FINAL

2024 Monitoring of Metal Leaching and Acid Rock Drainage Potential at the Ulu Camp

Ulu Gold Project, Nunavut, Canada

Blue Star Gold Corp

SRK Consulting (Canada) Inc. ▪ CAPR003217 ▪ March 2025

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Sampling for rinse pH testing

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The development of this annual report represents the collaborative efforts of several individuals from Blue Star Gold Corp. and SRK including:

- Blue Star Gold Corp.: Darren Lindsay, Annabelle Perry, Crystal Mitchell.
- SRK: Kirsty Ketchum, Colton Vessey, Stephen Day.

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Useful Definitions

This list contains definitions of symbols, units, abbreviations, and terminology that may be unfamiliar to the reader.

ARD	Acid rock drainage
BV	Bureau Veritas Labs
CCME	Canadian Council for Ministers of the Environment
CCME PAL-FW	Water quality guidelines for the protection of aquatic life freshwater
DI	De-ionized
DL	Detection limit
DO	Dissolved oxygen
EC	Electrical conductivity
FCSAP	Federal Contaminated Sites Action Plan
ICP-MS	ICP metal scan
ML/ARD	Metal leaching and acid rock drainage
NWB-WL	Nunavut Water Board Water Licence
ORP	Oxidation-reduction potential
PAG	Potentially acid generating
QA/QC	Quality assurance/quality control
STF	Soil treatment facility
TDS	Total dissolved solids
TSS	Total suspended solids

Executive Summary

The Ulu project was historically an advanced gold exploration project with underground development occurring in 1996 and 1997. Waste rock from underground was placed in infrastructure pads which remain on the surface of the site. Studies in 2020 and 2021 have shown that around 90% of the waste rock in the infrastructure pads was classified as potentially acid generating, and the rock is currently acidifying in the pads. Monitoring of the rock and seepage from the pads has been used to understand the current metal leaching and acid rock drainage (ML/ARD) conditions to inform management of the rock as part of site reclamation.

On acidification, the 2024 ML/ARD program indicated that:

- The south side of the ore pad, the waste rock-portal area and the camp pad are not at present generating ARD. Drainage from the camp pad, waste rock-portal area and the south side of the ore pad is currently (in 2024) being neutralized before it exits the pads. However, as carbonates continue to be depleted, the capacity for neutralization declines and ARD is expected to become more widespread without management of the rock.
- ARD is present seasonally (July/August) at the northwest edge of the ore pad and impacting the tundra through sub-surface drainage. Water quality has declined there since 2020; however, acid generating rock in this catchment was removed in August and September 2024.
- Rinse pH testing of grab samples from the northwest edge of the ore pad, as the rock was being excavated for relocation, indicated the rock (pH 2.9-6.4) and underlying tundra soil (pH 3.2-4.5) were dominantly acidic.
- Rinse pH tests on mineralized rock stockpiled above the portal pond had pH 4.6 to 7.9 (average 6.4, n=13). Combined with two results in 2023 of pH 4.3, this indicates that weathering conditions in the mineralized rock are highly variable (acidic and circum-neutral).

The 2024 monitoring program indicates the following regarding element leaching:

- Dissolved arsenic, copper, lead, nickel, and zinc were all below the maximum average and maximum grab sample effluent quality limits in the NWB water license in all the seepage monitored from the ore pad, camp pad, waste rock-portal pad area and landfill.
- Dissolved zinc was close to the NWB-WL effluent quality limit in ore pad seepage from the north edge of the ore pad. Zinc leaching has increased there since 2020. Zinc leaching in seepage at the south edge of the ore pad was lower than in 2023 but still the same order of magnitude as the effluent quality limit and is expected to get worse unless rock in the ore pad is managed.
- Aluminum, cadmium, copper, fluoride, iron, manganese, nickel, selenium, sulphate, and zinc were present in ore pad seepage at concentrations above background and above the water quality guidelines. Concentrations of most of these parameters would be expected to increase if conditions became more acidic.
- Aluminum, arsenic, cadmium, copper, fluoride, sulphate, and zinc concentrations were above background and above the water quality guidelines at the waste rock-portal area.

- Zinc leaching in the landfill area (ULU-15) was an order of magnitude lower in June 2024 than the June 2023 high that was close to the NWB limit. This may be a result of switching to monitoring it upstream of the culvert (rather than downstream).
- Only copper and fluoride were above the water quality guidelines at the camp pad area, which were consistent with background concentrations for these parameters.

The rock at Ulu needs to be managed to prevent further development of ARD and avoid deterioration of water quality. As SRK (2024a) previously recommended, an ML/ARD management plan needs to be developed and implemented. The apparent trajectory of acidification indicates that acidification needs to be arrested this year to avoid impact to the surrounding environment from ARD.

Continued monitoring of seepage is recommended. Additionally, an EM-31 geophysical survey at the north and south side of the ore pad is recommended to identify shallow sub-surface flow paths receiving loadings from mine rock which will support on-site ML/ARD monitoring and future management.

1 Introduction

1.1 Scope of Work

SRK Consulting (Canada) Inc. is providing support to Blue Star Gold Corp. for monitoring of current metal leaching and acid rock drainage (ML/ARD) conditions at the Ulu reclamation project in Nunavut.

Objectives of the ML/ARD program for the 2024 season were to:

- Monitor seepage from infrastructure pads at the Ulu camp to inform understanding of current ML/ARD conditions from rock brought to surface during historical mining activities.
- Monitor rinse pH of relocated mineralized rock at the portal-mine sump area, to assess the development of acidic weathering conditions.
- Report on the results and interpretations related to the development of ML/ARD.
- Provide input for management of problematic rock as part of on-going reclamation activities.

This report summarizes the methods used, results, interpretations, and findings from the 2024 program and is the deliverable for Task 400 of SRK's scope of work dated April 9, 2024. It is intended for use by Blue Star to inform reclamation activities and support reporting on ML/ARD conditions to regulators.

1.2 Regulatory Setting

Under the Nunavut Water Board (NWB) licence (2BM-ULU2030), water quality sampling of runoff and discharge from the Ulu reclamation project is required for compliance and to assess development of acid generating conditions associated with historic mining waste on site. Water quality sampling is only required during months when the site is active. The following ML/ARD-related active monitoring locations are mandated as part of the NWB water licence (NWB-WL): ULU-7, ULU-8, ULU-15, and are reported here.

ULU-4 (sampled as ULU-4a from the portal pond), and ULU-4b, were not required as there was no pumping from underground or discharge from the portal pond, but these were sampled to inform the understanding of seepage downgradient of the portal area, and results are included here.

A number of monitoring locations in the NWB-WL are listed as inactive (ULU-2, ULU-3, ULU-5, ULU-6, ULU-10) and were not sampled in 2024; or are associated with monitoring of lakes (ULU-1, ULU-9, ULU-11) and are reported elsewhere by Blue Star.

All effluent discharge and runoff from site must adhere to the NWB-WL effluent quality limits outlined in Table 1-1.

Table 1-1. Summary of NWB-WL Effluent Quality Limits

Parameter	Maximum Average Concentration (mg/L)	Maximum Concentration of any Grab Sample (mg/L)
Total Arsenic	0.3	0.6
Total Copper	0.3	0.6
Total Lead	0.1	0.2
Total Nickel	0.5	1.0
Total Zinc	0.5	1.0
TSS	15.0	30.0
pH	6.0 to 9.5	6.0 to 9.5
Oil and Grease	No visible sheen	No visible sheen

Source: Compiled in report

1.3 Background Information

1.3.1 Site History and Description

The Ulu project was historically an advanced gold exploration project with underground development occurring in 1996 and 1997. An estimated 126,900 tonnes of waste rock were produced during the underground exploration program (Wolfden 2005). Development waste rock brought to surface was used to construct the camp pad, sections of the road network and to build the ore pad and waste rock-portal pad (Figure 1-1). Estimated volumes in each of the pads from BGC (2003) are 15,000 m^3 in the camp pad, 20,000 m^3 in the ore pad, and 8,000 m^3 in the waste rock-portal pad including approximately half of which is in a waste rock stockpile on the waste rock-portal pad (4,300 m^3). The pads are estimated to be around 1 to 3 m thick.

Approximately 2,200 tonnes of mineralized bulk sample were brought to surface and temporarily stored on the ore pad prior to removal off-site (Cowley et al 2015). An estimated 750 m^3 of this remained on the ore pad in a stockpile when the project was abandoned, until 2018 when the mineralized rock was subsequently relocated to the portal-mine sump area (Figure 1-1).

Sand and gravel from an esker approximately 6 km south of the Ulu camp was also used as a construction material at the site and overlies waste rock on much of the ore pad and parts of the camp pad. Based on test pit programs, the earliest (central) part of the camp pad is built from esker material with waste rock additions around the margins, as development rock from underground became available.

2020

As part of Blue Star’s reclamation activities in 2020, much of the esker sand on the ore pad surface was stockpiled along the centre of the pad to expose the underlying rock. The esker sand had reportedly been up to a meter thick in places (A. Stearman, personal communication, 2020). Waste rock from an area of approximately 6 m by 50 m along the northwest edge of the ore pad (that had not historically been covered in esker sand) was removed by excavator and stockpiled in preparation for building a new soil treatment facility (STF) on the ore pad. Some of the waste rock was used to fill in low points on the ore pad STF site and was then covered with the stockpiled esker sand (A. Stearman, personal communication, 2021). Some of this waste rock remained stockpiled on the ore pad (Figure 1-1). Both the stockpiled waste rock and residual waste rock on the tundra along the northwest edge of the ore pad were identified as acid generating based on rinse test results (SRK 2021). The stockpiled waste rock was covered with tarps in July 2022 to limit precipitation ingress. The STF has not yet been built pending decisions on management of the rock in and on the ore pad.

2021

During August and September 2021, acid generating waste rock removed from camp 3 (200 m^3) and culvert 6 (68 m^3) during remediation works was temporarily relocated to the ore pad (SRK 2022a). The waste rock was subsequently covered with tarps, to limit precipitation ingress, pending development of a long-term management plan for the larger volumes of acid generating and potentially acid generating (PAG) rock at the Ulu site.

The broader Ulu property is undergoing exploration by Blue Star, however, infrastructure at the Ulu camp site that is not required for the exploration program is being reclaimed. A landfill facility was constructed to the south of the camp pad during the 2021 season, and stockpiled scrap materials from various locations around the camp pad and on the waste rock-portal pad were removed and relocated to the landfill and covered with esker sand. The landfill was contoured such that drainage at freshet should run-off the frozen esker sand cover and into the compliance monitoring site ULU-15 and subsequently into down-gradient seeps towards East Lake (Figure 3-3).

2024

During August and September 2024, acid generating waste rock from within the northwest edge of the ore pad, and residual waste rock lying on the tundra that was exposed in 2020, was relocated by Blue Star onto the ore pad, as part of initial consolidation works in preparation for covering for interim management. The rock was added to the existing temporary stockpile at the centre of the ore pad.

LEGEND

NOTES

1. Drone Imagery: Blue Star Gold Corp - 2023.
2. Basemap Imagery: ESRI, Maxar Earthstar Geographics.

REFERENCES

1. Coordinate System: NAD 1983 UTM Zone 12N

0 25 50 75 100
Meters

srk consulting	BLUE STAR GOLD CORP.	2024 ML/ARD Characterization
		Site Layout
SRK JOB NO: CAPR003217 LAYOUT: CAPR003217_Ulu_Annual_reports	Ulu	Date: Mar 2025 · Approved: KYK · Figure: 1.1

1.3.2 Geology and Mineralization

The Ulu property lies towards the southern end of the Archean High Lake greenstone belt of the Slave Geological Province. Cowley et al (2015) indicated that the greenstone belt in the Ulu area is dominated by a basaltic sequence of pillow lavas, massive flows and contemporaneous gabbro sills, with lesser turbidites and younger granites. The greenstone belt has been regionally metamorphosed to upper greenschist to amphibolite grade and is intruded by McKenzie diabase dykes.

Waste Rock

SRK has observed that waste rock in the infrastructure pads (representing waste removed during portal and ramp development) is basaltic. Mineralogy on seven test pit samples (SRK 2022b) indicated the dominant minerals are amphibole (26-38%), plagioclase feldspar (21-28%) and quartz (17-22%), with minor pyroxene, chlorite, biotite, K-feldspar, and ilmenite (2-7%). In the samples tested, total sulphide minerals were present at 0.94 to 2.3%, with pyrrhotite (or sometimes pyrite) dominating. Chalcopyrite, sphalerite, arsenopyrite and millerite were present in all samples at less than 0.1% abundance, except for one sample that contained 0.39% sphalerite. Calcite was the dominant carbonate mineral (present at 0.02% to 0.69% in five samples, and 2.1% in one sample), with dolomite also present (0.01 to 0.21%).

The waste rock in the pads is variably oxidized, and ranges from predominantly grey, to predominantly orange/brown with particle surfaces coated in the weathering products of sulphide oxidation. Accordingly, goethite/limonite was present in all the mineralogy samples at 0.60 to 1.30%, jarosite was present in all samples at 0.001 to 0.004%, and gypsum was present in two samples at 0.00003 to 0.11% (SRK 2022b). Additionally, the surface of the infrastructure pads in areas of more strongly oxidized rock, may become coated in prominent secondary minerals as the rock dries out and porewater evaporates during dry periods.

In general, the most oxidized areas of waste rock are near the surface of the pads, where there has historically been no esker sand cover, including around the edges of the pads, although strongly oxidized rock has also been found at depth (down to 2 m; SRK 2024a).

Mineralized Rock Above the Mine Sump

Rock above the portal pond and partially in the mine sump (Figure 1-1) was previously stockpiled on the ore pad from 2006 through 2018 representing the remnants of the bulk mineralized sample removed from underground for processing at Lupin Mine. The rock includes both waste rock and ore that has been somewhat mixed during relocation. The surface rock is predominantly grey metabasalt that appears to contain only rare fresh sulphides and is not strongly oxidized; however, there are common brown oxidized surface coatings comprising up to 30% of the visible surfaces, and grey-brown fines are present just below the surface. There is also material with more abundant fresh sulphides (around 10% abundance, that appears to be predominantly pyrrhotite, and likely also contains pyrite, arsenopyrite, chalcopyrite, sphalerite, and galena, based on ore mineralogy reported in Cowley (et al 2015).

1.3.3 Previous Studies on ML/ARD Potential at Ulu

Previous geochemical studies at Ulu have been documented in SRK (2021, 2022b, 2023, 2024a). The main conclusions from the static characterization work conducted in 2020 and from rinse pH and seepage monitoring conducted in 2020 to 2023 were:

- Around 90% of the waste rock in the infrastructure pads was classified as potentially acid generating (PAG).
- Waste rock was acidifying to some extent in all the pads, particularly in near-surface rock, and down the outer edges of the pads, as shown by rinse pHs of 2.9 to 3.9.
- Most waste rock at depth had circum-neutral pH (6.5 to 8); however, acidic areas existed at depths of up to 2 m within the pads, associated with areas that were not covered in esker sand, and with higher than typical sulphide content.
- Seepage monitoring indicated that the waste rock in the camp pad and waste rock-portal pads was not generating ARD, as contact water seeps and tundra seepage had pHs above 6.5 (from 2020 through 2023). Local acid generation within the waste rock was being neutralized by carbonates before drainage left the pads.
- ARD is apparent seasonally (July/August) at the northwest edge of the ore pad, and impacting the tundra through sub-surface drainage as indicated by pHs down to 4.3 (in 2023) and elevated electrical conductivity, extending for at least 15 m (but less than 25 m) from the north edge of the ore pad. Water quality has declined there since 2020.
- Based on calculations using all the available datasets, delay to onset of ARD estimates for PAG rock not covered in esker sand ranged from less than a year to six years (from 2020) for “worst case” material, depending on the depth, and six to 16 years for material with “typical” ARD potential, again depending on the depth. Where rock had historically been covered in esker sand, the estimated delay to ARD was longer at 11 to 25 years (from 2020).
- Where surface to near-surface rock is underlain by rock with longer delay to ARD onset, the underlying materials may temporarily help maintain circum-neutral pH from acidic surface rock; however, as calcite gradually becomes depleted, acidic conditions are expected to advance and lead to widespread ARD.
- Seepage from the infrastructure pads is impacted by metal leaching at levels above CCME water quality guidelines, which is predominantly being driven by oxidation of pyrrhotite and pyrite (as the dominant sulphides) along with trace chalcopyrite, sphalerite, arsenopyrite and millerite; resulting in widespread leaching of sulphate and zinc, in addition to leaching of cadmium, iron, manganese, nickel, and selenium in ore pad seepage, and leaching of arsenic from mineralized rock.
- Metal leaching was at levels below the Nunavut Water Board effluent water quality criteria[1]; however, dissolved zinc was within an order of magnitude of the criteria.

[1] Parameters that have criteria are total arsenic, total copper, total lead, total nickel, and total zinc.

- Trace element leaching is expected to increase if pH declines further or if local acidic conditions within the pads become more widespread.

1.3.4 ML/ARD Monitoring Programs

Based on the findings and recommendations provided in SRK (2021, 2022b), a comprehensive seepage monitoring program was initiated by SRK and Blue Star in June 2021 so that changing pH conditions are identified. The program was conducted as part of Blue Star's reclamation research and was formalized in a seepage monitoring protocol (SRK 2022c). Comprehensive seepage monitoring has been conducted at Ulu since 2021 during each open water season, as per the monitoring protocol. Seepage monitoring in 2020 was conducted for Blue Star by Peridotite 932 Consulting, with subsequent monitoring conducted by Blue Star with training and guidance provided by SRK.

In 2024 the monitoring program was reduced to a few key seeps as per recommendations provided in SRK (2024a). This was recommended due to the substantial ML/ARD monitoring dataset that had been acquired to feed into ML/ARD management planning. The sites for on-going monitoring were based on providing coverage of the different areas that generate drainage and the likelihood that flow would continue for the summer. The main ore pad seeps were included to monitor sub-surface drainage. The locations were in addition to the seepage compliance stations that are also monitored. Further information is provided with the methods (Section 3.2).

A rinse pH monitoring program on the waste rock in the infrastructure pads was also recommended in SRK (2022b) to provide an "early warning system" compared to seepage monitoring, providing information on the degree of acidic weathering conditions within the pads. The rinse pH monitoring protocol was formalized as SRK (2022d). Site-wide rinse pH monitoring at the Ulu camp was conducted in 2020 to 2021, and in 2023. Specific areas underwent rinse pH testing in 2024 as documented in subsequent sections of this report.

1.3.5 Climate Conditions and the Effect of Esker Sand Cover on the Infrastructure Pads

Based on climate normals for the nearby Lupin Mine (Environment and Climate Change Canada 2022), the Ulu site has a mean annual air temperature of around –11ºC, with a mean air temperature in July at around 12ºC. Mean annual snowfall recorded at the Lupin Mine is 138 mm. Mean annual rainfall is 160 mm, mostly occurring in July and August. Freshet occurs during May or June at Ulu, when the majority of flowing water is encountered at site.

The site is within continuous permafrost with an active layer that thaws seasonally. Thermal modelling work conducted by SRK (2022e & 2024b) indicated that exposed (uncovered) waste rock in the infrastructure pads at Ulu annually thaws back to depths exceeding 2.0 m thickness. Thaw duration is at least 4 months per year for rock down to depths of 1.3 m; however, average temperature of thawed rock declines substantially over this depth range (15 ºC at surface vs 0.9 ºC at 1.3 m depth). As temperature is a control on reaction rates, degree of sulphide oxidation is expected to decline with depth.

The modelling also showed that an esker sand cover on the pads would be expected to reduce the active layer depth and therefore somewhat limit the portion of seasonally unfrozen waste rock susceptible to oxidation of sulphides. The modelling also indicated that a sand cover reduces the seasonal thaw duration and temperature for the portion of waste rock that does become unfrozen, to an extent that it would somewhat limit geochemical reactions. However, modelling results from SRK (2024b) found that even esker sand covers up to 5.0 m thick cannot completely prevent seasonal thawing under high greenhouse gas emission scenarios (e.g., SSP585) and associated climate change.

The modelling is consistent with observations from the site of the degree of oxidation being lowest in waste rock at depth where there was historically an esker sand cover (i.e., on the central part of the ore pad (Figure 1-1).

In 2022, Blue Star installed ground temperature monitoring instruments in the ore pad at two locations, one with and one without an esker sand cover, to ground truth the modelling work and improve the understanding of the thermal effects of an esker sand cover over the waste rock. Data collection has been on-going since August 2022 and is being used as an input to determine cover thickness requirements in planning for further reclamation, and closure of the site.

2 2024 ML/ARD Monitoring Program

To address regulatory requirements, outlined in Section 1.2, the following components were part of the 2024 ML/ARD program:

- Monitoring of seepage from the at the ore pad, waste rock-portal pad, and infrastructure pad during freshet and through the open water season to improve understanding of ML/ARD and to identify changing conditions.
  - As part of this, samples were also collected from temporary ponds/pools around the portal area in an attempt to identify potential water sources to down-gradient seepage.

Additionally, the following monitoring components were undertaken as part of the 2024 ML/ARD program to assist in assessing water quality and ongoing reclamation management:

- Monitoring of seepage from the ore pad (Seep-01, Seep-05), waste rock-portal pad area (Seep-02, Seep-13), and camp pad (Seep-17) at freshet and through the open water season to improve understanding of ML/ARD and identify changing conditions.
- Monitoring rinse pH of mineralized rock above the portal area to assess the development of acidic weathering conditions. This was to follow up on findings from 2023, where two samples had an acidic rinse pH of 4.3 (SRK 2024a).

3 Methods

SRK Principal Consultant (Geochemistry) Kirsty Ketchum (PGeo) visited the site from May 22 through May 27 for the freshet 2024 seepage monitoring program and rinse pH testing, and to train Blue Star's Environment Technician Annabelle Perry (BSc).

Kirsty Ketchum and Colton Vessey (SRK Consultant, Geochemistry) visited the site from August 21 to August 23 for inspections and discussions with Blue Star including observing the progress of rock excavation from the northwest edge of the ore pad.

3.1 Rinse pH Monitoring

Blue Star's Environment Technician was trained in rinse pH monitoring by SRK on May 24, 2024 (sampling) and May 25 (testing). Rinse pH monitoring was conducted using the methods in the rinse pH monitoring protocol (SRK 2022d). Materials sampled for rinse pH testing included:

- Mineralized rock above (east of) the portal pond (13 samples collected from 7 hand-dug pits).
- Waste rock and tundra soil exposed during remediation works along the north edge of the ore pad (7 samples collected from hand dug pits and one surface composite sample), during waste rock relocation.

Pits were dug by shovel or hand-shovel. Sample locations are shown in Figure 3-1 and Figure 3-2, and sample coordinates and logs are provided in Appendix A and Appendix B, respectively. Sample depths ranged from 0 to 45 cm and are provided with the results in Sections 5.2.5 and 5.3.2. Rinse testing included measurement of rinse pH and rinse conductivity.

LEGEND

2024 Test Pit Locations

NOTES

1. Drone Imagery: Blue Star Gold Corp - 2023.
2. Basemap Imagery: ESRI, Maxar Earthstar Geographics.

REFERENCES

1. Coordinate System: NAD 1983 UTM Zone 12N

0 25 50 75 100
Meters

srk consulting

SRK JOB NO: CAPR003217

LAYOUT: CAPR003217_Ulu_2024_MLARD_Characterization

BLUE STAR GOLD CORP.

Ulu

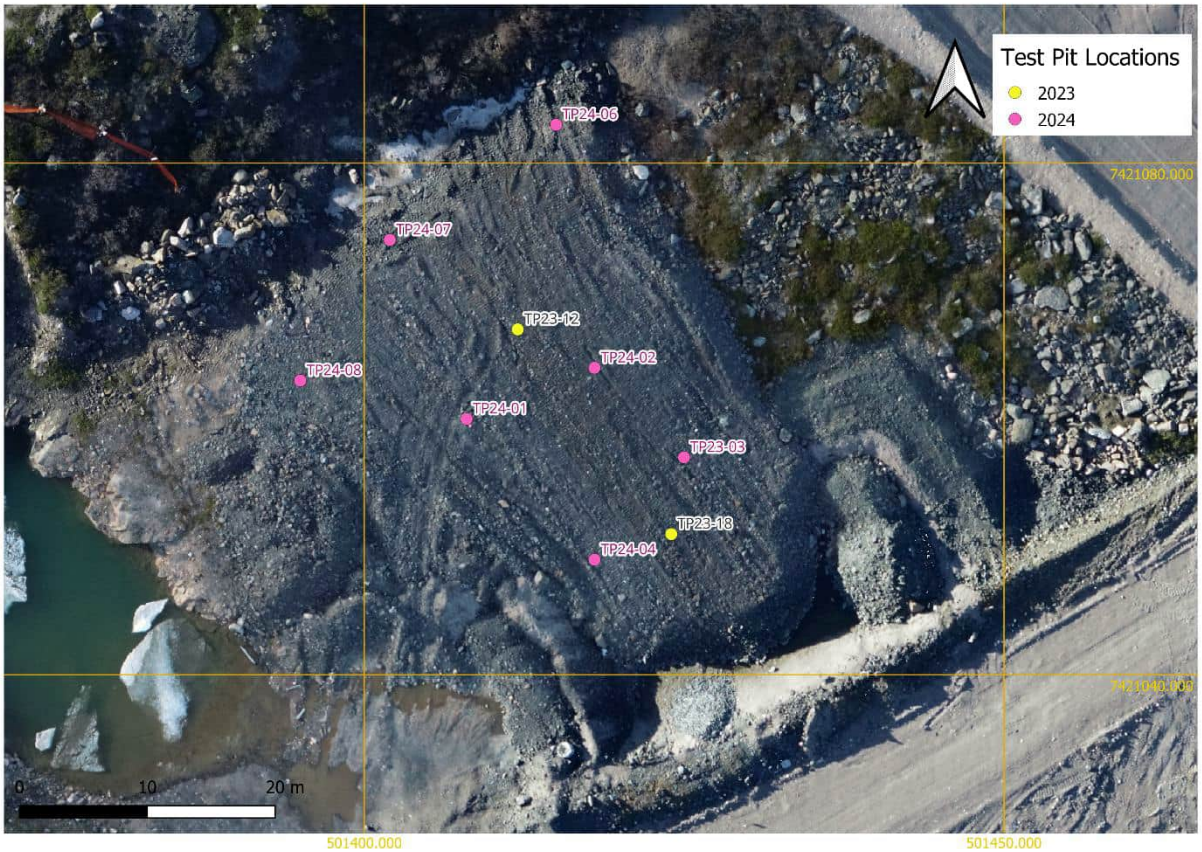
2024 ML/ARD Characterization

2024 Test Pit Locations for Rinse pH Monitoring

Date: Mar2025 | Approved: CV | Figure: 3.1

PROJECT PATH: C:\Users\MSMITH\SRK Consulting\FS725 Ulu - 1040_AutoCAD\GIS\Projects\CAPR003217_Ulu_2024_MLARD_Characterization\CAPR003229_Ulu_2024_MLARD_Characterization.aprx - L-Fig 3-1_Test Pits

Figure 3-2. Location (Zoomed in) of Rinse pH Samples from Mineralized Rock (2023 and 2024).



Source: Blue Star Gold (SRK Consulting\NA CAPR003217 Ulu Gold 2024 Scope of Work - Internal\Task400_ML-ARD Monitoring\400-04_Field support\Ore rinse pH\ Relocated ore_2023&2024_Test_Pit_Locations.png

3.2 Seepage Monitoring

The Ulu seepage monitoring protocol (SRK 2022c) documents the methods to be used for seepage monitoring at Ulu including monitoring frequency, field data to be collected, sample collection procedures (including QC samples) and setting up new monitoring stations.

More recent recommendations to monitoring locations and frequency have been made since the protocol was developed, based on the results and understanding developed from the program. Key changes have been:

- Including monitoring of standing water pools down-gradient of the ore pad (that are thought to represent the surface expression of sub-surface drainage from the ore pad); due to the presence of acidic pH's and elevated sulphate (SRK 2023, 2024a); and

- Reducing the program down from 29 seepage monitoring locations (including the "ULU-" compliance sites) to key seeps, as identified in SRK (2024a).

Monthly compliance monitoring (during periods of flow, when the site is active) is required by the Nunavut Water Board for seeps that are identified in the water license (ULU-7, ULU-8, and ULU-15).

The seepage monitoring program in 2024, therefore, included the locations and frequencies indicated in Table 3-1. The locations provide coverage of the different areas that generate drainage and include sites with a high likelihood that flow would continue for the summer, in addition to the compliance seepage locations.

Table 3-1. Summary of 2024 Seepage Monitoring Program Locations and Frequences.

Drainage Area	Monitoring Location	Sampling Frequency	Additional Comments
Ore pad, southwest	Seep-01	At freshet, then monthly. For ULU-8A after significant rainfall (as defined in the protocol), or monthly if there is no significant rainfall.	Typically standing water.
Ore pad, northwest	Seep-05		Typically standing water.
Ore pad, southeast	ULU-8A if flowing, otherwise ULU-8		Compliance station. Weekly checks of ULU-8A during July are recommended to identify if flow is present, associated with thawing of the pad at depth.
Camp pad, north	Seep-17	At freshet, then after significant rainfall (as defined in the protocol), or monthly if there is no significant rainfall.	Weekly checks of the edge of the camp pad upstream of Seep-17 during July/August are recommended to identify if direct flow out of the pad is present, associated with thawing of the pad at depth. If present, then also sample the upstream flowing seepage (at monthly frequency).
Camp pad, south/landfill	ULU-15	At freshet, then after significant rainfall (as defined in the protocol), or monthly if there is no significant rainfall.	Compliance station.
Waste rock portal pad area, east	Seep-02	At freshet, then after significant rainfall (as defined in the protocol), or monthly if there is no significant rainfall.	
Waste rock portal pad area, west	Seep-13		
Waste rock stockpile	ULU-7		Compliance station but flow is rare.

Source: Compiled in report

Key information on all the 2020 to 2024 seepage monitoring stations is tabulated in Table 3-2 including year established, upstream and downstream locations and what the water is thought to represent. Locations are shown in Figure 3-3 and coordinates are provided in Appendix A.

Table 3-2. Overview of All Ulu Seepage Monitoring Locations.

Seep	Area	Year Established	Upstream Location	Comments/Represents	Downstream Location
Seep-01	Ore pad (south)	2019	Ore pad/tundra	Ore pad tundra seep, sub-surface drainage.	Seep-06, then East Lake
Seep-02	Within tundra between waste rock pad and East Lake	2020	Seep-09, ULU-15	Waste rock pad seepage modified by tundra interaction	Seep-14 and seep-15 (flow splits into two), then East Lake
Seep-03	Camp pad (NE)	2020	Camp pad	Camp pad contact water/standing water.	Seep-20 then sub-surface to Ulu Lake
Seep-04	Within tundra between waste rock pad and East Lake	2020	Seep-11 and ULU-7	Waste rock pad seepage modified by tundra interaction	Seep-13 then East Lake
Seep-05	Ore pad (NW)	2020	Ore pad/tundra	Ore pad tundra seep, sub-surface drainage.	Seep-12 then Lake G43
Seep-06	Inflow to East Lake (S)	2020	ULU-8 and Seep-01	Flow into East Lake from south side of ore pad (plus surface/sub-surface waters)	East Lake
Seep-07	Camp pad (N)	2021	Camp pad	Camp pad contact water	Sub-surface to Seep-17/Seep-20 drainage
Seep-08	Camp pad (N)	2021	Camp pad	Camp pad contact water	Sub-surface to Seep-17/Seep-20 drainage
Seep-09	Waste rock pad (E)	2021	Waste rock pad	Waste rock pad contact water	Sub-surface to Seep-02, -26, -14, -15 then East Lake
Seep-10	Waste rock pad (C)	2021	Waste rock pad	Waste rock pad/stockpile contact water	Sub-surface to Seep-13 or Seep-14
Seep-11	Waste rock pad (W)	2021	Waste rock pad	Waste rock pad/stockpile contact water	Seep-04, then Seep-13 to East Lake
Seep-12	Inflow to small lake (G43) west of ore pad	2021	Seep-05 and boggy drainage area becoming defined surface flow	Flow into small lake (G43), part of West Lake catchment, from northwest side of ore pad	Lake G43
Seep-13	Inflow to East Lake (W)	2021	Seep-04 (and potentially sub-surface from Seep-10)	Flow into East Lake from waste rock pad and waste rock stockpile.	East Lake
Seep-14	Inflow to East Lake (W)	2020	Seep-02 (and sub-surface from Seep-09, -10)	Flow into East Lake from waste rock pad	East Lake
Seep-15	Inflow to East Lake (NW)	2021	Seep-02 and higher ground to the east	Flow into East Lake from waste rock pad, also receives drainage from higher ground to the east.	East Lake
Seep-16	Portal area	2021	Mineralized rock above mine sump	Flow from snow melt passing through a few meters of waste rock/ore above portal/mine sump.	Portal pond
Seep-17	Camp pad (NE)	2021	Camp pad/tundra	Tundra seep from camp pad area where drill core is stored. Location also receives drainage from higher ground to the NW.	Seep-20, then sub-surface towards Ulu Lake
Seep-18	Camp pad (NE)	2021	Seep-17	Tundra seep from camp pad area, downstream of Seep-17. Location also receives drainage from higher ground to the NW. (Discontinued as too close to Seep-17)	Seep-20, then sub-surface towards Ulu Lake
Seep-20	Camp pad (NE)	2022	Seep-17, Seep-03, Seep-21	Tundra seepage from Camp pad area, multiple flow paths converge upstream.	Disappears into tundra, sub-surface towards Ulu Lake
Seep-21	Camp pad (NE)	2022	Camp pad	Camp pad contact water/standing water	Seep-20
Seep-22	Ore pad (W)	2023	Ore pad	Ore pad tundra seep, likely sub-surface drainage.	Seep-06, then East Lake
Seep-23	Ore pad (S)	2023	Ore pad	Ore pad tundra seep, sub-surface drainage.	Seep-06, then East Lake
Seep-24	Portal area	2023	Waste rock west of portal entrance	Waste rock contact water	Waste rock-portal pad
Seep-25	Waste rock pad (C)	2023	Waste rock pad	Waste rock pad/stockpile contact water	Sub-surface to Seep-13 or Seep-14
Seep-26	Within tundra between waste rock pad and East Lake	2023	Seep-02, -09	Waste rock pad seepage modified by tundra interaction	Sub-surface to Seep-14 then East Lake
ULU-7	Waste rock stockpile	Historical	Waste rock stockpile	Waste rock pad/stockpile contact water	Seep-04, then seep-13 to East Lake
ULU-8	Ore pad (S)	Historical	Ore pad	Ore pad seepage, likely predominantly sub-surface.	Seep-06, then East Lake
ULU-8A	Ore pad (S)	2023	Ore pad	Direct surface flow out of ore pad	Sub-surface to ULU-8
ULU-15	Camp pad (S)	2021	Camp pad/landfill	Seepage from south side of camp pad and drainage through/run-off from landfill.	Sub-surface, likely to Seep-02
Ref-03	North of Camp	2022	Tundra	Background conditions	Ulu Lake
Ref-06	North of Ulu Lake	2022	Tundra	Background conditions	Ulu Lake
Seep-19	Camp 3	2021	Camp 3 road	Camp 3 road contact water, prior to removal of acidic waste rock. No longer represents seepage.	Lake K29a

Source: https://srk.sharepoint.com/sites/NACAPR003217/Internal/Task400_ML-ARD Monitoring/400-06_Data Management/[Ulu_Compiled_Seepage_CAPR003217_rtc_kyk_rev00.xlsx] \

Notes: highlighting indicates: grey=waste rock contact water, green=flows or daylights within tundra, blue=downstream inflow to lake

LEGEND

- Portal Pond
- Seepage Monitoring Locations
- Monitoring Locations Sampled in 2024

NOTES

1. Drone Imagery: Blue Star Gold Corp - 2023.
2. Basemap Imagery: ESRI, Maxar Earthstar Geographics.

REFERENCES

1. Coordinate System: NAD 1983 UTM Zone 12N

0 50 100 150 200
Meters

srk consulting

SRK JOB NO: CAPR003217

LAYOUT: CAPR003217_Ulu_MLARD_Characterization

BLUE STAR GOLD CORP.

Ulu

2024 ML/ARD Characterization

Seepage Monitoring Locations

Date:	Approved:	Figure:
Mar 2025	CV	3.3

PROJECT PATH: C:\Users\MSMITH\SRK Consulting\FS725 Ulu - !040_AutoCAD\!GIS\!Projects\CAPR003217_Ulu_MLARD_Characterization\CAPR003217_Ulu_MLARD_Characterization.aprx - L-Fig 3-3_Seepage Monitoring Locations

Samples were also collected this season from ponds/pools around the portal area in an attempt to identify potential water sources to down-gradient seepage, particularly to ULU-15 (which in 2023 had zinc concentrations close to the WL limit) and Seep-02. This was done for two reasons:

- Because observations at freshet in 2024 suggested that during high flow conditions, water flows across/through/under the roads east and south of the portal area, from pools/ponds that are in contact with mineralized rock (Figure 3-3, and further details provided in Section 5.3.1).
- To determine whether the water chemistry in ULU-4a had changed substantially as a result of weathering and leaching of the mineralized rock stockpiled above it, since the pond was previously sampled in 2020 and 2021.

Sample locations are included with the seepage locations (Figure 3-3, Appendix A).

Blue Star’s Environment Technician was trained in seepage sampling by SRK on May 25 and 26 during freshet monitoring. Freshet monitoring occurred during peak freshet conditions, unlike 2021 to 2023, where sampling occurred at the end of freshet.

Freshet samples were collected by SRK and Blue Star and subsequent samples were collected by Blue Star. A summary of the samples collected in 2024 is provided in Table 3-3, including 27 seep samples and five additional samples from the pools/ponds in the portal area. Additional field readings (pH and conductivity) were also collected from the standing water in the ore pad seeps throughout August while waste rock relocation was occurring, and on September 3 when that work was halted for the season.

Quality assurance/quality control (QA/QC) sampling included collection of three field method blanks (no field method blank was collected in July), and four duplicate samples. Nine trip blanks were included, associated with the seepage monitoring samples and additional compliance samples (i.e., from lakes not reported here). The QA/QC results are discussed in Section 4.

The reference monitoring sites were not sampled as per a recommendation in SRK (2024) as background conditions were established from the data collected at the reference sites in 2022 and 2023 and were not expected to change substantially.

Table 3-3. Summary of Seepage Monitoring Program Samples Collected in 2024.

Area	Monitoring Location	Sample Collected			
		May	June	July	August
Ore pad, southwest	Seep-01	Yes	Yes	Yes	Yes
Ore pad, northwest	Seep-05	Yes	Yes	Yes	Yes
Ore pad, southeast	ULU-8A if flowing, otherwise ULU-8	Yes ULU-8	Yes ULU-8	Yes ULU-8A and ULU-8	Yes ULU-8
Camp pad, north	Seep-17	Yes	Yes	Yes	Yes (two)
Camp pad, south/landfill	ULU-15	Yes	Yes	No – dry	No – dry
Waste rock portal pad area, east	Seep-02	Yes	Yes	Yes	No – dry
Waste rock portal pad area, west	Seep-13	Yes	Yes	Yes	Yes
Waste rock stockpile	ULU-7	No – audible flow present beneath boulders but could not be accessed	No – dry	No – dry	No – dry
Portal pond	ULU-4a	No – mostly frozen	Yes	Yes	-
East of portal pond	ULU-4b	Yes	Yes	-	-
East of portal pond	Pool-4c	Yes	No – dry	-	-

Source: compiled within body of report from information provided by Blue Star Gold

3.3 Analytical Methods

3.3.1 Rinse Tests

Where necessary prior to sieving, gravel samples were spread out on trays indoors and dried at room temperature. Rinse testing was conducted on the −2 mm fraction of each sample. The method is documented in SRK (2022d) and uses a 1:1 ratio (by weight) of sample to de-ionized water. pH and conductivity were measured in the samples, and in blank tests containing only de-ionized water.

3.3.2 Seepage Analysis

The following chemical parameters were measured in the field at seepage sampling locations:

- pH and electrical conductivity (EC); and
- Oxidation reduction potential (ORP) or dissolved oxygen (DO) (depending on which meter was available/functioning at site).

Samples were submitted to Bureau Veritas Labs (BV) in Yellowknife and then forwarded to BV in Calgary for analysis of the following parameters:

- Lab pH and EC;
- Total suspended solids (TSS), total dissolved solids (TDS), hardness, acidity;
- Anions (alkalinity, sulphate, chloride, nitrate, nitrite, ammonia, bromide, fluoride); and
- Total and dissolved metals.

3.4 Seepage Data QA/QC and Compilation

SRK checked sample receipt confirmation reports issued by the lab for correct sample login and analytical requirements. SRK compiled the seepage lab results with field data provided by Blue Star, for QC assessment (Section 4). Seepage results were subsequently compiled with the seepage results from previous years of monitoring for data interpretation. The compiled seepage data is shown on charts throughout this report and in Appendix C, and all seepage data are provided in Appendix D.

3.5 Data Interpretation Methods

3.5.1 General

Where results were below the detection limit (DLs), the DL value was used in charts and calculations.

3.5.2 pH, ARD and Acidic Water in the Tundra

For the purpose of classification, direct drainage from an infrastructure pad (contact water) that has pH of 5 or below is considered to be acidic (ARD). Drainage with pH 5 to 6.5 is considered mildly acidic. pH 6.5 to 8 is considered circum-neutral, and pH above 8 is considered alkaline.

A localized area within an infrastructure pad that has pH less than 5 (identified through rinse pH testing) is not considered acidic unless it produces drainage with pH less than 5, i.e., surface or sub-surface flow out of the pad.

Water within the tundra may have acidic pH that is not necessarily ARD as the tundra is expected to be naturally acidic due to the presence of organic acids, which is indicated by rinse pHs of pH 4.3 to 5.8 from background tundra soil samples measured in 2022 (SRK 2023). Acidic waters caused by organic acids typically have much lower conductivity than typical acidic waters resulting from oxidation of sulphide minerals.

Seepage from the infrastructure pads is expected to interact with the tundra which may lower the pH of the seepage if the source drainage had circum-neutral pH but low alkalinity.

Within the seepage monitoring program, attempts have been made to establish whether water sampled in the tundra represents:

- Flow (or recent flow) from the infrastructure pads, that may have minor interaction with the tundra but is indicative of the direct influence the pads are having on drainage chemistry, and the processes (geochemical reactions) occurring in the pads.
- Standing water (with no visible flow) that likely originated from the infrastructure pads (through sub-surface drainage) but may have been modified through extended interaction with the tundra, or evaporation. The chemistry of standing water could become more "severe" (e.g., lower pH) or concentrated through extended tundra interaction and/or evaporation, in which case it is no longer indicative of drainage chemistry from the pads; however, it would still represent the conditions present downgradient of the pads in water that may have the potential to migrate further downstream.

Where there is a lack of direct flow out of the pads, the difference between these scenarios is important for data interpretation and understanding whether ARD from the infrastructure pads is present. Water that is considered likely to have drained from an infrastructure pad (through sub-surface flow) that has pH of 5 or below may be considered ARD based on interpretation of other results such as field conductivity, concentrations of sulphate and metals, and context from the up-stream/up-gradient rock. This is discussed with the results in Section 5.

3.5.3 Methods of Metal Leaching Interpretation

The 2020 to 2024 seepage data were used to interpret metal leaching characteristics, trends and controls. Metal leaching interpretation included:

- Assessment of major ions and their proportions to indicate dominant processes controlling water chemistry.
- Assessment of the molar ratio of calcium plus magnesium (representing calcite and dolomite dissolution) to sulphate (representing sulphide oxidation) with pH to provide an indication of how effectively carbonate minerals are neutralizing the acid generated by sulphide oxidation.
- Charting of key parameters against time to examine trends from 2020 through 2024.
- Charting of key parameters against pH and sulphate to examine controls.
- Assessment of current parameters of concern through comparison of the seepage data (dissolved concentrations) to applicable water quality guidelines and regulations. These include:
  - The Nunavut Water Board Water License (NWB-WL) effluent quality limits (Table 1-1) for the Ulu project. The limits are applicable to total metal concentrations; however, they are shown here on the dissolved element charts as the focus is on metal leaching resulting from mineral dissolution.
  - Canadian Council for Ministers of the Environment (CCME) water quality guidelines for the protection of aquatic life, freshwater (PAL-FW), long-term (CCME 2021). These are applicable to lake inflows. Additionally, the FCSAP (2012) interim groundwater quality guidelines are applicable to groundwater in the active zone of permafrost areas and would therefore apply to seepage from the infrastructure pads that travels sub-surface through the tundra to downgradient lakes. For inorganic parameters, the FCSAP groundwater quality guidelines are

based on the CCME PAL-FW guidelines (as no distinct guidelines exist for wildlife watering or soil organism pathways for these parameters). Therefore, the CCME guidelines are shown on the charts; however, they should be considered applicable to all samples.

- For sulphate, the BC guideline for PAL-FW (MOE 2013) of 218 mg/L is used (for soft to moderately soft water) as no CCME sulphate guideline exists. The BC guideline has been adopted for use in other Canadian jurisdictions.

4 Quality Control Results

SRK used the three field method blanks and five duplicate sample pairs along with the broader lab and field data for QC evaluation of the overall seepage dataset. The nine trip blanks were used to evaluate potential external contamination (outside of the sampling procedures).

A summary of the QC checks performed are summarized in Table 4-1, along with SRKs acceptance criteria, and the results of the QC analysis. The QC failures are discussed below (see letter reference to the failures in the table below).

A – One field blank (DI water sampled and filtered in the field) had levels of dissolved barium and strontium (7 to 10 times DLs) that are often seen with the filtration cups used at Ulu. The source of this contamination could also potentially be from the HDPE bottles used for sample collection (Reimann et al., 2007). However, the field blank had higher dissolved barium and strontium than total barium and strontium suggesting the source of contamination was more likely from the filtration cup. The level of barium and strontium contamination was lower than concentrations observed in the seepage samples and total fractions were greater than dissolved fractions in the seepage samples (within 30% RPD for samples >10x DL); therefore, contamination of barium and strontium in seepage samples is not considered significant.

B – One trip blank (which was not opened at site) had levels of total tin (94x DL) and dissolved tin (6x DL) that failed the QC criteria (SRK and BV's). The rerun confirmed the measured concentrations. This contamination in the trip blank was considered insignificant as all water samples had total and dissolved tin concentrations below the limit of detection.

C – One sample failed for having dissolved metal results higher than total metal results for zinc, which was confirmed in a sample rerun. Heterogeneity is expected in flowing water.

Overall, the dataset was considered acceptable.

Table 4-1. Seepage QA/QC Results.

QC Test	SRK QC Criteria	Results and Comments	Comment Reference
Physical Test[1]			
Field Blank (n=3)	<5X DL; pH is within 5-6.	SEEP-00C (8/13/2024) failed at 4.82. As per lab, DI water can lie between 4.8-5.5.	
Trip Blank (n=9)	<3X DL	All passed.	
Field vs. Lab pH Samples (n=32)	Within 1 pH unit difference.	All passed.	
Field vs. Lab Conductivity (n=32)	For samples >10X DL, should be within +/-30% RPD.	In May, field EC was biased high due to not calibrating in the field due to lack of calibration solution.	
Field Duplicate (n=4)	For samples >10X DL, should be within +/-30% RPD. For pH should be +/-0.2 difference pH units.	All passed.	
Anions and Nutrients[2]			
Field Blank (n=3)	<5X DL	All passed.	
Trip Blank (n=9)	<3X DL	All passed.	
Field Duplicate (n=4)	For samples >10X DL, should be within +/-30% RPD.	All passed.	
Ion Balance (n=32)	For EC>100 uS/cm, % difference should be within +/-10%.	All passed.	
Trace Elements with ICP-MS Finish			
Field Blank (n=3)	<5X DL	SEEP-00C (8/13/2024) failed for: D-Ba, D-Sr. Reruns confirmed.	A
Trip Blank (n=9)	<3X DL	TRIP BLANK-07 (7/15/2024) failed for: T-Sn at 93.5X DL (outlier). Rerun confirmed. Flagged TRIP BLANK (5/15/2024) for D-Sn at <6X DL but not a parameter of concern.	B
Field Duplicate (n=5)	For samples >10X DL, should be within +/-30% RPD. For ICP metal scan, it is acceptable for 10% of parameters to be outside of this criterion.	All passed.	
Total vs. Dissolved Metals (n=32)	For samples >10X DL, Total metals>Dissolved metals, (Dissolved metals-Total metals)/(average(total metals, dissolved metals) is within +/-30% RPD. For ICP metal scan, it is acceptable for 10% of parameters to be outside of this criterion.	SEEP-13 (6/10/2024) failed for: Zn. Rerun confirmed.	C

Source: https://srk.sharepoint.com/sites/NACAPR003217/Internal/Task400_ML-ARD Monitoring/400-05_Lab liaison and QC/[Ulu_Compiled_QAQC_Seepage_CAPR003217_rtc_rev00.xls]

Notes
1 – parameters include Conductivity, pH, Acidity (pH 4.5), Acidity (pH 8.3), Total Dissolved Solids (TDS), Total Suspended Solids (TSS), Turbidity.
2 – parameters include: total alkalinity and species, Br, F, Cl, SO_4, total ammonia, NO_2, NO_3

5 Results

5.1 Introduction

Rinse pH and seepage results are discussed by area, incorporating both the existing understanding of the pH weathering conditions of the rock, and the down-gradient seepage chemistry. Discussion of the rinse pH results at the start of each area incorporates both the 2024 results and the previous monitoring data to summarize the degree of acidification of the rock.

Two main types of charts are used in the following sections to show the seepage data:

- Multi-parameter charts against time are used to show seasonal and longer-term trends for each of the key seeps that have been identified for on-going monitoring (Table 3-1, Section 3.2). For each of these seeps, several charts are shown with parameters grouped as follows: i) pH and alkalinity (as indicators of pH and carbonate buffering), ii) sulphate, calcium, magnesium, sodium, silicon, potassium (as indicators of the main minerals dissolving), iii) aluminum, iron, manganese (grouped as typically strongly controlled by pH and redox), iv) zinc, nickel, copper, selenium, cadmium, arsenic (grouped as released through sulphide oxidation).
  - It is notable on these charts that the period of data varies between years (e.g. some years only have late freshet data) and 2024 is the first year where the full season from peak freshet to late August has been represented. This complicates data comparison between years, as seasonal variation within a year (due to dilution) is typically expected to be a strong control on concentrations.
- Scatter plots comparing parameters, with multiple seeps plotted, and showing the water quality guidelines (as discussed in Section 3.5.3). In these charts the following formatting is used throughout:
  - Samples from the two reference locations (Ref-03 and Ref-06 data from 2022 and 2023; SRK 2024a) are shown with pink squares.
  - Samples that represent waste rock contact water from the infrastructure pads are shown with filled grey symbols. These are seeps that drain directly from the rock without traversing the tundra.
  - Seeps that flowed across or surfaced within the tundra are shown with filled green symbols. These seeps are more likely to be influenced by the tundra and background waters, than the contact water seeps.
  - Seepage flowing into downstream lakes is shown with filled blue symbols. These are also expected to be influenced by the tundra and background waters and provide an indication of potential for downstream dilution or attenuation.
  - Ore pad seeps are represented by circles, camp pad seeps by triangles, and waste rock-portal pad seeps by squares (includes for contact water, tundra seeps and lake inflows). Different shades (light versus dark) are used for seepage from different parts of the pads as indicated in the chart legends.

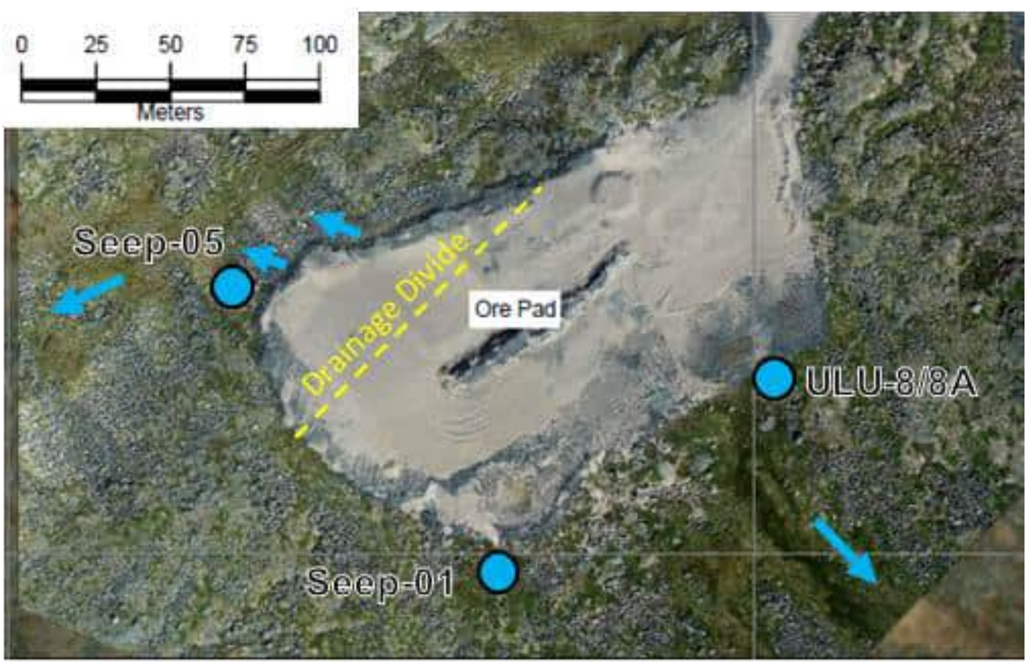
- Additional field data (samples with no lab results) are shown on a few pH and conductivity charts with the above colour formatting, but different symbols.
- Samples from the portal area ponds are shown with open black squares. At times (historically and in 2020) portal pond water was discharged and drained through the waste rock-portal pad and downstream into East Lake, and therefore influenced seepage water chemistry.
- Seepage in the portal area is shown with open grey squares.
- The landfill seepage is shown with a green diamond.

Key charts are shown in the text with the full set of charts shown in Appendix C.

5.2 Ore pad

Snowmelt and rainfall are thought to drain directly down into the flat surface of the ore pad, rather than run off. Most of the drainage from the ore pad appears to be sub-surface. There is a drainage divide (Figure 5-1) based on the original topography. The northwest section of the ore pad drains to the northwest and west towards Lake G43 in the West Lake catchment (Figure 5-1 Figure 3-3). The rest of the ore pad drains south towards East Lake (Figure 5-1, Figure 3-3, in the Ulu Lake catchment). These natural (somewhat swampy) drainage paths have been observed to contain surface flow associated with melting snow at freshet, further down-gradient from the ore pad where gradients are steeper. However, the extent of shallow sub-surface flow paths receiving loadings from the rock in the ore pad is not well understood.

Figure 5-1. Ore Pad Drainage Divide with Key Seeps and Generalized Drainage Directions.



5.2.1 Ore Pad Drainage Paths (South of the Drainage Divide)

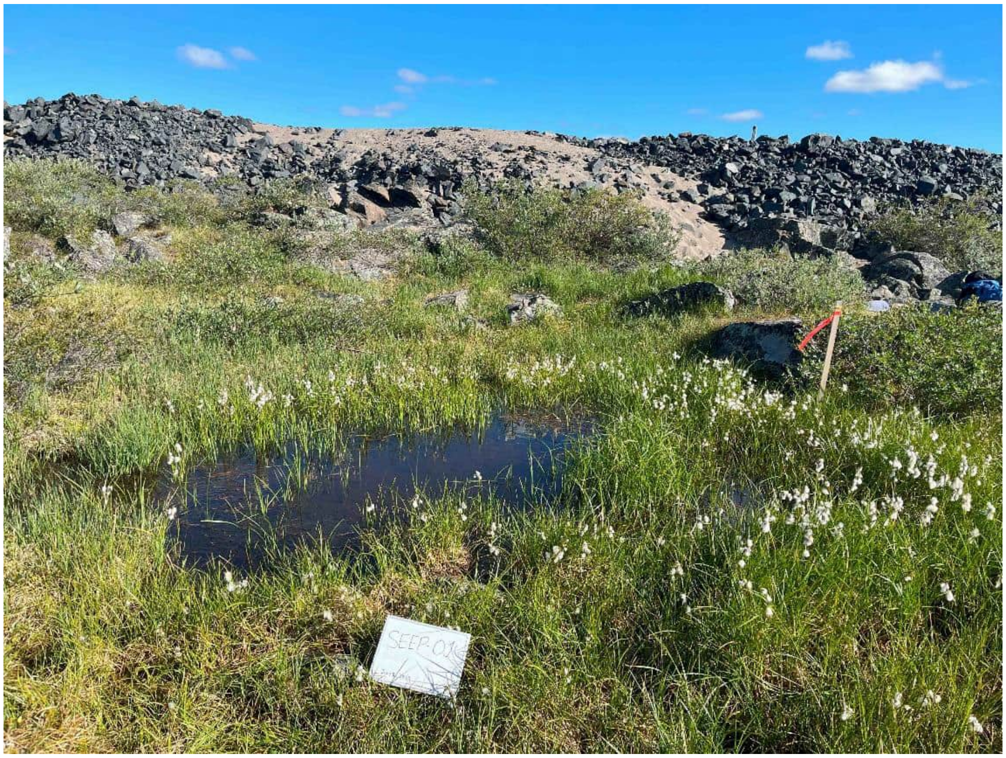
Only one site of flowing water directly out of the ore pad has been found since the seepage monitoring program was formalized in June 2021 and this occurs at ULU-8A. Flow at ULU-8A immediately becomes sub-surface, draining to the ULU-8 compliance station, 5m from the edge of the ore pad (Figure 5-1).

It appears that sub-surface drainage at ULU-8, pools amongst large glacial boulders, that provide a depression for shallow groundwater to daylight (Figure 5-2). ULU-8 typically has standing water, but flowing water is observed when the up-gradient ULU-8A is flowing. Flow returns to the sub-surface away from the boulders. Seep-06 is the inflow to East Lake at the bottom of the drainage from the south side of the ore pad (Figure 3-3). It has been sampled in previous years (SRK 2024a) but was not monitored in 2024.

Seep-01 at the southwest corner of the ore pad is a pool in a depression within the tundra a few meters from the ore pad (Figure 5-3). No flow into the pool from the ore pad has been observed. It is unknown if there is sub-surface flow out of the depression down to Seep-06.

Figure 5-2. Looking SE From the South Edge of the Ore Pad (Above ULU-8A) to ULU-8.

Figure 5-3. Seep-01 Looking North to the Edge of the Ore Pad.



5.2.2 Ore Pad Rinse pH (South of the Drainage Divide)

The southeast part of the ore pad contained mineralized rock that was stockpiled upgradient of ULU 8/8A until it was relocated to the portal/mine sump area in 2018 (Figure 1-1). Strongly rusted rock remains on the surface of the ore pad at this location and white precipitates are common. At this site in 2020, brown rusted rock extended down to 0.7 m and had rinse pH of 7.4 (SRK 2021).

Other test pit samples from the ore pad, south of the drainage divide had rinse pH's of 8.2 to 8.6 in 2020 and 7.9 to 8.2 in 2023, except near the southwest corner of the ore pad (above Seep-01) where a 2 m deep test pit in July 2023 contained strongly oxidized orange rock down to frozen ground. Rinse pH was 3.9 from a sample from 1.8 m deep. Also, just south of the drainage divide, rinse pH's of 3.2 (from 0.75 m deep) and 5.9 (in underlying rock) were present in one 2023 test pit.

Near-surface samples from the outer edges of the ore pad also had acidic rinse pH of 3.3 to 3.5 (in 2021).

The central part of the ore pad contains stockpiled acid generating rock that was relocated from Camp 3 and Culvert 6 in 2021 pending management, however this was covered with tarps (Figure 5-1). In August and September of 2024 mixed acid generating rock and PAG rock was relocated from the north edge of the ore pad to south of the drainage divide, in preparation for interim management (Figure 5-4).

Much of the rock in the ore pad (south of the drainage divide) therefore still appears to be weathering at circum-neutral pH; however, areas of acid generating rock have been identified, particularly along the south edge of the pad. Rock directly up-gradient of Seep-01 is more problematic as acid generating rock extends to 2 m, and rock directly upgradient of ULU-8/8A is more problematic due to leaching of weathering products likely resulting from the previously stockpiled mineralized rock. The newly placed acid generating rock is also particularly problematic; however, there are plans to cover this for mitigation.

Figure 5-4. Newly Relocated Rock on the Ore Pad (August 2024), Looking SE from the Covered Thermistor Site (Shown in Figure 5-1).

5.2.3 Ore Pad Seepage Results (South of the Drainage Divide)

The ore pad seeps are generally observed as standing water pools in low points in the tundra, although surface flow has been recorded periodically at Seep-01, and ULU-8/8A, including in late July/early August in 2020 and at ULU-8/8A in July 2023. In 2024 flowing water was again documented in July at ULU-8A.

In May 2024, SRK and Blue Star observed freshet and the formation of standing water pools at ULU-8 and Seep-01 from melting of in situ snow and ice. Sub-surface drainage into these pools from the ore pad is also assumed to occur, based on the seepage results.

Although acid generating rock has been identified at the edge of the ore pad directly up-gradient of ULU-8/8A, the seepage pH indicates that contact water is currently neutralized before it exits the pad and ARD is not present. All ore pad seepage charts, and comparison to water quality limits are provided in Appendix C (Figures C1–C38).

pH and Conductivity Trends in 2024

Measured pH at ULU-8/8A and Seep-01 were generally consistent between the two locations in 2024, ranging from 6.0 to 7.2 and 5.9 to 6.5, respectively (Figure 5-5). At ULU-8/8A, pH varied through the summer months; whereas at Seep-01, pH gradually decreased through the summer from 6.5 in May to 5.9 in August. Previously, pH values at ULU-8 (about 5 m from the south edge of the pad) between 2020 and 2023 have ranged from 6.0 to 6.7 when there has been no flow recorded, but with higher pH values of 6.7 to 7.7 in water flowing directly out of the edge of the pad (at ULU-8A in 2023 and four additional locations informally recorded as -8a, -8b, -8c and -8d in 2020).

Electrical conductivity measurements at both seeps increased through the season in 2024, with lowest values being recorded during freshet in May and June (Figure 5-6). By August, conductivity values at ULU-8/8A and Seep-01 were 1569 and 1095 µS/cm, respectively. Highest conductivities have occurred late in the season and been similar between ULU-8 and -8A, as well as similar over time.

Major Ions

During 2024, the major anions present in seepage on the south side of the ore pad were sulphate, alkalinity, and chloride. In terms of molar equivalent proportions sulphate was the dominant anion in ULU-8/8A (Figure 5-7, Figure 5-8) and Seep-01 (Figure 5-11, Figure 5-12), and comprised 64% to 96% of the total anions, followed by alkalinity (4–25%) and then chloride (1–27%) (Appendix D). The anion molar proportions indicate that sulphide oxidation was the dominant process influencing water chemistry. Alkalinity represents the waters capacity to neutralize acid and limit pH decline and is generated through carbonate (and to a lesser degree silicate) mineral dissolution.

Chloride concentrations were below the CCME water quality guideline in 2024, although one sample from ULU-8/8A (August, chloride = 110 mg/L) approached the water quality guideline (120 mg/L). The presence of chloride in some of the seepage appears to be related to use of sodium chloride during portal development and ore extraction (Klohn-Krippen 1998). Chloride has shown a decline at ULU-8/8A in terms of both concentrations and molar proportion of total anions between 2020 and 2023, from 24-42% of the total anions in 2020 to 2-5% of the total anions in 2023. This is likely to be related to removal of the stockpiled ore from the ore pad in 2018 when it was relocated to the portal-mine sump area (Figure 1.1). Prior to 2018, saline water was likely predominantly frozen in the stockpiled ore porewater and/or in the pad beneath the stockpile (frozen due to the greater thickness of rock associated with the stockpile). Removal of the ore stockpile appears to have allowed thawing at that location, facilitating the saline water to seep out of the ore pad at ULU-8/8A. The high concentration of chloride measured in August at ULU-8/8A suggests that chloride is still being flushed from the ore pad.

Sulphate concentrations exceeded the BC water quality guideline (218 mg/L) in four out of 5 samples at ULU-8/8A and two out of 4 samples at Seep-01. Sulphate concentrations ranged from 59 to 400 mg/L and 17 to 530 mg/L at ULU-8/8A and Seep-01, respectively in 2024. Sulphate concentrations at ULU-8/8A were consistent with previous years of data following freshet but had lower sulphate in May 2024 reflecting earlier sampling and greater dilution than previous years. Historic data for Seep-01 is sparse and the highest sulphate concentrations were observed at this location in 2024.

Similar to previous years, calcium was the predominant major cation present in ULU-8/8A (Figure 5-8) and Seep-01 (Figure 5-12) followed by magnesium, sodium, and potassium. Calcium and magnesium together proportionally made up 69 to 95% of the total cations. At ULU-8/8A, however, sodium accounted 29% of the total cation proportions in August 2024, consistent with previous samples collected late in the season, and consistent with proportionally higher chloride.

The molar ratio of dissolved calcium and magnesium to sulphate in contact waters, can be used with pH to provide an indication of the effectiveness of carbonate minerals to neutralize the acid generated by sulphide oxidation in waste rock. Contact water seepage from ULU-8/8A had carbonate:sulphate molar ratios between 0.97 and 1.14 (average of 1.03) and Seep-01 had carbonate:sulphate molar ratios between 0.95 and 1.29 (average of 1.05), both of which are consistent with previous year values. These ratios indicate that carbonate dissolution rates were just barely keeping up with the rates of local acid generation.

Trace Ions

Seasonal trends in trace element concentrations for ULU-8/8A and Seep-01 are shown in Figure 5-9 and Figure 5-10, and Figure 5-13 and Figure 5-14, respectively. Arsenic, copper, lead, nickel, and zinc have effluent quality limits through the NWB water license, and dissolved concentrations of these parameters were all below the maximum average and maximum grab sample limits at ULU-8/8A and Seep-01. Highest zinc was lower in 2024 (0.17 mg/L) than in 2023 (0.31 mg/L), with the higher concentration in 2023 possibly reflecting drier than typical conditions.

Nitrate, ammonia, arsenic, boron, chromium, lead, mercury, molybdenum, silver, thallium, and uranium concentrations were below the CCME water quality guidelines in ULU-8/8A and Seep-01 2024 samples. The following parameters had some 2024 results above the CCME PAL-FW water quality guidelines (all charts shown in Appendix C): aluminum, fluoride, cadmium, copper, iron, manganese, nickel, selenium, and zinc. Background levels of aluminum, copper, and fluoride are naturally elevated in the Ulu area based on concentrations in the reference stations in 2022 and 2023. The concentrations of these parameters at ULU-8/8A and Seep-01 were similar to the background.

As with sulphate discussed above, trace elements (i.e., cadmium, nickel, selenium, and zinc) had similar concentration ranges and trends to 2023 data. This provides an indication that contact waters are being increasingly impacted through the season by metal leaching associated with sulphide oxidation on the south side of the ore pad. Leaching of arsenic, cadmium, copper, iron, nickel, selenium, and zinc are associated with sulphide oxidation, and consistent with the presence of iron sulphides and trace chalcopyrite, sphalerite, arsenopyrite, and millerite in the waste rock (SRK 2022b). Leaching of manganese may also be associated with sulphide oxidation or carbonate dissolution.

Figure 5-5. Seep-01 and ULU-8/8A (2024) pH trends.

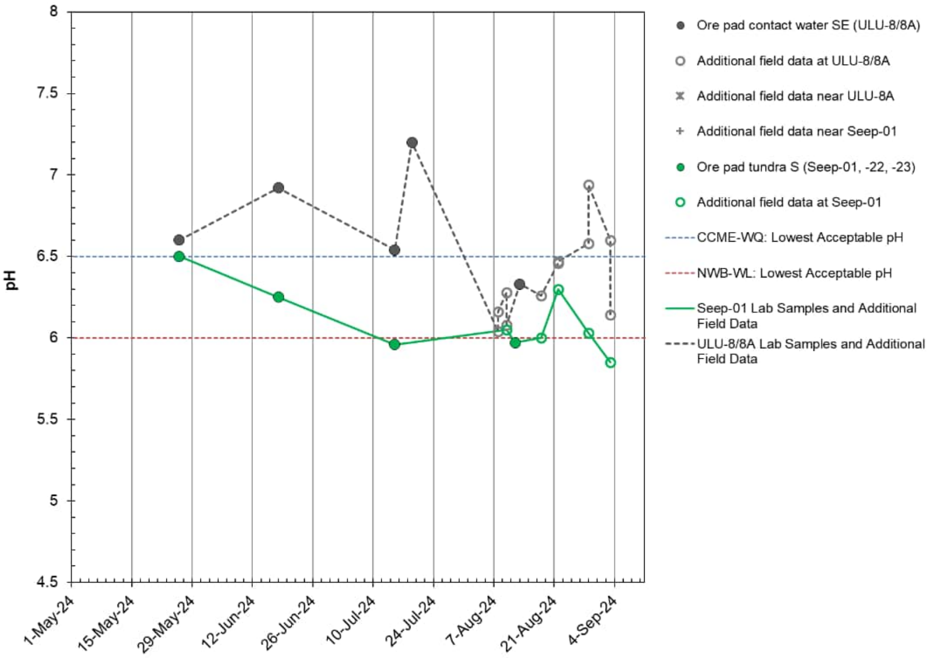


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Figure 5-6. Seep-01 and ULU-8/8A (2024) conductivity trends.

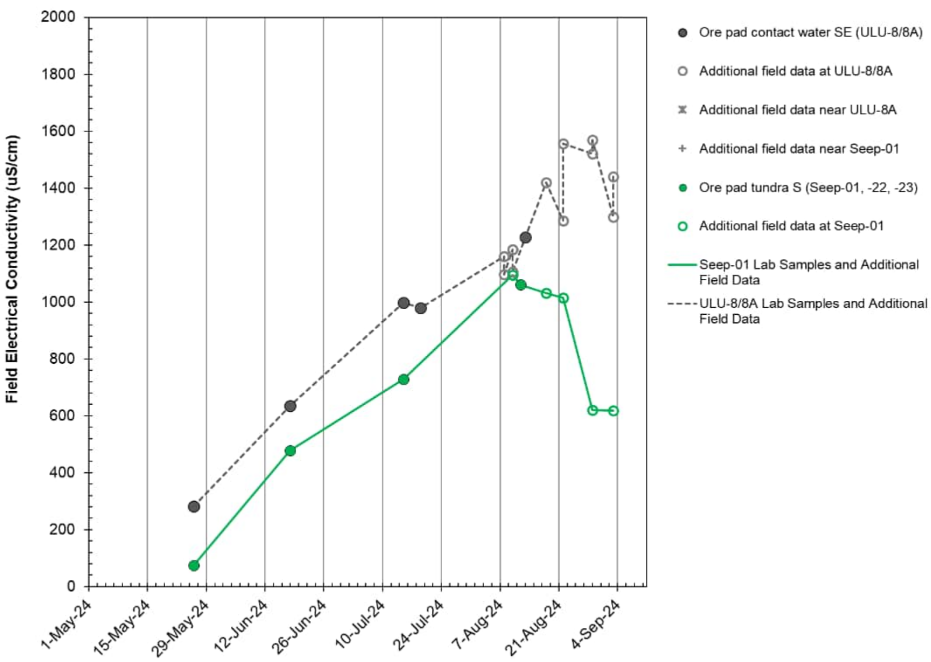

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Figure 5-7. Ulu-8/8A ore pad seepage pH and alkalinity.

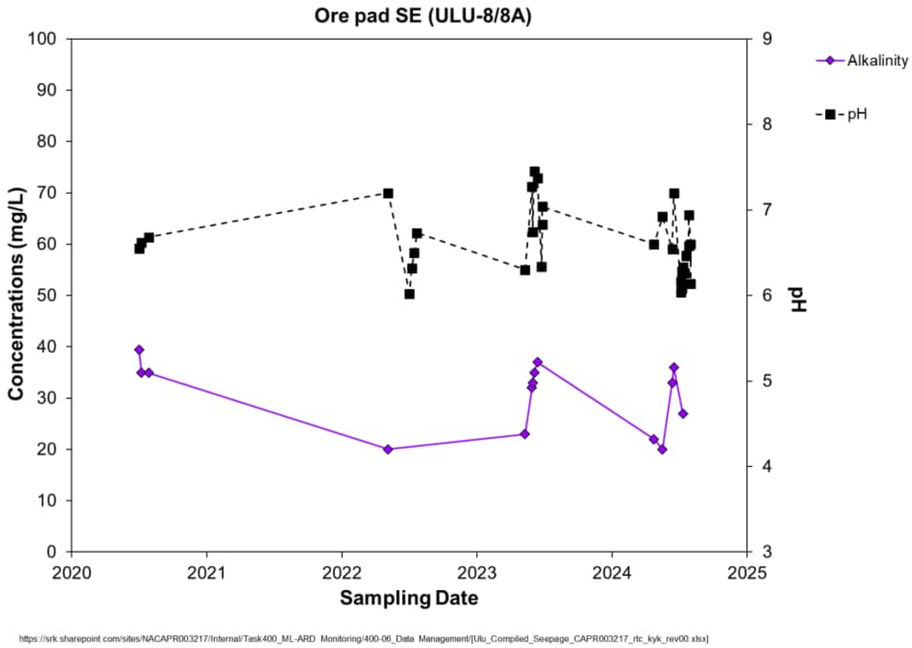

Figure 5-8. Ulu-8/8A ore pad seepage major cations and anions.

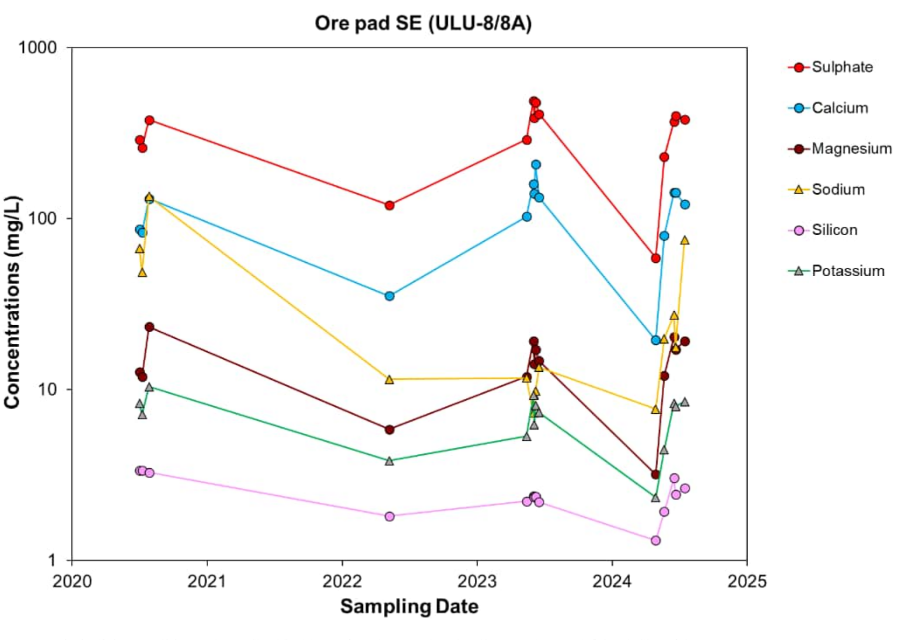

Figure 5-9. Ulu-8/8A ore pad seepage oxyhydroxide forming elements.

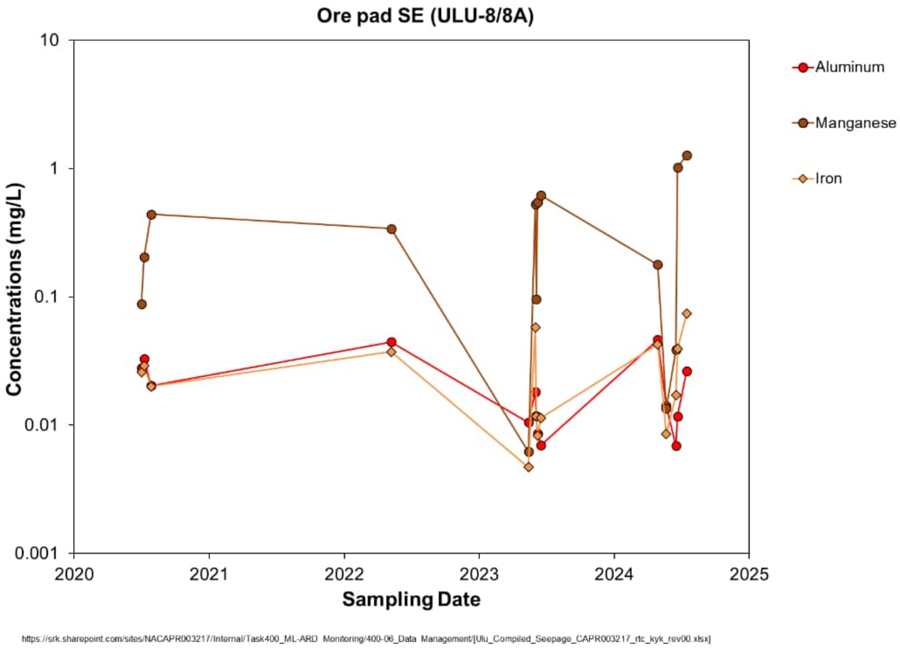

Figure 5-10. Ulu-8/8A ore pad seepage trace elements.

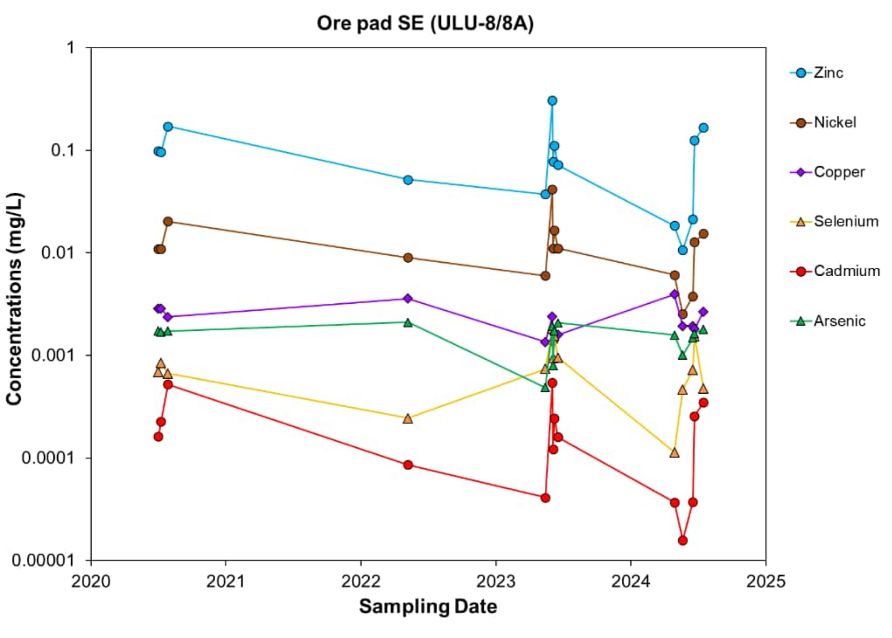

Figure 5-11. Seep-01 ore pad seepage pH and alkalinity.

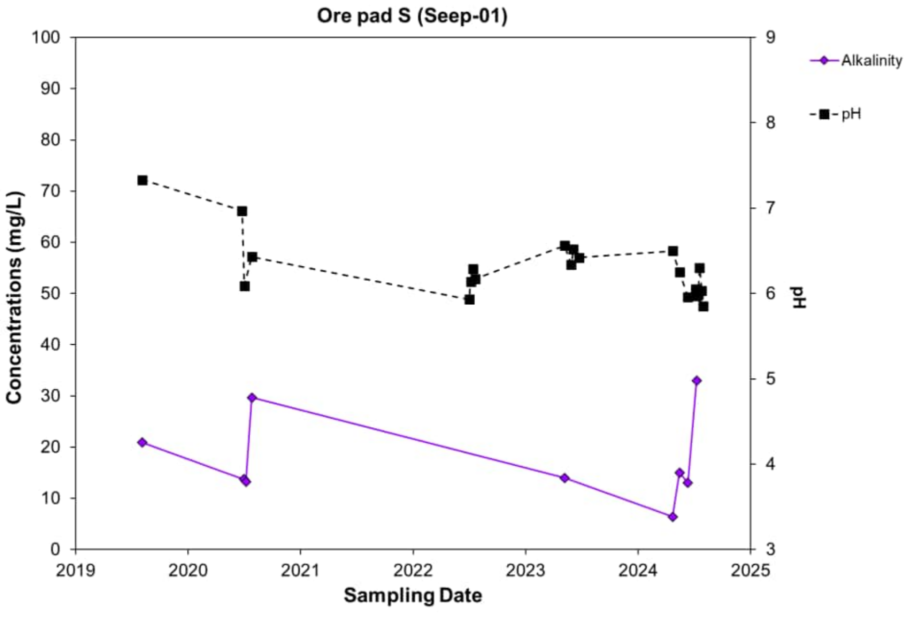

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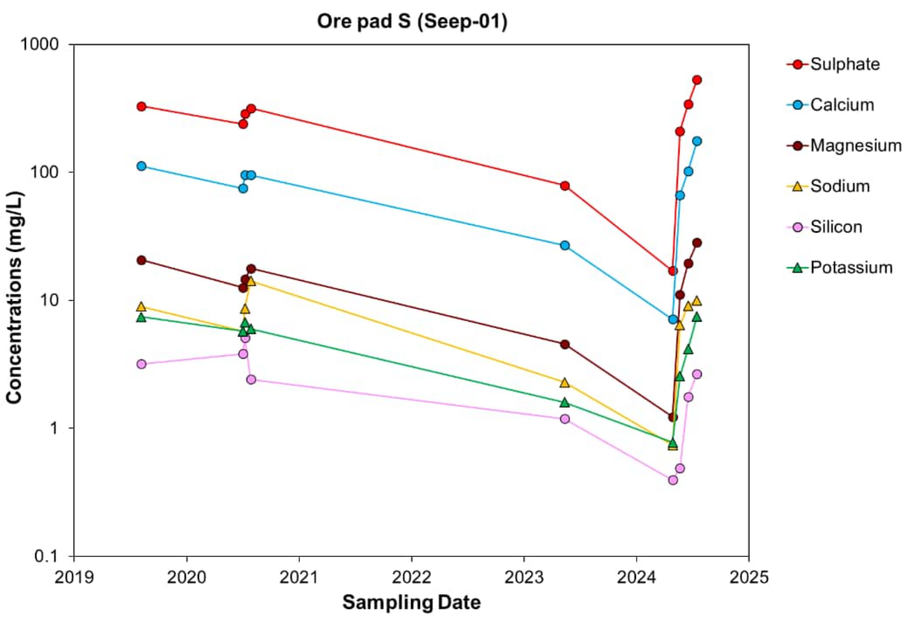
Figure 5-12. Seep-01 ore pad seepage major cations and anions.



https://srk.sharepoint.com/sites/NACAPR003217/Internal/Task400_ML-ARD Monitoring/400-06_Data Management/[Ulu_Compiled_Seepage_CAPR003217_rfc_kyk_rev00.xlsx]

Figure 5-13. Seep-01 ore pad seepage oxyhydroxide forming elements.

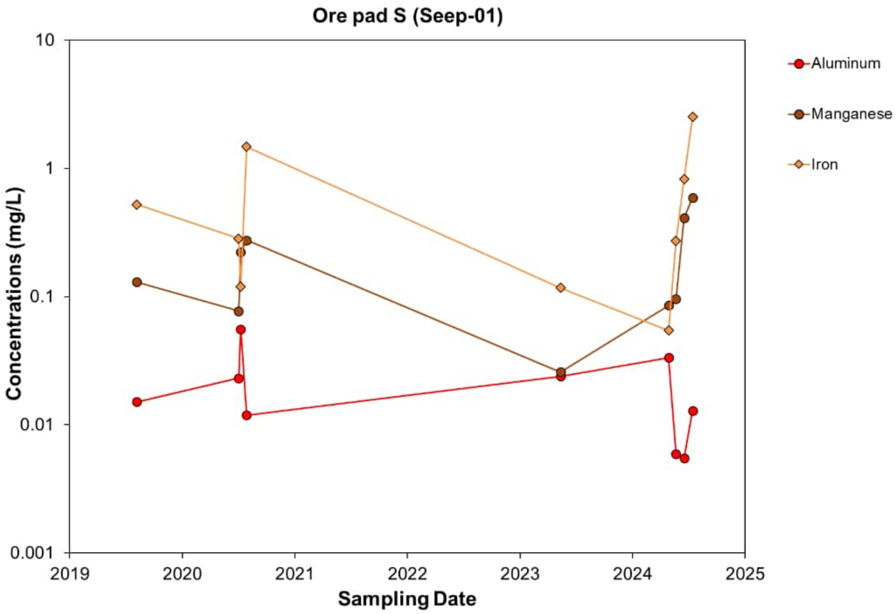


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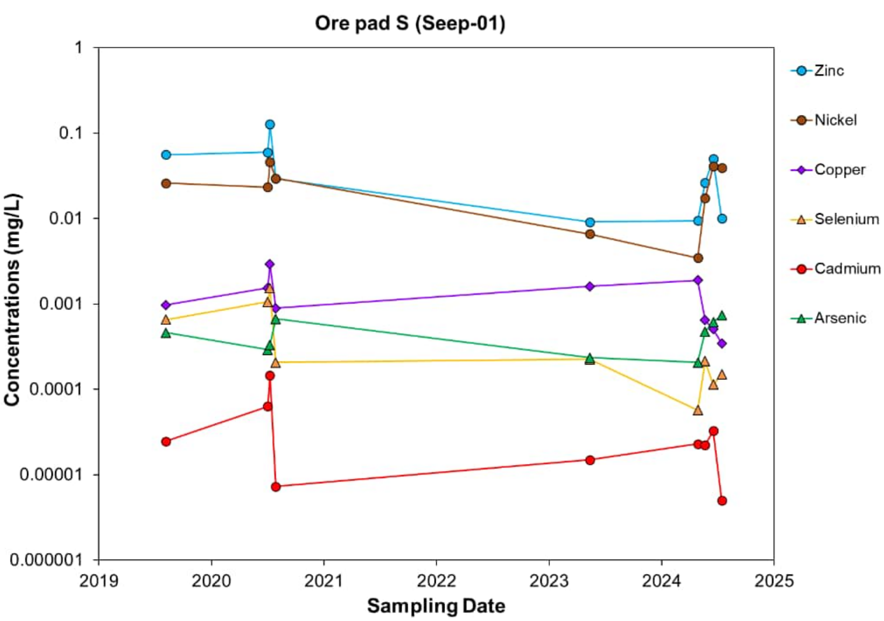
Figure 5-14. Seep-01 ore pad seepage trace elements.



https://srk.sharepoint.com/sites/NACAPR003217/Internal/Task400_ML-ARD Monitoring/400-06_Data Management/[Ulu_Compiled_Seepage_CAPR003217_rtc_kyk_rev00.xlsx]

5.2.4 Ore Pad Drainage Paths (North of the Drainage Divide)

North of the ore pad drainage divide, sub-surface flow is thought to drain to the northwest (Figure 5-1), where it daylights at Seep-05 (approximately 10 m from the NW corner of the ore pad) amongst large glacial boulders (Figure 5-15). Seep-05 typically has standing water and is at the start of a swamp that extends down-gradient to the west. Seep-12 is the inflow to Lake G43 at the bottom of the drainage from the north side of the ore pad (Figure 3-3). Seep-12 was sampled in previous years (SRK 2024a) but was not monitored in 2024.

Based on a pH-conductivity survey that tested in-situ pooled water amongst boulders along the drainage in July 2023, acidic pH's (pH 4.2 to 4.9) and conductivity an order of magnitude above background levels, were present within 25 m of the edge of the ore pad. Mildly acidic pH (6.0-6.3) and elevated conductivity extended from 25 m to 75 m from the NW corner of the ore pad, whereas conductivity was at background levels at 130 m from the corner of the ore pad (and pH remained mildly acidic, and similar to background). Sub-surface drainage was, therefore, interpreted to be impacted by acid generating rock at the edge of the ore pad (SRK 2024a).

Figure 5-15. Seep-05 Looking SE to the Ore Pad.

5.2.5 Ore Pad Rinse pH Results (North of the Drainage Divide)

Rock to the north of the ore pad drainage divide includes rock within the pad, and also residual rock left lying on the tundra from removal of part of the north edge of the pad in 2020 (Figure 1-1, Section 1.3.1, Figure 5-16). Part of the ore pad was not historically covered in esker sand (see pre-2018 ore pad inset in Figure 1-1), and this area contains more strongly oxidized rock than other parts of the pad. Where residual rock from this uncovered part of the pad was left exposed on the tundra, it had rinse pH of 2.9 in 2023 (SRK 2024a). Adjacent rock within the edge of the pad had rinse pHs of 3.6 to 7.9 in 2023, with acidic pH's associated with orange strongly oxidized rock, and circum-neutral pH's associated with grey rock with minor oxidation of sulphides (SRK 2024a).

During remediation works in August and September of 2024, the acid generating residual rock on the tundra was excavated, along with an adjacent area of the pad that had not been historically covered in esker sand and contained a mixture of orange and grey rock. Grab samples of the rock and underlying tundra soil, were collected by Blue Star during excavation and stockpiling of the rock onto the ore pad. Rinse test results for the 2024 grab samples are provided below.

Figure 5-16. Arial View of the North Edge of the Ore Pad Prior to Remediation in August 2024 (Looking East).

2024 Rinse pH Results

The 2024 sample logs and photographs are provided in Appendix B. The rinse test results for the ore pad samples collected in August 2024 are presented in Table 5-1, and rinse pH versus rinse conductivity are plotted in Figure 5-17 with samples collected from 2020 to 2024.

The 2024 results were as follows:

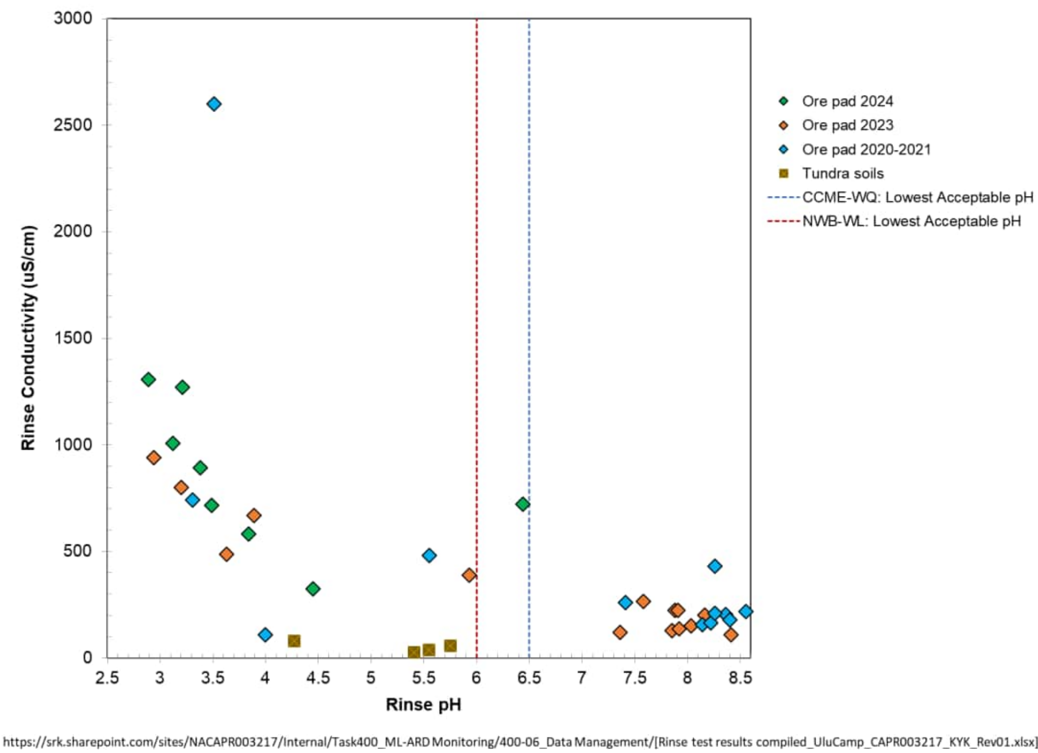
- Three out of the 4 samples identified as rock had rinse pH values less than 5.0 and were described as orange-brown and strongly oxidized. One sample was mildly acidic with a rinse pH of 6.4 (rock identified as grey at 20–25 cm depth). Rinse conductivity for all rock samples ranged from 720 to 1,300 µS/cm.
- All of the samples identified as tundra soil had a rinse pH of less than 5.0 (ranging from 3.2 to 4.5) and are classified as acidic. The rinse conductivity was variable, and ranged from 320 to 1,300 µS/cm.
- Highest rinse conductivities corresponded to the lowest rinse pH, likely due to the presence of soluble secondary sulphate minerals and is consistent with the brown-orange colour of the low pH samples, resulting from precipitation of oxidized iron on the surfaces of the weathered rock. Both sulphate and iron are expected to be released through oxidation of the pyrrhotite and pyrite present in the waste rock.

Table 5-1. 2024 Rinse Test Results for Ore Pad (North).

Area	Test Pit	Sample	Sample Depth (cm)	Material Type	Colour of <2 mm Sieved Fraction	Rinse pH	Rinse Conductivity (µS/cm)
Ore pad (North)	TP24-09	9A	0-10	Tundra Soil	Dark Brown	3.2	1300
Ore pad (North)	TP24-09	9B	40-45	Tundra Soil	Orange	3.8	580
Ore pad (North)	TP24-10	10A	0-10	Rock	Orange	2.9	1300
Ore pad (North)	TP24-10	10B	25-30	Tundra Soil	Brown	3.5	720
Ore pad (North)	TP24-11	11A	20-25	Rock	Grey	6.4	720
Ore pad (North)	TP24-12	12A	15-20	Tundra Soil	Orange/Brown	4.5	320
Ore pad (North)	TP24-13	13A	0-10	Rock	Orange	3.4	890
Ore pad (North)	TP24-14	14A	0-5	Rock/Tundra Soil	Orange	3.1	1000

Source: SRK Consulting\NA CAPR002649 Ulu Reclamation SOW 2023 - Internal\Task100_ML-ARD\160_Data management\Rinse test results compiled_UluCamp_KYK_Rev01.xlsx

Figure 5-17. Rinse pH vs rinse conductivity for 2024 Ore Pad samples.



5.2.6 Ore Pad Seepage Results (North of the Drainage Divide)

Similar to the south ore pad seeps (ULU-8/8A, Seep-01), no water flow in 2024 was documented at the north ore pad seep (Seep-05); however, sub-surface drainage into this pool from the ore pad is assumed to occur based on the seepage results. All ore pad seepage plots, including comparisons to water quality limits, are provided in Appendix C (Figures C1–C38).

pH and Conductivity Trends in 2024

Measured pH in 2024 at Seep-05 was consistent with 2023 pH values and trends, with pH ranging from 4.6 to 6.5 and decreased from freshet to early August and then increased (Figure 5-18). In previous years, the lowest recorded pH was 5.5 in 2020, pH 4.6 in 2022 and pH 4.8 in 2023. The drop in pH lows after 2020 corresponds in timing to disturbance of the nearby north edge of the ore pad. Acid generating rock has been identified at the edge of the ore pad directly up-gradient of Seep-05, and is thought to be impacting water quality. Electrical conductivity measurements increased through the season in 2024 from 87 to 1069 µS/cm, with lowest values being recorded during freshet in May and June (Figure 5-19). The highest electrical conductivity values for Seep-05 have also previously occurred late in the season.

Major Ions

At Seep-05, sulphate was the predominant anion present, which accounted for 81% to 97% of the total anions (Figure 5-21). Alkalinity and chloride were proportionally much lower between 0 and 14% and 3 to 6%, respectively. Similar to the south ore pad seeps, the anion molar proportions indicate that sulphide oxidation was the dominant process influencing water chemistry.

Chloride concentrations were below the CCME water quality guideline in 2024, whereas sulphate concentrations exceeded the BC water quality guideline (218 mg/L) in one out of 4 samples at Seep-05. Sulphate concentrations in 2024 (ranged from 20 to 560 mg/L) and were consistent with 2023 trends following freshet, where concentrations increased through the summer months (Figure 5-21).

Calcium was the predominant major cation present in Seep-05 followed by magnesium, sodium, and potassium (Figure 5-21). Calcium and magnesium together proportionally made up 86 to 92% of the total cations. Carbonate:sulphate molar ratios at Seep-05 ranged between 0.80 and 1.05 (average of 0.97), which is consistent with 2023 values. It remains unclear whether the seepage from the northwest part of the ore pad can be considered contact water and the degree to which the water chemistry was modified through tundra interaction or evaporation (Seep-05 is approximately 14 m from the edge of the ore pad). However, the results suggest that ARD is present seasonally at the northwest edge of the ore pad, and rates of sulphide oxidation (and corresponding acid generation) overwhelm rates of neutralization once the ore pad has thawed later in the season.

Notably, acid generating rock upgradient of Seep-05 had been removed by mid-September 2024 and placed in the center of the ore pad for management.

Trace Ions

Seasonal trends for oxyhydroxide forming metals (aluminum, manganese, and iron) are shown in Figure 5-22 and other trace elements are shown in Figure 5-23. None of the regulated parameters exceeded the NWB water license at Seep-05; although, the maximum zinc concentration measured in 2024 was 0.41 mg/L (August), which is approaching the NWB effluent quality limit.

Nitrate, ammonia, arsenic, boron, chromium, iron, lead, mercury, molybdenum, silver, thallium, and uranium concentrations were below the CCME water quality guidelines in Seep-05. The following parameters had some 2024 results above the CCME PAL-FW water quality guidelines (all charts shown in Appendix C): aluminum, fluoride, cadmium, copper, manganese, nickel, selenium, and zinc. Background levels of aluminum, copper, and fluoride are naturally elevated in the Ulu area; however, due to the lower pH at Seep-05 in late summer (4.6) aluminum and copper concentrations were two orders of magnitude higher than background, and fluoride was three times higher than background.

Aluminum concentrations are conventionally higher at lower pH. Aluminum is typically released through weathering of aluminosilicate minerals and the tundra is a potential source (the mineral component of tundra soils) based on aluminum concentrations present in the reference stations, or acidic weathering of aluminosilicate minerals in the waste rock.

As with sulphate discussed above, trace elements trends in 2024 (i.e., cadmium, nickel, selenium, and zinc) were consistent with 2023 trends and provide an indication that drainage was being increasingly impacted through the season by metal leaching and low pH associated with sulphide oxidation in rock within the north side of the ore pad.

Figure 5-18. Seep-05 (2024) pH trends.

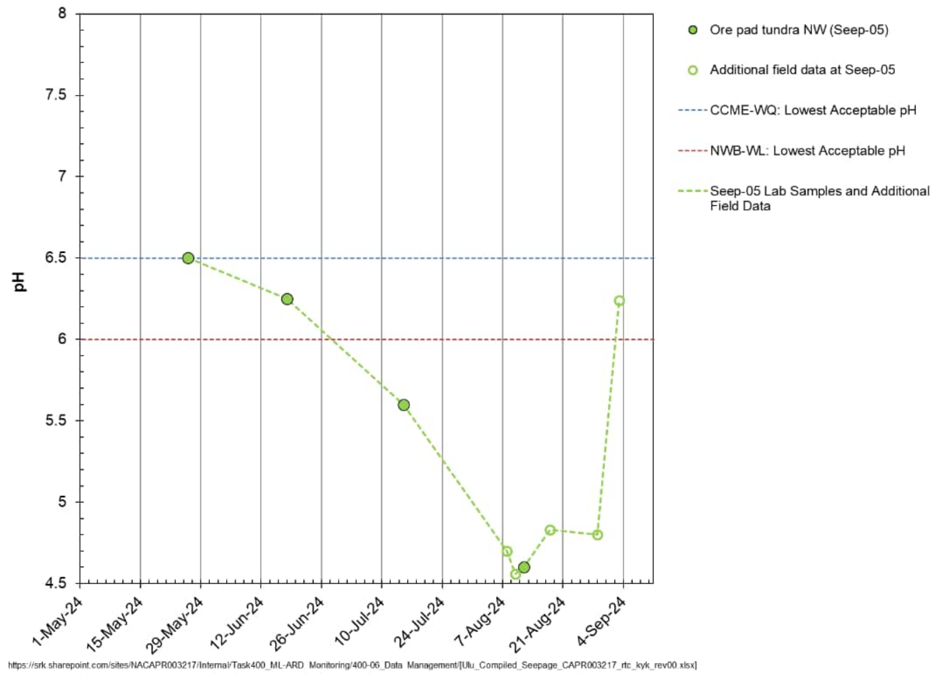


Figure 5-19. Seep-05 (2024) conductivity trends.

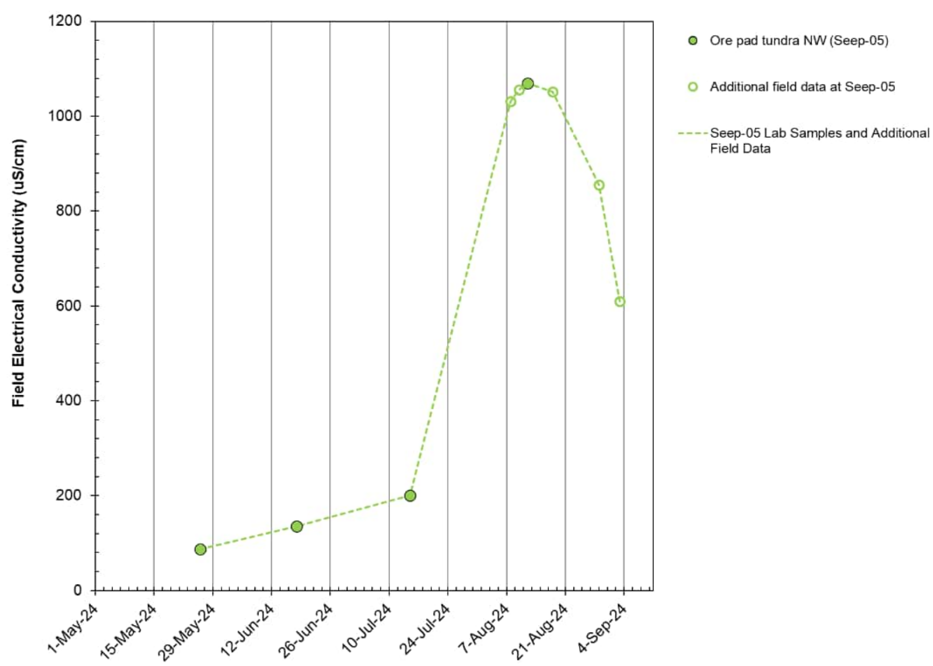


Figure 5-20. Seep-05 ore pad seepage pH and alkalinity.

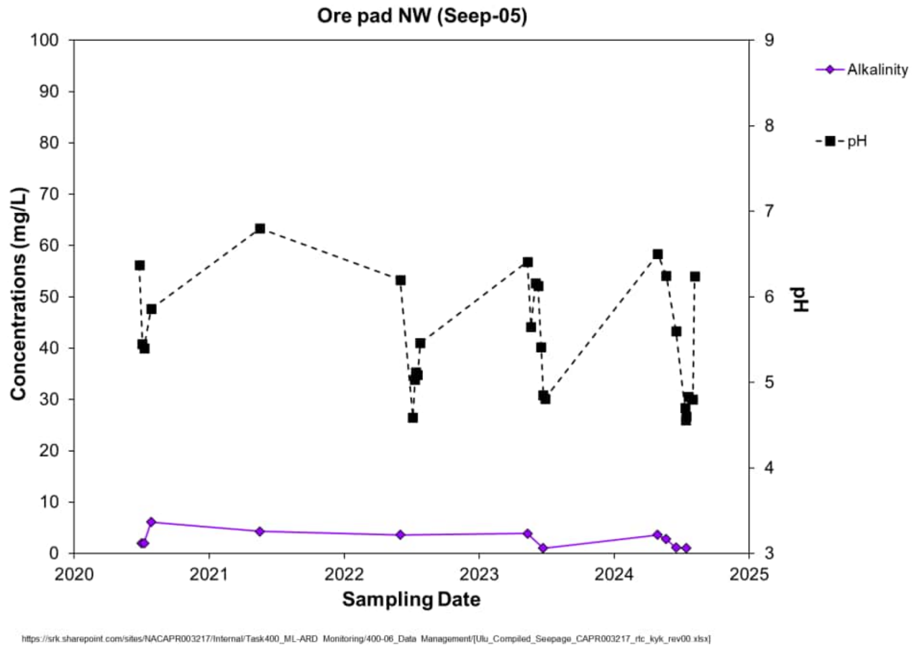


Figure 5-21. Seep-05 ore pad seepage major cations and anions.

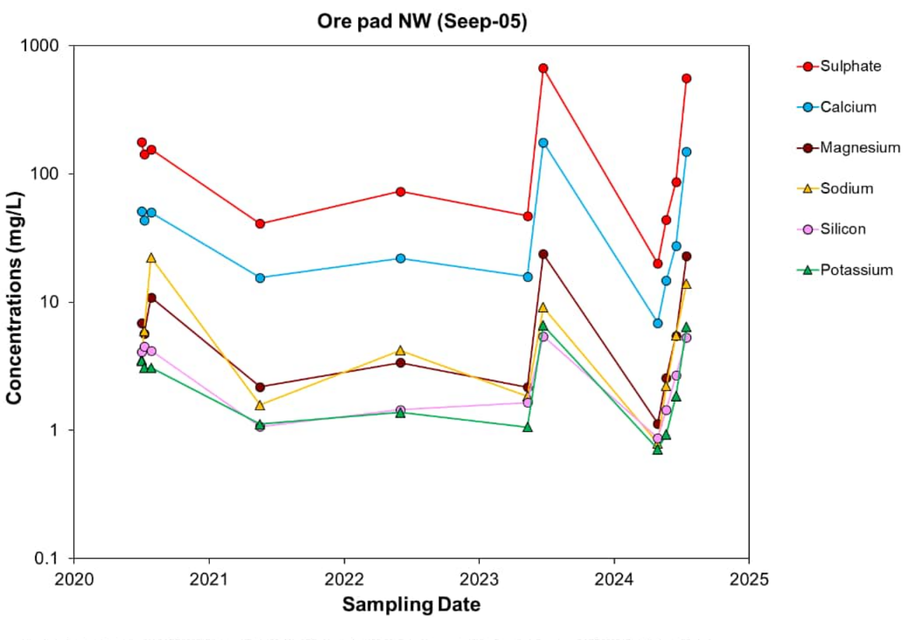


Figure 5-22. Seep-05 ore pad seepage oxyhydroxide forming elements.

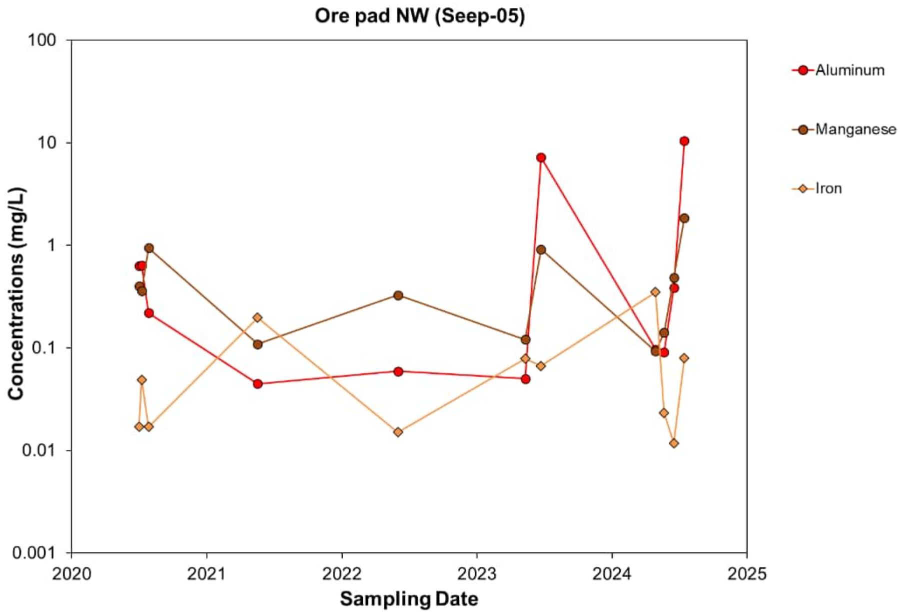


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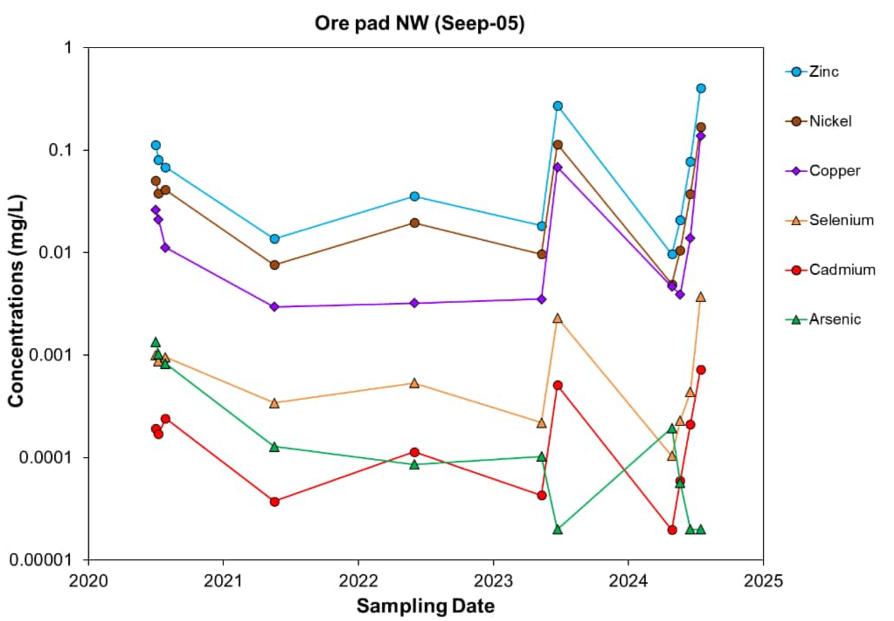
Figure 5-23. Seep-05 ore pad seepage trace elements.



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