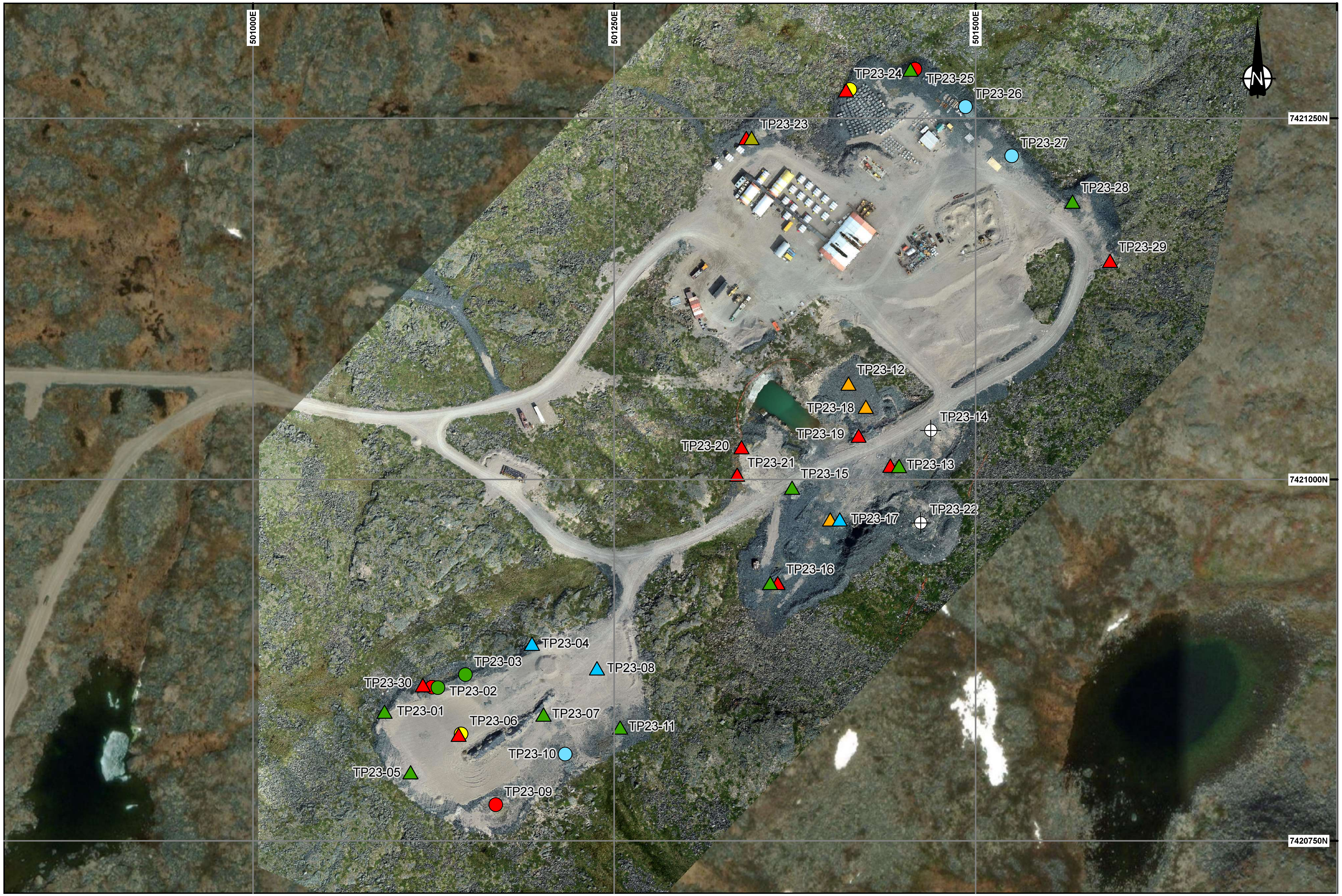


LEGEND

Depth < 1 m

Rinse pH Results

- pH < 3.99
- pH 4.0 - 4.99
- pH 5.0 - 5.99
- pH 6.0 - 6.99
- pH 7.0 - 7.99
- pH > 8.0

Depth 1 m or deeper

Rinse pH Results

- pH < 3.99
- pH 4.0 - 4.99
- pH 5.0 - 5.99
- pH 6.0 - 6.99
- pH 7.0 - 7.99
- pH > 8.0
- Not Excavated / Not Sampled

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: CAPR002649

LAYOUT: CAPR002649_Ulu_Annual_reports

BLUE STAR GOLD CORP.

Ulu

2023 ML/ARD Characterization

2023 Rinse pH Monitoring Results

Date:	Approved:	Figure:
Mar 2024	KYK	5.4

PROJECT PATH: C:\Users\MSMITH\SRK Consulting\FS725 Ulu - 040_AutoCAD\GIS\Projects\CAPR002649_Ulu_Annual_reports\CAPR002649_Ulu_Annual_reports.aprx - L-Fig 5-4_2023 Rinse pH Monitoring

Compilation of Acid Generating Locations

The map in Figure 5.5 shows all areas where acid generating rock (i.e. < pH 5) has been identified, in the infrastructure pads and at other site locations, based on a compilation of rinse pH results from 2020, 2021, and 2023 test pits and additional targeted near-surface sampling conducted in 2021 (at the edge of the ore pad, in the portal area, and the edge of the drill core storage area; SRK 2022b).

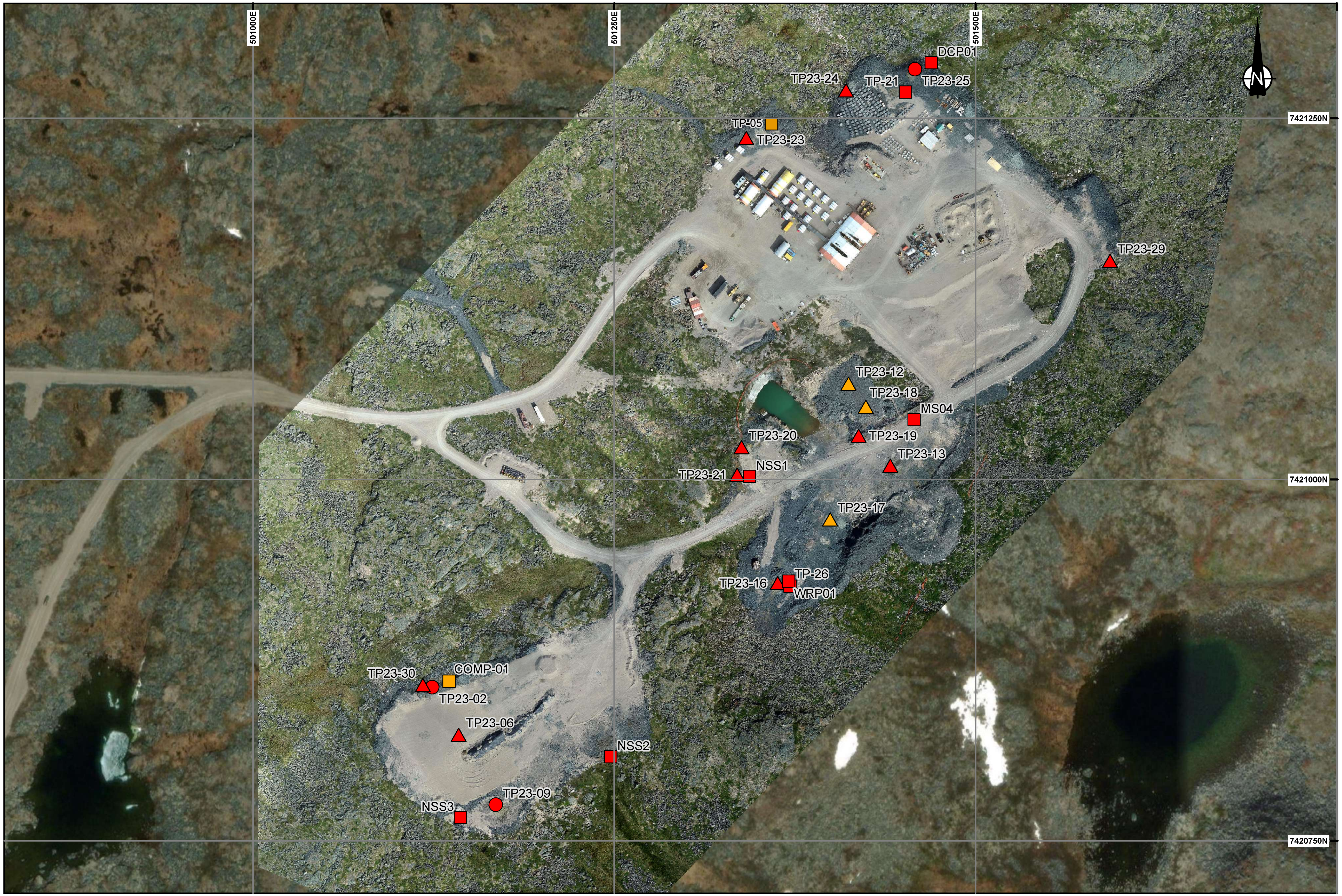
With the 2023 test pitting program, more areas with acid generating rock have been identified. This is a result of a combination of factors:

- Test pits were excavated in different places to previously, therefore there is now more coverage of the pads.
- Parts of the west part of the ore pad contain acid generating rock that was likely placed there during construction of the base of the soil treatment facility (and was previously along the north edge of the ore pad).
- pH is lower in relocated ore above the portal pond, than results indicated in 2021.

Areas where pH 2.9 to 3.3 was identified include residual rock lying on the tundra adjacent to the north edge of the ore pad, within the edge of the drill core storage area of the camp pad, and near the portal pond (at the mine sump berm east of the portal pond, and at piled rock west of the portal pond). This pH is significant as above around pH 3.5 most iron precipitates under oxidizing conditions, whereas below this pH, iron dissolves rather than precipitates. Dissolved iron can itself become an oxidizing agent and contribute to sulphide oxidation.

This highlights two concerns:

- The site has the potential to develop widespread severe pH conditions if rock is not managed appropriately.
- Low pH conditions are already present in multiple locations and developing and implementing an ML/ARD management plan should be a priority.



LEGEND

Previous Results
- pH 4.0 - 4.99
- pH < 4

Depth < 1 m

Rinse pH Results
- pH < 3.99
- pH 4.0 - 4.99

Depth 1 m or deeper

Rinse pH Results
- pH < 3.99

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: CAPR002649

LAYOUT: CAPR002649_Ulu_Annual_reports

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Ulu

2023 ML/ARD Characterization

Compilation of 2020 to 2023 Acidic Rinse pH Results

Date: Mar 2024 | Approved: KYK | Figure: 5.5

PROJECT PATH: C:\Users\MSMITH\SRK Consulting\FS725 Ulu - !040_AutoCAD\GIS\Projects\CAPR002649_Ulu_Annual_reports\CAPR002649_Ulu_Annual_reports.aprx - L-Fig 5-5_Compilation 2020 to 2023

5.2 In Situ pH-Conductivity Survey

The location of pooled water tested in the tundra adjacent to the ore pad, and along the swampy drainage path towards Lake G43 were shown in Figure 3.2. Photos and description below provide further context for the results in this section. Figure 5.6 shows the north edge of the ore pad photographed from a drone. The pH-conductivity survey locations that are within the view are shown (i.e., for the eastern part of the survey area). Strongly oxidized orange rock remaining on the tundra following removal of part of the ore pad in 2020 (used to level the ore pad surface for the soil treatment facility) is circled. This extends for several meters to the north of the current edge of the ore pad. Rinse testing of a sample of this material in July 2023 gave pH of 2.9 and conductivity of 940 µS/cm (Section 5.1).

Any drainage from this north edge of the ore pad may generally be expected to proceed to the north into swampy tundra (on the left side of the photograph) and then potentially to the west, but gradients are very shallow in the eastern part of the survey area and flowing water has not been observed in the swamp. Seep-05 is shown in Figure 5.7, with the ore pad in the background. Gradients increase in the western part of the survey area beyond the ore pad (west of Seep-05) and down towards Lake G43. At freshet the swamp is relatively wet with pooled water. Flowing water has only been observed in June, and only in the last few tens of meters of the drainage path, directly upstream of Lake G43 (Figure 3.2).

Figure 5.6. Arial view of the north edge of the ore pad (looking east)

Figure 5.7. Seep-05 with the ore pad in the background (looking southeast)

The pH and conductivity results are plotted in Table 5-2 with distance relative to Seep-05 used on the x-axis. Key location information is also shown adjacent to the x-axis, including where along the survey path the strongly oxidized rock occurs. Absolute distance to the nearest edge of the ore pad is shown as data labels on the conductivity trend, and field data from the down-gradient Seep-12 are also shown for reference from a seepage sampling event one month before the pH-conductivity survey (Seep-12 was dry when the pH-conductivity survey was conducted in July). Results are shown in Table 5-2.

Table 5-2. pH and Conductivity Survey Results

Sample name	Distance relative to Seep-05 (m)	Distance from edge of ore pad (m)	pH	EC (uS/cm)
SEEP-05 SW-175m	-175	50	6.7	170
SEEP-05 SW-125m	-125	27	6.5	190
SEEP-05 SW-50m	-50	15	4.2	580
SEEP-05 SW-20m	-20	25	6.3	340
SEEP-05 SW	0	14	4.9	1040
SEEP-05 SW+15m	15	33	6.0	380
SEEP-05 SW+63m	63	75	6.3	150
SEEP-05 SW+120m	120	130	5.9	56
Seep-12 (21 July 2023)	150	176	na	na
Seep-12 (19 June, 2023)	150	176	6.2	68

Source: SRK Consulting\NA CAPR002649 Ulu Reclamation SOW 2023 - Internal\Task100_ML-ARD\160_Data management\ Ulu_Compiled_Seepage_CAPR002649_rtc_kyk_rev00.xlsx

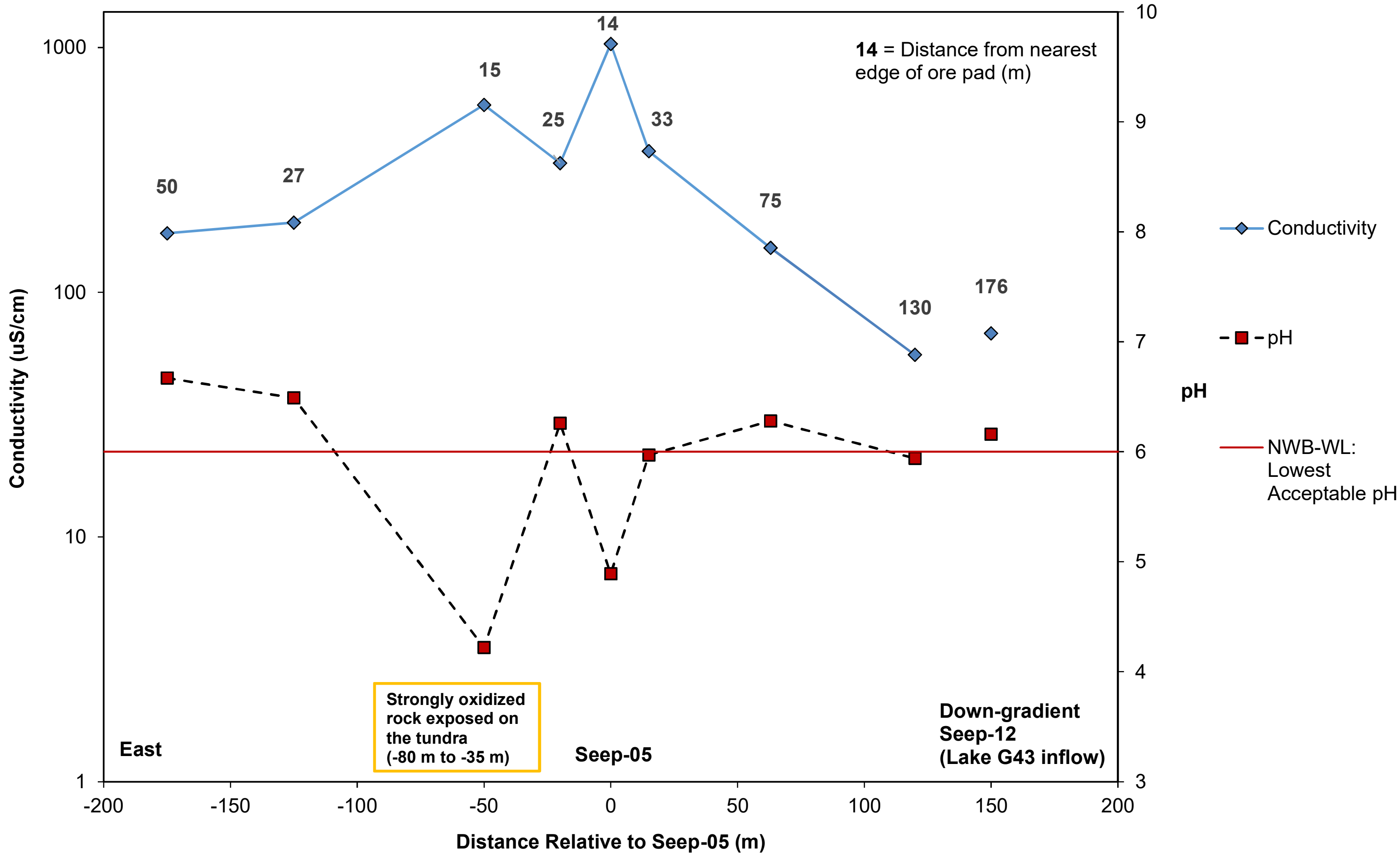
Note: na=not available as seep was dry when survey was conducted..

At the east end of the drainage path (furthest up-gradient of Seep-05), pH was 6.5 to 6.9 and conductivity was 170 to 190 µS/cm. Results showed a decrease to acidic pH (pH 4.2 and 4.9) in pooled water close to the ore pad (within 25 m from the edge) i.e. at Seep-05 and close to (6 m from) the strongly oxidized acid generating gravel on the tundra. This was associated with an increase in conductivity (580-1040 µS/cm), with Seep-05 having the highest conductivity.

15 to 20 m away from Seep-05 (at locations 25 m and 33 m from the edge of the ore pad) the pH was mildly acidic (pH 6.0-6.3), but conductivity was still elevated at 340 to 380 µS/cm. At 60 m away from Seep-05, in the down-gradient swamp (approximately 75 m from the corner of the ore pad), pH was similarly 6.3 and conductivity was reduced at 150 µS/cm. At 120 m away from Seep-05 (approximately 130 m from the corner of the pad), pH was 6.0 and conductivity was the lowest recorded in the survey (56 µS/cm). pH and conductivity were similar further down-gradient at Seep-12 (pH 6.2, 68 µS/cm). For comparison, the seepage reference stations had pH 6.6 and 6.7, with conductivity of 32 and 70 µS/cm in July 2023, and rinse tests on background tundra soil samples had pH 4.3 to 5.8 and conductivity of 27 to 79 µS/cm when tested last August (SRK 2023).

Comparisons to background conductivity therefore indicate that:

- Conductivity was elevated along the survey path to somewhere between 75 to 130 m down-gradient of the corner of the ore pad (there were no sampling points in between this distance due to the drier than typical conditions in the summer of 2023).
- Further down-gradient, conductivity was similar to background levels.
- Conductivity was an order of magnitude above background levels within 25 m of the edge of the ore pad, and highest at Seep-05 (1040 µS/cm), indicating the extent of greatest influence from the ore pad.
- pH was acidic (pH 4.2-4.9) at both sites within 25 m of the edge of the ore pad. Further away pHs were mildly acidic to circum-neutral. Although the acidic pHs were at the low end of the range present in tundra soil rinse tests, the drop in pH (of more than 2 pH units) and much higher conductivities of water close to the ore pad, indicate that acid generating rock in the ore pad or on the tundra next to the ore pad, is the source of acidity within 25 m of the edge of the pad, rather than natural organic tundra acidity.



https://srk.sharepoint.com/sites/NACAPR002649/Internal/Task100_ML-ARD/160_Data management/[Ulu_Compiled_Seepage_CAPR002649_rtc_kyk_rev00.xlsx]

Figure 5.8. pH-conductivity results from an in-situ survey of pooled water along the drainage path adjacent to the north edge of the ore pad

Sulphate concentrations from water samples collected from four of the survey sites (Figure 3.2) are shown on Figure 5.9, and dissolved zinc and nickel are shown on Figure 5.10. Data from Seep-12 from late June are also plotted. Results showed:

- Sulphate - indicative of oxidation of sulphides in the rock, increased from 51 mg/L (27 m from the pad and up-gradient of Seep-05) to 260 mg/L closest to the strongly oxidized acid generating gravel on the tundra, and 670 mg/L at Seep-05, and decreased to 180 mg/L 15 m down-gradient from Seep-05. At the end of the drainage path Seep-12 had 17 mg/L sulphate (compared to 4.9-5.5 mg/L in the reference stations).
- Zinc – indicative of leaching from sphalerite, was 0.23-0.27 mg/L closest to the pad and one to two orders of magnitude lower further from the pad (0.009 mg/L 27 m from the pad, and 0.023 mg/L 15 m down-gradient from Seep-05). At the end of the drainage path Seep-12 had 0.0023 mg/L zinc (lower than the background of 0.0027-0.0029 mg/L measured in the reference stations).
- Nickel - indicative of leaching from millerite (or trace levels from iron sulphides), was 0.10-0.11 mg/L closest to the pad and one to two orders of magnitude lower further from the pad (0.0012 mg/L 27 m from the pad, and 0.016 mg/L 15 m down-gradient from Seep-05). At the end of the drainage path Seep-12 had 0.0011 mg/L nickel (compared to 0.00075-0.0014 mg/L in the reference stations).

Acid generation and release of sulphate and metals through oxidation of sulphides contained in the rock at the north edge of the ore pad therefore has a significant influence on the chemistry of pooled water in the tundra within 25 m of the edge of the ore pad and close to strongly oxidized rock that remains on the tundra adjacent to the ore pad. Concentrations of zinc are close to the NWB-WL effluent quality limit (0.5 mg/L maximum average concentration) and are expected to increase further if pH continues to decline at the source, or the volume of rock that is generating acid increases.

Beyond 25 m from the edge of the ore pad, pH is mildly acidic (pH 6.0 to 6.3) suggesting that the tundra currently has minor buffering capacity to neutralize acid. Conductivity results indicate water chemistry is affected over a greater distance, but likely not more than around 100 m down-gradient from the NW corner of the ore pad.

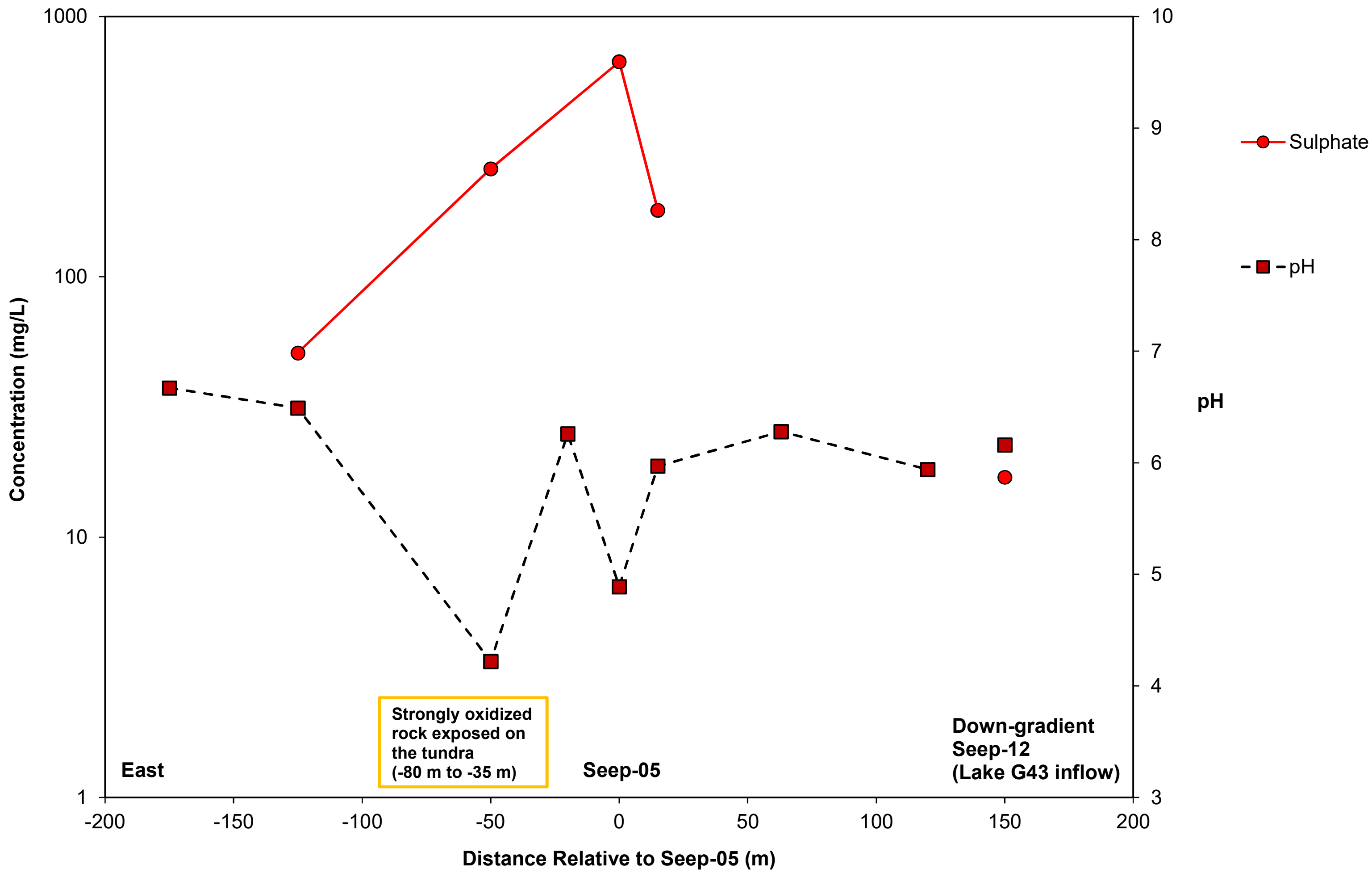


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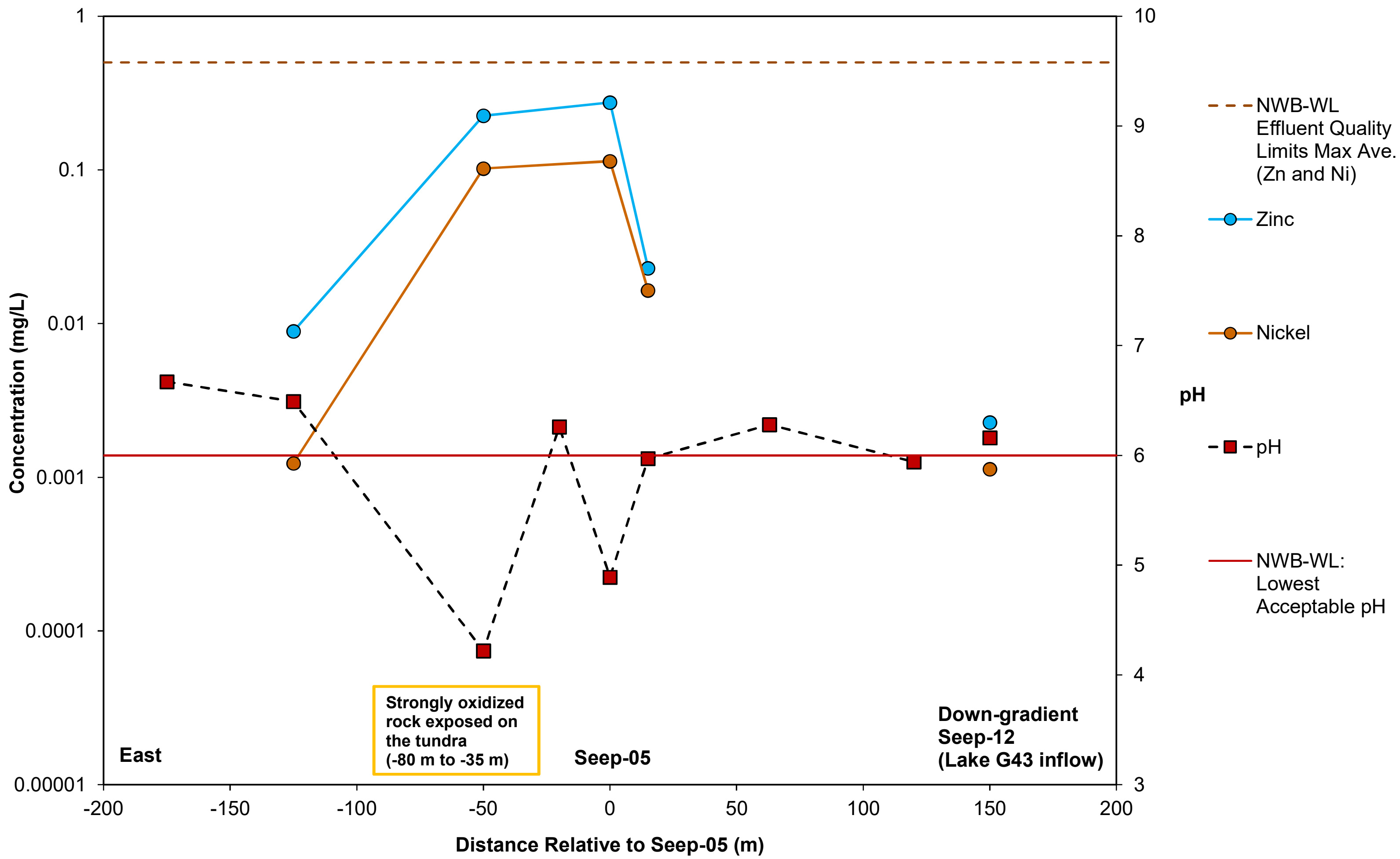
Figure 5.9. pH and sulphate results from pooled water along the drainage path adjacent to the north edge of the ore pad



https://srk.sharepoint.com/sites/NACAPR002649/Internal/Task100_ML-ARD/160_Data management/[Ulu_Compiled_Seepage_CAPR002649_rtc_kyk_rev00.xlsx]

Figure 5.10 pH, nickel, and zinc results from pooled water along the drainage path adjacent to the north edge of the ore pad

5.3 Seepage Results

5.3.1 Introduction

The 2020-2023 seepage dataset (Appendix C) provides an indication of the recent/current pH and metal leaching conditions at the Ulu site for data interpretation purposes. Location information were summarized in Table 3-1 and sample locations are shown on Figure 3.3.

In the charts in the following sections (and Appendix B), the following formatting is used throughout:

- Samples from the two reference locations (Ref-03 and Ref-06 set up in 2022; SRK 2023) 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 degree of 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
- The portal pond water is shown for reference on the charts (open black squares) as it has at times (historically and in 2020) been discharged to the waste rock-portal pad and drained through the pad and into East Lake and is therefore expected to influence seepage water chemistry during discharge.
- Seepage in the portal area is shown with open grey squares.

Charts of key elements are shown in the text with the full set of charts shown in Appendix B.

The charts show water quality guidelines (compared to dissolved element concentrations) for CCME protection of aquatic life (freshwater; PAL-FW), long-term) which 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.

The Nunavut Water Board Water licence (NWB-WL) effluent quality limits for the Ulu project are also shown on the charts. The limits are applicable to total metal concentrations; however, they are shown here on the dissolved element charts as the focus is on mineral dissolution and metal leaching.

5.3.2 pH and Conductivity of Seepage

Seepage pH results have been evaluated in detail (particularly for the ore pad), in combination with other field measurements, to understand whether ARD is present. Seepage pH versus electrical conductivity (indicating combined dissolved element concentrations) are shown against time for each area separately, including the additional field data collected around the ore pad and camp pad from seeps close to the pads, between water sampling events. Reference station results are shown for comparison and have ranged from pH 6.4 to 6.9 and conductivity of 20 to 97 µS/cm since 2022 when there monitoring began.

Ore Pad

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 each of the three longer term monitoring sites (Seep-01, Seep-05, ULU-8), including in late July/early August in 2020, and at ULU-8 in July 2023. Sub-surface drainage into these pools from the ore pad is also assumed to occur, based on the seepage results. Ore pad seepage pH and conductivity are shown in Figure 5.12 and Figure 5.13. pH was above 6 except for at Seep-05 which had the lowest pH of all seeps in the seepage monitoring program (pH 4.8 in late July 2023). Conductivity in the three main ore pad seeps was greater than 1000 µS/cm throughout July 2023 and highest at ULU-8A (1720 µS/cm) where seepage was flowing directly out of the south edge of the ore pad.

Lowest pH measured from 2020 to 2023 in the ore pad seeps is summarized in the map in Figure 5.11 and trends in Seep-05 and ULU-8/8A pH and conductivity are shown in Figure 5.14 and Figure 5.15 to highlight further details. At Seep-05, pH varied substantially through the summer, being pH 6.4 at freshet (in 2023) and acidic later in the season with results below the NWB lowest acceptable pH limit of 6.0. Lowest pH has been recorded during the last week of July or first week of August during all three years that have late-season data (although there are no data for July 2022 or August 2023). Lowest recorded pH was 5.5 in 2020, pH 4.6 in 2022 and pH 4.8 in 2023. The drop between pH lows in 2020 and 2022/2023 corresponds in timing to disturbance of the nearby north edge of the ore pad (Figure 5.6). As noted in previous sections, rock remaining on the tundra had rinse pH 4.0 in September 2020, and rinse pH 2.9 in July 2023, and rock within the edge of the pad (TP23-02) had rinse pH 3.6.

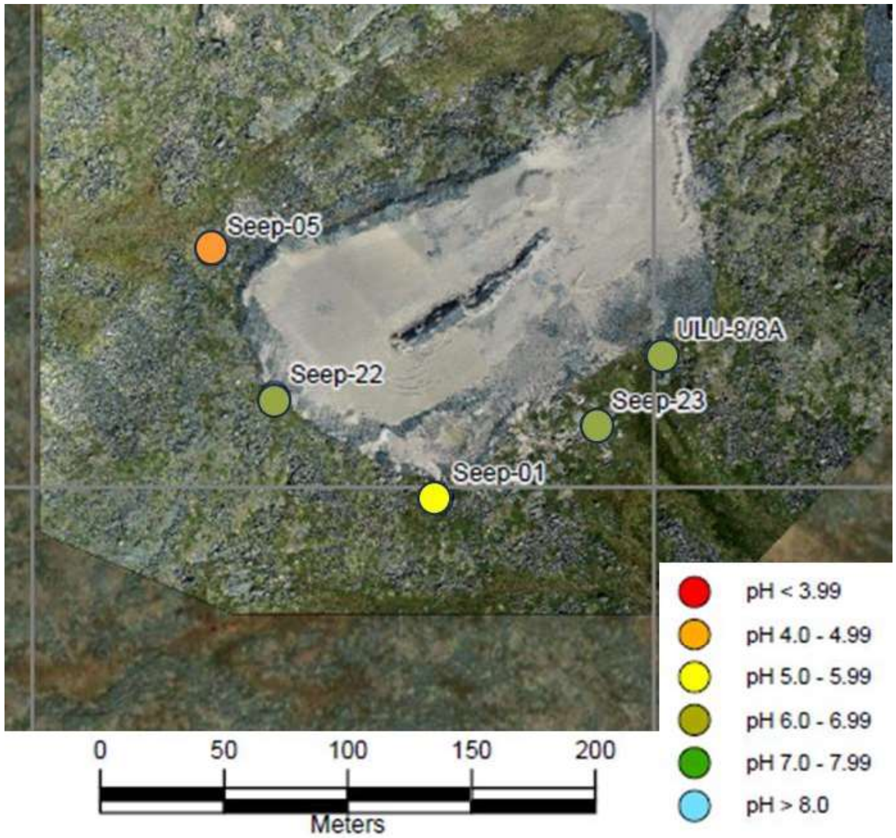


Figure 5.11. Lowest pH of ore pad seepage measured during 2020 to 2023

Conductivity at Seep-05 has been lowest at freshet (120-200 µS/cm in 2021 to 2023), with highs late in the season, i.e., August in 2020 (520 µS/cm) and 2022 (1090 µS/cm), and at the end of July when monitoring ceased in 2023 (1100 µS/cm). The conductivity increase through the season reflects an increase in major ion concentrations, particularly sulphate which is the dominant ion present (in molar proportions; see next section) and is consistent with increased sulphide oxidation and acid generation from rock within the drainage catchment of Seep-05, likely as the edge of the ore pad thawed/warmed through the season.

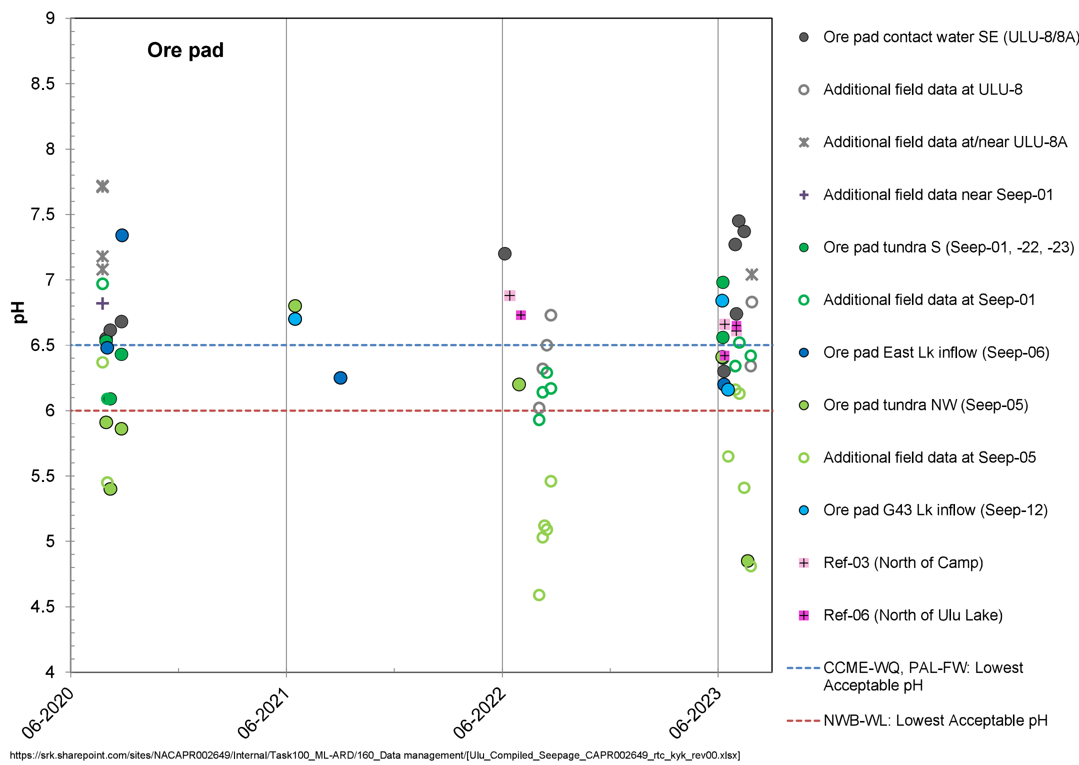


Figure 5.12. Ore pad seepage pH

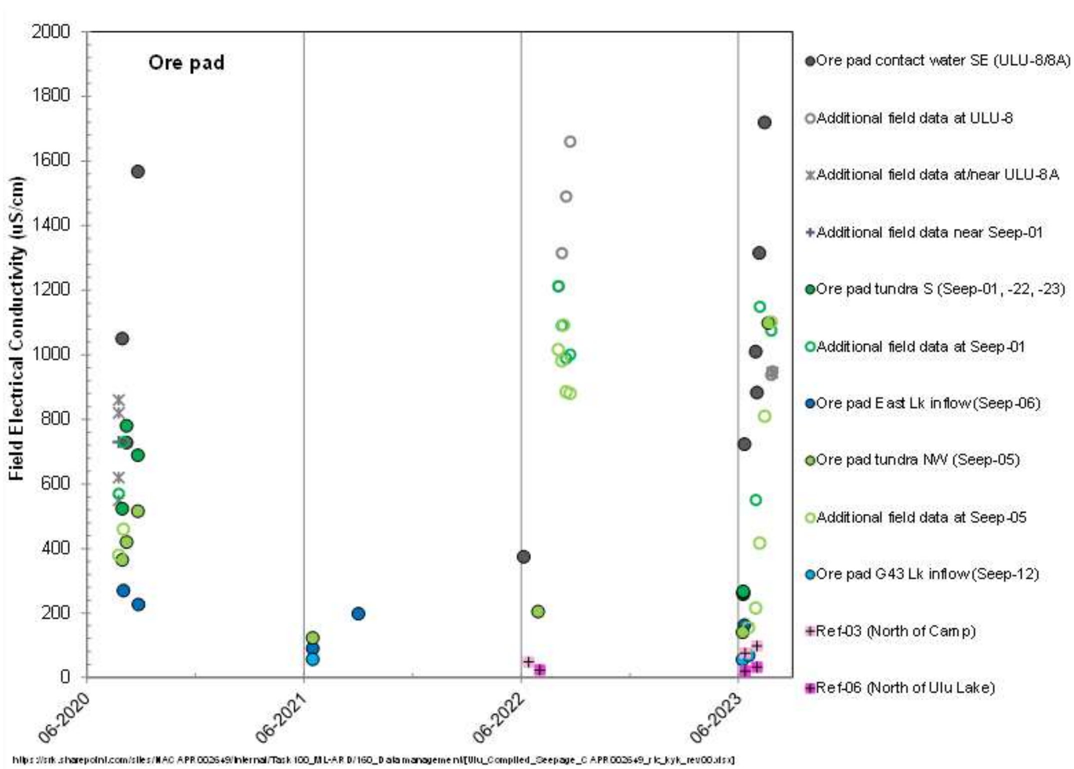


Figure 5.13. Ore pad seepage conductivity

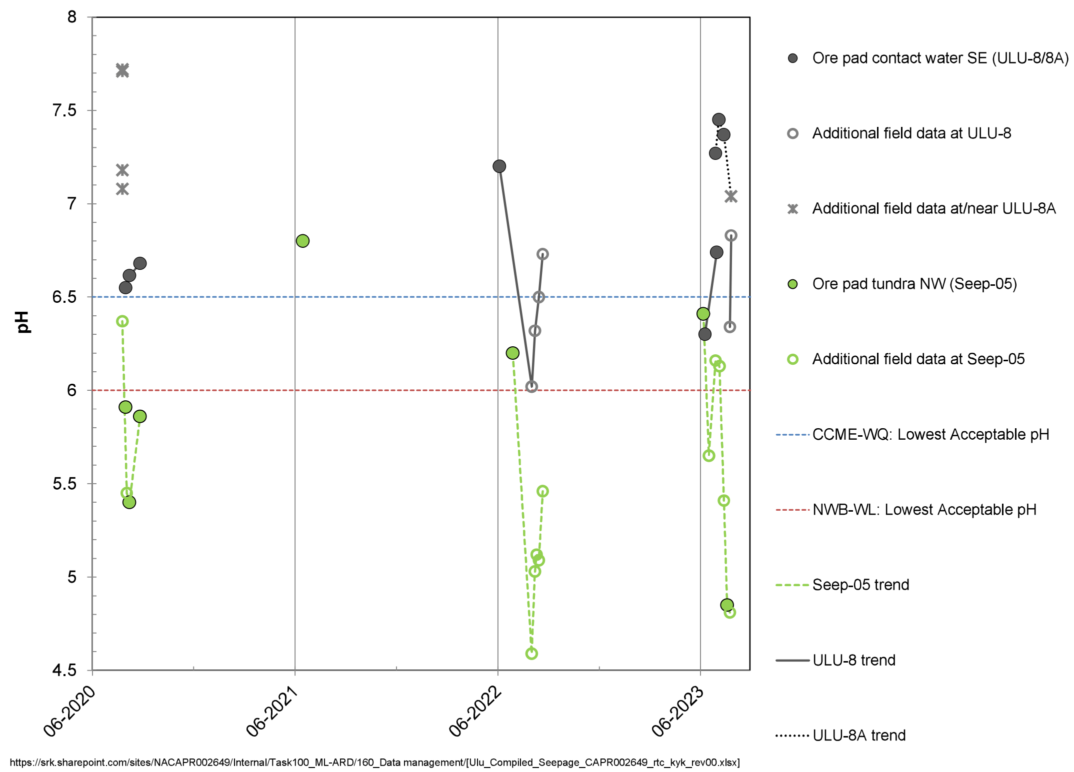


Figure 5.14. Seep-05 and ULU-8/8A pH trends

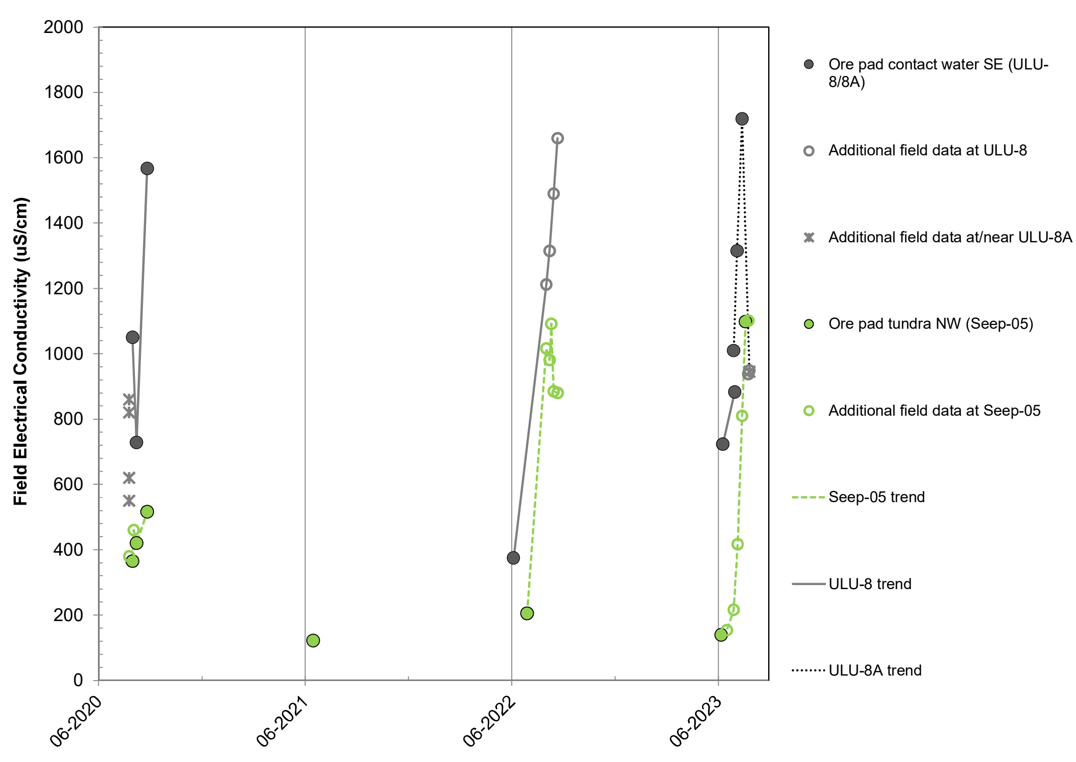


Figure 5.15. Seep-05 and ULU-8/8A conductivity trends

During 2020 to 2023 pHs at ULU-8 (about 5 m from the south edge of the pad), have been 6.0 to 6.7 when there has been no flow recorded, but pH 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). Highest conductivities have occurred late in the season and been similar between ULU-8 and -8A and similar over time (1570 to 1720 µS/cm; Figure 5.15). Although acid generating rock has been identified at the edge of the ore pad directly up-gradient of ULU-8A, the seepage pH indicates that contact water is currently neutralized before it exits the pad and ARD is not present. The high conductivities (and sulphate concentrations; see next section) are indicative of sulphide oxidation occurring within the pad, and that this increases seasonally as the pad thaws/warms through the season.

Seep-05 and ULU-8/8A pH and conductivity data lie on different trends in Figure 5.16, with Seep-05 increasing conductivity related to declining pH, with metal leaching associated with incipient ARD; whereas ULU-8/8A increasing conductivity occurs with no pH decline, consistent with metal leaching associated with circum-neutral pH conditions.

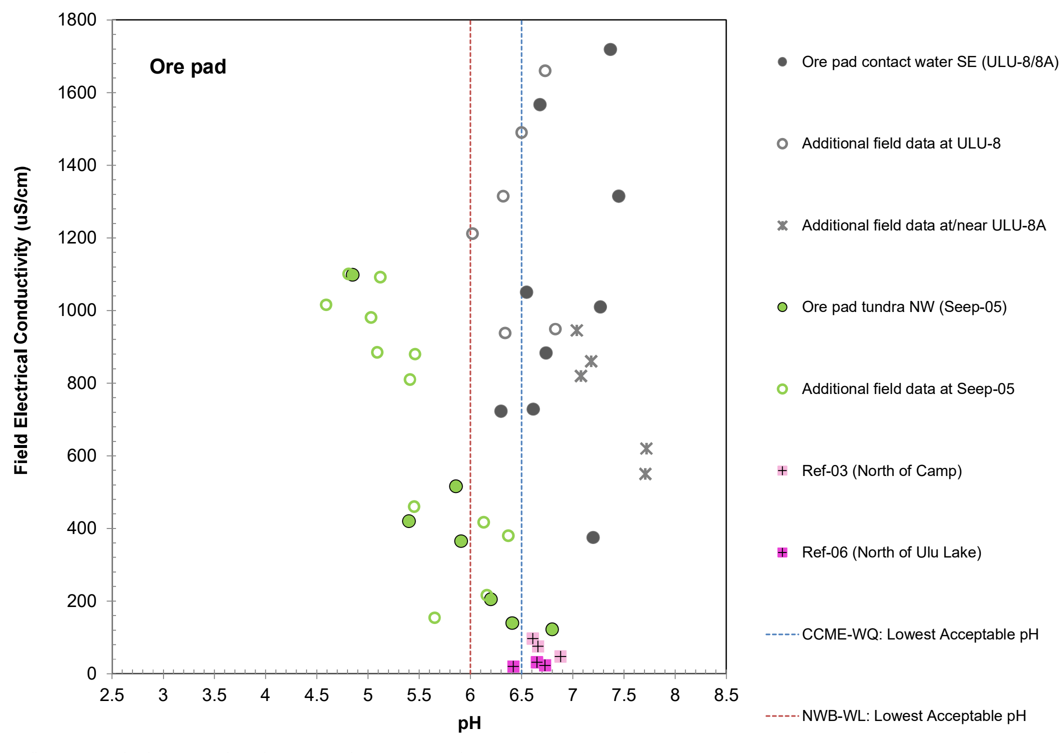


Figure 5.16. pH versus conductivity in Seep-05 and ULU-8/8A

Waste Rock-Portal Area

Seepage flows out of the waste rock pad at several locations at freshet (Figure 5.17) and flows downstream partly on the surface and partly sub-surface (and can intermittently be traced as audible flows beneath boulders in the tundra). The seepage flows into East Lake at three surface inflows. ULU-15 (that may capture drainage from the south side of the camp pad and the landfill) is included with the results for seeps from the waste rock-portal area, as it drains to the south towards East Lake and may be a sub-surface input to Seep-02.

pH of seepage draining from the waste rock-portal area has been pH 7.0 to 8.5 from the upstream sites during 2020 to 2023 monitoring, and pH 6.6 to 7.5 at the downstream East Lake inflows (except when portal pond water was discharged in 2020 and downstream pH was higher; Figure 5.18). Lowest pH measured at each seep between 2020 and 2023 is summarized on the map in Figure 5.17.The lower pHs downstream are consistent with the pHs observed in the tundra reference stations (pH 6.4 to 6.9) reflecting the influence of water flowing across the tundra. pH results currently indicate a lack of ARD from the waste rock portal area.

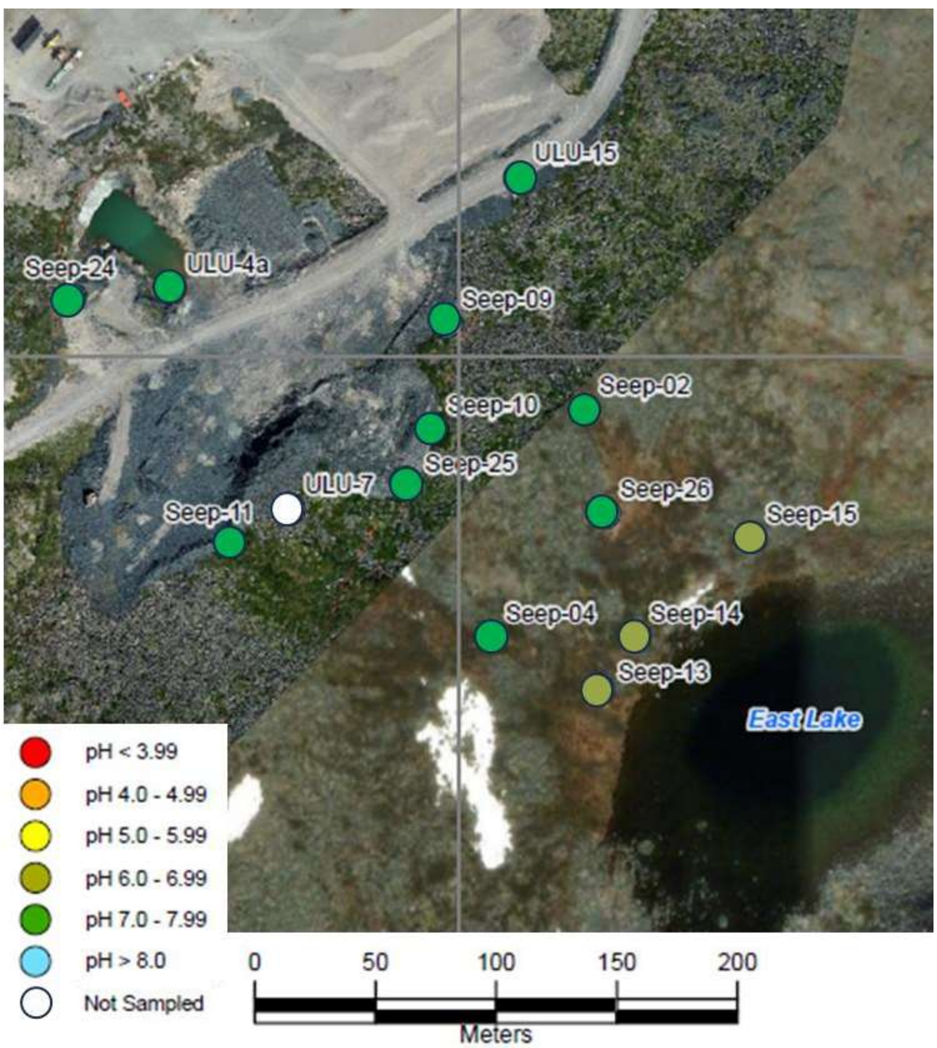


Figure 5.17. Lowest pH of waste rock-portal area seepage measured during 2020 to 2023

Conductivities in seepage from the waste rock-portal area are lower than the ore pad and in 2023 ranged from 177 to 870 µS/cm, compared to background in the reference stations of 20 to 97 µS/cm (Figure 5.19). Seep-02, part way downgradient towards East Lake typically flows later into the season than the contact water seeps draining directly from the pad at freshet, and therefore usually has higher conductivities than the contact water seeps. Highest conductivities in this seep have not changed significantly between 2020 and 2023, being 560 to 650 µS/cm.

Conductivity at ULU-15 was higher in June 2023 (870 µS/cm) than when it was last measured in June 2021 before the landfill was built (300 µS/cm).

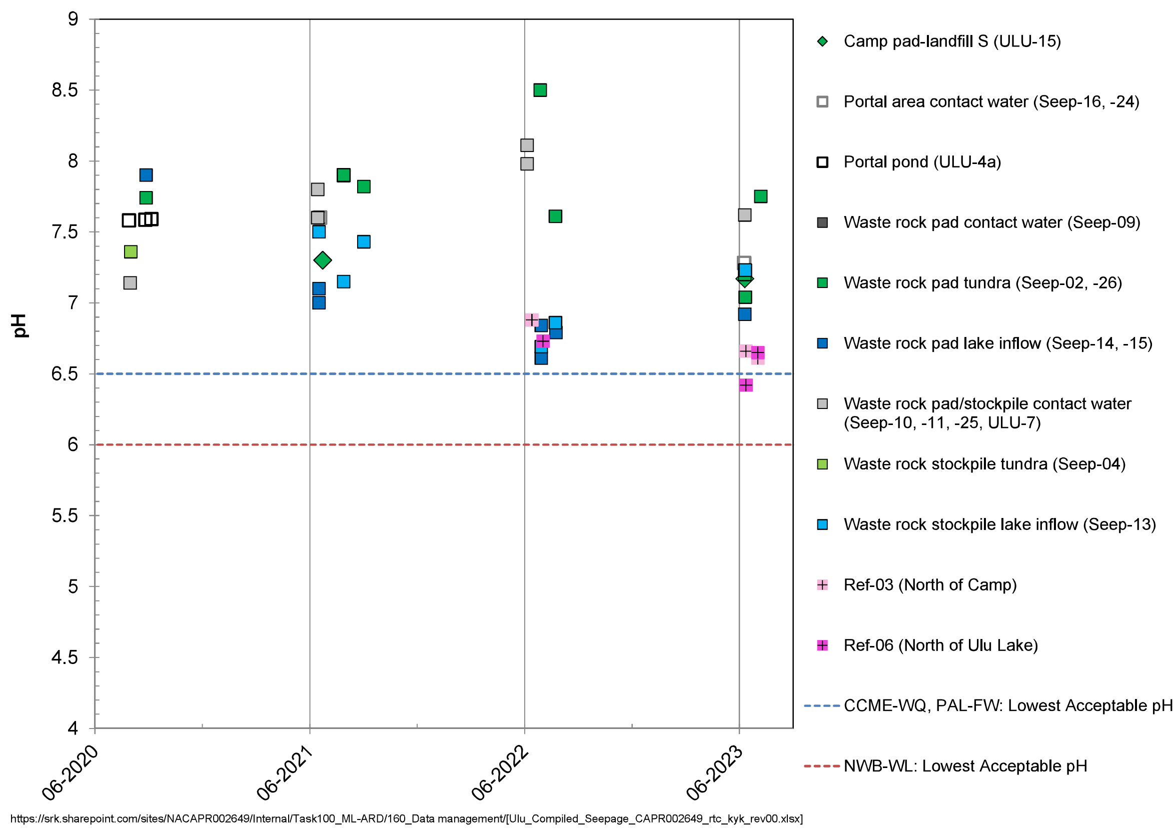


Figure 5.18. Waste rock-portal area seepage pH

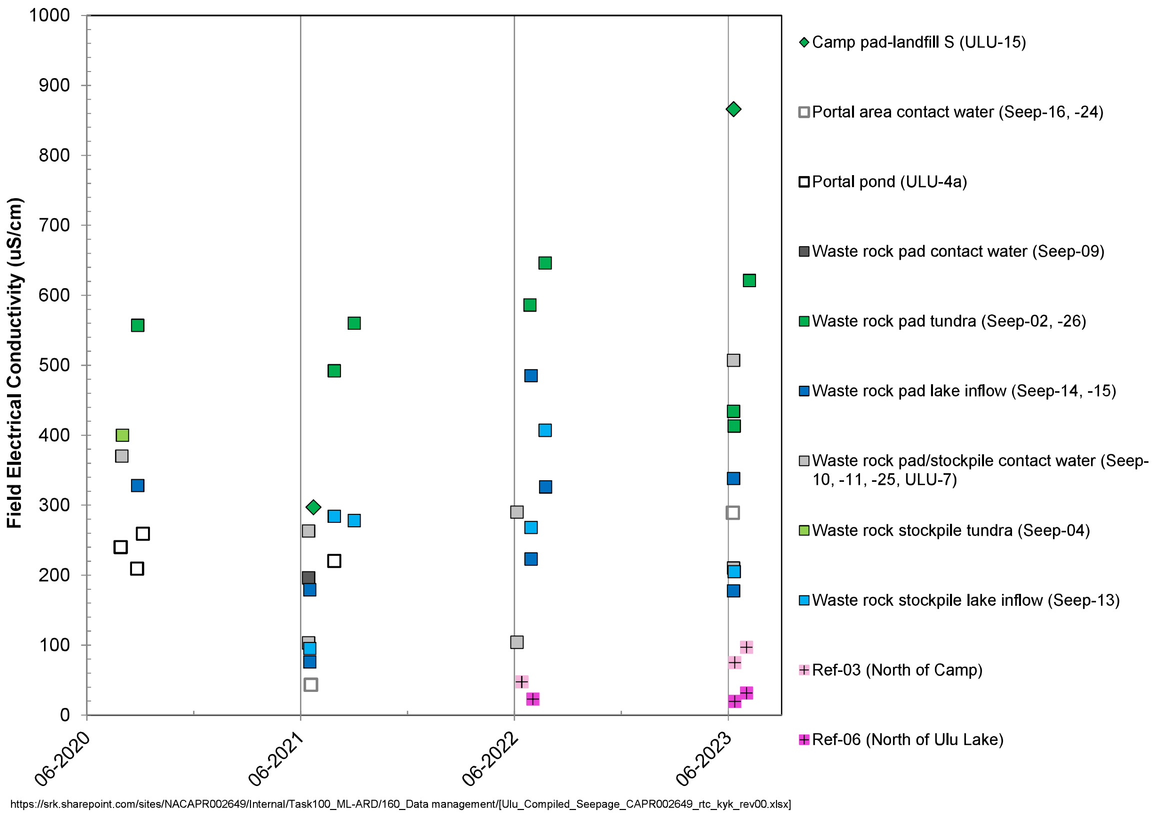


Figure 5.19. Waste rock-portal area seepage conductivity

Camp Pad

Seepage from the north side of the camp pad drains to the northeast towards Ulu Lake (Figure 3.4). Drainage from the pad at Seep-07 and Seep-08 (Figure 5.20) disappears in the tundra but is initially audible beneath boulders and parallels the edge of the pad. It potentially re-surfaces downgradient at Seep-17, 35 m northeast of the pad where water upwells from a pool where a large boulder compresses the tundra. Surface flow occurs along this small valley which is also expected to capture drainage from Seep-03 and Seep-21 from the northeast edge of the camp pad (Figure 3.3). Flow along this valley disappears into the tundra just beyond the Seep-20 downstream monitoring site (approximately 200 m NE from the edge of the pad). Seep-17 and Seep-20 appear to flow throughout the season. Seep-07 and Seep-08 typically flow at freshet although Seep-07 is not always accessible between the glacial boulders. Seep-08 is a large pool (a few meters across) with standing water present later in the season. Only small standing water pools (<0.5 m across) amongst boulders have been observed at Seep-03 and Seep-21 since the monitoring program was formalized in 2021. These pools were monitored for field pH and conductivity by Blue Star in 2023.

pH of seepage from the north side of the camp pad in 2023 was between pH 6.2 and 7.6, with conductivities of 95 to 600 µS/cm (lower than the ore pad and similar to the waste rock-portal pad). pH was above 7.0 in July, with the lower pHs measured when conductivities were lower (<300 μS/cm) and there was more dilution from snow melt. The extra field readings taken in pooled water close to the pads showed pH and conductivity were similar to the downstream Seep-17 and Seep-20 results, and therefore the broader set of results from Seep-17 and Seep-20 are likely a reasonable representation of drainage coming directly from the north side of the camp pad. Lowest pHs measured in seepage from 2020 to 2023 are shown on the map in Figure 5.20 and results currently indicate a lack of ARD from the camp pad.

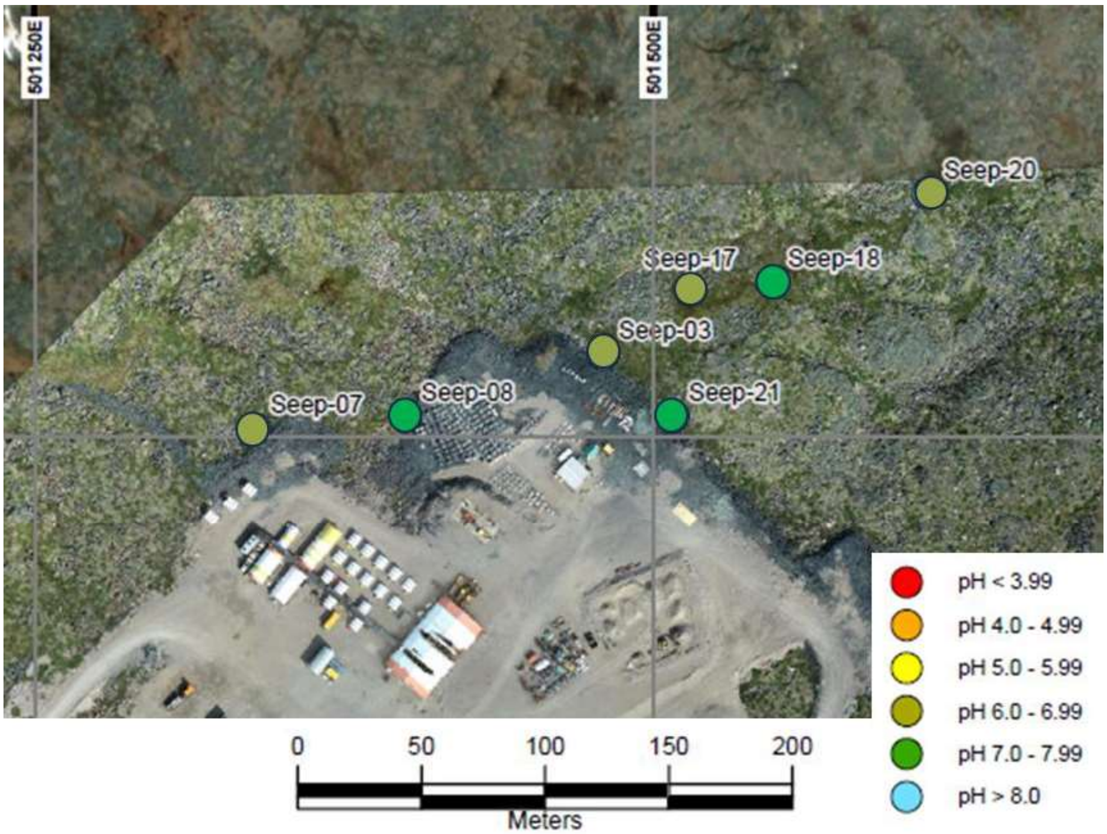


Figure 5.20. Lowest pH of camp pad seepage (draining to the north) measured during 2020 to 2023

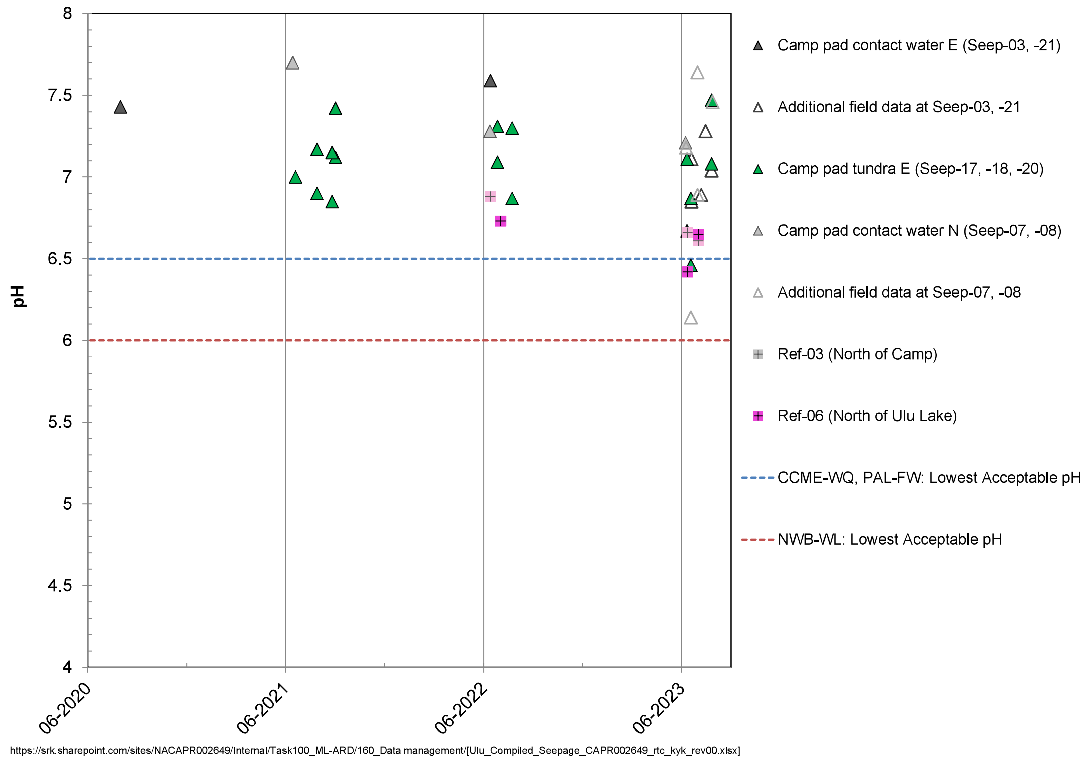


Figure 5.21. Camp pad seepage pH

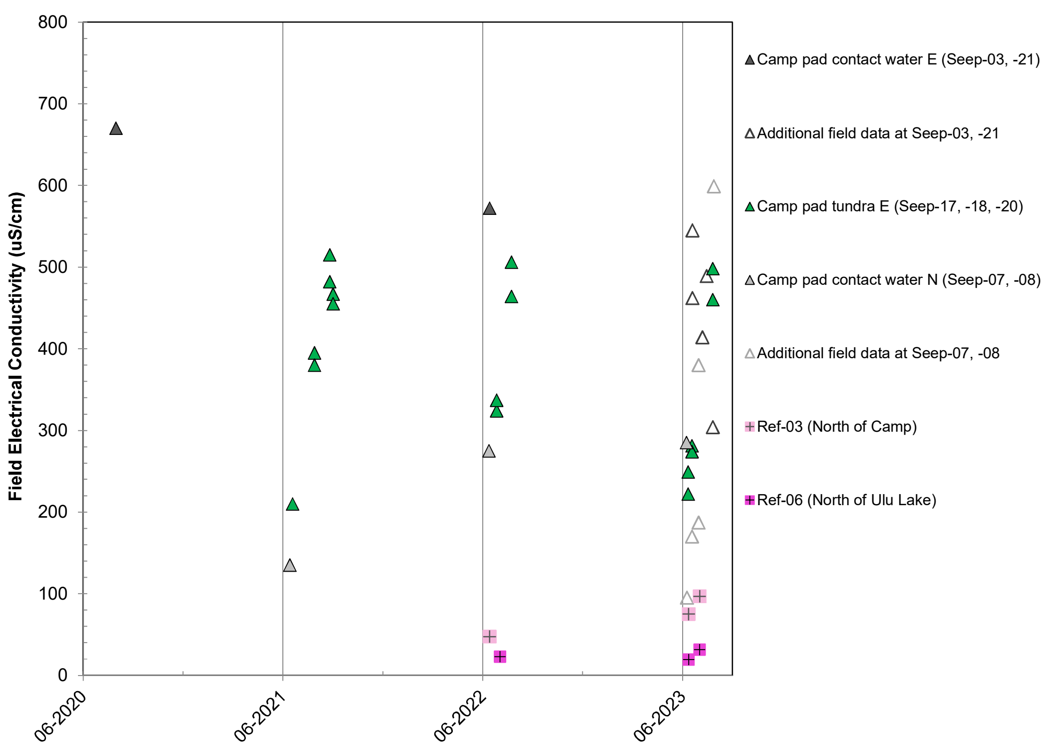


Figure 5.22. Camp pad seepage conductivity

5.3.3 Leaching of Major Ions

The dominant dissolved major anions and cations provide information on the main chemical processes that are operating to generate the observed water chemistry. Major anion and cation molar equivalent proportions are shown in Appendix C with the compiled seepage data, and concentrations of major ions against pH are shown with the full set of charts in Appendix B.

Major Anion Proportions

During 2023, the major anions present in seepage were sulphate, alkalinity, and chloride. In terms of molar equivalent proportions:

- Sulphate was the dominant anion in most seepage, comprising greater than 55% (and up to 99%) of total anions present.
- In Seep-01, Seep-05 and ULU-8/8A seepage from the ore pad, sulphate comprised 84% to 99% of the total anions, followed by alkalinity (0-14%) then chloride.
- In seepage on the north side of the camp pad, sulphate comprised 55% to 70% of the total anions, followed by alkalinity (25-43%) then chloride.
- In seepage on the south side of the waste rock-portal area, sulphate comprised 57% to 88% of the total anions, followed by alkalinity (6-39%) then chloride. The exception to this was Seep-24 just west of the portal where the dominant anion was chloride (65% of total anions present), followed by sulphate (29%) then alkalinity.
- For comparison, Ref-06 contained sub-equal proportions of sulphate and alkalinity (chloride was undetectable), and Ref-03 was dominated by chloride (52% to 64% of total anions present), followed by alkalinity (24-31%), then sulphate (12-17%).

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.

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). Saline water was present in the portal pond when samples were analyzed in 2020 and 2021, and similarly chloride was present in Seep-24 close to the portal in 2023. 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. Chloride molar proportions and concentrations at ULU-8/8A in 2023 had dropped to similar level at most other seeps.

Major Cation Proportions

The major dissolved cations present in seepage were calcium, magnesium, sodium, and potassium. In terms of molar equivalent proportions:

- During 2023, the dominant cation in all seepage was calcium comprising greater than 59% (and up to 84%) of total anions present. At all but Seep-24, calcium was followed by magnesium, and together they proportionally made up 80% to 96% of the total cations.
- At Seep-24 close to the portal, calcium (64%) was followed by sodium (18%) and then magnesium (16%). The proportionally higher sodium was consistent with the proportionally higher chloride in this seep.
- In contact water seepage where the influence from saline water is lacking, sodium was present at around 2 to 8% of the total cations and potassium was present at around 1 to 3% of the total cations. The proportion of sodium was slightly higher in some of the downstream monitoring sites, up to 11% of the total cations downstream of the waste rock pad, and 16 to 17% of total cations downstream of the ore pad (at both the Lake G43 and East Lake inflows).

The dominance of calcium indicates dissolution of calcite is a significant process in the pads. Magnesium likely includes a contribution from both dolomite and the abundant mafic silicate minerals in the rock; and sodium and potassium also suggest minor dissolution of silicate minerals. Silicate mineral dissolution is expected to be minor at neutral pH but to increase at acidic pH. The higher downstream proportions of sodium may reflect historical conditions and placement of the rock in the pads. For context, limited monitoring data from 2006 show that seepage downstream of the waste rock-portal pad was strongly dominated by sodium and chloride (on average comprising 80% of the major cations and major anions respectively).

Major Ion Concentrations

Alkalinity and the major cations are not regulated therefore charts showing concentrations are provided in Appendix B rather than here. Chloride and sulphate have water quality guidelines and concentrations in 2023 seepage are shown in Figure 5.23 and Figure 5.24 respectively.

Chloride concentrations were below the CCME water quality guideline in 2023, whereas they had previously been above the guideline at ULU-8 in 2020. Highest concentrations in 2023 were in Seep-24 close to the portal (53 mg/L).

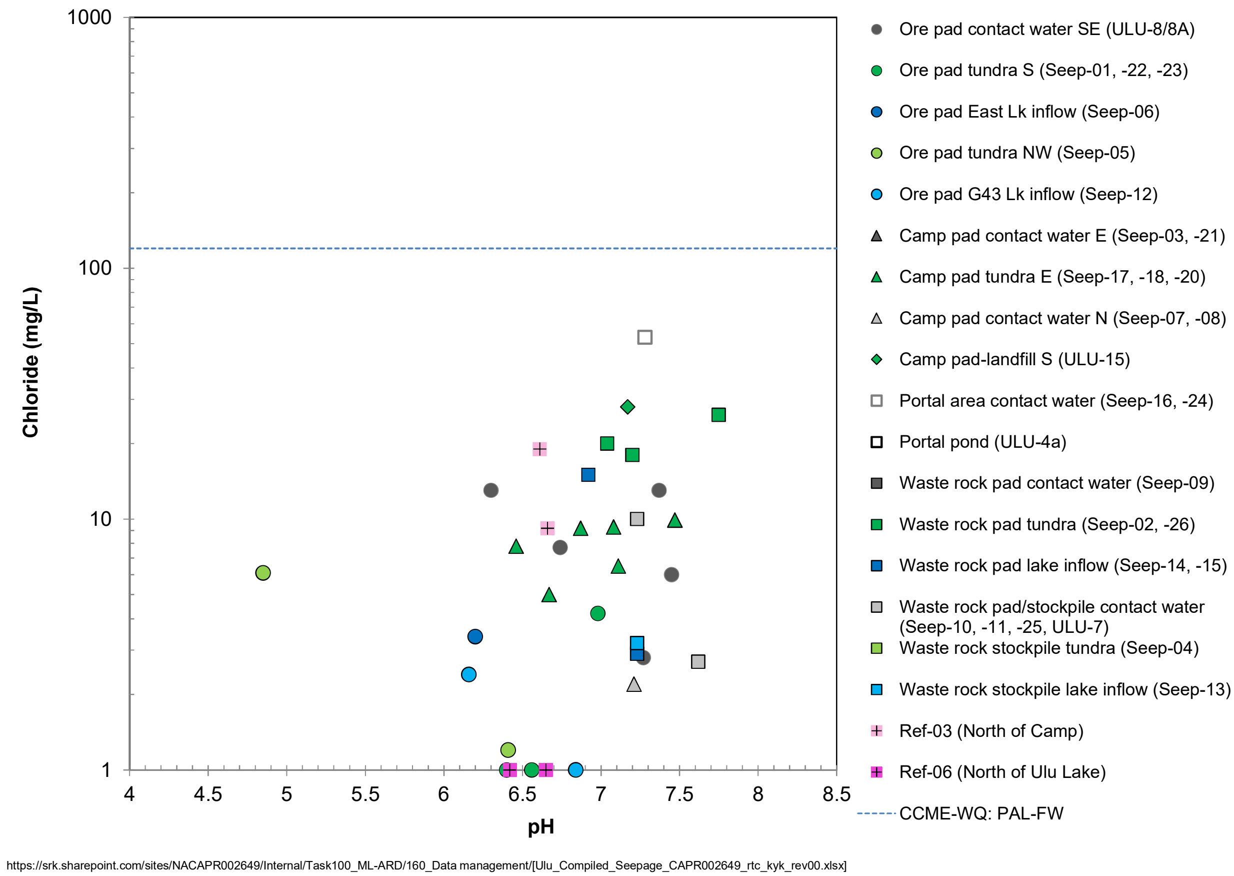


Figure 5.23. Chloride in 2023 Seepage

Sulphate concentrations were highest (and above the 218 mg/L water quality guideline) in ore pad seepage, at ULU-8/8A with 290 to 490 mg/L, and Seep-05 in July with 670 mg/L, with lower concentrations present at Seep-05 at freshet (47 mg/L; Figure 5.24). Sulphate has increased since 2020 in ULU-8/8A and Seep-05 (Figure 5.25). In both 2020 and 2023 these seeps were sampled in July, whereas in the intervening years they were only sampled at freshet when concentrations are diluted.

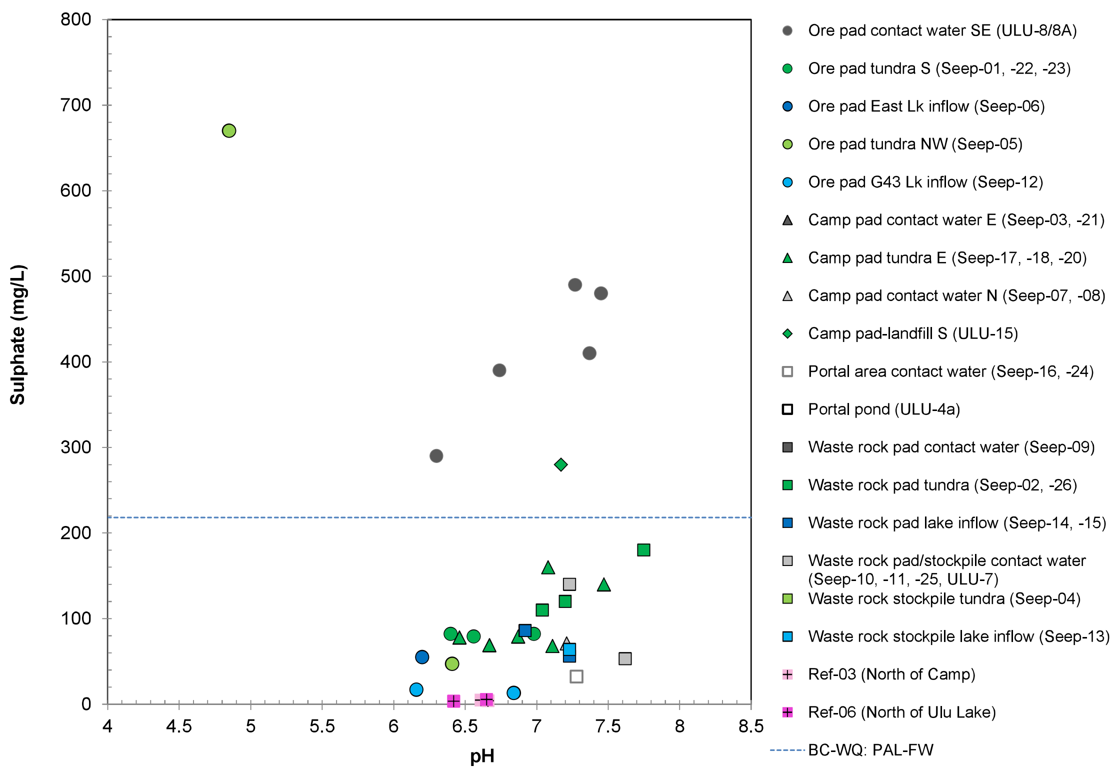
The downgradient flows from the ore pad had significantly lower sulphate (and below the guideline), i.e., 55 mg/L into East Lake (Seep-06) and 13 to 17 mg/L into Lake G43 (Seep-12). In comparison, sulphate concentrations in reference stations in 2023 were 3.5 to 5.5 mg/L.

Sulphate concentrations in the ore pad seepage indicate leaching of weathering products generated through sulphide oxidation. The increase in sulphate since 2020 indicates that contact waters are being increasingly impacted by sulphide oxidation on both the north and south side of the ore pad. Dilution and/or attenuation of sulphate appears to be occurring downgradient from the ore pad along both drainage pathways through the tundra before water drains into East Lake and Lake G43.

Sulphate was also above the water quality guideline at ULU-15 draining the south side of the camp pad and the landfill. Sulphate was 280 mg/L (in June 2023) which was higher than in June 2021 when it was last measured before the landfill was built (74 mg/L; Figure 5.25).

Sulphate concentrations in waste rock-portal pad contact waters were 53 to 140 mg/L, and in camp pad contact water was 71 mg/L. Downstream waters within the tundra were higher as they were flowing later into the season, with 110 to 180 mg/L sulphate in the tundra below the waste rock-portal pad and 68 to 160 mg/L in the tundra below the north side of the camp pad.

Inflows to East Lake from the waste rock-portal pad had 56 to 86 mg/L sulphate but these were only sampled at freshet and not later in the summer (Table 3-2). Sulphate in waste rock-portal pad and camp pad seepage samples was below the sulphate water quality guideline but indicated leaching of weathering products generated through sulphide oxidation.



https://srk.sharepoint.com/sites/NACAPR002649/Internal/Task100_ML-ARD/160_Data management/[Ulu_Compiled_Seepage_CAPR002649_rtc_kyk_rev00.xlsx]

Figure 5.24. Sulphate in 2023 Seepage

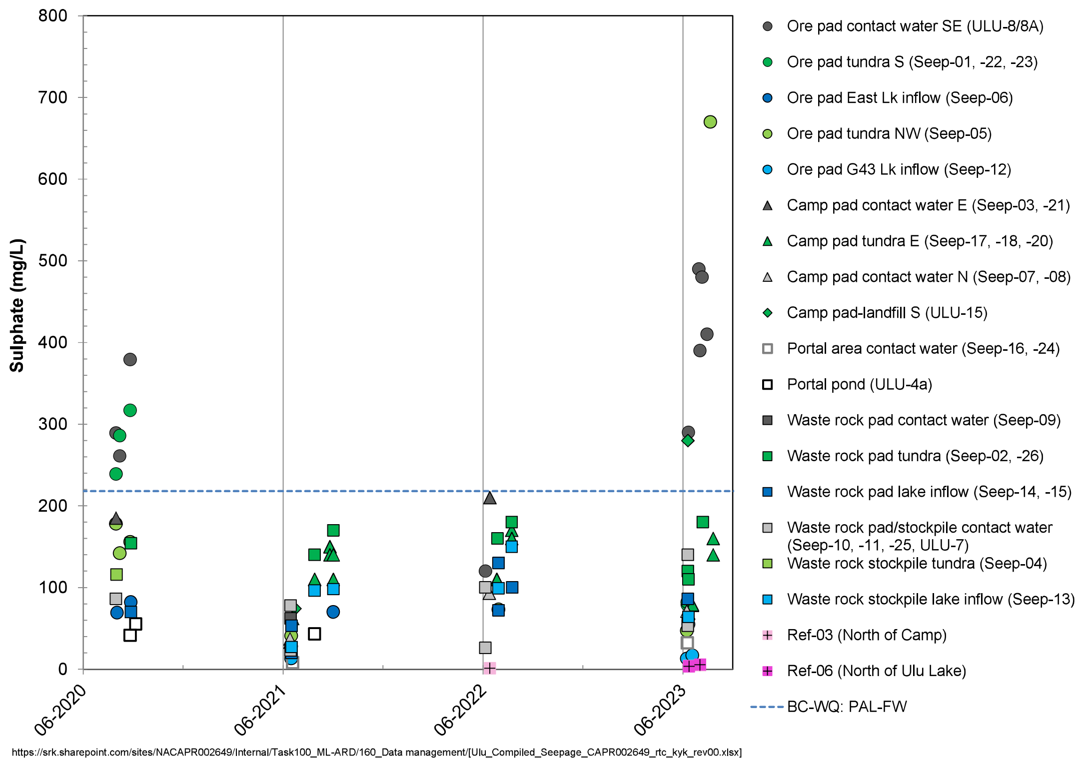


Figure 5.25. Sulphate over time in seepage

Carbonate-Sulphate Molar Ratio

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 the pads.

Based on 2022 and 2023 samples, contact water seepage from the camp pad and the waste rock-portal area had a carbonate:sulphate molar ratio of 1.2 to 1.6 with pHs above 7.0 (Figure 5.26), indicating that local acid generation from the rock in these areas is being neutralized by carbonates, and resulting in net-neutral pH drainage.

Contact water seepage from the SE part of the ore pad (ULU-8/8A) had a carbonate:sulphate molar ratio of 0.90 to 1.2 (average of 0.99), with pHs of 6.3 to 7.5, and higher sulphate concentrations (Figure 5.26), indicating that carbonate dissolution rates were just barely keeping up with the rates of local acid generation.

The carbonate:sulphate molar ratio of seepage from the northwest part of the ore pad is not plotted as it is not considered contact water. It is uncertain whether the molar ratio may have been modified through tundra interaction or evaporation (Seep-05 is approximately 14 m from the edge of the ore pad). However, the carbonate:sulphate molar ratio at Seep-05 was 0.99 at freshet 2023 (pH 6.4) and 0.77 in late July (pH 4.9) (Appendix C), so the results are as expected and consistent with the trends described from the field data above, indicating 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.

The only other tundra seepage that had a carbonate:sulphate molar ratio of less than 1.1 was also associated with the ore pad. This was Seep-01 at the southwest corner of the ore pad (CMR of 1.0 and pH of 6.6) and two other sites from the late July pH-conductivity survey along the north edge of the ore pad (Figure 3.2); at Seep-05 SW-50 (closest to the acid generating gravel on the tundra, with CMR of 0.71 and pH 4.3) and Seep-05 SW+15 (15 m downgradient of Seep-05, with CMR of 0.82 and pH 5.9 (Appendix C).

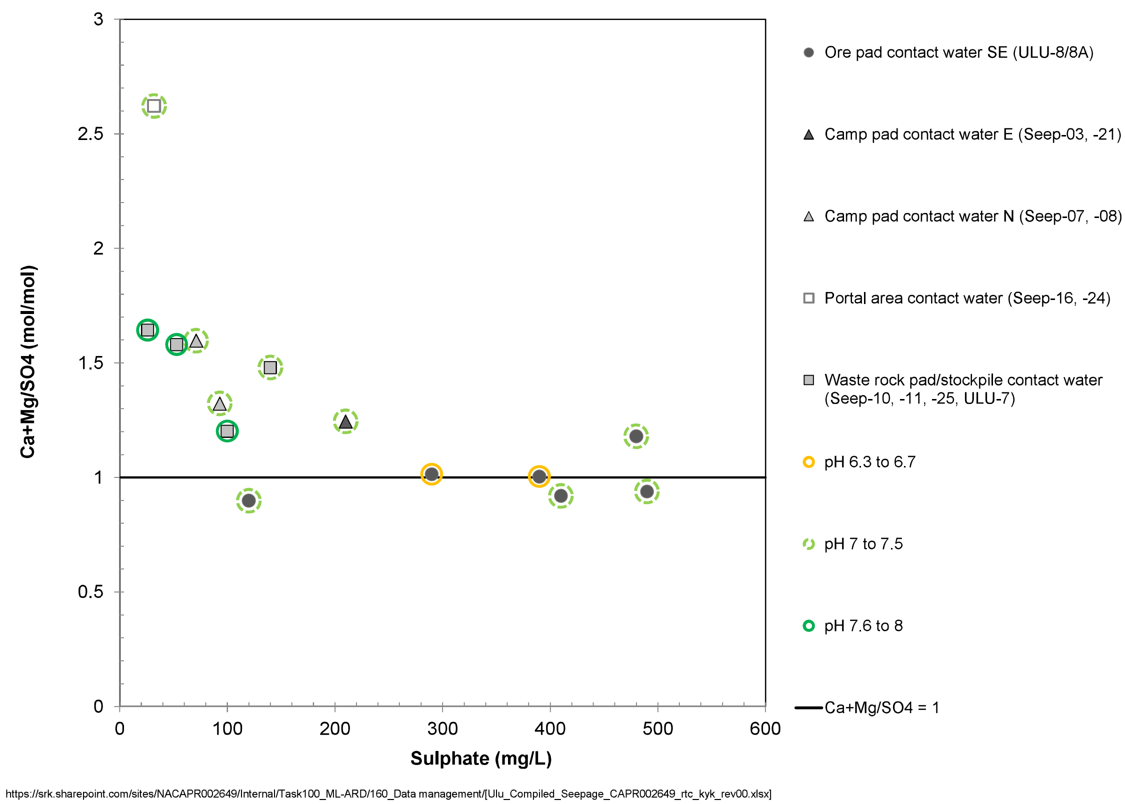


Figure 5.26. Carbonate-sulphate molar ratio vs sulphate concentration in 2022 and 2023 contact water seepage samples

5.3.4 Leaching of Trace Ions with CCME Guidelines or NWB-WL Limits

Nitrate, ammonia, arsenic, boron, chromium, lead, mercury, molybdenum, silver, thallium, and uranium concentrations were below the CCME water quality guidelines in the contact water seeps and downgradient seepage in the 2023 samples. Charts of these parameters showing dissolved concentrations in the 2023 seepage compared to the guidelines are shown in Appendix B (except for arsenic that is shown below). A single sample also exceeded the nitrite CCME guideline

(Seep-17 at the end of July). This seems anomalous based on below DL results downstream on the same day, and below DL results usually measured at Seep-17 (Appendix C).

The following parameters had some results above the CCME PAL-FW water quality guidelines and are shown on Figure 5.27 to Figure 5.36 (with full page charts also shown in Appendix B):

- In seepage around the ore pad: aluminum, **fluoride**, **cadmium**, copper, **iron**, **manganese**, **nickel**, **selenium**, and **zinc.** Exceedances in bold were in contact water and tundra seepage, whereas those not in bold were also present in downstream lake inflows.
- In ULU-15 draining the south side of the camp pad and landfill: cadmium, copper, fluoride, and zinc.
- In seepage draining the waste rock-portal pad: aluminum, copper, and fluoride.
- In seepage draining the north side of the camp pad: aluminum, copper, and fluoride.
- In downstream lake inflows: aluminum (Lake G43 and East Lake inflows via drainage paths from the ore pad), copper (Lake G43 inflow), and fluoride (East Lake inflow via drainage paths from the waste rock pad).
- In the reference monitoring stations: aluminum (Ref-06), and fluoride (both Ref-03 and Ref-06).

Background levels of aluminum (Figure 5.28), copper (Figure 5.31), and fluoride (Figure 5.27) are naturally elevated in the Ulu area based on concentrations in the reference stations in 2022 and 2023. The concentrations of these parameters in seepage were similar to the background except for at Seep-05. Concentrations in the pH 4.9 sample from Seep-05 were one to two orders of magnitude higher than background for aluminum and copper; and three times higher than background for fluoride.

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.

Leaching of arsenic (Figure 5.29), cadmium (Figure 5.30), copper, iron (Figure 5.32), nickel (Figure 5.34), selenium (Figure 5.35), and zinc (Figure 5.36) 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 (Figure 5.33) may also be associated with sulphide oxidation or carbonate dissolution.

Arsenic, copper, lead, nickel, and zinc have effluent quality limits through the NWB water licence, and dissolved concentrations of these parameters were all below the maximum average and maximum grab sample limits. Recent highest zinc concentrations however at ULU-8/8A (0.31 mg/L), ULU-15 (0.29 mg/L), and Seep-05 (0.27 mg/L) are just below the 0.5 mg/L NWB effluent quality limit, and concentrations will be expected to increase with declining pH.

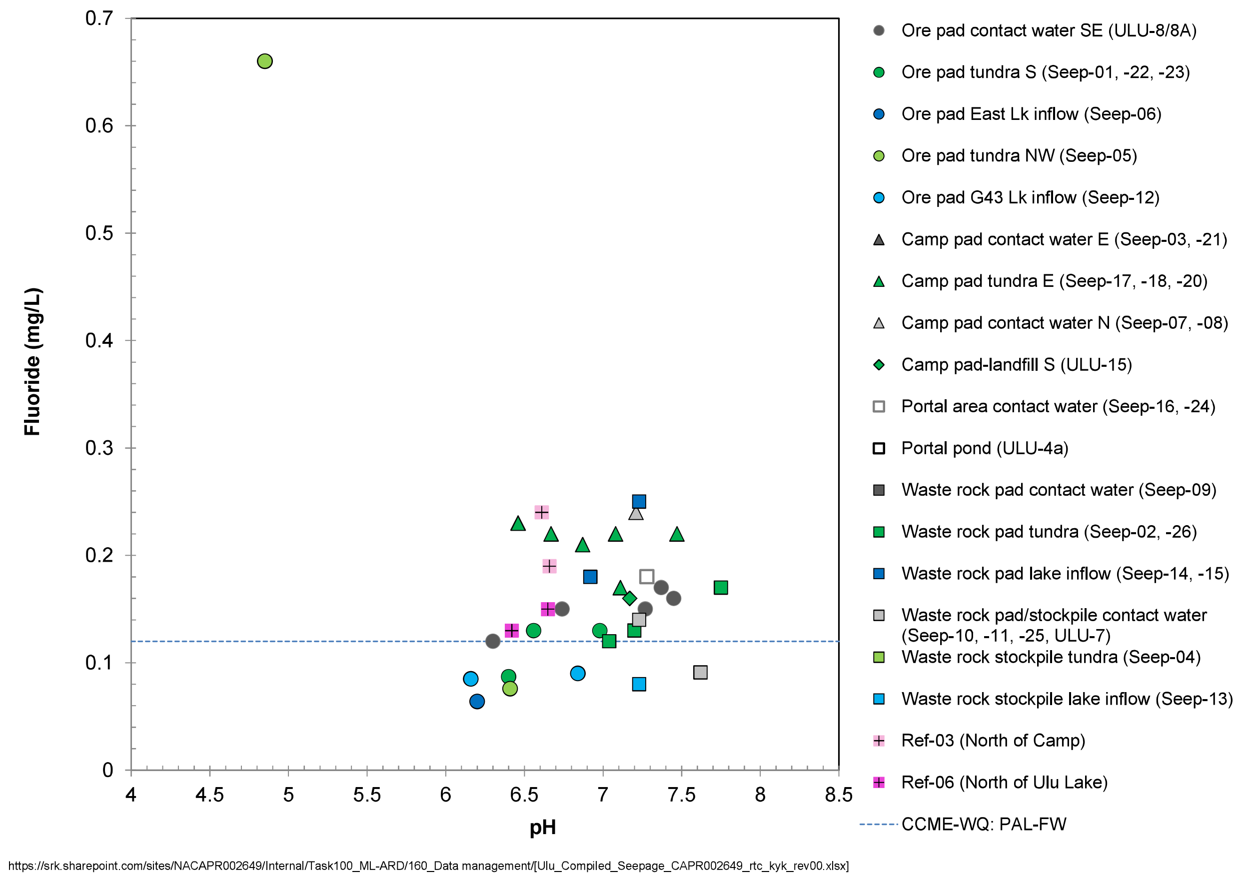


Figure 5.27. Fluoride in 2023 seepage

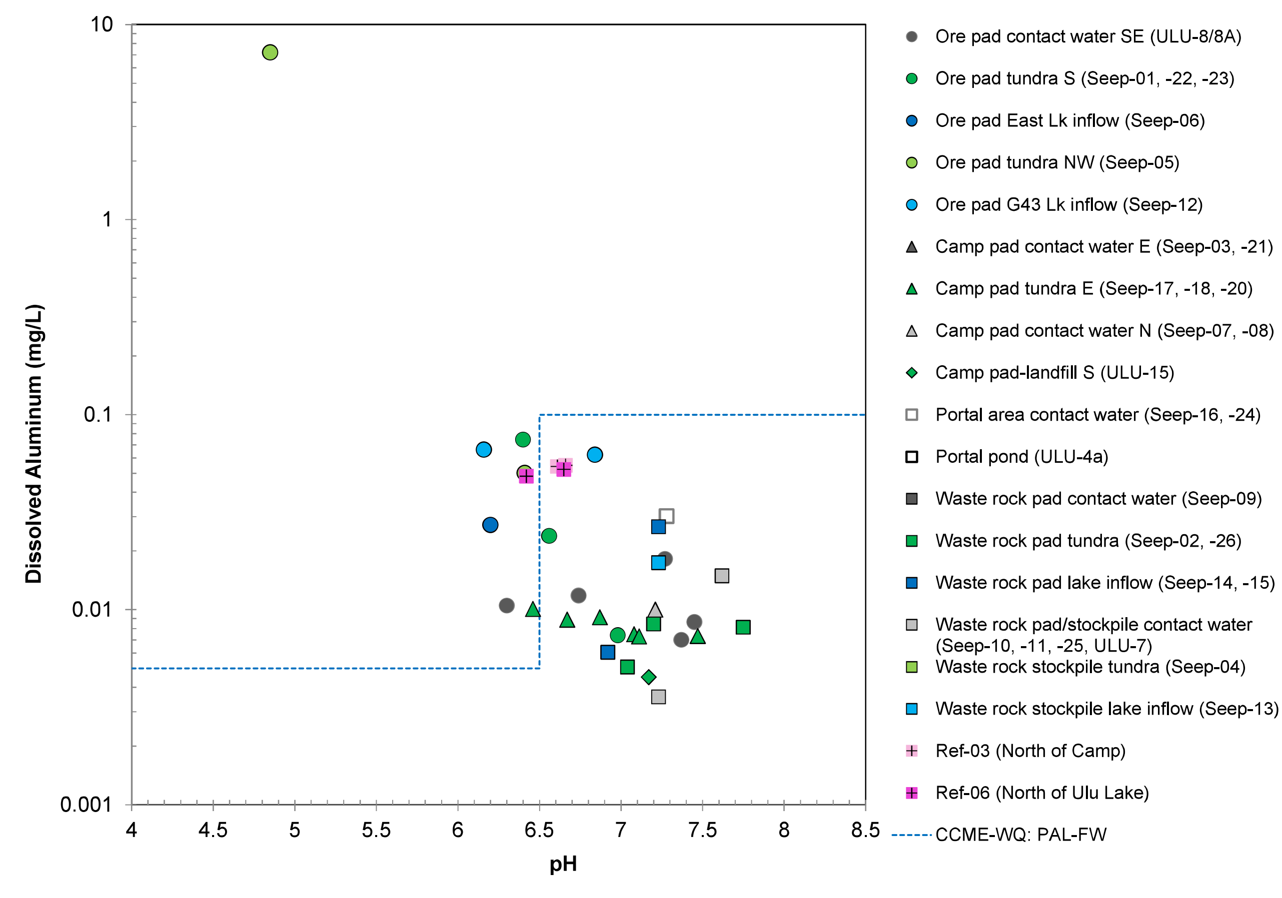


Figure 5.28. Aluminum in 2023 seepage

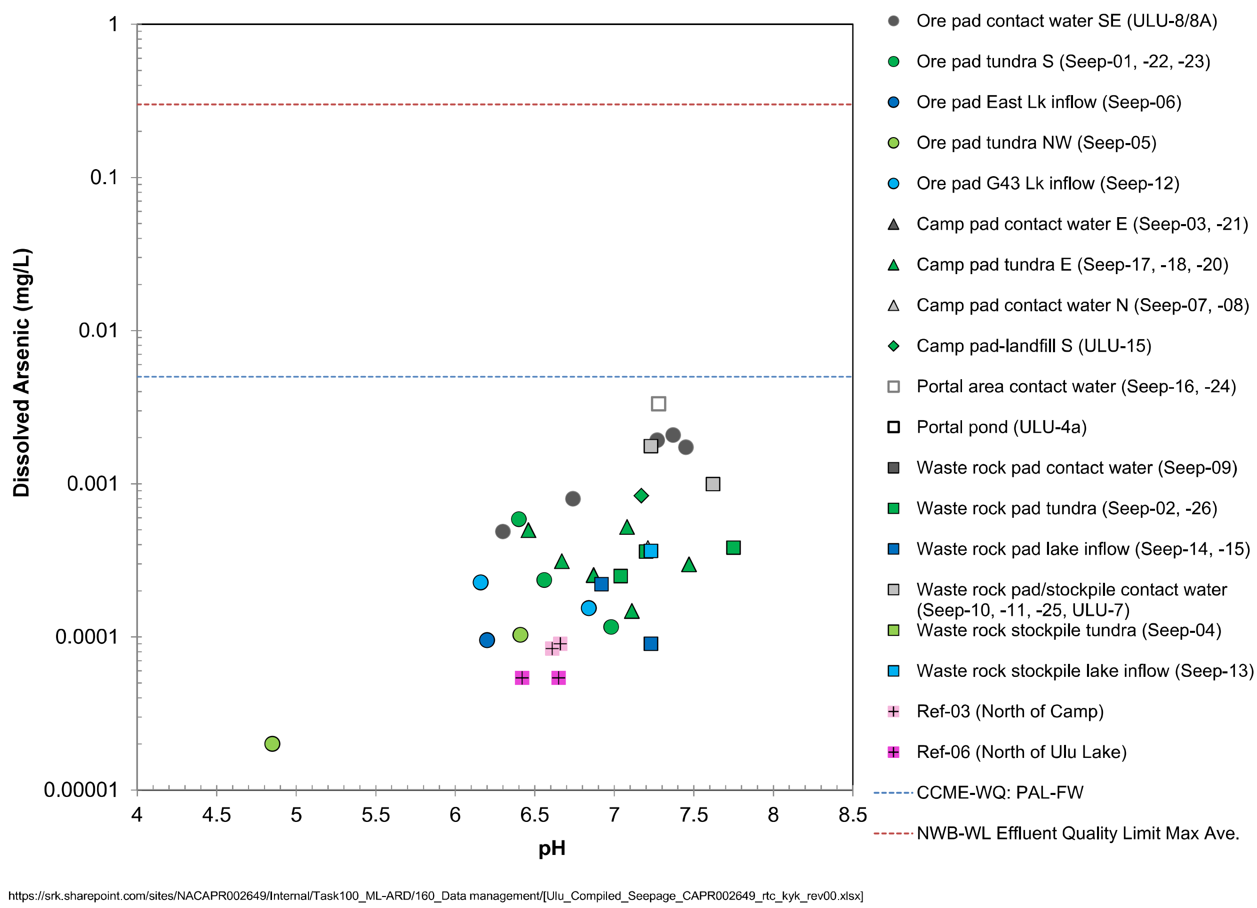


Figure 5.29. Arsenic in 2023 seepage

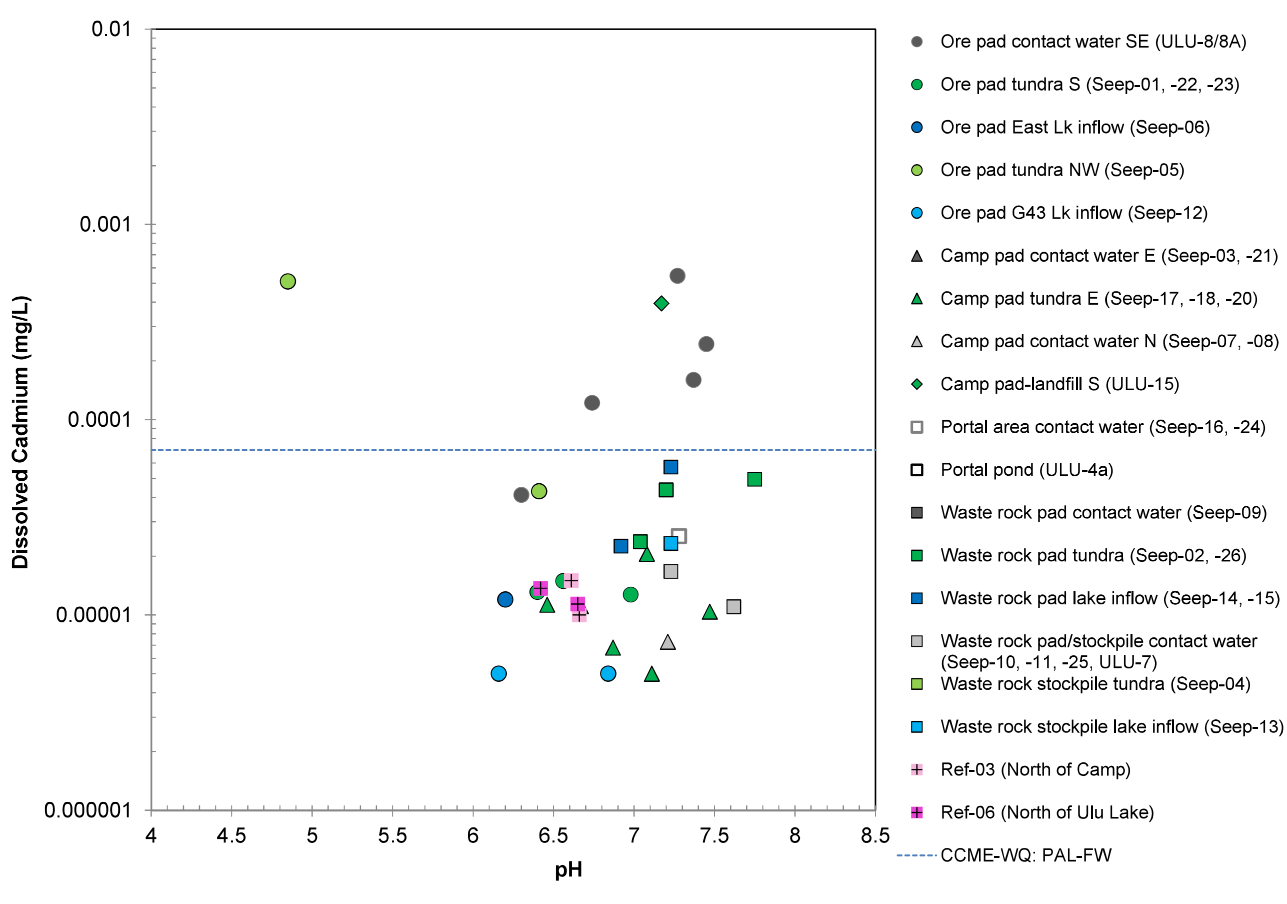


Figure 5.30. Cadmium in 2023 seepage

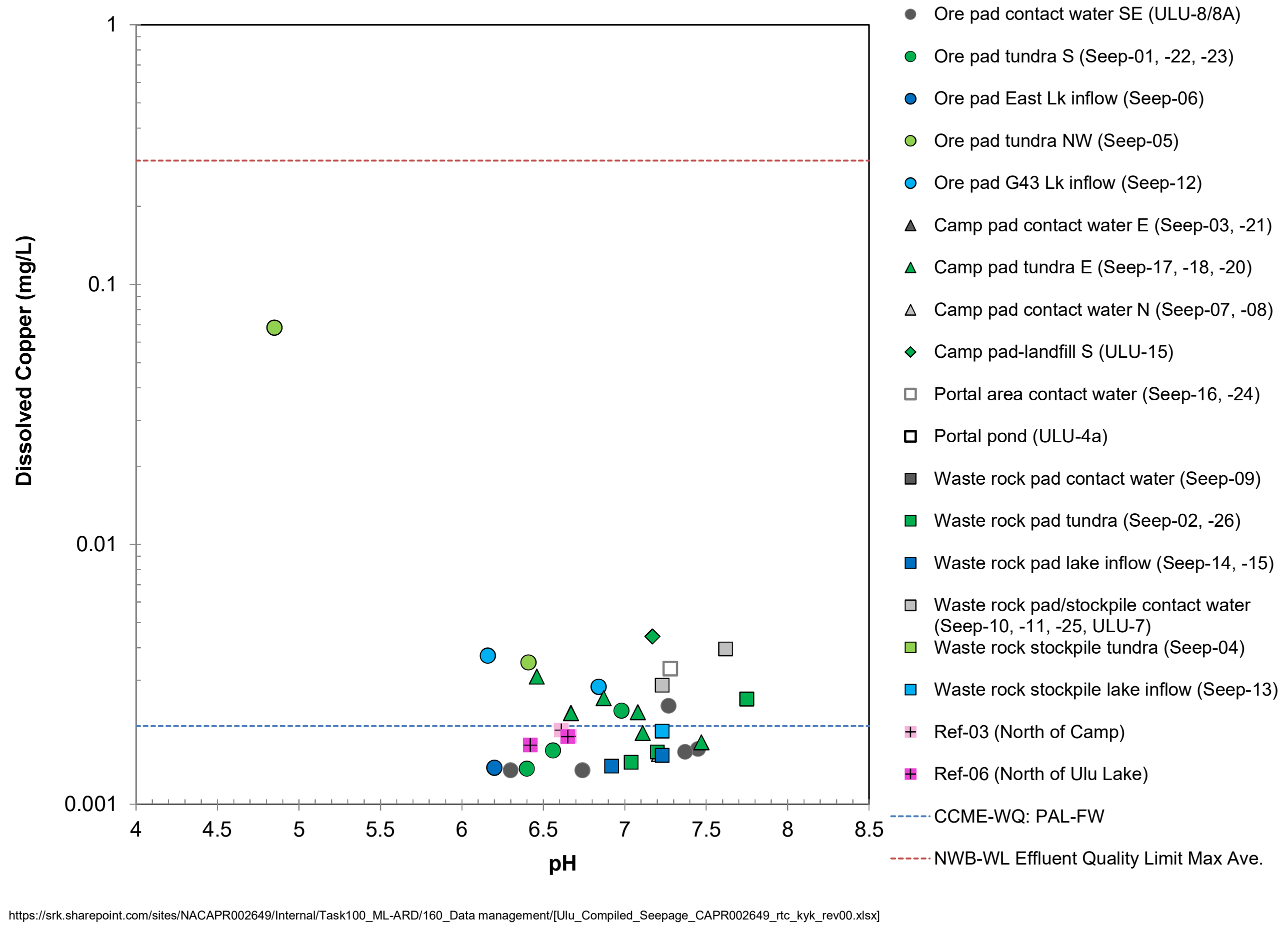


Figure 5.31. Copper in 2023 seepage

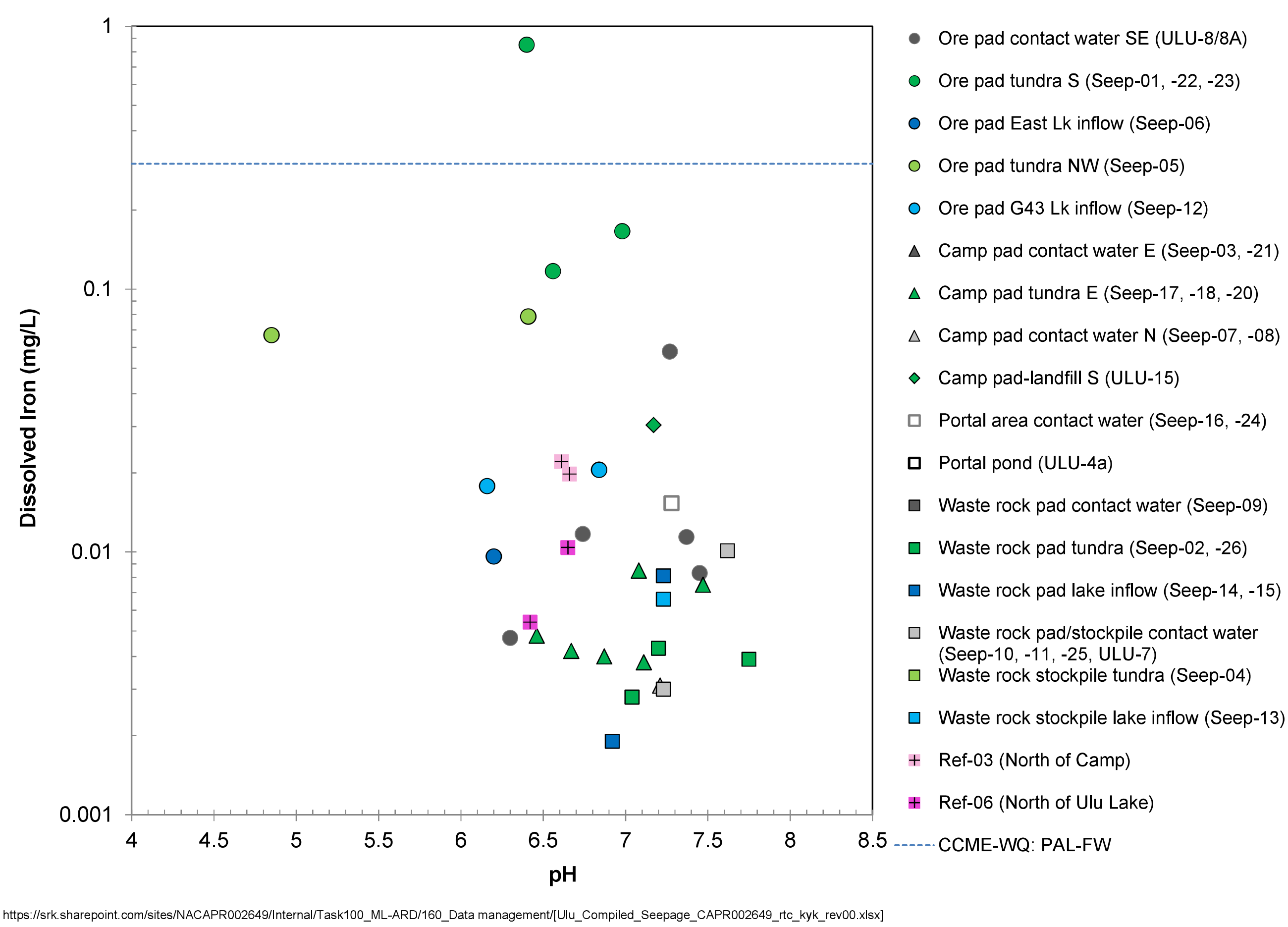


Figure 5.32. Iron in 2023 seepage

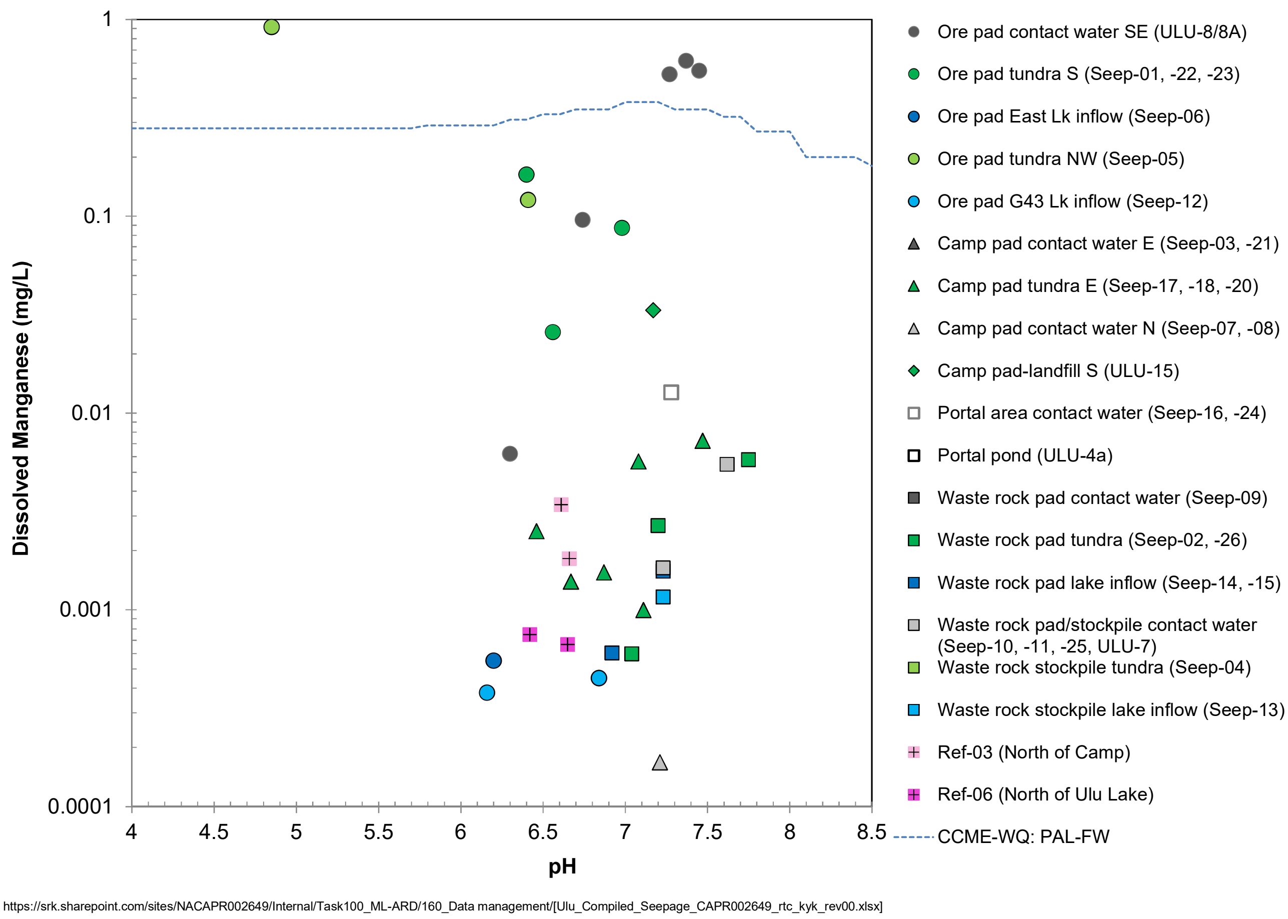


Figure 5.33. Manganese in 2023 seepage

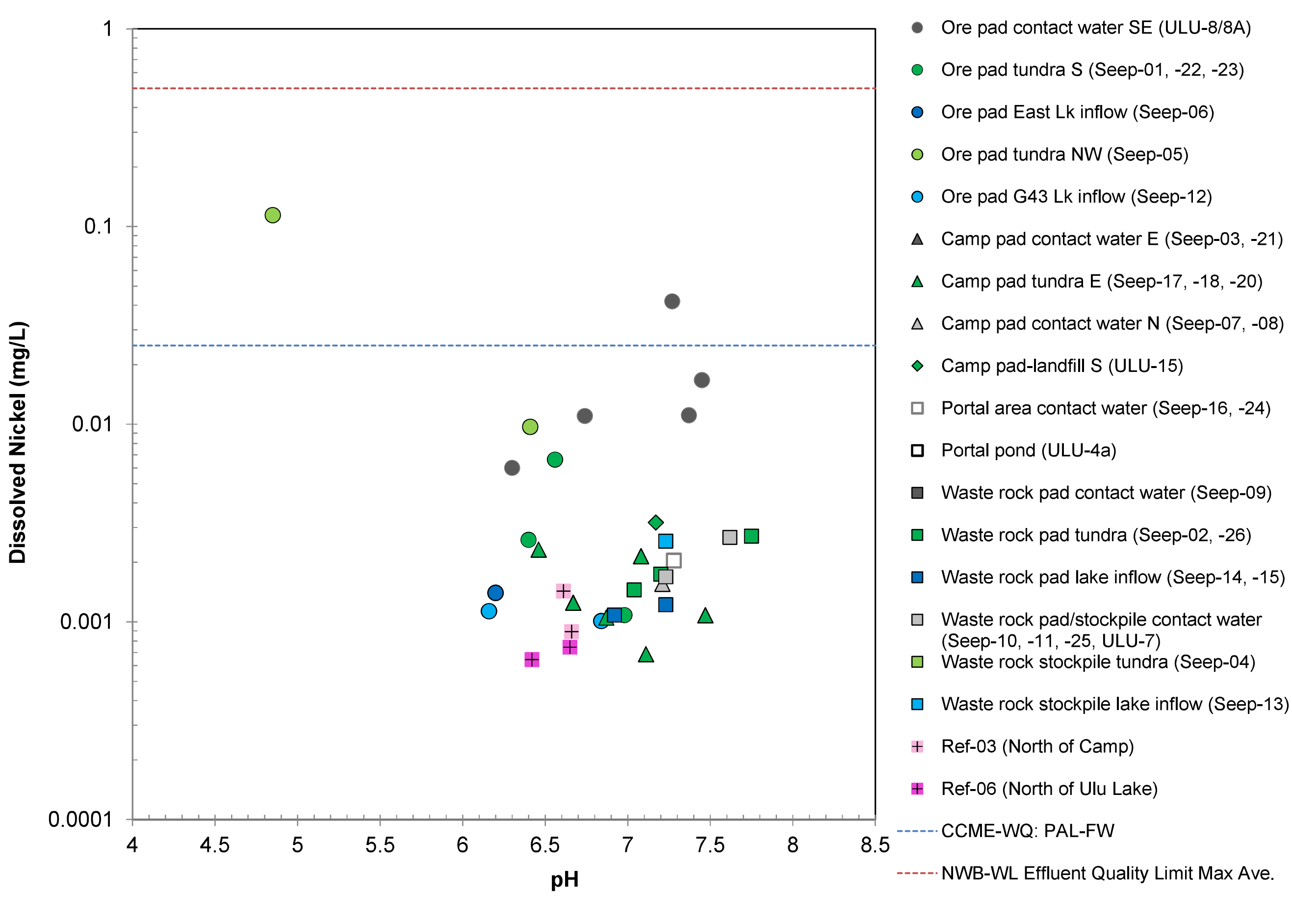


Figure 5.34. Nickel in 2023 seepage

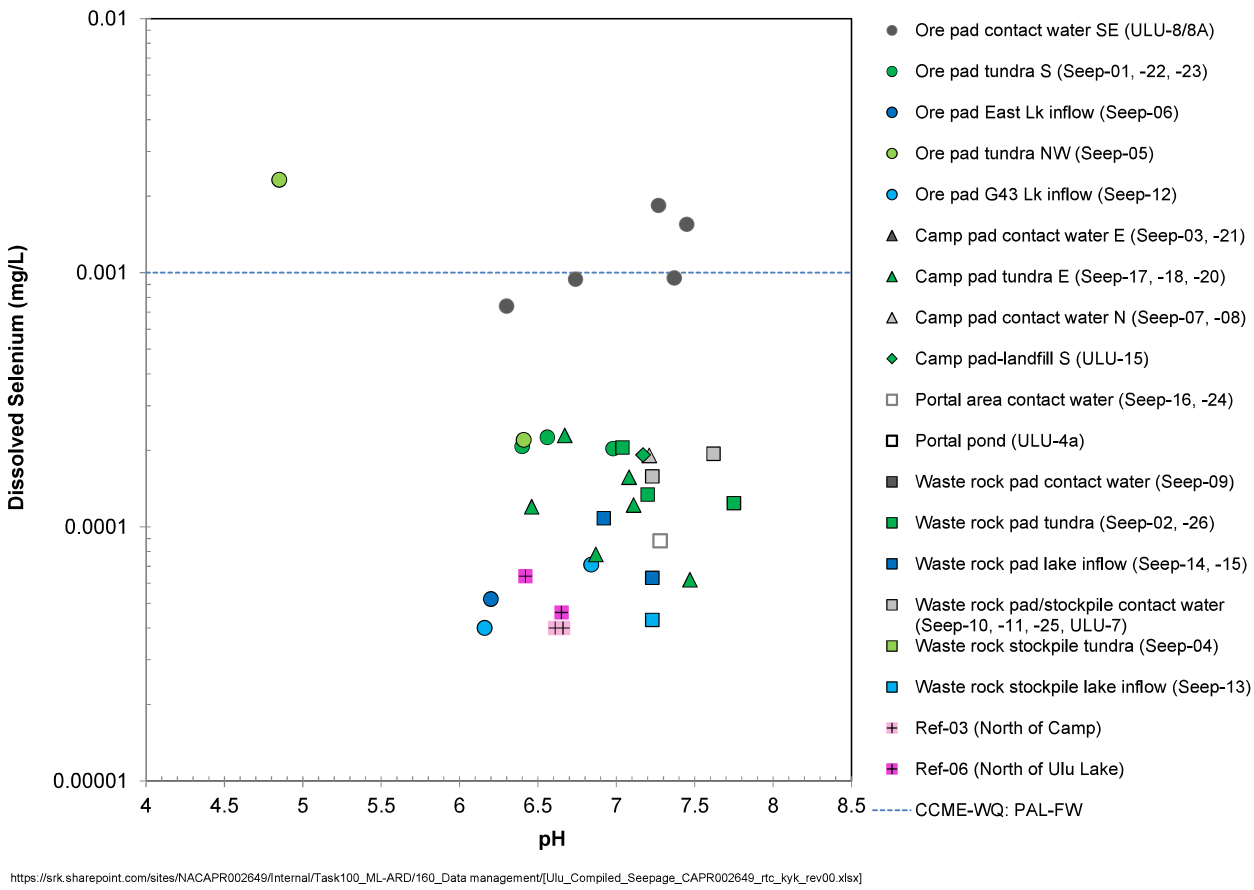


Figure 5.35. Selenium in 2023 seepage

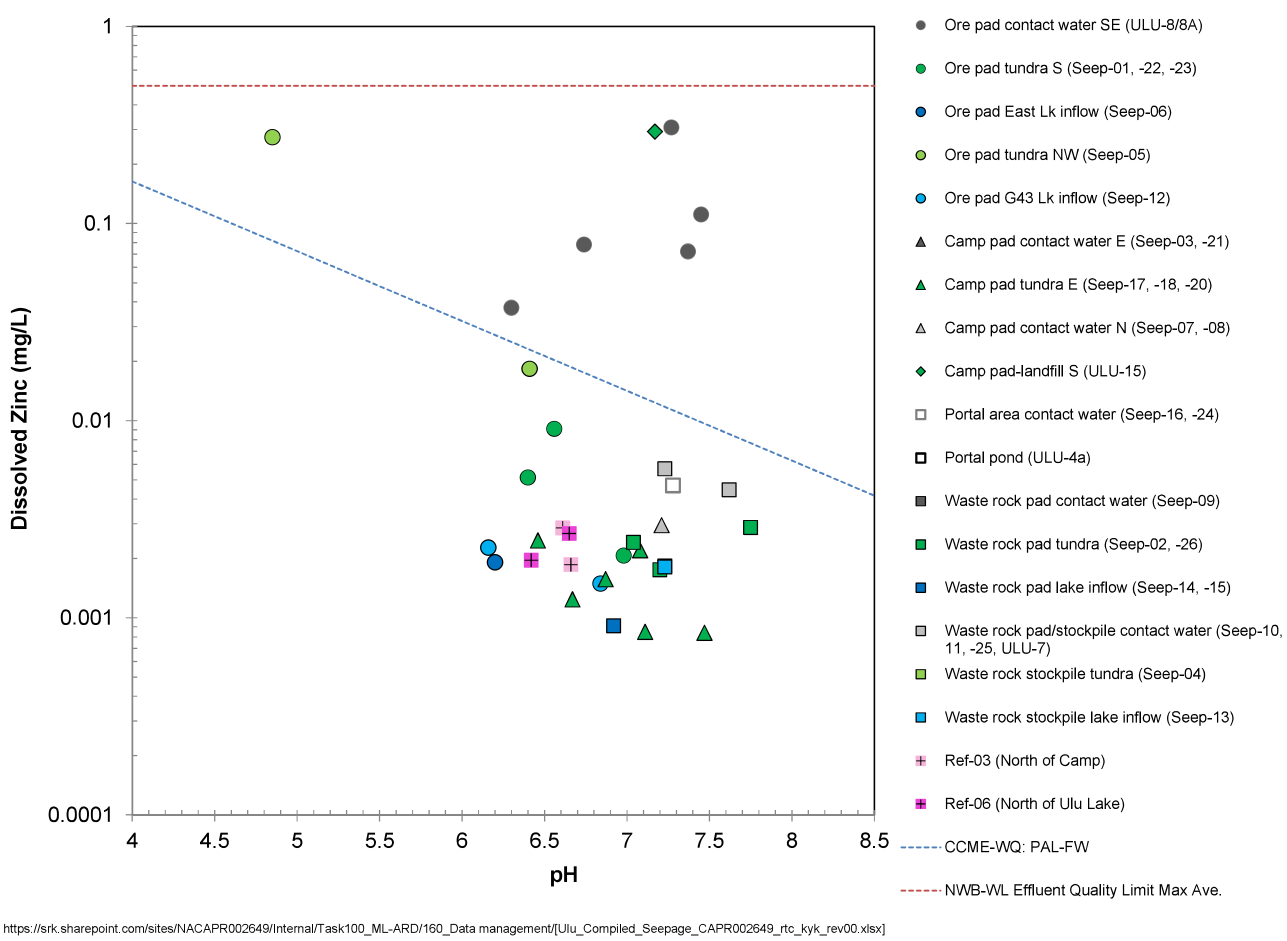


Figure 5.36. Zinc in 2023 seepage

5.3.5 Leaching Trends Over Time

Leaching trends over time are shown for key parameters that exceeded the CCME guidelines in Figure 5.37 to Figure 5.39 (and sulphate over time was shown in Figure 5.25). The vertical gridlines are shown for June 1 each year. The log scale has been removed from the y-axes to focus on the most significant data in relation to the guidelines.

The variation in concentrations within a single season, can be large (orders of magnitude) compared to variation between years. Within a single season lower concentrations are typically observed during freshet (due to dilution) and higher concentrations are expected later in the season when there is a greater thawed rock thickness, which facilitates weathering of greater volumes of rock, and reaction rates are higher due to higher temperatures. Variation between years can also be expected due to different precipitation patterns (e.g., a wet year vs a dry year). But highest concentrations between years, providing there are data from throughout the season may be an indicator of changing conditions.

In 2021 and 2022 the ore pad seeps were not sampled in July/August as the focus was on flowing water to indicate seepage. The 2020 and 2023 datasets are therefore more insightful for comparing highest concentrations in late season seepage from the ore pad. As with sulphate discussed above, nickel, selenium, and zinc concentrations were all higher in 2023 than 2020 in ore pad seepage and provide an indication that contact waters are being increasingly impacted by metal leaching associated with sulphide oxidation on both the north and south sides of the ore pad.

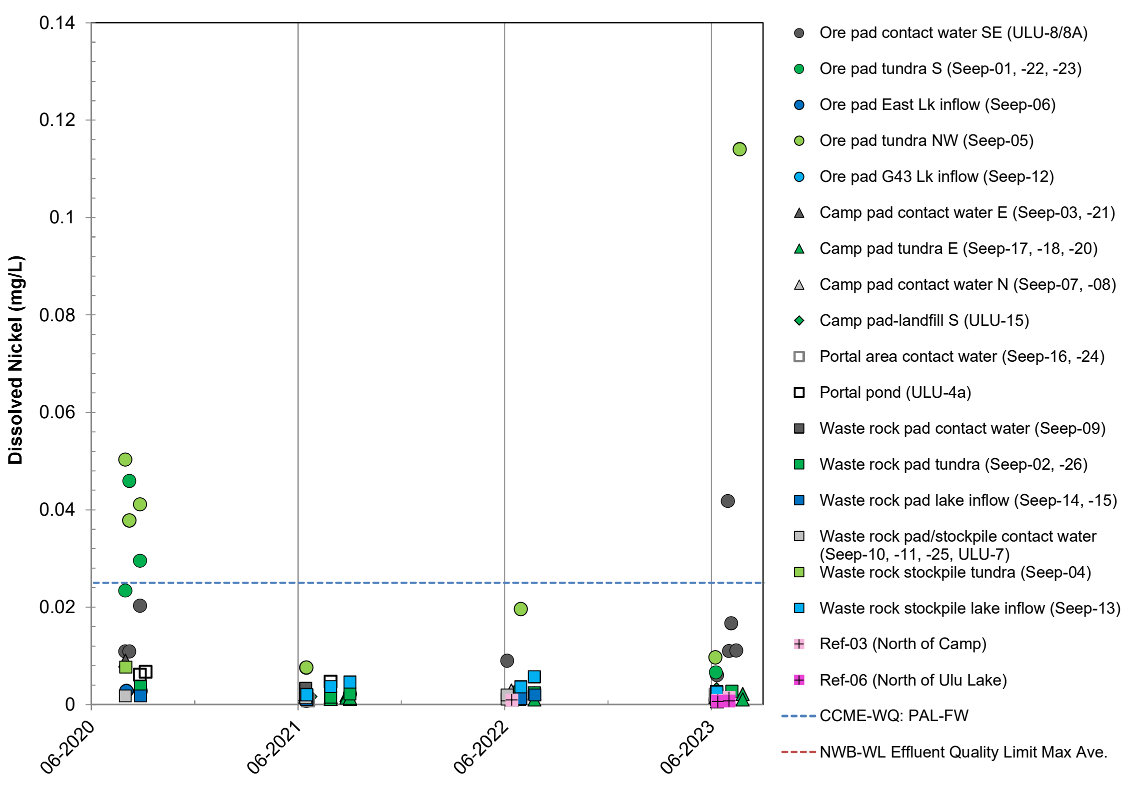


Figure 5.37. Nickel over time in seepage

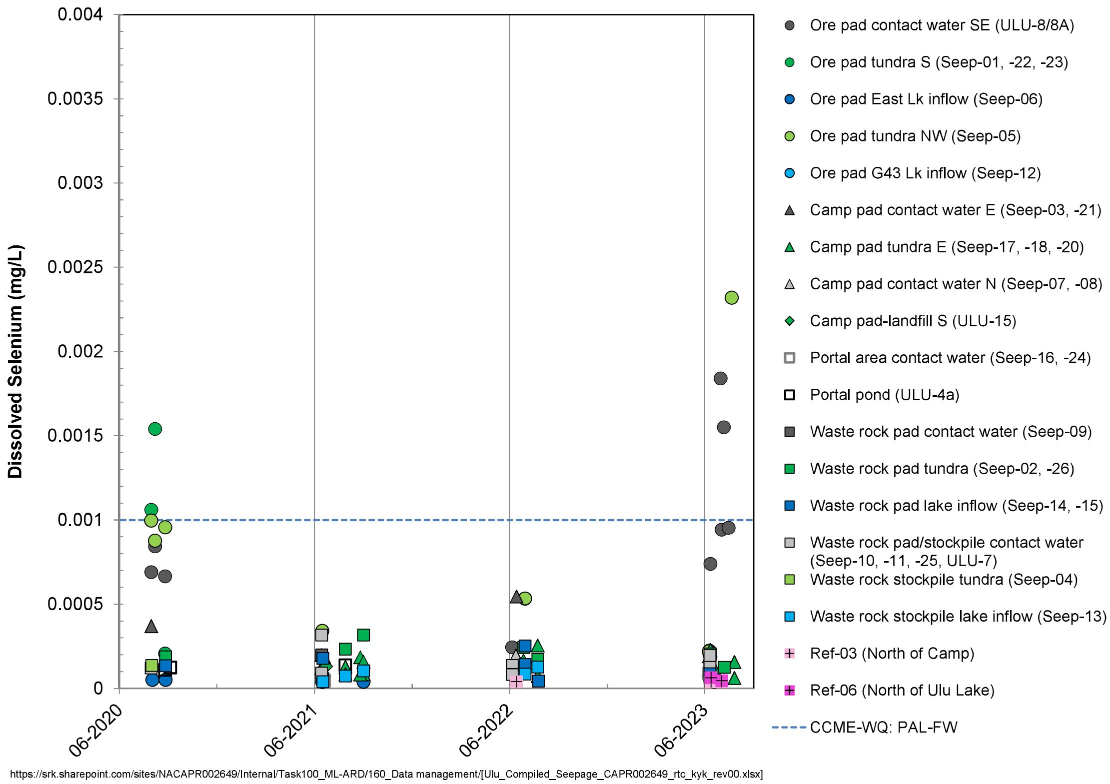


Figure 5.38. Selenium over time in seepage

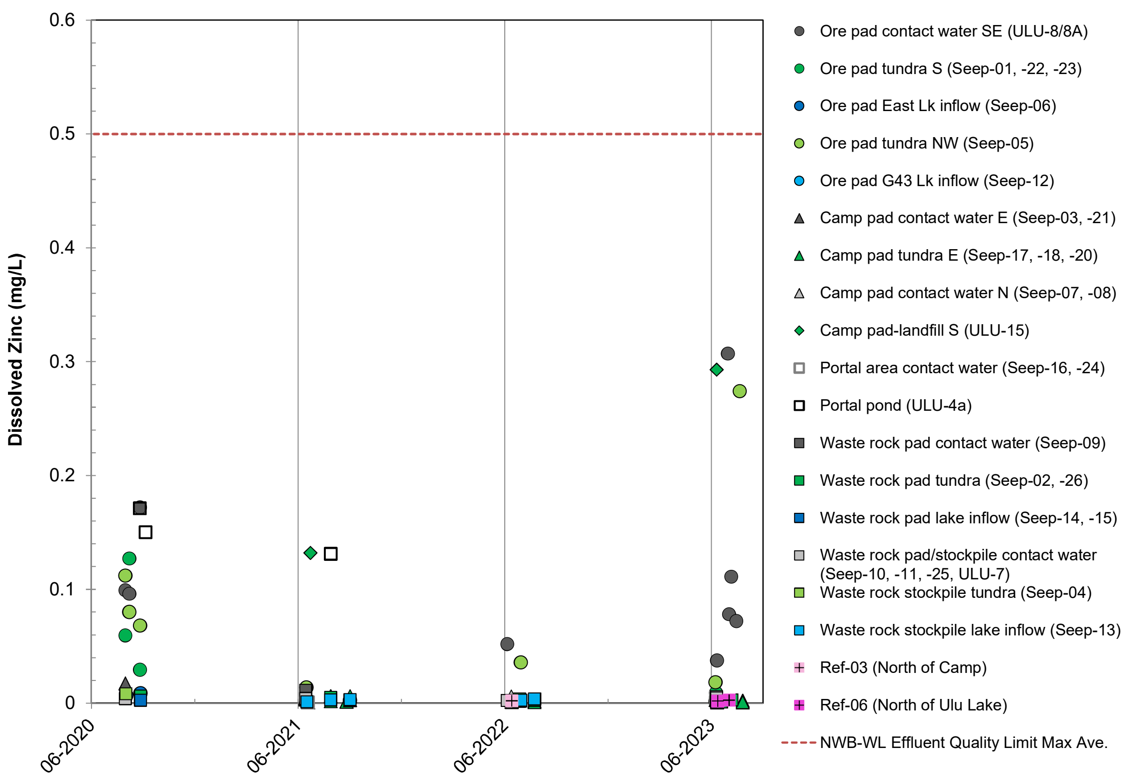


Figure 5.39. Zinc over time in seepage

6 Conclusions

The 2023 monitoring program indicates the following regarding ARD:

- The waste rock-portal area and the camp pad are not at present generating ARD.
- The south side of the ore pad is not at present generating ARD.
- 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 and is expected to continue to get worse unless acid generating rock in this catchment is managed.
- In July 2023, acidic conditions in the tundra extended for at least 15 m, but less than 25 m from the north edge of the ore pad.
- Rinse pH testing of samples from test pits in the pads showed that acid generating rock has been identified in each of the pads at multiple locations, and in ore and waste rock stored on the east and west side of the portal. Drainage from the camp pad, waste rock-portal area and the south side of the ore pad is currently (in 2023) 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.
- Lowest rinse pH results were pH 2.9, and lowest pH measured in drainage in the tundra was pH 4.2 therefore this site has the potential to develop more severe pH drainage conditions.
- To reiterate estimates of timing of ARD onset provided in SRK (2022b); based on calculations of site weathering rates, and measured ARD potential of the rock in the pads, delay to onset of ARD estimates for 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 (from 2020) for material with average ARD potential, again depending on the depth. There is therefore a short window of opportunity to manage the rock not covered in esker sand before widespread ARD is likely.

The 2023 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 licence.
- Dissolved zinc was close to the NWB-WL effluent quality limit in ore pad seepage, from both the north and south edges of the ore pad. Zinc leaching has increased since 2020 and is expected to get worse unless rock in the ore pad is managed.
- Aluminum, cadmium, copper, fluoride, iron, manganese, nickel, selenium, and zinc were present in ore pad seepage at concentrations above background and above the CCME PAL-FW water quality guidelines. Concentrations of most of these parameters would be expected to get worse if conditions became more acidic.

7 Recommendations

7.1 ML/ARD Management

SRK (2021) showed that 90% of the waste rock in the infrastructure pads was classified as potentially acid generating, therefore areas of the pads that currently contain circum-neutral pH rock will need managing to prevent ML/ARD.

Therefore, SRK recommends the rock at Ulu be managed to prevent further development of ARD and acceleration of leaching of regulated parameters. Limiting pH decline in the infrastructure pads is necessary to avoid deterioration of water quality and remain compliant with the water licence. Developing and implementing an ML/ARD management plan should therefore be a priority.

Highest priority areas that need management within a short time frame (in 2024) to limit ML/ARD are currently:

- The north edge of the ore pad where the rock was not historically covered in esker sand, including residual waste rock tying on the tundra. Rock here is currently at risk of generating more severe ARD.
- The southeast part of the ore pad where ore was previously stockpiled (this is currently at high risk of developing more severe metal leaching conditions).
- The southern edge of the ore pad where there is limited sand cover (also at risk of generating ARD and more severe metal leaching).

Additional acidic rock that has the capacity to locally generate severe contact water chemistry, but water drains into the portal pond or into the waste rock pad before it may exit the site, include:

- Waste rock just west of the portal pond and in the mine sump berm (seepage drains across the road into the waste rock pad).
- Ore above the portal. Seepage drains into the mine sump pond or the portal pond; however, the integrity of the mine sump liner is uncertain since rock was pushed into part of it, and seepage may drain into the waste rock pad.

Managing this rock may limit localized release of acidity and metals into water that may drain through the waste rock pad (acidic water draining through this pad contributes to depleting its neutralization capacity).

The drill core storage area has a significant volume of rock around pH 3 but due to the pads greater thickness (more than 3 m on the northeast side), it may remain frozen at the base providing some mitigation. Managing acid generating rock in this area is needed, but drainage chemistry is currently less problematic than ore pad drainage chemistry.

In May 2022, SRK presented Blue Star with a variety of preliminary options for managing the waste rock at Ulu to limit ML/ARD (SRK 2022f). SRK recommends that Blue Star revisit this and decide on a long-term management plan so that rock that needs management in 2024 does not have to be re-handled in the future.

7.2 ML/ARD Monitoring

There is now a substantial ML/ARD monitoring dataset to feed into ML/ARD management planning. SRK therefore recommends that seepage monitoring as per the protocol (SRK 2022c) can be reduced to a few key monitoring stations that can be used to identify any significant changes in the site conditions. The sites are based on coverage of the different areas that generate drainage and the likelihood that flow will continue for the summer. The main ore pad seeps are included to monitor sub-surface drainage. Table 7-1 shows the recommended seeps and frequency for on-going monitoring of ML/ARD conditions at Ulu. Monitoring of the reference stations is also no longer considered necessary.

Table 7-1. Summary of On-going Seepage Monitoring Recommendations

Area	Monitoring Location	Sampling Frequency	Additional Comments
Ore pad, southwest	Seep-01	At freshet, then after significant rainfall (as defined in the protocol), or monthly if there is no significant rainfall.	
Ore pad, northwest	Seep-05		
Ore pad, southeast	ULU-8A if flowing, otherwise ULU-8		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 sample this upstream flowing seepage too (monthly frequency).
Waste rock portal 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 area, west	Seep-13		

- Continue rinse pH monitoring of the waste rock in the infrastructure pads as per the rinse pH monitoring protocol (SRK 2022d), at a frequency of every two years. This provides an “early warning system” compared to seepage monitoring, providing information on the degree of acidic weathering conditions within the pads.
- Conduct rinse pH testing of additional samples of ore above the portal pond to determine whether the two samples tested in 2023 are representative of development of acidic weathering conditions in the ore.

This report, 2023 Monitoring of Metal Leaching and Acid Rock Drainage Potential at the Ulu Camp, Ulu Gold Project, Nunavut , was prepared by

March 27, 2024

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Principal Consultant (Geochemistry)

and reviewed by

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Practice Leader (Geochemistry)

NAPEG Permit to Practice P255.

All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

8 References

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