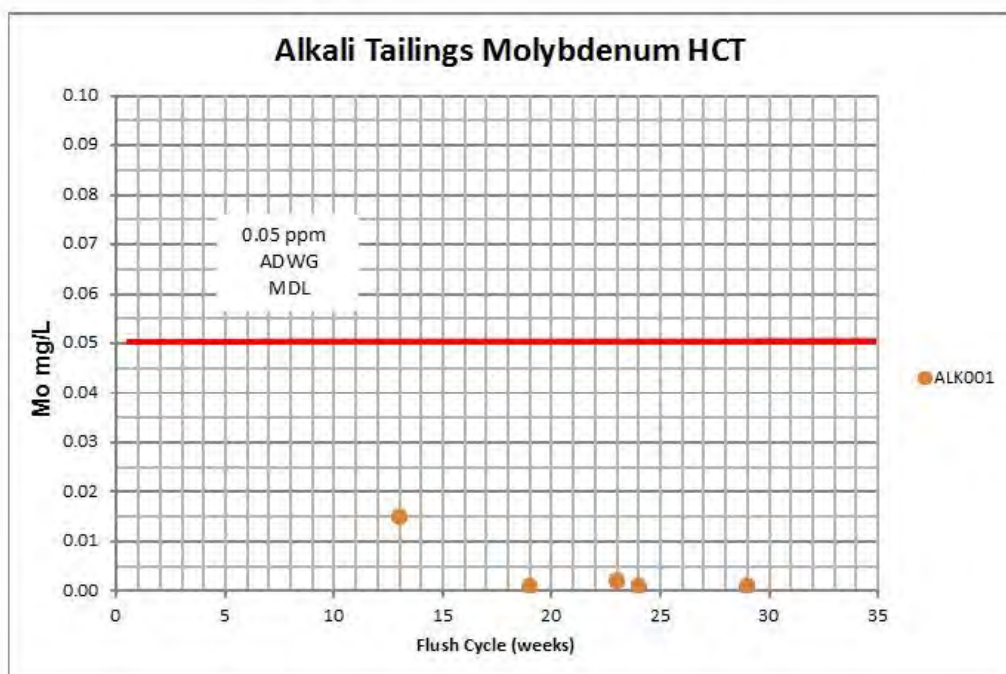
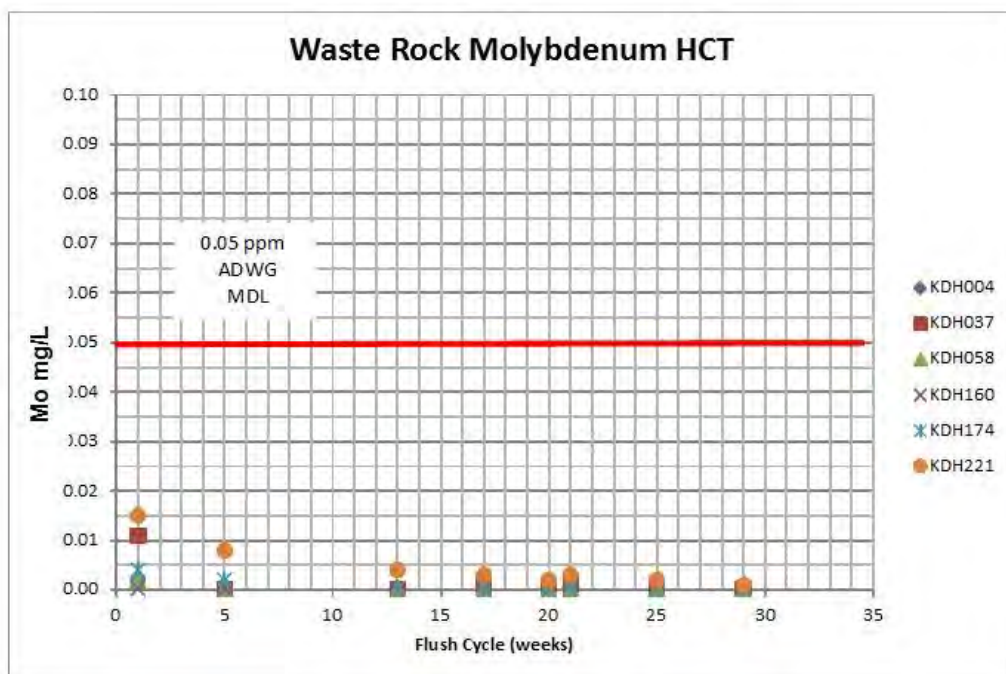


Figure 16-11. Humidity Cell Mo Plot.

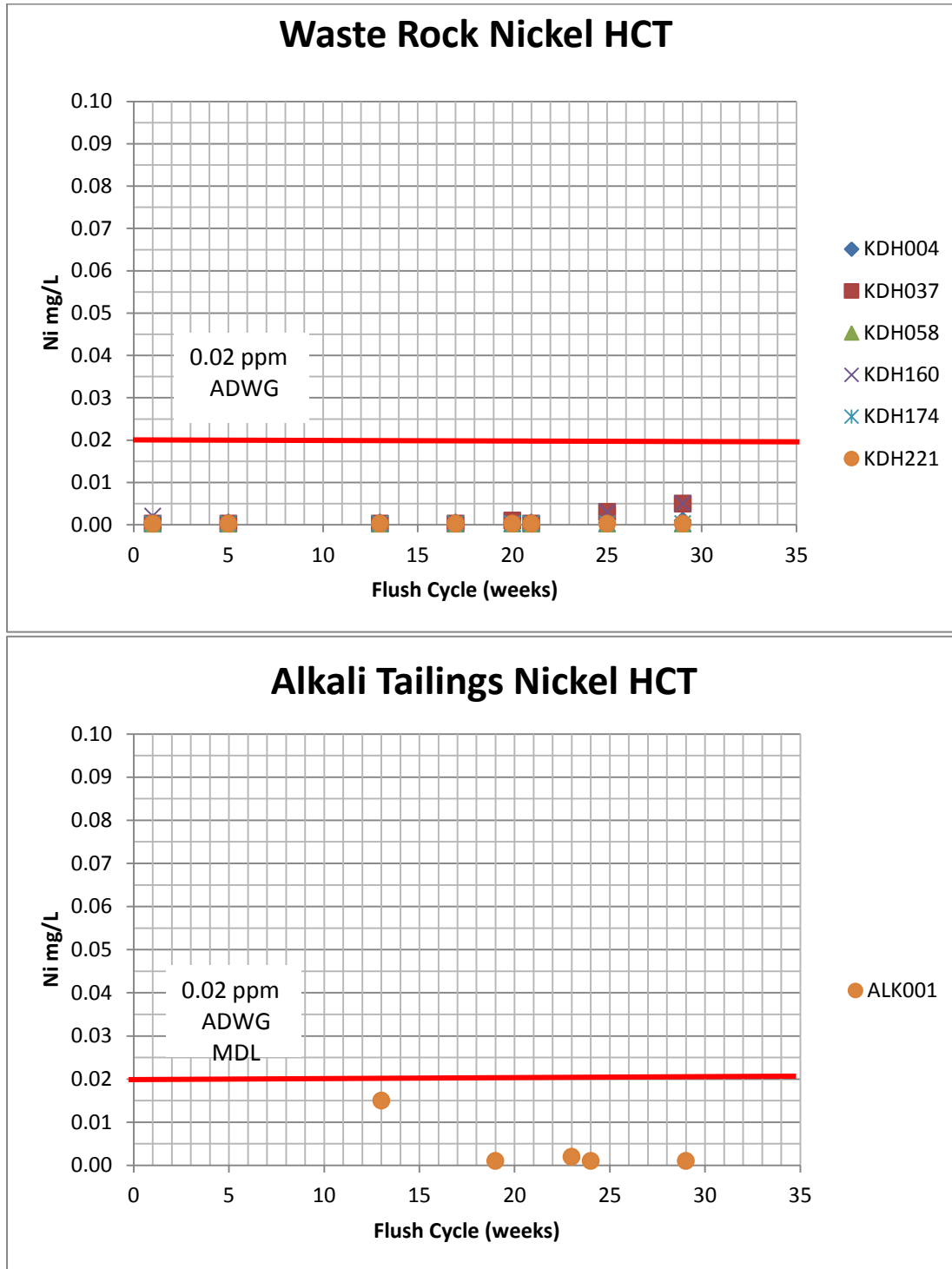


Figure 17-12. Humidity Cell Ni Plot.

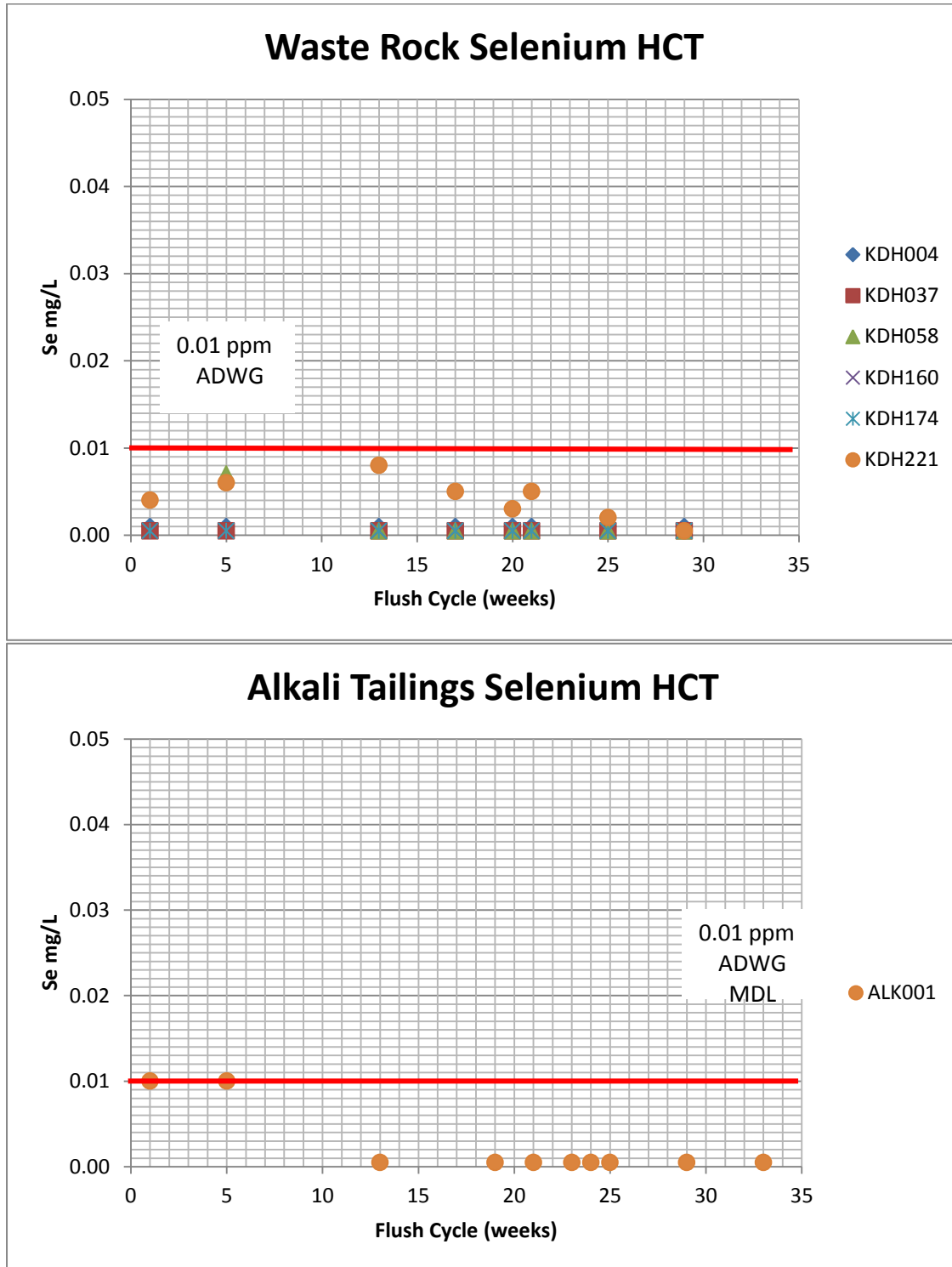


Figure 18-13. Humidity Cell Se Plot

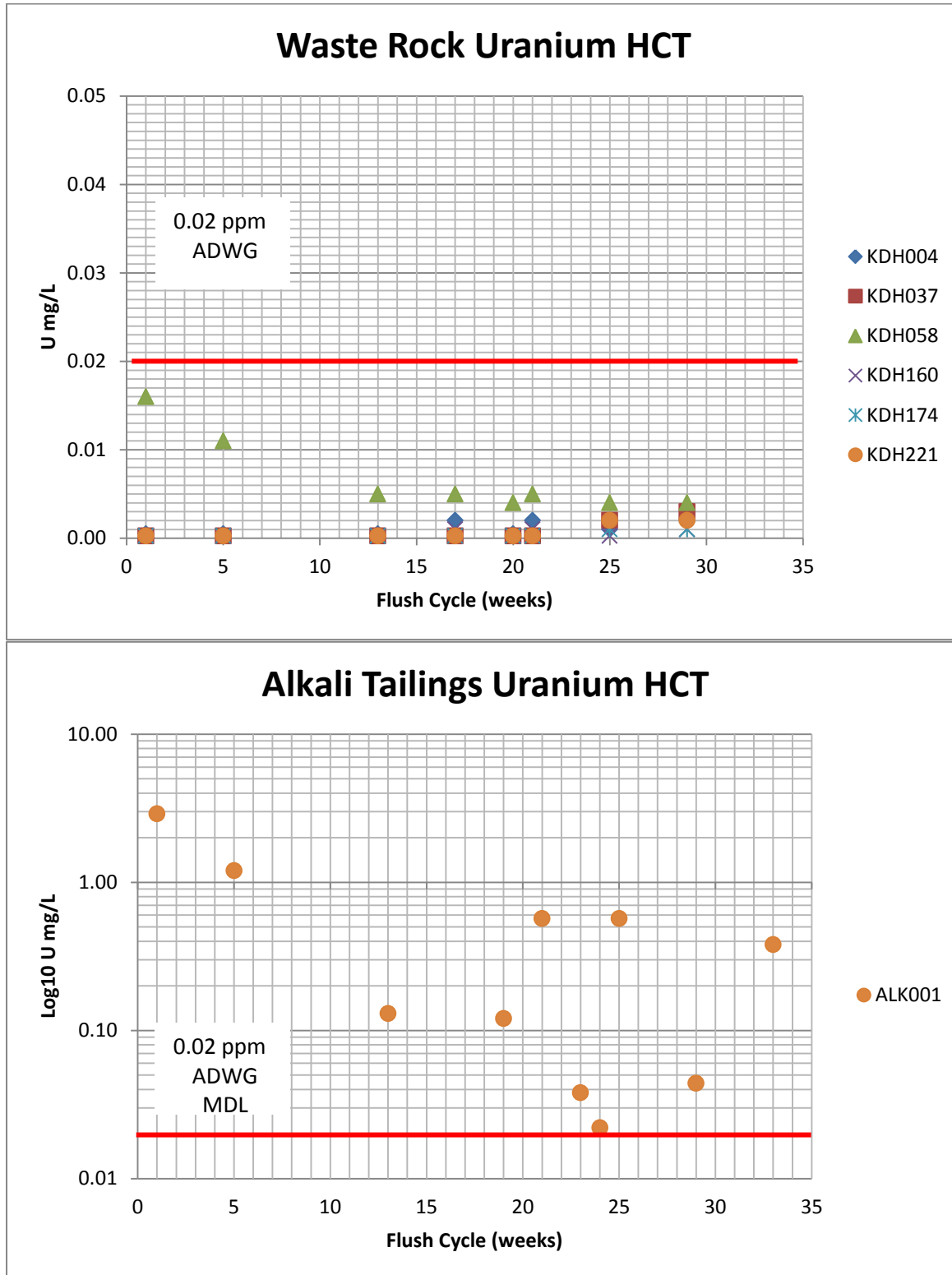


Figure 19-14. Humidity Cell U Plot

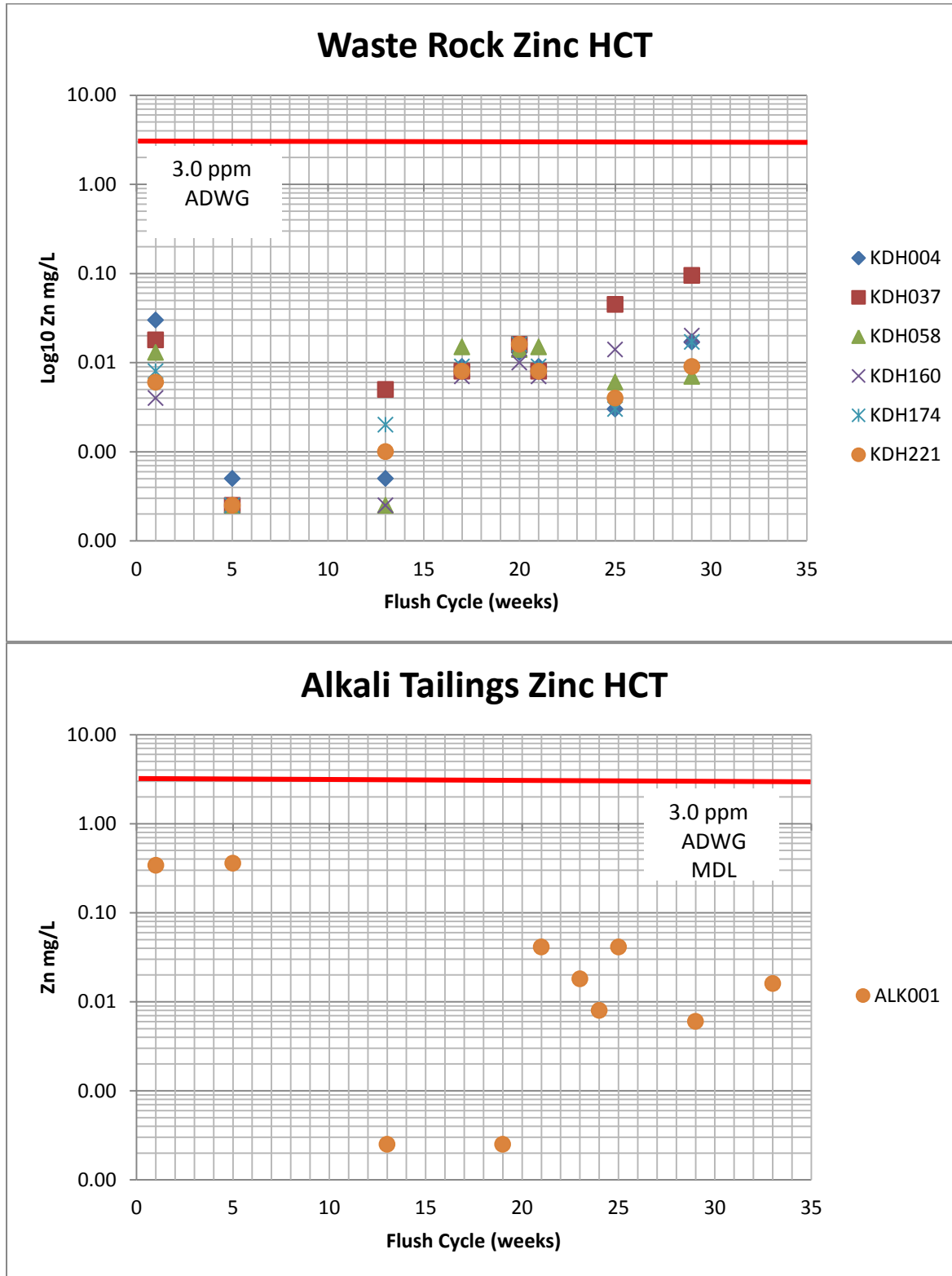


Figure 20-15. Humidity Cell Zn Plot.

4.0 CONCLUSIONS AND RECOMMENDATIONS

A geochemical assessment of historical assay data (1624 samples) and a more detailed analysis of 15 selected samples from the Kintyre Uranium Project area suggest that ARD/ML should not be a significant issue. While several metals of concern were identified (Pb, Zn, U, and Al) that showed an increase in kinetic test effluents and/or exceeded Australian Drinking Water Standards, most metals were either present in quantities below the analytical detection limit, or were well below Australian Drinking Water Guidelines. In light of the fact that humidity cell cycle week 25 showed a noticeable increase in certain metals for several samples starting in flush cycle 25 onward, these humidity cells should be continued for a few more cycles to ascertain if this is merely a spurious release from the breakdown of host minerals in the matrix, or represents a longer-term ML release. In all cases, no acid generation was noticed and overall the system appears to be neutral to basic in regards to pH.

As development of the property continues, future actions recommended are to obtain additional samples, of waste rock from deeper portions of the proposed pit as well as samples in close proximity to the proposed ultimate pit surface. These samples should be submitted for analysis to assist in filling in areas with sparse data, including the use of humidity cell tests.

5.0 REFERENCES

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