Crown-Indigenous Relations and Northern Affairs Canada
Relations Couronne-Autochtones et Affaires du Nord Canada

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January 30th, 2025 File: W2020L8-0003 and W2020X0005

Dr. Anneli Jokela,
Acting Executive Director
Wek'èezhìi Land and Water Board
#1-4905 48th St., Yellowknife, NT X1A 3S3

Dear Dr. Jokela,

Re: Rayrock (Kwetᵱʔaà) Remediation Project
Submission of Responses to Information Requests - Aquatic Effects Monitoring Program Design Plan

Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) Contaminants and Remediation Division (CARD) received from the Wek'èezhìi Land and Water Board (WLWB) a Type A Water Licence (W2020L8- 0003) and a Type A Land Use Permit (W2020X0005) on November 18th, 2021. In response to the WLWB's Decision Letter dated May 22, 2024, CIRNAC-CARD submitted an updated Response Framework (Section 12) of the of the Aquatic Effects Monitoring Program Design Plan (AEMP DP) Version 1.1.

Based on the information provided by CIRNAC-CARD in the updated Response Framework and responses to comments received during the public review, additional information was requested on November 4, 2023, to help inform the WLWB's decision. These Information Requests were discussed between CIRNAC-CARD and WLWB staff on November 14, 2024, and an additional technical discussion was held between WLWB staff and AECOM Canada Ltd. on November 21, 2024.

CIRNAC is pleased to provide the following information in response to the November 4, 2024, Information Requests.

Information Request #1: CIRNAC-CARD to provide information that defines a Significance Threshold for water quality.

CIRNAC-CARD has revised the AEMP Response Framework (attached) to include Significance Thresholds for water quality. These Significance Thresholds are primarily derived from Site-Specific Significance Thresholds (SSSTs) previously developed for the Rayrock remediation project (CanNorth 2023), specifically for Mill Lake water discharge into Sherman Lake. The SSSTs for non-radionuclides were primarily derived from species sensitivity distributions and radionuclides were derived using a back-calculation of acceptable doses associated with a factor of 10 times the radiation dose benchmark.

A detailed list of Significance Thresholds for nutrients, metals, and radionuclides and their rationale for selection is provided in Section 12.3 of the Response Framework.

Information Request #2A: Considering the response provided to IR#1, CIRNAC-CARD is to clarify the appropriateness of the proposed Action Levels (i.e., that they progressively approach the Significance Threshold and provide adequate time to respond).

The revised Response Framework includes updated Action Levels for water quality based on the defined Significance Thresholds (i.e., % of the Significance Threshold value), instead of levels of change from baseline. Exceptions to this approach are required for specific parameters based the baseline conditions of some AEMP lake locations; these are outlined in the Response Framework.

Information Request #2B: CIRNAC-CARD wish to revisit the number of Action Levels, that can be done at this time. If new Action Levels are proposed, they are to address the expectations outlined in IR#2A.

CIRNAC-CARD has reduced the number of Action Levels in the revised Response Framework to 'Low' and 'High'. CINRAC-CARD considers these levels to be appropriate for maintain the intent of the AEMP Design Plan: identifying potential changes in the aquatic environment as a result of remediation activities and responding with the appropriate investigation or management action.

Concluding Remarks

If you require any additional information, please do not hesitate to contact me at ron.breadmore@rcaanc-cirnac.gc.ca.

Yours truly,

Ron Breadmore
Project Leader, CIRNAC-CARD

cc:

Dawn Keim, Acting Senior Manager, CIRNAC-CARD
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Encl:

Updated Section 12 of the AEMP Design Plan (Response Framework)

12 RESPONSE FRAMEWORK

12.1 Overview

This section describes the Response Framework for the AEMP that has been developed in recognition that the Kwetıı̨ʔaà (Rayrock) Remediation Project is a short-term remediation project and therefore may be different to those developed for new development projects. The Response Framework links monitoring results to actions with the objective of maintaining the valued aquatic ecosystem conditions or assessment endpoints described in Section 9.3 within the current or existing baseline range. The Response Framework provides an approach to responding to the results of the AEMP and was developed with guidance from the *Guidelines for Adaptive Management – A Response Framework for Aquatic Effects Monitoring* (WLWB 2010; MVLWB/GNWT 2019) and Racher et al. (2011).

The AEMP is designed to detect potential changes in Sherman Lake after discharge commences from the water treatment facility, as well as any changes to other receiving water bodies (i.e., Gamma and Beta Lakes) during remediation. Changes are not deemed "effects" until a link to the Rayrock Remediation Project has been established. Should an effect be detected, a corresponding "action" will occur. The type of action taken depends on the magnitude or severity of an effect relative to an assessment endpoint. This is termed the "Action Level."

The goal of the Response Framework is to systematically respond to monitoring results to prevent significant adverse effects from occurring. This is accomplished by requiring proponents to take actions at defined Action Levels, which are triggered well before significant adverse effects could occur. A level of change that, if exceeded, would result in a significant adverse effect is termed a "significance threshold."

The Rayrock Remediation Project is a federal contaminated site that will be undergoing remediation. The EQCs developed and approved in the Water Licence were established to meet the Canadian Water Quality Guidelines (CWQGs) for the protection of aquatic life (CCME 1999a) and existing pre-remediation baseline conditions in Sherman Lake so as not to change the water quality. As a result, there was no requirement to establish an effluent mixing zone. If treated effluent exceeds the EQCs set out in the Water Licence in any one grab sample, it will not be discharged to the receiving environment, therefore conditions in Sherman Lake are not anticipated to change during the AEMP.

However, if upset conditions were to occur during remediation or other changes to water quality parameters identified due to remediation activities, the AEMP has been designed to address two impact hypotheses: 1) changes to Sherman Lake are from effluent discharges or 2) changes to the receiving water bodies is due to physical remediation activities.

The measurement of an effect is determined by comparing AEMP results from Sherman Lake sampling sites (Sherman Lake B, Sherman Lake L, Sherman Lake K, Alpha Bay (Alpha Lake) and Lake A) as well as other Rayrock water bodies (i.e., Lake B, Kwetsǫ̀tìa, Gamma Lake and Beta Lake) to Action Levels provided in this document. For example, a water quality result that falls within the normal range of the baseline data set or is well below an applicable CWQG would not lead to an action. Whereas a water quality result that falls outside the range of normal variability of the baseline data and or exceeds an applicable CWQG while also being linked to the Rayrock Remediation Project would be of low ecological consequence. This would be classified as a Low Action Level and constitutes a "flag" for follow up and possible additional investigation and or proactive management actions.

Should the initial Low Action Level management interventions or investigation results not be sufficient to mitigate the potential threat to the Sherman Lake aquatic environment, and conditions worsen to a level that is of high concern relative to the Significance Threshold, then the magnitude of the effect will be classified as a High Action Level. Water quality results that exceed the High Action Level while also being linked to the Rayrock Remediation Project are considered effects that have increased considerably above the normal variability of the baseline data and or applicable CWQG. High Action Levels require timely management interventions to stop or reverse the effect. Any effect that exceeds the High Action Level and poses a potential threat to the aquatic receiving environment of Sherman Lake must be investigated by measures including: additional investigation into dissolved metals concentrations (if the action level is triggered by metals) and/or ortho phosphate (if the action level is triggered by total phosphorus), the collection of samples for acute toxicity testing, and the development of a Response Plan.

The Response Framework involves definition of conditions for the Low and High Action Levels for all aquatic environment components of the AEMP (water level survey, water quality, sediment quality, benthic invertebrate community, benthic tissue, and fish tissue) as per the MVLWB el al. (2019) guidance on AEMP response frameworks. Action Levels were established for key water quality indicators of possible significant adverse effects and were not developed for every water quality parameter being measured in the AEMP. Therefore, the Response Framework consists of Action Levels and Significance Thresholds for key water quality indicators and spells out the types of action that may be taken. Similarly, the Action Levels for the other AEMP components spell out the types of responses required. Specific actions to be taken depend on the type and severity of the effect detected. Specifics on the Significance Thresholds, Action Levels, and types of actions that may be taken are outlined below.

12.2 Significance Thresholds

It is important to recognize the context in which the Response Framework for the Rayrock Remediation Project has been developed. Changes to the exposure endpoints of water and sediment quality in the Rayrock study lakes have already occurred due to historical mining activities and other anthropogenic activities in the area. Unlike other large-scale and long-term civil projects in the Northwest Territories, the duration of the water discharge will be short (during the open water season only) and there is little opportunity for a chronic build-up of Constituents of Potential Concern (COPC).

The Significance Thresholds and Action Levels were therefore designed around identifying if unacceptable changes in the water quality COPC's selected for this project are occurring. These thresholds will protect Sherman Lake from unacceptable changes that can impact the aquatic receiving environment and would precede possible downstream changes. The rationale for each endpoint and related effect to describe the Significance Threshold are discussed below.

12.3 Action Levels

The proposed Action Levels for the aquatic environment survey, water quality, sediment quality, benthic invertebrate community, benthic tissue, and fish tissue are presented in Tables 12-2 to 12-7. The spatial extent of the Action Level evaluation includes all receiving water bodies adjacent to the Rayrock Remediation Project, which includes the Sherman Lake waterbody (Sherman Lake, Alpha Lake, Lake A), Gamma Lake, Beta Lake, and Kwetsǫ̀tìa. Responses to occur if an Action Level is triggered are also presented in Tables 12-1 to 12-6, and follow recommendations provided on Version 1.0 and guidance in MVLWB and GNWT (2019).

12.3.1 Effluent Quality

The effluent quality Action Level is based on the EQCs established in the Water Licence W2020L8-0003 (Table 10-1). The EQCs apply to effluent coming directly out of the water treatment facility (SNP 1663-7), prior to discharge to the receiving environment of Sherman Lake. The Water Licence established these EQCs based on both the baseline water quality conditions in Sherman Lake and the CWQGs for the protection of aquatic life (CCME 1999a). The CWQGs are set to protect all forms of aquatic life and all aspects of aquatic life cycles, including the most sensitive life stage of the most sensitive species (i.e., alga species) over the long term from anthropogenic stressors such as chemical inputs or changes to physical components. They provide a science-based benchmark for a nationally consistent level of protection for aquatic life in Canada. The guidelines identify waterborne concentrations intended to protect all forms of aquatic life for indefinite exposure periods.

The effluent quality treatment goals, established in the Water Licence, for Mill Lake effluent include:

- Ammonia - 499 µg/L, Total Ammonia Nitrogen
- Fluoride - 120 µg/L
- Nitrate - 13,000 µg/L
- Nitrite - 197 µg-NO2/L
- Copper - 2.8 µg/L
- Iron - 300 µg/L
- Nickel - 25 µg/L
- Uranium - 15 µg/L
- Zinc - 23 mg/L
- Total Petroleum Hydrocarbons - 5 mg/L
- Total Suspended Solids - 15 mg/L

Compliance

Compliance with the Water Licence requires that effluent discharge stop if the effluent quality exceeds the EQCs in any one grab sample or if the effluent is determined to be acutely toxic to fish (i.e., Rainbow Trout) and zooplankton (i.e., *Daphnia magna*). Effluent quality and toxicity are tested prior to commencing or resuming discharge. Daily tests of effluent for ecological parameters (i.e., temperature, conductivity, pH, redox potential, TDS, turbidity, dissolved oxygen), and daily on-site analysis of copper and uranium is required. Effluent quality samples will be shipped weekly to a certified laboratory for all sampling parameters outlined for SNP 1663-7, including major ions, nutrients, solids, standard laboratory parameters, total metals, and total radionuclides, and monthly for acute toxicity testing (Table 9-3).

These effluent quality compliance levels have been established through the Water Licence and discharge must stop if the water treatment facility does not meet either the EQCs or toxicity requirements. The WLWB and the Inspector will be notified immediately, a spill report will be submitted, and corrective actions taken and reported on (Table 12-2).

12.3.2 Aquatic Environment

The target lakes included in the aquatic environment survey are the Sherman Lake waterbody, Beta Lake, Gamma Lake, and New Control Lake. The Action Levels for aquatic environment combine both water level (hydrology) and shoreline observation results that may change due to the Rayrock Remediation Project.

A physical change in water level and shoreline aquatic habitat is not expected due to the discharge of Mill Lake water into the Sherman Lake waterbody. Approximately 322,085 cubic meters (m^3) of treated Mill Lake water will be discharged into Sherman Lake over the course of three open water seasons. In total, the

water treatment plant is expected to operate for less than 12 months over the three years of operation, with the majority of the water to be treated and discharged in the first year (187,820 m^3), and the remaining of the following two seasons (68,940 m^3 and 65,325 m^3, respectively) (Sanexen 2023).

The Sherman Lake waterbody is 178.5 ha in area and is quite deep in places, with depths of up to 9 m measured in the Lake. If an average water depth of 3 m is assumed, then the volume of Sherman Lake is 5,355,000 m^3. The first year of discharge would add approximately 3.5% of the total volume of Sherman Lake, and approximately 1.2% of the total volume in the second and third treatment seasons. Without consideration of lake water retention or discharge rates, these annual volumes would contribute up to 0.11 m to the water level in year one, and up to 0.04 m in year two and three (if the water in Sherman Lake waterbody remained static).

The probability of an Action Level being triggered is extremely low due to volume of water to be discharged from Mill Lake relative to the size of the Sherman Lake waterbody, the daily discharge limits, and the short duration of time that discharge will occur in the open water season. Also, due to site access and operational limitations during the spring break up and thaw period, annual commissioning and start-up of the Mill Lake water treatment facility and the Confined Disposal Facility are not anticipated to occur until after the annual freshet. Therefore, freshet levels measured on Sherman Lake and Lake A will not be influenced by discharge of treated water from the Rayrock site.

The Action Level triggers for changes in water level on Sherman Lake have been set using the elevation difference between the maximum spring freshet water level and the average summer water level measured during the pre-remediation baseline in 2023. At the Sherman Lake hydrologic monitoring station, the maximum water level was measured in June at 180.475 masl and the average water level from June to September 2023 was 180.345. This elevation difference of 0.130 m (130mm) between the annual peak and the summer average will be used to trigger Action Levels for Sherman Lake hydrology.

Water level data will be downloaded each June, immediately prior to commencement of effluent discharge, and then on a monthly schedule during open water. The annual water level data collected before and during discharge periods on Sherman Lake and on the other lakes will be used to actively update our understanding of the expected hydrograph and seasonal ranges for the Sherman Lake waterbody.

Low Action Level

The Low Action Level is based on maintaining water elevations and shoreline aquatic habitats in the Sherman Lake waterbody at pre-remediation baseline conditions during the period of remediation when the Water Treatment Plant is in operation. The Low Action Level is triggered if during active effluent discharge water levels rise by 130 mm (based on the water level measured at the start of discharge), indications of environmental change or stress are observed at 25% of the observation locations, and the changes are due to the Rayrock Remediation Project (Table 12-3). The Low Action Level is intended to be sensitive to changes in water level in the Sherman Lake waterbody that are outside of the normal or expected hydrograph. Seasonal and annual fluctuations in water level are anticipated, and regions in the north have been experiencing extreme variability in water levels in recent years (ECCC and GNWT 2021). If this water level is reached and an increasing or irregular trend in the summer water level on Sherman Lake is detected when treated water discharge is occurring then an initial investigation of precipitation rates and potential blockages (e.g., beaver dam or log jam) of drainage pathways will be undertaken along with the evaluation of water levels on Beta and Gamma lakes and New Control Lake to determine if a similar trend is occurring.

The frequency of water level data retrieval would switch to weekly until the water level falls to a measure below the 130 mm difference in elevation. Results of shoreline surveys would be used to determine whether the change in water level has affected the stability and structure of habitat features. A review of remediation activity, including the discharge volumes from the water treatment facility and physical works adjacent to shoreline locations and site drainage features would be undertaken to determine if an Action Level related to activity at the remediation site has been confirmed.

High Action Level

The High Action Level is based on water levels in Sherman Lake rising by 130 mm during active effluent discharge without any blockage of drainage pathways and persisting for more than six weeks. This duration of elevated water level combined with evidence of environmental changes in shoreline aquatic habitat (e.g., altered shoreline features or stress to vegetation) observed at 75% of the observation locations would trigger the High Action Level (Table 12-3). Evaluation and comparison to water levels in Beta, Gamma, and New Control lakes would be undertaken along with a review of remediation activity. If the High Action Level is triggered, notification will be provided within 24 hours of confirmation of the Action Level exceedance, and a response plan will be prepared and submitted within 30 days, as required under the Water Licence.

12.3.3 Water Quality

Low and High Action Levels for water quality are intended to screen COPC's from all water bodies adjacent to the Rayrock Remediation Project with concentrations that are increasing due to the Rayrock Remediation Project. This includes the Sherman Lake waterbody (Sherman Lake, Alpha Lake, Lake A), Gamma Lake, Beta Lake, and Kwetsǫ̀tìa. The results from the other AEMP study lakes not adjacent to the Remediation Project (Lake B, Dlah Lake, New Control Lake, and Alternative Reference Lake) will be evaluated against the Action Levels for water quality in the monthly and annual reports but will not be reported to the inspector for exceeding the Action Levels.

The screening of water quality COPC's was established using the pre-remediation baseline conditions in these receiving waterbodies (Section 8.3 and Appendix B). The Low Action Levels are based on screening baseline data against CCME guidelines (or 95th Percentile of the baseline concentration for a given study lake that was above CCME Guidelines) and the High Action Levels are based on 75% of the SSSTs developed for CanNorth, 2023 and described in Section 12.3.3.3 (Table B-2; Appendix B).

Water quality Action Levels are independent of Action Levels for water level, benthic invertebrates and fish. Biological monitoring of benthic and fish communities will determine if effects are occurring on aquatic organisms from changes in the environment from remediation activity and have their own Action Levels. Water quality parameter concentrations for COPC's in the Rayrock Study Lakes should remain below values that are protective of freshwater aquatic life to allow suitable types and quantity of food for fish eat to survive and fish to survive, grow, and reproduce. Relevant AEMP WQOs and SSSTs will be used to assess the degree of potential impact to the water quality in the receiving water downstream of the treated effluent discharge ranging from negligible to approaching the Significance Threshold. An exceedance of a relevant Action Level does not automatically mean that adverse effects will occur, unless it is linked to the remediations activities occurring on site. Exceedance of a Significance Threshold indicates that impacts to the aquatic receiving environment are likely occurring.

12.3.3.1 SELECTION OF CHEMICALS OF POTENTIAL CONCERN

A selection process was performed to identify COPCs at the Rayrock Mine site. The following sections describe the process followed for the selection of chemicals of concern. The 97 constituents that were provided by the analytical laboratory during the AEMP water quality baseline program of the study lakes and the Mill Lake Process Water Treatment Plant (PWTP) effluent monitoring include:

General Chemistry Parameters:

- Alkalinity
- Bicarbonate
- Carbonate
- Total ammonia
- Calcium
- Chloride
- Conductivity
- Hydroxide
- Magnesium
- Total phosphate
- pH
- Fluoride
- Hardness
- Magnesium
- Nitrate
- Nitrite
- Nitrate plus Nitrite
- Ortho Phosphate
- Total Phosphate
- Potassium
- Sodium
- Elemental Sulfur
- Sulfate
- Total dissolved solids (TDS)
- Total Suspended Solids (TSS)
- Dissolved Organic Carbon (DOC) and
- Total Organic Carbon (TOC)

Total Metals and Metalloids:

- Aluminum
- Antimony
- Arsenic
- Barium
- Beryllium
- Boron
- Cadmium
- Calcium
- Chromium
- Cobalt
- Copper
- Iron
- Lead
- Lithium
- Magnesium
- Manganese
- Mercury
- Molybdenum
- Nickel
- Phosphorus
- Potassium
- Selenium
- Silicon
- Silver
- Sodium
- Strontium
- Thallium
- Tin
- Titanium
- Uranium
- Vanadium
- Zinc

Dissolved Metals, Metalloids, and Radionuclides:

- Aluminum
- Antimony
- Arsenic
- Barium
- Beryllium
- Boron
- Cadmium
- Calcium
- Chloride Ion
- Chromium
- Cobalt
- Copper
- Iron
- Lead
- Lithium
- Magnesium
- Manganese
- Mercury
- Molybdenum
- Nickel
- Phosphorus
- Potassium
- Selenium
- Silicon
- Silver
- Strontium
- Thallium
- Tin
- Titanium
- Uranium
- Vanadium
- Zinc
- Uranium-238
- Lead-210
- Radium-226
- Polonium-210
- Thorium-230

12.3.3.2 Water Quality COPC Selection Process

At a minimum, the COPC selection process encompasses the parameters listed in the Water Licence including Dissolved Nitrate, Dissolved Nitrite, Total Ammonia, pH Range, TSS, Dissolved Fluoride, Copper, Iron, Nickel, Uranium, Zinc. A conservative screening for other potential parameters was performed using the maximum effluent concentrations from 2024 and the maximum concentrations from the Sherman Lake study sites from the AEMP baseline sampling program conducted from 2021 to 2023. To address the potential influence of the PWTP an effluent screening was conducted on both the effluent data collected during 2024 and the pre remediation sediment concentrations in Mill Lake. Using the maximum measured concentrations in Mill Lake sediment the list of COPCs were informed by the maximum possible concentrations that may occur during the treatment of Mill Lake water. Additional screening of potential sediment influence on water quality at the Rayrock Mine Site was completed by comparing the highest sediment concentrations in the waterbody being treated (Mill Lake) and in the receiving waterbody (Sherman Lake). Parameters were screened in if the maximum concentrations from the Sherman Lake sites exceeds the available CCME sediment quality guidelines (PEL values) and if the maximum concentrations in the Mill Lake sediment exceeded the baseline concentrations from Sherman Lake study sites by 10X.

The details of the screening are summarized in Figure 12-1. The screening steps include:

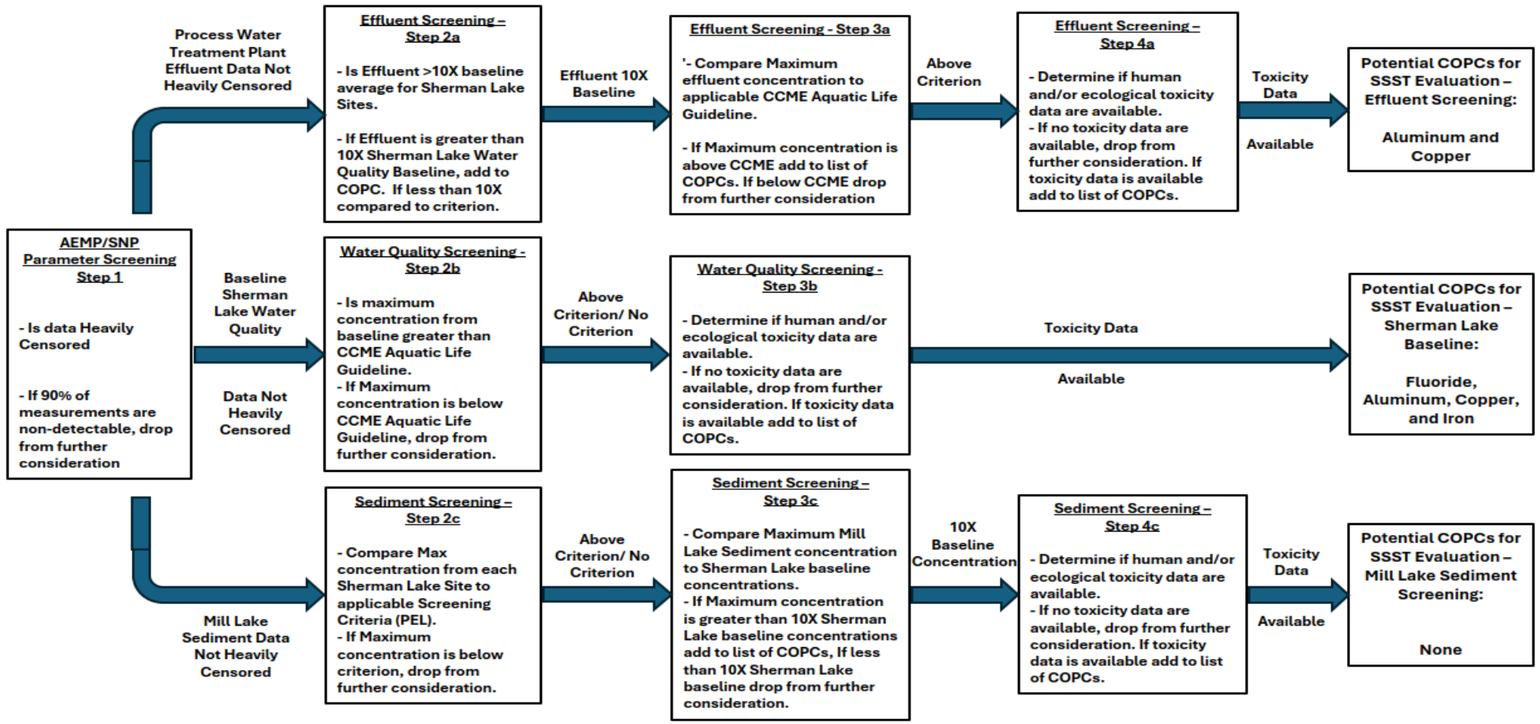
1. For each screening (effluent, surface water, or sediment), if 90% or more of the measurements for a constituent were non-detectable (i.e., below the method detection limit [MDL]), then the data were considered to be essentially not measured, and the constituent was dropped from further assessment.

2. The maximum measured concentrations were compared to the appropriate screening criteria (as discussed below). Constituents with concentrations lower than the screening criteria were dropped from further assessment, while those with concentrations exceeding the screening criteria, or with no criteria available, were carried forward to Step 3.

3. Constituents remaining as potential COPC after steps 1 and 2 were then checked to see if corresponding human health and/or ecological toxicity data are available. Constituents with available toxicity data were selected as COPC, while those without toxicity data were not further assessed. Dismissing parameters with no available toxicity data adds some uncertainty to the assessment, however, the lack of toxicity data generally denotes constituents that are not considered to be toxic.

4. Of the remaining parameters select constituents were removed for other reasons specific to the parameter and/or knowledge of the site conditions.

Figure 12-1. Contaminants of Potential Concern Screening for Water Quality Action Levels.



The Final List of COPCs For SSSTs for Design Plan Includes: Dissolved Nitrate, Dissolved Nitrite, Total Ammonia, TSS, Dissolved Fluoride, Copper, Iron, Nickel, Uranium, Zinc, Radium-226, Uranium-238, Lead-210, Polonium-210, Thorium-230.

Exclusion Notes:

- Aluminum is not generally a COC at Rayrock but results from the effluent and 2 Sherman Lake sites are higher than the CCME guideline. Aluminum was not considered in the HHERA after considering aluminum speciation. " At pH values between 5.5 and 9, there is very little aluminum that is in true solution and available for uptake by biological species. The pH in the water at Rayrock Mine typically measures between 7.5 and 7.9 pH units, thus it is not expected that aluminum is in solution to exert a toxic effect, and it is dropped from further assessment."

- pH Range will be monitored in the receiving environment and pH results outside of the CCME guidelines will be reported in the monthly and annual reports.

12.3.3.3 Development of Site Specific Significance Thresholds

A significance threshold is defined as a limit of environmental change which, if reached, would likely result in significant adverse impacts. As part of the AEMP for the Rayrock Remediation, SSSTs were developed for surface water in Sherman Lake so that adaptive management actions can be taken to ensure that significant adverse impacts will not occur in Sherman Lake while remedial activities are completed at Mill Lake as treated water from Mill Lake will be discharged to Sherman Lake (CanNorth, 2023). In order to develop SSSTs the potential for adverse impacts in the aquatic environment were considered for total concentrations of ammonia, fluoride, nitrate, nitrite, copper, iron, nickel, uranium, zinc and radionuclides in accordance with AEMP guidance (MVLWB and GNWT 2019).

For the Rayrock Remediation Project SSSTs for the non-radionuclides were primarily derived from species sensitivity distributions (SSDs) and the radiological SSSTs were based on a back-calculation of acceptable doses associated with a factor of 10 times the radiation dose benchmark. The detailed rationale for development of each SSST was provided in CanNorth, 2023. The final COPC's for water quality evaluation include the following nutrients, metals, and radionuclides (Table 12-1).

Table 12-1. Water Quality COPC's and CCME Guidelines and SSST's used for Action Level Evaluations.

Parameter	CCME Guideline	SSST*	SSST Rationale
Dissolved Nitrate,	13 mg/L	82 mg/L	Protection of 50% of the aquatic community from the species sensitivity distribution (SSD) curve
Dissolved Nitrite,	0.197 mg/L	1.4 mg/L	Protection of 50% of the aquatic community from the SSD curve
Ammonia, Total Ammonia Nitrogen	0.499 mg/L	4 mg/L	Protection of 50% of the aquatic community from the SSD curve, adjusted to pH 7 and temperature 20º C
TSS,	15 mg/L	28 mg/L	Change from baseline
Dissolved Fluoride,	0.120 mg/L or 95th Percentile of the Baseline Concentration (Each Study Lake)	19 mg/L	Protection of 50% of the aquatic community from the SSD curve
Total Copper,	0.0028 mg/L or 95th Percentile of the Baseline Concentration (Each Study Lake)	0.018 mg/L	Protection of 50% of the aquatic community from the SSD curve
Total Iron,	0.3 mg/L	19 mg/L	Protection of 50% of the aquatic community from the SSD curve
Total Nickel,	0.025 mg/L	0.063 mg/L	Protection of 50% of the aquatic community from the SSD curve
Total Uranium,	0.015 mg/L	0.744 mg/L	Protection of 50% of the aquatic community from the SSD curve
Total Zinc,	0.023 mg/L	0.135 mg/L	Protection of 50% of the aquatic community from the SSD curve, adjusted for 50 mg/L hardness
Total Radium-226	95th Percentile of the Baseline Concentration (Each Study Lake)	39.6 Bq/L	Based on back-calculated dose
Total Uranium-238		0.33 Bq/L	Based on back-calculated dose
Total Lead-210		11.6 Bq/L	Based on back-calculated dose
Total Polonium-210		0.66 Bq/L	Based on back-calculated dose
Total Thorium-230		0.66 Bq/L	Based on back-calculated dose

Notes:

- CCME Guidelines - CWQGs for the protection of aquatic life (CCME 1999a)
- SSST's (CanNorth, 2023).

Low Action Level

For water quality the Low Action Level indicates that impacts have the potential to occur and is considered to be sensitive to changes in water quality. The baseline concentrations of parameters in Sherman Lake are low and the EQCs for discharge to Sherman Lake have been established to meet the CWQGs level of aquatic protection, but where baseline conditions are greater than the CCME guideline the Low Action Level shall be equal to the 95th percentile of the baseline values. Copper and fluoride are the only parameters with an EQC that may trigger a Low Action Level in the AEMP. The mean copper concentration of 2.1 µg/L for Sherman Lake K is only 25% lower than the current CWQG of 2.8 µg/L in the Water Licence. The mean fluoride concentration of 170 µg/L for Sherman Lake K is higher than the current CWQG of 120 µg/L in the Water Licence. All other mean values for parameters in Sherman Lake with associated EQCs are between 200-2,400% lower than the EQC values.

The Low Action Level is triggered if the concentration from an AEMP location in a receiving waterbody during one sampling event is greater than the CCME guideline or the 95th percentile of the baseline values (copper, fluoride, and radionuclides only), an increasing trend is observed for that parameter, and the increase is linked to the Rayrock Remediation Project (Table 12-4). The Low Action Level indicates that impacts have the potential to occur and is intended to be sensitive to changes in water quality.

High Action Level

The High Action Level is triggered if the concentration from an AEMP station in a receiving waterbody during one sampling event is 3/4 of the SSST values and the increase is linked to the Rayrock Remediation Project. However, where baseline conditions are greater than the SSST values (e.g. Beta Lake and Gamma Lake) the High Action Level shall be equal to the 95th percentile of the baseline + 100% of the 95th Percentile. Beta Lake and Gamma Lake are not associated with the effluent receiving environment but are associated with capped tailings at the Rayrock Site.

Triggering of High Action Levels are not expected as action will be taken to prevent water from being discharged that does not meet the EQCs and to bring water quality concentrations down if they are found to be increasing during treatment or in the receiving environment (e.g. previous Low Action Level flag). A single exceedance of an EQC or a result above the established pre-remediation baseline concentration is not expected to result in effects to the biological components; however, these would be unexpected occurrences requiring action (Table 12-4).

A concentration above the High Action Level could occur due to one high outlying value (e.g., one high concentration and three results below) or could be a result of a persistent increase in concentrations over the course of a month (e.g., four values that are above or close to Action Levels). A short-term spike in water quality levels at concentrations compliant with the discharge EQCs are not expected to cause acute effects and the short-term duration of the effluent discharge is unlikely to cause sublethal (chronic) effects to aquatic life in Sherman Lake. However, if concentrations in water continue to increase up to or exceeding the High Action Levels, additional investigations, mitigation, and an immediate response will occur (Table 12-4).

12.3.4 Sediment Quality

Low and High Action Levels for sediment quality are intended to screen COPC's with concentrations that are increasing due to the Kwetıı̨ʔaà (Rayrock) Remediation Project. Results from the AEMP locations in the Sherman Lake waterbody (Sherman Lake, Alpha Lake, and Lake A), Gamma Lake, Beta Lake, and Kwetsǫ̀tìa will be evaluated against the Action Levels for sediment quality. Sediment quality parameter concentrations in the Rayrock Study Lakes should remain below values that are protective of freshwater aquatic life to allow suitable types and quantity of food for fish eat to survive and fish to survive, grow, and reproduce. Sediment quality Action Levels were developed using the existing baseline conditions, with the understanding that some of these waterbodies have impacts from historical mining These Action Levels are independent of Action Levels for water level, water quality, benthic invertebrates and fish.

The High Action Level for sediment quality is based on a magnitude of change from baseline conditions, with the intent of preventing parameters from increasing in the receiving environment. A Low or High Action Level is triggered if the concentration from an AEMP location in a receiving waterbody during one sampling event are 10% or 40% greater, respectively than the 95th percentile of the pre-remediation baseline concentration and the increase is linked to the Rayrock Remediation Project (Table 12-5).

For sediment quality, the focus will be on the AEMP locations in waterbodies immediately adjacent to the Rayrock Remediation Project that may receive surface runoff or drainage from the remediation site. Sediment quality results from each of the receiving waterbodies (i.e., Sherman Lake, Alpha Lake, Lake A, Gamma Lake, Beta Lake, and Kwetsǫ̀tìa) will be compared to the 95th percentile of the pre-remediation baseline values from each respective lake (Table B-3). An exceedance of a relevant sediment Action Level does not automatically mean that adverse biological effects will occur, unless it is linked to the remediations activities occurring on site. Separate biological monitoring of benthic and fish communities will determine if effects are occurring on aquatic organisms from changes in the environment from remediation activity and have their own Action Levels. A Sediment and Erosion Control Plan (SECP) has been approved for civil works close to the site waterbodies. The SECP includes more frequent monitoring of remedial activity for the potential movement of solids and the development of erosion issues that could lead to sedimentation events. It outlines methods that will be employed before, during, and after remediation to prevent erosion and mitigate movement of sediment through local runoff to receiving waterbodies.

It is possible that concentrations in sediment may approach or exceed the 95th percentile plus 10% from the pre-remediation baseline period simply due to seasonal fluctuations or other factors (e.g., single high result due to a wind event, sample contamination, natural variability). Treated effluent concentrations, remediation activity, temporal trends (i.e., changes over time), and spatial trends (e.g., proximity to immediate discharge point or civil work) will be considered when determining if an Action Level trigger is due to activity from the Kwetıı̨ʔaà (Rayrock) site, and what actions are necessary to be taken. If no source from the Rayrock Remediation Project is identified (i.e., the result is not linked to the remediation activity), there is no increasing trend (visual evaluation or statistical test), and/or the spatial pattern is unexpected (e.g., an increase occurred at a farther downstream station but not immediately downstream of the effluent discharge or adjacent to the site), the result may be due to analytical error, contamination of the sample, or other unidentified source. Individual anomalous or erroneous results would not immediately trigger a Low Action Level but would be further investigated as appropriate depending on the nature of the exceedance (e.g., parameter, magnitude, duration of the trend, and confirmation of link to remediation activity) prior to an Action Level response being confirmed.

12.3.4.1 SELECTION OF CHEMICALS OF POTENTIAL CONCERN

The AEMP will monitor and evaluate each of the 32 constituents in sediment that were provided by the analytical laboratory. These include:

- Antimony
- Arsenic
- Barium
- Beryllium
- Boron
- Cadmium
- Chromium
- Chromium (Hexavalent)
- Cobalt
- Copper
- Lead
- Mercury
- Molybdenum
- Nickel
- Phosphorus
- Selenium
- Silver
- Thallium
- Tin
- Uranium
- Vanadium
- Zinc
- Percentage moisture
- Percentage nitrogen
- pH
- Percentage Elemental Sulfur
- Percentage Total Organic Carbon (TOC);
- Uranium-238
- Lead-210
- Radium-226
- Polonium-210
- Thorium-230

12.3.5 Benthic Invertebrates

Biological monitoring of benthic invertebrates is used to detect effects on the benthic community. Action Levels have been set for two benthic invertebrate indicators: invertebrate density (i.e., how many) and richness (i.e., how many different types of invertebrates). Invertebrate density and richness were chosen as they are expected to respond predictably to increased toxicity or nutrient enriched conditions, according to identifiable response patterns (Environment Canada 2012). A decrease in density and richness greater than the CES indicates reductions in both the number and type of invertebrates, which provides the most reliable and interpretable evidence of community change in a negative direction. Community indices (e.g., dominance, Simpson's diversity index, Simpson's evenness index) provide additional useful information for inclusion in the overall community assessment but were not included in the Action Levels. Indirect responses in the benthic community assemblages are of interest for evaluating long-term trends and for investigating potential linkages to environmental causes (e.g., habitat, substrate, sediment quality, and water quality); however, they are less useful for establishing Action Levels, particularly when the alterations are not easily categorized as harmful to ecological function.

As outlined in Section 10.4, benthic invertebrates are to be collected directly from the sediment at each AEMP location. The spatial extent of the Action Level evaluation is focused on the sample locations immediately adjacent to the Rayrock Remediation Project but applies to all sampling sites in the receiving waterbodies in order to understand and evaluate potential changes in the aquatic environment. As part of the benthic invertebrate assessment, the water and sediment quality monitoring will be used to indicate the potential cause of any unacceptable effects and inform potential management responses. Sediment quality and habitat data are also important to support the biological evaluation and to establish if there is a linkage to the Rayrock Remediation Project (primarily effluent discharge) or if the observed effects to the community are due to other factors (e.g., habitat differences, historical sediment contamination, changes in climate).

Low Action Level

The Low Action Level for benthic invertebrates is defined as significantly lower invertebrate density and richness in the receiving waterbodies (Sherman Lake waterbody, Beta Lake, Gamma Lake, Kwetsǫ̀tìa) compared to the pre-remediation baseline conditions of a magnitude greater than 1 SD for benthic invertebrates (Table 12-6). A CES of 2 SD is used in EEM Technical Guidance (Environment Canada 2012). However, the variability of the pre-remediation baseline data in a few of the lakes is high enough that a decrease of 1 SD may approach or exceed densities of zero. This Action Level also requires reasonable evidence that changes to these endpoints is linked to activity at the Rayrock Remediation Project, as indicated by water quality and sediment quality. The Low Action Level is focused primarily on change related to potential toxicity, as it is most directly relevant to preventing reductions in benthic communities.

High Action Level

The conditions required for the High Action Level to be triggered for benthic invertebrates are defined in Table 12-6. This Action Level provides a more definite warning of potential alteration of the invertebrate community in the receiving waterbodies. The High Action Level requires a link to the Rayrock Remediation Project and either:

a) A magnitude of change that represents more than a 50% reduction in mean densities of three key invertebrate taxa compared to baseline conditions (i.e., chironomids, bivalves, oligochaetes) over two successive sampling events; or

b) A magnitude of change that represents more than an 80% reduction in mean densities of four key prey taxa compared to baseline conditions (i.e., chironomids, bivalves, oligochaetes, and mayflies) during a single sampling event.

Under the High Action Level an 80% reduction in mean densities, requires a reduction in mean mayfly densities as well as a reduction in mean chironomids, bivalves, and oligochaete densities. Collectively, these four taxonomic groups represent a large proportion of the dietary food items available fish species Sherman Lake. Mean densities of these taxa can be variable, but a reduction of this magnitude in multiple invertebrates would signal a definite change that should be addressed consistent with a High Action Level. The inclusion of the trigger of 50% reduction over two successive sampling events that confirms a pattern may represent a more substantial outcome than a single event which is more likely to be due to chance or a confounding factor.

12.3.6 Fish and Benthic Tissue

Conditions required for Action Levels related to changes in the concentration of metals in fish and benthic tissues are outlined in Table 12-7. For fish and benthic tissue, the effects indicators were identified as an increase in tissue concentrations compared to the pre-remediation baseline levels. Muscle, liver, and bone tissue will be analyzed on large-bodied fish (i.e., Northern Pike) and a composite sample of whole benthic organisms to monitor the potential movement of contaminants into the food chain. The typical effect indicators for sentinel fish species used in EEM programs (i.e., length, weight, condition, relative liver size, and relative gonad size) will be recorded for the large-body fish collected but are not included in the Action Level evaluation for the Response Framework. Change in tissue concentrations is not indicative of an

impairment to fish or benthic health but will inform on going assessment and risk evaluation of the Rayrock Remediation Project.

12.3.6.1 SELECTION OF CHEMICALS OF POTENTIAL CONCERN

The AEMP will monitor and evaluate each of the 35 constituents in benthic tissue and fish tissue that were provided by the analytical laboratory. These include:

- Aluminum
- Antimony
- Arsenic
- Barium
- Beryllium
- Bismuth
- Boron
- Cadmium
- Chromium
- Cobalt
- Copper
- Iron
- Lead
- Magnesium
- Manganese
- Mercury
- Molybdenum
- Nickel
- Phosphorus
- Potassium
- Selenium
- Silver
- Sodium
- Strontium
- Thallium
- Tin
- Titanium
- Uranium
- Vanadium
- Zinc
- Radium-226
- Uranium-238
- Lead-210
- Polonium-210
- Thorium-230

Low Action Level

The Low Action Level for fish and benthic tissue is triggered if an increase in any metal or radionuclide concentration is measured in the tissue that is greater than 10% above the 95th percentile of the pre-remediation baseline concentration for that waterbody (Table 12-7). Reasonable evidence that the change is linked to inputs from the Kwetıı̨ǫà (Rayrock) Remediation Project is also required, as indicated by water and sediment quality data.

High Action Level

The High Action Level for fish and benthic tissue is triggered if an increase in any metal or radionuclide concentration is measured in the tissue that is greater than 40% above the 95th percentile of the pre-remediation baseline concentration for that waterbody (Table 12-7). Reasonable evidence that the change is linked to inputs from the Rayrock Remediation Project is also required, as indicated by water and sediment quality data.

12.4 Action Level Responses and Notifications

The AEMP Action Levels and Response Framework are outlined in Tables 12-1 to 12-6.

12.4.1 Responses to Action Levels

Low and High Action Levels for water quality, sediment, benthic invertebrates, fish and benthic tissue, and water levels will apply to the Sherman Lake study sites and the other Rayrock study lakes (i.e., Lake B, Beta Lake, Gamma Lake, and Kwetsǫ̀tìa). Screening and reporting will also be conducted for the other Rayrock study lakes (i.e., Lake B, Dlah Lake, New Control Lake, and Alternative Reference Lake) but the results will not be reported to the inspector.

Part F Conditions 6 and 7 of the Type A Water Licence (W2020L8-0003) include responses to low and high Action Levels. Responses that will occur following an exceedance of an AEMP Action Level are provided in Table 12-2 to 12-7 and include guidance provided in MVLWB and GNWT (2019). The AEMP responses apply to the aquatic environment (water level), water quality, sediment quality, benthic invertebrates, and fish and benthic tissue quality. If an Action Level is exceeded the initial steps are to follow AEMP best practices and to confirm and verify the data used to determine the Action Level exceedance.

If a Low Action Level trigger is confirmed, additional steps include evaluating temporal trends and examining linkages between the remediation activity and the change in the aquatic component being monitored. If the concentrations continue to increase, an evaluation to predict when a High Action Level would be exceeded (if the trend continues) may be undertaken. Follow-up desktop and field studies may be recommended to address data gaps, linkages, or areas of uncertainty, and the need to increase the extent or frequency of monitoring.

If a High Action Level is triggered and is linked to the Rayrock Remediation Project, then the responses for the Low Action Level apply. However, other possible immediate responses will be to collect additional water samples to look at dissolved metals or other factors affecting bioavailability, toxicity samples for acute and chronic testing, and to develop an AEMP Response Plan, and implement mitigation, if applicable.

If a High Action Level is triggered, the responses for the Low Action Level applies, and efforts will focus on understanding the trend, mitigating, or reversing where possible, and preventing further adverse environmental changes from occurring. Typically, special studies are required to evaluate the long-term trends, potential ecological implications, and the recovery of the aquatic ecosystem. The High Action Levels may be reviewed and adjusted, if warranted and scientifically defensible, based on new data collected as part of the response. Proposed changes would be submitted to the WLWB for review and approval.

12.4.2 Notification and Response Plan Timeline

As outlined in the Water Licence (Part H, Condition 9), an AEMP Response Plan is not required for a Low Action Level exceedance for water quality, sediment quality, benthic invertebrates, or fish. If responses, mitigations, or follow-up studies are initiated the year following the Low Action Level exceedance, then these results will be reported in the following annual AEMP report.

For all High Action Level triggers, the WLWB and Inspector will be notified within 24 hours of the confirmation of the data triggering the Action Level and is confirmed to be linked to the Rayrock Remediation Project. Notification and submission of an AEMP Response Plan to the Board for approval will be completed within 30 days of the confirmation of the data triggering the high Action Level.

Table 12-2 Effluent Discharge Action Levels and Responses Licence Requirement for the Kwetıı̨ʔaà (Rayrock) Aquatic Effects Monitoring Program

Location	SNP 1663-7	
Action Level Type	**Effluent Discharge Quality**	**Action Level Response**
Compliance	If one of the following are met: 1. Effluent quality exceeds the Effluent Quality Criteria (EQCs) established in the Water Licence in any one grab sample (daily tests for in situ ecological, copper and zinc done onsite and weekly submissions to lab). 2. Effluent quality is determined to be acutely toxic (tested prior to initial discharge and monthly during discharge).	Action to be undertaken in accordance with Part E, Condition 21 of the Water Licence: - Cease discharge - Notify Inspector and WLWB immediately - Report the spill immediately - Submit report of incident with summary of corrective actions

a) All water quality results must be confirmed, meaning that the final analytical result or field measurement has been checked and validated (i.e., no probe calibration or transcription errors).

b) Acute toxicity analysis (multi-concentration) – Rainbow Trout and Daphnia magna; as described in Reference Method EPS 1/RM/13 – Biological Test Method: Reference method for Determining Acute Lethality of Effluents to Rainbow Trout and EPS 1/RM/14 – Biological Test Method: Reference for Determining Acute Lethality of Effluents to Daphnia magna.(as specified in Annex A, Part A of the Water Licence)

EQC = effluent quality criteria; WLWB = Wek'èezhìi Land and Water Board

Table 12-3 Aquatic Environment Action Levels for Surface Water Elevation Changes and Responses for the Kwetıı̨ʔaà (Rayrock) Aquatic Effects Monitoring Program Response Framework

Location	Water Level Increase in Sherman Lake and Lake A	
Action Level Type	**Aquatic Environment**	**Possible Responses to Action Levels**
Low	If the following are met: 1. Water levels rise in Sherman Lake by 130 mm from the water level measured at the start of effluent discharge. **AND** 2. Signs of stressed vegetation or other clear indications of environmental change are present along the shoreline at any 25% of the shoreline observation locations **AND** 3. Linked to the Kwetıı̨ʔaà (Rayrock) Remediation Project activity (i.e., during effluent discharge,)	Increase water level logger download frequency to weekly. Compare water levels to New Control Lake and other study lakes – if similar trends are observed, then no further action. Review precipitation records and check the drainage pathways for potential blockage – if blocked, develop a plan for clearing the pathway. Compare shoreline location with previously documented conditions from 2021,2022, and 2023. Evaluate links to Rayrock Remediation Project activity upstream or adjacent to the shoreline location (e.g., comparing to regional background lakes, inspecting site for potential blockages, reviewing recent remediation activities, comparing to baseline shoreline conditions). Identify potential mitigation measures.
High	1. Water levels rise by 130 mm from the water level measured at the start of effluent discharge and continues for >6 weeks. **AND** 2. Signs of stressed vegetation or other clear indications of environmental change are present along the shoreline at any 75% of the shoreline observation locations **AND** 3. Linked to the Kwetıı̨ʔaà (Rayrock) Remediation Project activity (i.e., during effluent discharge, tailings cap repair)	Increase download frequency of water levels to weekly. Compare trends to New Control Lake and other study lakes – if changes observed are similar, then no further action is required. Review precipitation records and check the drainage pathways for potential blockage – if blocked, develop a plan for clearing the pathway. Compare shoreline location with previously documented conditions, including pre-remediation baseline records from 2021,2022, and 2023.

Location	Water Level Increase in Sherman Lake and Lake A	
Action Level Type	**Aquatic Environment**	**Possible Responses to Action Levels**
		Evaluate links to Rayrock Remediation Project activity upstream or adjacent to the shoreline location (e.g., comparing to regional background lakes, inspecting site for potential blockages, reviewing recent remediation activities, comparing to baseline shoreline conditions). Identify potential mitigation measures. The WLWB and Inspectors will be notified within 24 hours of confirmation of the Action Level. An AEMP Response Plan will be prepared by a qualified hydrologist within 30 days of the Action Level being identified, with detailed actions to correct the issue.

a) Temporal trends to be evaluated visually.

AEMP = Aquatic effects monitoring program; WLWB = Wek'èezhìi Land and Water Board

Table 12-4 Water Quality Action Levels and Responses for the Kwetıı̨ʔaà (Rayrock) Aquatic Effects Monitoring Program

Locations	**All AEMP stations located in receiving water bodies adjacent to the Rayrock Remediation Project (Sherman Lake, Alpha Lake, Lake A, Gamma Lake, Beta Lake, Kwetsǫ̀tìa)**	
Action Level Type	**Water Quality**	**Possible Responses to Action Levels**
Low	All of the following are met: 1. A concentration greater than the Low Action Threshold (CCME Guideline or site-specific maximum baseline concentration). **AND** 2. Supported by an increasing temporal trend **AND** 3. Linked to the Kwetıı̨ʔaà (Rayrock) Remediation Project	Follow AEMP best practices: - confirm Low Action Level was triggered (e.g., confirm reliability of chemistry data) - review processes, procedures, and data to further evaluate cause/linkage to Site (e.g., water treatment plant effluent), as appropriate - evaluate temporal trends in water quality parameters at monitoring stations - examine potential linkage between increased concentration and results for other aquatic monitoring parameters. Report in Annual AEMP Report. Increase monitoring frequency at the station to weekly, increase sample numbers, include monitoring at depth, and expand the monitoring area around that location for water quality to confirm findings. Identify potential mitigation options (e.g., investigate changes in source water [mine water] chemistry and treatment practices). Implement mitigation/further controls, as appropriate (e.g., install extra sediment control measures in construction areas). Initiate follow-up desktop/field studies if required – examine linkages between concentration, toxicity, and biological responses. Predict water quality trends and predict time to reach a potential next action level, where appropriate. Review appropriateness of the Low Action Level and refine if warranted and scientifically defensible.
High	Both of the following are met: 1. A concentration greater than the High Action Threshold. **AND** 2. Linked to the Kwetıı̨ʔaà (Rayrock) Remediation Project	Confirm High Action Level. (e.g., confirm reliability of chemistry data). Confirm Link to the Rayrock Remediation Project. Conduct desktop or field special study to examine ecological significance, causation, and/or linkage

		Rayrock Remediation Project as described for the Low Action Level. This may include additional toxicity tests and/or benthic invertebrate surveys described below. Notify Inspector and WLWB within 24 hours. Follow AEMP best practices as outlined for Low Action Level. Collect additional water samples for evaluation of dissolved metals if Action Level triggered by metals. Collect additional water samples for evaluation of orthophosphate if Action Level triggered by total phosphorus. Increase or continue to increase monitoring frequency or spatial extent of monitoring for water quality, toxicity, benthic invertebrates Collect water sample for chronic and acute toxicity analysis (including more sensitive phytoplankton and zooplankton species) following ECCC standard test methods. Develop Response Plan. If High Action Level confirmed, implement appropriate mitigations on a priority basis to slow or stop trend as recommended in the approved Response Plan. The focus would be on eliminating the source and preventing adverse impacts to biological receptors in Sherman Lake. Conduct special study to examine effectiveness of mitigation, long-term monitoring of mitigation effectiveness ecological significance and reversibility, causation, and/or linkage to Site. Refine Low and High Action Levels if warranted and scientifically defensible.

c) All water quality results must be confirmed, meaning that the final analytical result or field measurement has been checked and validated (i.e., no probe calibration or transcription errors).
d) Temporal trends to be evaluated visually.
AEMP = Aquatic effects monitoring program; ECCC = Environment and Climate Change Canada

Table 12-5 Sediment Quality Action Levels and Responses for the Kwetıı̨ʔaà (Rayrock) Aquatic Effects Monitoring Program

Locations	**All AEMP stations located in receiving water bodies adjacent to the Rayrock Remediation Project (Sherman Lake, Alpha Lake, Lake A, Gamma Lake, Beta Lake, Kwetsǫ̀tìa)**	
Action Level Type	**Sediment Quality**	**Possible Responses to Action Levels**
Low	All of the following are met: 1. An increase in concentration greater than 10% above the 95th percentile of the pre-remediation baseline monitoring period. **AND** 2. Supported by an increasing temporal trend **AND** 3. Linked to the Kwetıı̨ʔaà (Rayrock) Remediation Project	Follow AEMP best practices: - confirm Low Action Level was triggered (e.g., confirm reliability of chemistry data) - review processes, procedures, and data to further evaluate cause/linkage to Site (e.g., sediment and erosion control plan implementation and results), as appropriate - evaluate temporal trends in sediment quality parameters at monitoring stations - examine the potential linkage between the increased concentration and results for other aquatic monitoring parameters. Report in Annual AEMP Report. Increase monitoring frequency at the station and expand the monitoring area around that location for sediment quality to confirm findings. Identify potential mitigation options (e.g., investigate changes in water chemistry and erosion and sediment control practices). Implement mitigation/further controls, as appropriate (e.g., install extra sediment control measures in construction areas). Initiate follow-up desktop/field studies if required – examine linkages between concentration, toxicity reference values, and biological responses. Predict sediment quality trends and predict time to reach a potential next action level, where appropriate. Review appropriateness of the Low Action Level and refine if warranted and scientifically defensible.
High	Both of the following are met: 1. An increase in concentration greater than 40% above the 95th percentile of the pre-remediation baseline monitoring period. **AND**	Follow AEMP best practices as outlined for Low Action Level. Confirm High Action Level. (e.g., confirm reliability of chemistry data).

	2. Linked to the Kwetıı̨ǫà (Rayrock) Remediation Project	Notify Inspector and WLWB within 24 hours. Collect samples for chronic and acute toxicity analysis following ECCC standard test methods. Develop Response Plan. If High Action Level confirmed, implement appropriate mitigations on a priority basis to reverse trend, review SECP and site runoff conditions, as well as increasing or continuing to increase monitoring frequency or spatial extent of monitoring for water quality, sediment quality, toxicity, benthic invertebrates. Conduct desktop or special field study to examine ecological significance, causation, and/or linkage to Rayrock Remediation Project as described for the Low Action Level. This may include additional toxicity tests and/or benthic invertebrate surveys. Conduct special study to examine effectiveness of mitigation, long-term monitoring of mitigation effectiveness, ecological significance and reversibility, causation, and/or linkage to Site.

a) All sediment quality results must be confirmed, meaning that the final analytical result or field measurement has been checked and validated (i.e., no transcription errors).
b) Temporal trends to be evaluated visually.

AEMP = Aquatic effects monitoring program; ECCC = Environment and Climate Change Canada

Table 12-6 Benthic Invertebrate Action Levels and Responses for Kwetıı̨ʔaà (Rayrock) Aquatic Effects Monitoring Program

Locations	**All AEMP stations located in receiving water bodies adjacent to the Rayrock Remediation Project (Sherman Lake, Alpha Lake, Lake A, Gamma Lake, Beta Lake, Kwetsǫ̀tìa)**	
Action Level Type	**Benthic Invertebrates[a]**	**Possible Responses to Action Levels**
Low	Both of the following are met: 1. Density and richness[b] in the receiving water bodies are significantly lower compared to baseline conditions, with an effect size equal to or above the CES (i.e., 1 SD) **AND** 2. Linked to the Kwetıı̨ʔaà (Rayrock) Remediation Project	Follow AEMP best practices: - confirm Low Action Level was triggered (e.g., confirm reliability of sample and lab data) - review processes, procedures, and data to further evaluate cause/linkage to Site (e.g., WTP effluent, Sediment and Erosion Control Plan implementation and results), as appropriate - evaluate temporal trends in water and sediment quality parameters at monitoring stations - examine the potential linkage between increased concentration and results for other aquatic monitoring parameters. Report in Annual AEMP Report. Increase monitoring frequency and expand the monitoring area to confirm findings. Identify potential mitigation options (e.g., investigate changes in water chemistry and erosion and sediment control practices). Initiate follow-up desktop/field studies if required – examine linkages between concentration, toxicity, and biological responses. Review appropriateness of the Low Action Level and refine if warranted and scientifically defensible.
High	1. . Significantly lower mean densities (50% or more difference) of chironomids, bivalves, and oligochaetes compared to baseline conditions over two successive sampling programs that confirm a pattern[c] **AND** 2. Density and richness(b) in the receiving water bodies are	Follow AEMP best practices as outlined for Low Action Level. Confirm High Action Level. (e.g., confirm reliability of chemistry data). Conduct desktop or field special study to examine ecological significance, causation, and/or linkage Rayrock Remediation Project as described for the Low

	significantly lower compared to baseline conditions, with an effect size equal to or above the CES (i.e., 1 SD) **OR** All of the following are met: 1. Density and richness[(b)] in the receiving water bodies are significantly lower compared to baseline conditions, with an effect size equal to or above the CES (i.e., 1 SD) **AND** 2. Significantly lower mean densities (80% or more difference) of chironomids, bivalves, oligochaetes, and mayflies, compared to baseline conditions **AND** 3. Linked to the Kwetıı̨ʔaà (Rayrock) Remediation Project	Action Level. This may include additional toxicity tests and/or benthic invertebrate surveys. Increase or continue to increase monitoring frequency or spatial extent of monitoring for water quality, sediment quality, toxicity, benthic invertebrates. Notify Inspector and WLWB within 24 hours. Collect samples for chronic and acute toxicity analysis following ECCC standard test methods. Develop Response Plan. If High Action Level confirmed, implement appropriate mitigations on a priority basis to reverse trend, with focus on eliminating source and preventing adverse impacts to biological receptors in Sherman Lake. Conduct special study to examine effectiveness of mitigation, long-term monitoring of mitigation effectiveness, ecological significance and reversibility, causation, and/or linkage to Site.

a) For this biological component of the AEMP Design Plan it is more appropriate to be consistent with monitoring under the EEM Framework and evaluate data against critical effects sizes as opposed to normal ranges.
b) Density and richness have been identified by EC (2012) as being primarily responsible for response patterns in benthic invertebrate communities.
c) Represents a more consequential outcome than a single event which is more likely to be due to chance or a confounding factor.

AEMP = Aquatic effects monitoring program; ECCC = Environment and Climate Change Canada; CES = critical effect size; SD = standard deviations

Table 12-7 Benthic and Fish Tissue Action Levels and Responses for the Kwetıı̨ʔaà (Rayrock) Aquatic Effects Monitoring Program

Location	**All receiving water bodies adjacent to the Rayrock Remediation Project (Sherman Lake, Alpha Lake, Lake A, Gamma Lake, Beta Lake, Kwetsǫ̀tìa)**	
Action Level Type	**Tissue Burden**	**Action Level Response**
Low	1. An increase in any metal or radionuclide concentration in the benthic or fish tissue of greater than 10% above the 95th percentile of the pre-remediation baseline monitoring period for that water body. **AND** 2. Linked to the Kwetıı̨ʔaà (Rayrock) Remediation Project	Follow AEMP best practices: - confirm Low Action Level was triggered (e.g., confirm reliability of sample and lab data) - review processes, procedures, and data to further evaluate cause/linkage to Site (e.g., WTP effluent, Sediment and Erosion Control Plan implementation and results), as appropriate - evaluate temporal trends in water and sediment quality parameters at monitoring locations Report in Annual AEMP Report. Initiate follow-up desktop/field studies if required – examine linkages between concentration, toxicity, and biological responses. Increase monitoring frequency and expand the monitoring area to confirm findings. Increase sample numbers and tissue volumes for analysis. If the average concentrations remain 25% greater than baseline in the second sampling, an investigation into the cause of the change will be completed by a biologist. Additional action may be required based on the recommendations of the biologist. Refine Low and High Action Levels if warranted and scientifically defensible.
High	1. An increase in any metal or radionuclide concentration in the benthic or fish tissue of greater than 40% above the 95th percentile of the pre-remediation baseline monitoring period.for that water body. **AND**	Follow AEMP best practices as outlined for Low Action Level Confirm High Action Level. (e.g., confirm reliability of chemistry data).

	2. Linked to the Kwetıı̨ʔaà (Rayrock) Remediation Project	If High Action Level confirmed, implement mitigation(s) to stop or slow trend as recommended in the approved Response Plan Notify Inspector and WLWB within 24 hours. Develop Response Plan Conduct special study to examine ecological or human health significance, causation, and/or linkage to Site.

a) All tissue quality results must be confirmed, meaning that the final analytical result or field measurement has been checked and validated (i.e., no transcription errors).
b) Temporal trends to be evaluated visually.

AEMP = Aquatic effects monitoring program; WLWB = Wek'èezhìi Land and Water Board

Table B-1: Rayrock Baseline Monitoring Location Details
Rayrock AEMP Design Plan V 1.2
Kwetısomàà (Rayrock) Remediation Project
Public Services and Procurement Canada

Drainage Pathway/Component	Location/Station ID*	Northing	Easting	Site Description	SNP Station (Y/N)	Shoreline Survey		Water Level		Water Chemistry		Sediment Chemistry		Benthic Community		Benthic Tissue		Fish Community		Fish Tissue [f]	
							# of Sampling Events		# of Sampling Events		# of Sampling Events		# of Sampling Events		# of Sampling Events		# of Sampling Events		# of Sampling Events		# of Sampling Events
Sherman Lake	Sherman Lake B	7035596 N	522837 E	Potentially Impacted	Y	X	3	X	2	X	(3) 2021, 2022, 2023	X	(3) 2021, 2022, 2023	X	(2) 2021, 2022	X	(1) 2022	X	(2) 2021, 2023	X	(2) 2021, 2023
	Sherman Lake L	7035950 N	523320 E	Potentially Impacted	Y	X	3			X	(3) 2021, 2022, 2023	X	(3) 2021, 2022, 2023	X							
	Sherman Lake K	7036101 N	523217 E	Potentially Impacted	Y	X	3			X	(3) 2017, 2021, 2022, 2023	X	(3) 2017, 2021, 2022, 2023	X		X	(2) 2021, 2022				
Surrounding Lakes	Alpha Lake	7035524 N	522561 E	Potentially Impacted	Y	X	3			X	(3) 2021, 2022, 2023	X	(3) 2021, 2022, 2023	X	(2) 2021, 2022	X	(1) 2022				
	Beta Lake	7035430 N	522440 E	Potentially Impacted	Y	X	3	X	2	X	(3) 2021, 2022, 2023	X	(3) 2021, 2022, 2023	X	(2) 2021, 2022	X	(1) 2022				
	Gamma Lake	7034745 N	522195 E	Potentially Impacted	Y	X	3	X	2	X	(3) 2021, 2022, 2023	X	(3) 2021, 2022, 2023	X	(2) 2021, 2022	X	(1) 2022				
	Lake A	7034281 N	523544 E	Potentially Impacted	Y	X	3	X	2	X	(3) 2021, 2022, 2023	X	(3) 2021, 2022, 2023	X	(2) 2021, 2022	X	(1) 2022				
	Lake B (Non SNP)	7032399 N	523038 E	Background Conditions	N					X	(3) 2021, 2022, 2023	X	(2) 2021, 2022	X	(2) 2021, 2022	X	(1) 2022				
	Kwetsǫ̀tìa (Non SNP)	7036019 N	523044 E	Potentially Impacted	N					X	(3) 2021, 2022, 2023		(2) 2021, 2022	X	(2) 2021, 2022	X	(2) 2021, 2022				
Regional Background	New Control Lake	7038516 N	519063 E	Background Conditions	Y	X	3	X	2	X	(3) 2021, 2022, 2023	X	(3) 2021, 2022, 2023	X	(2) 2021, 2022	X	(2) 2021, 2022	X			
	Alternate Reference Lake (Non SNP)	7036794 N	526373 E	Background Conditions	N					X	(3) 2021, 2022, 2023	X	(3) 2021, 2022, 2023	X	(2) 2021, 2022	X	(1) 2022	X	(2) 2021, 2023	X	(2) 2021, 2023
	Dlah Lake (Non SNP)	7033716 N	522362 E	Background Conditions	N					X	(2) 2022, 2023	X	(1) 2022	X	(1) 2022	X	(1) 2022				

Notes:
**All lake water sampling from Zone 11; Datum NAD 83*
Baseline AEMP was conducted in 2021 and 2022 and 2023.

Table B-2: Water Quality Baseline Results and Action Levels (2021-2023; Metals - mg/L; Radionuclides - Bq/L)
Rayrock AEMP Design Plan V 1.2
Kwetıı̨ʔaà (Rayrock) Remediation Project
Public Services and Procurement Canada

Parameter	Units	Mill Lake WTF	AEMP			Sherman Lake B (1663-1)						Sherman Lake L (1663-8)						Sherman Lake K (1663-10)					
		EQC	CCME	3/4 SSST	SSST	n	ND	95th Percentile	Average	Low (CCME WQG)	High (3/4 SSST)	n	ND	95th Percentile	Average	Low (CCME WQG)	High (3/4 SSST)	n	ND	95th Percentile	Average	Low (CCME WQG)	High (3/4 SSST)
Total Ammonia (N)	mg/L	0.499	0.499	3	4.0	10	8	0.0346	0.049	0.499	3.00	10	8	0.030	0.030	0.499	3.00	10	9	0.022	0.027	0.499	3.00
Nitrate (NO3)	mg/L	13	13	61.50	82.0	10	8	0.192	0.29	13	61.50	10	7	0.158	0.0996	13	61.50	10	9	0.049	0.054	13	61.50
Nitrite (N)	mg/L	0.197	0.0197	1.05	1.40	10	10	-	0.010	0.0197	1.05	10	10	-	0.010	0.0197	1.05	10	10	-	0.010	0.0197	1.05
Dissolved Fluoride	mg/L	0.12	0.12	14.25	19.00	6	0	0.18	0.17	0.18	14.25	6	0	0.218	0.18	0.218	14.25	6	0	0.188	0.17	0.188	14.25
Total Suspended Solids	mg/L	15	15	21.0	28.0	10	2	5.7	3.735	15	21.00	10	2	3.06	2.01	15	21.00	10	3	2.9	2.196	15	21.00
Total Copper	mg/L	0.0028	0.0028	0.014	0.018	10	0	0.0032	0.0025	0.0032	0.014	10	0	0.00234	0.0017	0.0028	0.014	10	0	0.00425	0.0021	0.00425	0.014
Total Iron	mg/L	0.3	0.3	14.25	19.0	10	0	0.40	0.15	0.3	14.25	10	5	0.2	0.12	0.3	14.25	10	5	0.21	0.138	0.3	14.25
Total Nickel	mg/L	0.025	0.025	0.05	0.06	10	2	0.0033	0.005	0.025	0.047	10	4	1.25E-03	0.0009	0.025	0.047	10	2	1.20E-03	0.00089	0.025	0.047
Total Uranium	mg/L	0.015	0.015	0.56	0.74	10	0	0.00093	0.0006	0.015	0.558	10	0	0.0006175	0.00051	0.015	0.558	10	10	0.000715	0.0005	0.015	0.558
Total Zinc	mg/L	0.023	0.023	0.10	0.14	10	8	0.0037	0.0038	0.023	0.101	10	9	0.017	0.017	0.023	0.101	10	10	0.004	0.005	0.023	0.101
Radium 226	Bq/L	-	Site Specific	8.7	11.6	10	9	0.0117	0.013	0.012	8.70	10	10	-	0.010	0.010	8.70	10	10	-	0.010	0.010	8.70
Lead-210	Bq/L	-	Site Specific	0.50	0.66	10	10	-	0.10	0.10	0.50	10	10	-	0.10	0.10	0.50	10	10	-	0.10	0.10	0.50
Uranium-238	Bq/L	-	Site Specific	29.70	39.6	10	3	0.032	0.023	0.032	29.70	10	6	0.0341	0.0202	0.034	29.70	10	6	0.024	0.0166	0.024	29.70
Thorium-230	Bq/L	-	Site Specific	0.25	0.33	10	9	0.019	0.026	0.019	0.25	10	10	-	0.010	0.010	0.25	10	10	-	0.010	0.010	0.25
Polonium-210	Bq/L	-	Site Specific	0.495	0.66	10	10	-	0.010	0.010	0.50	10	10	-	0.010	0.010	0.50	10	10	-	0.010	0.010	0.50

Notes:

The Mill Lake Water Treatment Facility EQCs are provided for reference only and were not used to screen lake concentrations.

The Low Action Level is based on the Canadian Water Quality Guidelines (CWQGs) for the protection of aquatic life (CCME 1999a) and the High Action Level is based on 3/4 of the SSST values developed for Sherman Lake (CanNorth, 2023).

For total copper and fluoride the baseline data in some of the study lakes exceeds CCME WQGs. In these study lakes the Low Action Level for the Response Framework was based on the 95th Percentile of the baseline dataset for that lake. The High Action Level is set to 3/4 of the SSST values, however, where baseline conditions are greater than the SSST values (e.g. Beta Lake and Gamma Lake) the High Action Level shall be equal to the 95th percentile of the baseline + 100% of the 95th Percentile. The 95th Percentile was calculated in ProUCL 5.2 using all of the baseline data collected in 2021, 2022, and 2023. In cases where non detects were present in the dataset values were derived using ProUCL 5.2 Statistics for Data Sets with Non-Detects.

In the absence of CCME WQGs for radionuclides the Low Action Level for the Response Framework was based on the 95th Percentile of the baseline dataset for each lake. The 95th Percentile was calculated in ProUCL 5.2 using all of the baseline data collected in 2021, 2022, and 2023. In cases where non detects were present in the dataset values were derived using ProUCL 5.2 Statistics for Data Sets with Non-Detects.

All data was less than the laboratory method detection limit. Baseline average is based on highest detection limit represented in the dataset.

At least one lab result was less than the method detection limit. Baseline averages for datasets with three or more detected concentrations were derived using ProUCL 5.2 - UCL Statistics for Data Sets with Non-Detects. ProUCL 5.2 provides Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs.

Table B-2: Water Quality Baseline Results and Action Levels (2021-2023; Metals - mg/L; Radionuclides - Bq/L)
Rayrock AEMP Design Plan V 1.2
Kwetıı̨ʔaà (Rayrock) Remediation Project
Public Services and Procurement Canada

Parameter	Units	Mill Lake WTF	AEMP			Alpha Lake (1663-4)						Beta Lake (1663-3)						Gamma Lake (1663-2)					
		EQC	CCME	3/4 SSST	SSST	n	ND	95th Percentile	Average	Low (CCME WQG)	High (3/4 SSST)	n	ND	95th Percentile	Average	Low (CCME WQG)	High (3/4 SSST)	n	ND	95th Percentile	Average	Low (CCME WQG)	High (3/4 SSST)
Total Ammonia (N)	mg/L	0.499	0.499	3	4.0	12	9	0.125	0.06	0.499	3.00	12	5	0.053	0.033	0.499	3.00	11	8	0.12	0.0692	0.499	3.00
Nitrate (NO3)	mg/L	13	13	61.50	82.0	12	10	0.079	0.08	13	61.50	12	12	-	0.044	13	61.50	11	8	0.16	0.100	13	61.50
Nitrite (N)	mg/L	0.197	0.0197	1.05	1.40	12	12	-	0.010	0.0197	1.05	12	12	-	0.010	0.0197	1.05	11	11	-	0.010	0.0197	1.05
Dissolved Fluoride	mg/L	0.12	0.12	14.25	19.00	7	0	0.217	0.19	0.22	14.25	6	0	0.20	0.16	0.2	14.25	7	0	0.17	0.15	0.17	14.25
Total Suspended Solids	mg/L	15	15	21.0	28.0	12	3	4.02	3.10	15	21.00	12	0	22.9	7.4	15	21.00	11	1	3.6	2.6	15	21.00
Total Copper	mg/L	0.0028	0.0028	0.014	0.018	12	0	0.0088	0.0068	0.0088	0.014	12	0	0.071	0.0221	0.071	0.142	11	0	0.028	0.019	0.028	0.056
Total Iron	mg/L	0.3	0.3	14.25	19.0	12	0	0.563	0.2783	0.3	14.25	12	0	10	3.0433	0.3	14.25	11	0	3.2	2.4	0.3	14.25
Total Nickel	mg/L	0.025	0.025	0.05	0.063	12	1	0.00238	0.00139	0.025	0.047	12	0	0.0144	0.0045	0.025	0.047	11	1	0.0017	0.00131	0.025	0.047
Total Uranium	mg/L	0.015	0.015	0.56	0.744	12	0	0.0042	0.0023	0.015	0.558	12	0	0.0185	0.008	0.015	0.558	11	0	0.0041	0.0035	0.015	0.558
Total Zinc	mg/L	0.023	0.023	0.10	0.135	12	10	0.0044	0.0059	0.023	0.101	12	7	0.071	0.0256	0.023	0.101	11	11	-	0.0030	0.023	0.101
Radium 226	Bq/L	-	Site Specific	8.7	11.6	12	0	0.14	0.09	0.14	8.70	12	1	0.354	0.236	0.35	8.70	11	0	0.835	0.60	0.84	8.70
Lead-210	Bq/L	-	Site Specific	0.50	0.66	12	12	-	0.10	0.10	0.50	12	5	0.208	0.166	0.21	0.50	11	0	0.868	0.47	0.87	0.50
Uranium-238	Bq/L	-	Site Specific	29.70	39.6	12	0	0.0426	0.03	0.04	29.70	12	0	0.20	0.09	0.20	29.70	11	0	0.058	0.05	0.06	29.70
Thorium-230	Bq/L	-	Site Specific	0.25	0.33	12	0	0.0909	0.05	0.09	0.25	12	0	0.609	0.32	0.61	0.25	11	0	0.63	0.46	0.63	0.25
Polonium-210	Bq/L	-	Site Specific	0.495	0.66	12	1	0.0594	0.0417	0.06	0.50	12	0	0.132	0.05	0.13	0.50	11	0	0.285	0.14	0.29	0.50

Notes:

The Mill Lake Water Treatment Facility EQCs are provided for reference only and were not used to screen lake concentrations.

The Low Action Level is based on the Canadian Water Quality Guidelines (CWQGs) for the protection of aquatic life (CCME 1999a) and the High Action Level is based on 3/4 of the SSST values developed for Sherman Lake (CanNorth, 2023).

For total copper and fluoride the baseline data in some of the study lakes exceeds CCME WQGs. In these study lakes the Low Action Level for the Response Framework was based on the 95th Percentile of the baseline dataset for that lake. The High Action Level is set to 3/4 of the SSST values, however, where baseline conditions are greater than the SSST values (e.g. Beta Lake and Gamma Lake) the High Action Level shall be equal to the 95th percentile of the baseline + 100% of the 95th Percentile. The 95th Percentile was calculated in ProUCL 5.2 using all of the baseline data collected in 2021, 2022, and 2023. In cases where non detects were present in the dataset values were derived using ProUCL 5.2 Statistics for Data Sets with Non-Detects.

In the absence of CCME WQGs for radionuclides the Low Action Level for the Response Framework was based on the 95th Percentile of the baseline dataset for each lake. The 95th Percentile was calculated in ProUCL 5.2 using all of the baseline data collected in 2021, 2022, and 2023. In cases where non detects were present in the dataset values were derived using ProUCL 5.2 Statistics for Data Sets with Non-Detects.

All data was less than the laboratory method detection limit. Baseline average is based on highest detection limit represented in the dataset.

At least one lab result was less than the method detection limit. Baseline averages for datasets with three or more detected concentrations were derived using ProUCL 5.2 - UCL Statistics for Data Sets with Non-Detects.

ProUCL 5.2 provides Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs.

Table B-2: Water Quality Baseline Results and Action Levels (2021-2023; Metals - mg/L; Radionuclides - Bq/L)
Rayrock AEMP Design Plan V 1.2
Kwetıı̨ǫà (Rayrock) Remediation Project
Public Services and Procurement Canada

Parameter	Units	Mill Lake WTF	AEMP			Lake A (1663-6)						Lake B (Non SNP)						Kwetsotia (Non SNP)					
		EQC	CCME	3/4 SSST	SSST	n	ND	95th Percentile	Average	Low (CCME WQG)	High (3/4 SSST)	n	ND	95th Percentile	Average	Low (CCME WQG)	High (3/4 SSST)	n	ND	95th Percentile	Average	Low (CCME WQG)	High (3/4 SSST)
Total Ammonia (N)	mg/L	0.499	0.499	3	4.0	14	13	0.048	0.110	0.499	3.00	7	7	-	0.015	0.499	3.00	10	4	0.040	0.029	0.499	3.00
Nitrate (NO3)	mg/L	13	13	61.50	82.0	14	11	0.28	0.14	13	61.50	7	7	-	0.044	13	61.50	10	10	-	0.044	13	61.50
Nitrite (N)	mg/L	0.197	0.0197	1.05	1.40	14	14	-	0.010	0.0197	1.05	7	5	0.08	0.10	0.08	1.05	10	10	-	0.010	0.0197	1.05
Dissolved Fluoride	mg/L	0.12	0.12	14.25	19.00	7	0	0.19	0.17	0.19	14.25	3	0	0.19	0.17	0.19	14.25	6	0	0.14	0.12	0.14	14.25
Total Suspended Solids	mg/L	15	15	21.0	28.0	14	0	7.3	4.2	15	21.00	7	0	4.7	4.0	15	21.00	10	2	13.2	7.6	15	21.00
Total Copper	mg/L	0.0028	0.0028	0.014	0.018	14	0	0.0030	0.0020	0.0030	0.014	7	2	0.002	0.002	0.0028	0.014	10	2	0.0059	0.0033	0.0059	0.014
Total Iron	mg/L	0.3	0.3	14.25	19.0	14	0	0.30	0.19	0.3	14.25	7	0	0.75	0.37	0.3	14.25	10	0	2.16	0.96	0.3	14.25
Total Nickel	mg/L	0.025	0.025	0.05	0.063	14	3	0.0012	0.0009	0.025	0.047	7	1	0.00172	0.00136	0.025	0.047	10	2	0.00352	0.00205	0.025	0.047
Total Uranium	mg/L	0.015	0.015	0.56	0.744	14	0	0.00040	0.00034	0.015	0.558	7	2	0.00020	0.00017	0.015	0.558	10	0	0.010	0.004	0.015	0.558
Total Zinc	mg/L	0.023	0.023	0.10	0.135	14	14	-	0.0030	0.023	0.101	7	6	0.00741	0.0093	0.023	0.101	10	4	0.0226	0.013	0.023	0.101
Radium 226	Bq/L	-	Site Specific	8.7	11.6	14	13	0.010	0.010	0.010	8.70	7	7	-	0.01	0.01	8.70	10	9	0.011	0.011	0.011	8.70
Lead-210	Bq/L	-	Site Specific	0.50	0.66	14	14	-	0.10	0.10	0.50	7	7	-	0.10	0.10	0.50	10	10	-	0.10	0.10	0.50
Uranium-238	Bq/L	-	Site Specific	29.70	39.6	14	10	0.020	0.014	0.020	29.70	7	6	0.0184	0.0220	0.018	29.70	10	0	0.115	0.05	0.115	29.70
Thorium-230	Bq/L	-	Site Specific	0.25	0.33	14	14	-	0.010	0.010	0.25	7	6	0.012	0.0120	0.012	0.25	10	10	-	0.010	0.010	0.25
Polonium-210	Bq/L	-	Site Specific	0.495	0.66	14	12	0.0207	0.035	0.021	0.50	7	6	0.0443	0.0590	0.044	0.50	10	8	0.0196	0.020	0.020	0.50

Notes:

The Mill Lake Water Treatment Facility EQCs are provided for reference only and were not used to screen lake concentrations.

The Low Action Level is based on the Canadian Water Quality Guidelines (CWQGs) for the protection of aquatic life (CCME 1999a) and the High Action Level is based on 3/4 of the SSST values developed for Sherman Lake (CanNorth, 2023).

For total copper and fluoride the baseline data in some of the study lakes exceeds CCME WQGs. In these study lakes the Low Action Level for the Response Framework was based on the 95th Percentile of the baseline dataset for that lake. The High Action Level is set to 3/4 of the SSST values, however, where baseline conditions are greater than the SSST values (e.g. Beta Lake and Gamma Lake) the High Action Level shall be equal to the 95th percentile of the baseline + 100% of the 95th Percentile. The 95th Percentile was calculated in ProUCL 5.2 using all of the baseline data collected in 2021, 2022, and 2023. In cases where non detects were present in the dataset values were derived using ProUCL 5.2 Statistics for Data Sets with Non-Detects.

In the absence of CCME WQGs for radionuclides the Low Action Level for the Response Framework was based on the 95th Percentile of the baseline dataset for each lake. The 95th Percentile was calculated in ProUCL 5.2 using all of the baseline data collected in 2021, 2022, and 2023. In cases where non detects were present in the dataset values were derived using ProUCL 5.2 Statistics for Data Sets with Non-Detects.

All data was less than the laboratory method detection limit. Baseline average is based on highest detection limit represented in the dataset.

At least one lab result was less than the method detection limit. Baseline averages for datasets with three or more detected concentrations were derived using ProUCL 5.2 - UCL Statistics for Data Sets with Non-Detects. ProUCL 5.2 provides Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs.

Table B-2: Water Quality Baseline Results and Action Levels (2021-2023; Metals - mg/L; Radionuclides - Bq/L)
Rayrock AEMP Design Plan V 1.2
Kwetıı̨ǫà (Rayrock) Remediation Project
Public Services and Procurement Canada

Parameter	Units	Mill Lake WTF	AEMP			Alternative Reference Lake (Non SNP)						New Control Lake (1663-9)						Dlah Lake (Non SNP)					
		EQC	CCME	3/4 SSST	SSST	n	ND	95th Percentile	Average	Low (CCME WQG)	High (3/4 SSST)	n	ND	95th Percentile	Average	Low (CCME WQG)	High (3/4 SSST)	n	ND	95th Percentile	Average	Low (CCME WQG)	High (3/4 SSST)
Total Ammonia (N)	mg/L	0.499	0.499	3	4.0	9	8	0.120	0.190	0.499	3.00	9	6	0.027	0.021	0.499	3.00	3	2	0.016	0.016	0.499	3.00
Nitrate (NO3)	mg/L	13	13	61.50	82.0	9	8	0.054	0.061	13	61.50	9	9	-	0.044	13	61.50	3	3	-	0.0440	13	61.50
Nitrite (N)	mg/L	0.197	0.0197	1.05	1.40	9	9	-	0.010	0.0197	1.05	9	9	-	0.010	0.0197	1.05	3	2	0.012	0.012	0.0197	1.05
Dissolved Fluoride	mg/L	0.12	0.12	14.25	19.00	5	0	0.0884	0.08	0.12	14.25	5	0	0.11	0.09	0.12	14.25	2	0	0.13	0.13	0.13	14.25
Total Suspended Solids	mg/L	15	15	21.0	28.0	9	2	3.4	2.4	15	21.00	9	3	8.9	5.4	15	21.00	3	1	2.5	2.6	15	21.00
Total Copper	mg/L	0.0028	0.0028	0.014	0.018	9	6	0.0013	0.0015	0.0028	0.014	9	3	0.0016	0.0013	0.0028	0.014	3	3	-	0.001	0.0028	0.014
Total Iron	mg/L	0.3	0.3	14.25	19.0	9	1	0.19	0.15	0.3	14.25	9	0	0.22	0.14	0.3	14.25	3	0	0.32	0.27	0.3	14.25
Total Nickel	mg/L	0.025	0.025	0.05	0.063	9	6	0.0007	0.0006	0.025	0.047	9	7	0.00054	0.00052	0.025	0.047	3	0	0.0017	0.0012	0.025	0.047
Total Uranium	mg/L	0.015	0.015	0.56	0.744	9	0	-	0.00010	0.015	0.558	9	0	0.00050	0.00041	0.015	0.558	3	2	0.00011	0.00011	0.015	0.558
Total Zinc	mg/L	0.023	0.023	0.10	0.135	9	7	0.0050	0.0062	0.023	0.101	9	7	0.051	0.034	0.023	0.101	3	2	0.014	0.0150	0.023	0.101
Radium 226	Bq/L	-	Site Specific	8.7	11.6	9	0	-	0.010	0.010	8.70	9	9	-	0.010	0.010	8.70	3	3	-	0.010	0.010	8.70
Lead-210	Bq/L	-	Site Specific	0.50	0.66	9	0	-	0.10	0.10	0.50	9	9	-	0.10	0.10	0.50	3	3	-	0.10	0.10	0.50
Uranium-238	Bq/L	-	Site Specific	29.70	39.6	9	0	0.035	0.035	0.035	29.70	9	7	0.020	0.016	0.020	29.70	3	1	0.017	0.017	0.017	29.70
Thorium-230	Bq/L	-	Site Specific	0.25	0.33	9	0	-	0.010	0.010	0.25	9	9	-	0.010	0.010	0.25	3	3	-	0.010	0.010	0.25
Polonium-210	Bq/L	-	Site Specific	0.495	0.66	9	0	-	0.010	0.010	0.50	9	9	-	0.010	0.010	0.50	3	3	-	0.010	0.010	0.50

Notes:

The Mill Lake Water Treatment Facility EQCs are provided for reference only and were not used to screen lake concentrations.

The Low Action Level is based on the Canadian Water Quality Guidelines (CWQGs) for the protection of aquatic life (CCME 1999a) and the High Action Level is based on 3/4 of the SSST values developed for Sherman Lake (CanNorth, 2023).

For total copper and fluoride the baseline data in some of the study lakes exceeds CCME WQGs. In these study lakes the Low Action Level for the Response Framework was based on the 95th Percentile of the baseline dataset for that lake. The High Action Level is set to 3/4 of the SSST values, however, where baseline conditions are greater than the SSST values (e.g. Beta Lake and Gamma Lake) the High Action Level shall be equal to the 95th percentile of the baseline + 100% of the 95th Percentile. The 95th Percentile was calculated in ProUCL 5.2 using all of the baseline data collected in 2021, 2022, and 2023. In cases where non detects were present in the dataset values were derived using ProUCL 5.2 Statistics for Data Sets with Non-Detects.

In the absence of CCME WQGs for radionuclides the Low Action Level for the Response Framework was based on the 95th Percentile of the baseline dataset for each lake. The 95th Percentile was calculated in ProUCL 5.2 using all of the baseline data collected in 2021, 2022, and 2023. In cases where non detects were present in the dataset values were derived using ProUCL 5.2 Statistics for Data Sets with Non-Detects.

All data was less than the laboratory method detection limit. Baseline average is based on highest detection limit represented in the dataset.

At least one lab result was less than the method detection limit. Baseline averages for datasets with three or more detected concentrations were derived using ProUCL 5.2 - UCL Statistics for Data Sets with Non-Detects.

ProUCL 5.2 provides Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs.

Table B-3: Sediment Quality Baseline Results and Action Levels (2021 - 2023; Metals - mg/kg; Radionuclides - Bq/g)
Rayrock AEMP Design Plan V 1.2
Kwetıı̨ʔaà (Rayrock) Remediation Project
Public Services and Procurement Canada

Parameter	Units	Sherman Lake B						Sherman Lake L						Sherman Lake K					
		n	ND	Average	95th Percentile	Low (+10%)	High (+40%)	n	ND	Average	95th Percentile	Low (+10%)	High (+40%)	n	ND	Average	95th Percentile	Low (+10%)	High (+40%)
Antimony	mg/kg	7	7	0.50	N/A	0.55	0.70	7	7	0.50	N/A	0.55	0.70	7	7	0.50	N/A	0.55	0.70
Arsenic	mg/kg	7	0	6.34	7.95	8.75	11.13	7	0	7.46	9.49	10.44	13.29	7	0	5.36	5.84	6.42	8.18
Barium	mg/kg	7	0	211.4	237.0	260.7	331.8	7	0	242.9	267.0	293.7	373.8	7	0	200.0	234.0	257.4	327.6
Beryllium	mg/kg	7	0	1.02	1.20	1.32	1.68	7	0	0.99	1.1	1.210	1.540	7	1	0.88	0.93	1.02	1.30
Cadmium	mg/kg	7	0	0.16	0.18	0.20	0.25	7	0	0.19	0.24	0.259	0.329	7	1	0.214	0.241	0.27	0.34
Chromium	mg/kg	7	0	68.29	76.70	84.4	107.4	7	0	71.86	79.4	87.34	111.16	7	0	63.29	76.50	84.15	107.10
Cobalt	mg/kg	7	0	16.7	19.80	21.78	27.72	7	0	16.29	18.7	20.57	26.18	7	0	14.0	15.0	16.5	21.0
Copper	mg/kg	7	0	177.7	250.0	275.0	350.0	7	0	103.57	178.0	195.80	249.20	7	0	82.86	183.20	201.52	256.48
Lead	mg/kg	7	0	15.69	18.70	20.57	26.18	7	0	10.77	12.70	13.97	17.78	7	0	10.80	13.00	14.30	18.20
Mercury	mg/kg	7	7	0.05	N/A	0.055	0.070	7	7	0.05	N/A	0.055	0.070	7	7	0.05	N/A	0.06	0.07
Molybdenum	mg/kg	7	0	0.78	1.17	1.28	1.64	7	0	1.23	1.51	1.66	2.11	7	1	1.131	1.176	1.29	1.65
Nickel	mg/kg	7	0	43.29	46.70	51.37	65.38	7	0	50.0	56.0	61.6	78.4	7	0	40.00	47.70	52.47	66.78
Selenium	mg/kg	7	4	1.841	2.563	2.8	3.6	7	4	3.238	4.47	4.92	6.26	7	4	1.851	2.56	2.82	3.58
Silver	mg/kg	7	7	0.20	N/A	0.22	0.28	7	7	0.20	N/A	0.22	0.28	7	6	0.25	0.25	0.28	0.35
Thallium	mg/kg	7	0	0.357	0.42	0.5	0.6	7	0	0.364	0.398	0.44	0.56	7	1	0.33	0.464	0.51	0.65
Tin	mg/kg	7	1	1.333	1.47	1.6	2.1	7	1	1.267	1.375	1.51	1.93	7	1	1.13	3.86	4.25	5.40
Uranium	mg/kg	7	0	15.87	20.40	22.4	28.6	7	0	12.81	19.70	21.670	27.580	7	0	15.57	23.70	26.07	33.18
Vanadium	mg/kg	7	0	60.71	64.70	71.2	90.6	7	0	58.29	65.10	71.610	91.140	7	0	54.43	63.10	69.41	88.34
Zinc	mg/kg	7	0	141.3	299.0	328.9	418.6	7	0	109.3	120.0	132.0	168.0	7	0	202.9	600.0	660.0	840.0
Radium-226	Bq/g	7	0	0.66	1.01	1.11	1.41	7	0	0.29	0.62	0.68	0.86	7	0	0.18	0.26	0.29	0.37
Lead-210	Bq/g	7	0	0.67	0.99	1.09	1.38	7	3	0.503	0.723	0.80	1.01	7	0	0.19	0.25	0.27	0.35
Uranium-238	Bq/g	7	0	0.29	0.38	0.41	0.53	7	0	0.16	0.26	0.287	0.365	7	0	0.21	0.27	0.30	0.38
Polonium-210	Bq/g	4	0	0.77	1.26	1.39	1.77	7	0	0.31	0.62	0.681	0.867	7	0	0.20	0.25	0.28	0.35
Thorium-230	Bq/g	7	0	1.65	2.47	2.72	3.46	7	0	0.35	0.88	0.97	1.23	7	0	0.15	0.26	0.28	0.36

Notes: The 95th Percentile of the baseline dataset for each lake was calculated in ProUCL 5.2 using all of the baseline data collected in 2021, 2022, and 2023. In cases where non detects were present in the dataset values were derived using ProUCL 5.2 Statistics for Data Sets with Non-Detects. Response Framework Action Levels were set using the baseline value (95th percentile) +10% (Low) and 40% (High).

All data was less than the laboratory method detection limit. Baseline average is based on highest detection limit represented in the dataset.

At least one lab was result was less than the method detection limit. Baseline averages for datasets with three or more detected concentrations were derived using ProUCL 5.2 - UCL Statistics for Data Sets with Non-Detects. ProUCL 5.2 provides Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs.

Table B-3: Sediment Quality Baseline Results and Action Levels (2021 - 2023; Metals - mg/kg; Radionuclides - Bq/g)
Rayrock AEMP Design Plan V 1.2
Kwetıı̨ʔaà (Rayrock) Remediation Project
Public Services and Procurement Canada

Parameter	Units	Alpha Lake						Beta Lake						Gamma Lake					
		n	ND	Average	95th Percentile	Low (+10%)	High (+40%)	n	ND	Average	95th Percentile	Low (+10%)	High (+40%)	n	ND	Average	95th Percentile	Low (+10%)	High (+40%)
Antimony	**mg/kg**	10	3	0.67	0.81	0.89	1.13	10	10	0.50	N/A	0.55	0.70	7	0	1.27	1.70	1.87	2.38
Arsenic	**mg/kg**	10	0	5.89	7.02	7.72	9.83	10	0	4.68	6.66	7.32	9.32	7	0	30.29	41.10	45.21	57.54
Barium	**mg/kg**	10	0	123.8	195.5	215.1	273.7	10	0	228.0	256.5	282.2	359.1	7	0	174.3	225.0	247.5	315.0
Beryllium	**mg/kg**	10	0	1.39	1.60	1.76	2.24	10	0	0.89	0.97	1.06	1.35	7	0	1.51	1.64	1.80	2.30
Cadmium	**mg/kg**	10	0	0.17	0.23	0.25	0.32	10	0	0.12	0.15	0.16	0.20	7	0	0.21	0.26	0.29	0.37
Chromium	**mg/kg**	10	0	44.9	60.8	66.8	85.1	10	0	67.7	78.6	86.4	110.0	7	0	87.9	94.0	103.4	131.6
Cobalt	**mg/kg**	10	0	9.9	13.6	14.9	19.0	10	0	14.1	17.6	19.3	24.6	7	0	11.9	14.7	16.2	20.6
Copper	**mg/kg**	10	0	817.0	1200.0	1320.0	1680.0	10	0	60.3	92.5	101.7	129.4	7	0	3500.0	4340.0	4774.0	6076.0
Lead	**mg/kg**	10	0	143.1	215.5	237.1	301.7	10	0	12.6	16.8	18.4	23.5	7	0	358.6	563.0	619.3	788.2
Mercury	**mg/kg**	10	9	0.06	0.05	0.06	0.08	10	10	0.25	N/A	0.28	0.35	7	1	0.0643	0.0644	0.07	0.09
Molybdenum	**mg/kg**	10	0	1.80	2.71	2.98	3.79	10	0	0.87	1.26	1.38	1.76	7	0	4.61	5.10	5.61	7.14
Nickel	**mg/kg**	10	0	26.4	37.7	41.4	52.7	10	0	42.3	49.6	54.5	69.4	7	0	37.1	46.2	50.8	64.7
Selenium	**mg/kg**	10	0	23.5	33.0	36.3	46.2	10	6	0.87	1.199	1.32	1.68	7	0	19.39	28.40	31.24	39.76
Silver	**mg/kg**	10	0	0.71	1.06	1.16	1.48	10	10	0.20	N/A	0.22	0.28	7	0	0.61	0.99	1.09	1.38
Thallium	**mg/kg**	10	0	0.31	0.39	0.43	0.55	10	0	0.386	0.456	0.50	0.64	7	0	0.86	1.40	1.54	1.96
Tin	**mg/kg**	10	2	1.39	1.46	1.60	2.04	10	0	1.311	1.56	1.72	2.18	7	0	1.66	2.07	2.28	2.90
Uranium	**mg/kg**	10	0	58.00	77.20	84.92	108.08	10	0	15.23	20.75	22.83	29.05	7	0	198.14	251.00	276.10	351.40
Vanadium	**mg/kg**	10	0	39.20	55.65	61.22	77.91	10	0	60.6	75.0	82.5	105.0	7	0	72.14	87.10	95.81	121.94
Zinc	**mg/kg**	10	0	134.00	155.50	171.05	217.70	10	0	80.2	87.0	95.7	121.8	7	0	101.14	110.00	121.00	154.00
Radium-226	**Bq/g**	10	0	23.33	33.26	36.59	46.56	10	0	0.92	1.95	2.15	2.73	7	0	43.14	59.70	65.67	83.58
Lead-210	**Bq/g**	10	0	23.15	33.76	37.14	47.26	10	0	0.69	1.57	1.72	2.19	7	0	45.34	69.50	76.45	97.30
Uranium-238	**Bq/g**	10	0	0.98	1.26	1.38	1.76	10	0	0.24	0.34	0.37	0.47	7	0	3.24	4.71	5.18	6.59
Polonium-210	**Bq/g**	4	0	18.95	21.00	23.10	29.40	8	0	0.69	1.85	2.03	2.58	4	0	29.75	41.20	45.32	57.68
Thorium-230	**Bq/g**	7	0	12.06	15.80	17.38	22.12	10	0	1.33	3.45	3.79	4.82	7	0	170.14	290.10	319.11	406.14

Notes: The 95th Percentile of the baseline dataset for each lake was calculated in ProUCL 5.2 using all of the baseline data collected in 2021, 2022, and 2023. In cases where non detects were present in the dataset values were derived using ProUCL 5.2 Statistics for Data Sets with Non-Detects. Response Framework Action Levels were set using the baseline value (95th percentile) +10% (Low) and 40% (High).

All data was less than the laboratory method detection limit. Baseline average is based on highest detection limit represented in the dataset.

At least one lab was result was less than the method detection limit. Baseline averages for datasets with three or more detected concentrations were derived using ProUCL 5.2 - UCL Statistics for Data Sets with Non-Detects. ProUCL 5.2 provides Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs.

Table B-3: Sediment Quality Baseline Results and Action Levels (2021 - 2023; Metals - mg/kg; Radionuclides - Bq/g)
Rayrock AEMP Design Plan V 1.2
Kwetıı̨ʔaà (Rayrock) Remediation Project
Public Services and Procurement Canada

Parameter	Units	Lake A						Lake B						Kwetsotia					
		n	ND	Average	95th Percentile	Low (+10%)	High (+40%)	n	ND	Average	95th Percentile	Low (+10%)	High (+40%)	n	ND	Average	95th Percentile	Low (+10%)	High (+40%)
Antimony	mg/kg	7	6	0.67	0.67	0.74	0.94	4	4	1	N/A	1.10	1.40	4	4	1	N/A	1.10	1.40
Arsenic	mg/kg	7	0	5.89	9.92	10.91	13.89	4	0	8.975	16.32	17.952	22.848	4	0	4.3	4.5	4.9335	6.279
Barium	mg/kg	7	0	200.0	277.0	304.7	387.8	4	0	245.0	373.0	410.3	522.2	4	0	162.5	178.5	196.35	249.9
Beryllium	mg/kg	7	0	0.85	1.14	1.25	1.60	4	2	1.005	1.31	1.44	1.83	4	4	0.8	N/A	0.88	1.12
Cadmium	mg/kg	7	0	0.24	0.43	0.47	0.60	4	0	0.21	0.32	0.35	0.45	4	0	0.17	0.204	0.224	0.286
Chromium	mg/kg	7	0	57.43	73.10	80.41	102.34	4	0	63.0	91.6	100.7	128.2	4	0	39.5	43.6	47.91	60.97
Cobalt	mg/kg	7	0	13.53	19.40	21.34	27.16	4	0	17.5	27.6	30.4	38.6	4	0	9.7	10.0	11	14
Copper	mg/kg	7	0	120.57	230.00	253.00	322.00	4	0	69.5	126.8	139.5	177.5	4	0	46.3	56.9	62.59	79.66
Lead	mg/kg	7	0	10.11	15.80	17.38	22.12	4	0	10.1	14.9	16.3	20.8	4	0	6.0	6.6	7.271	9.254
Mercury	mg/kg	7	6	0.081	0.072	0.08	0.10	4	4	0.05	N/A	0.06	0.07	4	4	0.10	N/A	0.11	0.14
Molybdenum	mg/kg	7	0	1.53	2.48	2.73	3.47	4	0	1.35	1.98	2.18	2.77	4	0	1.7	2.0	2.244	2.856
Nickel	mg/kg	7	0	44.71	60.70	66.77	84.98	4	0	51.25	82.1	90.31	114.94	4	0	33.0	35.7	39.27	49.98
Selenium	mg/kg	7	6	1.10	0.92	1.01	1.29	4	4	1.00	N/A	1.10	1.40	4	3	1.2	1.2	1.287	1.638
Silver	mg/kg	7	7	0.20	N/A	0.22	0.28	4	4	0.40	N/A	0.44	0.56	4	4	0.40	N/A	0.44	0.56
Thallium	mg/kg	7	0	0.32	0.48	0.53	0.67	4	0	0.35	0.52	0.57	0.72	4	2	0.22	0.23	0.2497	0.3178
Tin	mg/kg	7	4	1.17	1.31	1.44	1.83	4	3	7.00	6.25	6.88	8.75	4	4	2.0	N/A	2.20	2.80
Uranium	mg/kg	7	0	15.16	21.40	23.54	29.96	4	0	11	17.4	19.14	24.36	4	0	162.5	187.0	205.7	261.8
Vanadium	mg/kg	7	0	47.43	69.60	76.56	97.44	4	0	57.75	84.7	93.17	118.58	4	0	34.8	36.9	40.535	51.59
Zinc	mg/kg	7	0	87.71	119.20	131.12	166.88	4	0	107.25	147	161.7	205.8	4	0	61.5	67.0	73.645	93.73
Radium-226	Bq/g	7	0	0.21	0.33	0.36	0.46	4	0	0.09	0.09	0.10	0.13	4	0	0.70	1.91	2.10	2.68
Lead-210	Bq/g	7	3	0.405	0.481	0.53	0.67	4	0	0.22	0.25	0.27	0.35	4	0	1.13	2.98	3.28	4.17
Uranium-238	Bq/g	7	0	0.21	0.28	0.30	0.39	4	0	0.09	0.11	0.12	0.15	4	0	1.95	2.19	2.40	3.06
Polonium-210	Bq/g	7	0	0.31	0.47	0.51	0.65	4	0	0.16	0.19	0.20	0.26	4	0	0.95	2.59	2.85	3.63
Thorium-230	Bq/g	7	0	0.38	0.91	1.00	1.28	4	0	0.16	0.22	0.24	0.31	4	0	0.67	2.06	2.26	2.88

Notes: The 95th Percentile of the baseline dataset for each lake was calculated in ProUCL 5.2 using all of the baseline data collected in 2021, 2022, and 2023. In cases where non detects were present in the dataset values were derived using ProUCL 5.2 Statistics for Data Sets with Non-Detects. Response Framework Action Levels were set using the baseline value (95th percentile) +10% (Low) and 40% (High).

All data was less than the laboratory method detection limit. Baseline average is based on highest detection limit represented in the dataset.

At least one lab was result was less than the method detection limit. Baseline averages for datasets with three or more detected concentrations were derived using ProUCL 5.2 - UCL Statistics for Data Sets with Non-Detects. ProUCL 5.2 provides Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs.

Table B-3: Sediment Quality Baseline Results and Action Levels (2021 - 2023; Metals - mg/kg; Radionuclides - Bq/g)
Rayrock AEMP Design Plan V 1.2
Kwetıı̨ʔaà (Rayrock) Remediation Project
Public Services and Procurement Canada

Parameter	Units	Alternative Reference Lake						New Control Lake						Dlah Lake					
		n	ND	Average	95th Percentile	Low (+10%)	High (+40%)	n	ND	Average	95th Percentile	Low (+10%)	High (+40%)	n	ND	Average	95th Percentile	Low (+10%)	High (+40%)
Antimony	**mg/kg**	7	7	1.00	N/A	1.10	1.40	7	7	1.00	N/A	1.10	1.40	3	3	1.00	N/A	1.10	1.40
Arsenic	**mg/kg**	7	0	6.44	8.36	9.20	11.70	7	0	10.34	11.70	12.87	16.38	3	0	11.23	12.00	13.20	16.80
Barium	**mg/kg**	7	0	182.86	207.00	227.70	289.80	7	0	115.71	127.00	139.70	177.80	3	0	210.00	228.00	250.80	319.20
Beryllium	**mg/kg**	7	2	0.75	0.88	0.97	1.24	7	4	0.63	0.64	0.70	0.90	3	3	0.80	N/A	0.88	1.12
Cadmium	**mg/kg**	7	0	0.17	0.19	0.21	0.27	7	0	0.18	0.20	0.22	0.28	3	0	0.19	0.19	0.21	0.27
Chromium	**mg/kg**	7	0	58.43	72.50	79.75	101.50	7	0	42.43	63.00	69.30	88.20	3	0	42.00	43.00	47.30	60.20
Cobalt	**mg/kg**	7	0	14.04	15.70	17.27	21.98	7	0	8.93	9.54	10.49	13.36	3	0	17.33	18.00	19.80	25.20
Copper	**mg/kg**	7	0	29.71	32.70	35.97	45.78	7	0	37.86	41.70	45.87	58.38	3	0	24.67	25.90	28.49	36.26
Lead	**mg/kg**	7	0	8.00	8.94	9.83	12.52	7	0	6.47	6.98	7.68	9.77	3	0	5.97	6.35	6.99	8.89
Mercury	**mg/kg**	7	7	0.10	N/A	0.11	0.14	7	7	0.10	N/A	0.11	0.14	3	3	0.10	N/A	0.11	0.14
Molybdenum	**mg/kg**	7	0	1.02	1.17	1.29	1.64	7	0	1.67	1.91	2.10	2.67	3	0	4.13	4.78	5.26	6.69
Nickel	**mg/kg**	7	0	44.14	51.40	56.54	71.96	7	0	29.86	37.70	41.47	52.78	3	0	44.00	44.00	48.40	61.60
Selenium	**mg/kg**	7	7	1.00	N/A	1.10	1.40	7	5	0.54	1.00	1.10	1.40	3	3	1.00	N/A	1.10	1.40
Silver	**mg/kg**	7	6	49.00	34.42	37.86	48.19	7	7	0.4	N/A	0.44	0.56	3	3	0.40	N/A	0.44	0.56
Thallium	**mg/kg**	7	0	0.28	0.34	0.37	0.47	7	1	0.218	0.237	0.26	0.33	3	0	0.22	0.23	0.25	0.32
Tin	**mg/kg**	7	4	1.13	2.00	2.20	2.80	7	7	2	N/A	2.20	2.80	3	3	2.00	N/A	2.20	2.80
Uranium	**mg/kg**	7	0	3.61	4.18	4.60	5.85	7	0	7.11	8.13	8.94	11.38	3	0	3.63	3.88	4.27	5.43
Vanadium	**mg/kg**	7	0	48.29	56.10	61.71	78.54	7	0	32.86	34.70	38.17	48.58	3	0	42.33	43.00	47.30	60.20
Zinc	**mg/kg**	7	0	92.14	100.00	110.00	140.00	7	0	62.43	66.70	73.37	93.38	3	0	109.00	119.00	130.90	166.60
Radium-226	**Bq/g**	7	0	0.05	0.06	0.07	0.08	7	0	0.05	0.06	0.06	0.08	3	0	0.05	0.06	0.06	0.08
Lead-210	**Bq/g**	7	4	0.156667	0.175	0.19	0.25	7	4	0.170	0.187	0.21	0.26	3	0	0.17	0.25	0.27	0.35
Uranium-238	**Bq/g**	7	0	0.06	0.07	0.08	0.10	7	0	0.10	0.12	0.13	0.16	3	0	0.07	0.07	0.08	0.10
Polonium-210	**Bq/g**	7	0	0.09	0.13	0.14	0.18	7	0	0.11	0.15	0.16	0.21	3	0	0.10	0.13	0.15	0.19
Thorium-230	**Bq/g**	7	0	0.06	0.07	0.08	0.10	7	0	0.05	0.07	0.07	0.09	3	0	0.05	0.05	0.06	0.07

Notes: The 95th Percentile of the baseline dataset for each lake was calculated in ProUCL 5.2 using all of the baseline data collected in 2021, 2022, and 2023. In cases where non detects were present in the dataset values were derived using ProUCL 5.2 Statistics for Data Sets with Non-Detects. Response Framework Action Levels were set using the baseline value (95th percentile) +10% (Low) and 40% (High).

All data was less than the laboratory method detection limit. Baseline average is based on highest detection limit represented in the dataset.

At least one lab was result was less than the method detection limit. Baseline averages for datasets with three or more detected concentrations were derived using ProUCL 5.2 - UCL Statistics for Data Sets with Non-Detects. ProUCL 5.2 provides Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs. Data with only one or two detected concentrations defaulted to the maximum concentration.

Table B-4 - Sediment Physical Properties and Benthic Community Baseline Results (2021 and 2022)

Rayrock AEMP Design Plan V 1.2
Kwetıŋaà (Rayrock) Remediation Project
Public Services and Procurement Canada

Lake	Sediment Classification		Sediment Organic Matter (%)		Total Organic Carbon (%)		Density (Organisms/m2)				Total Number of Distinct Taxa (family)			
	2021	2022	2021	2022	2021	2022	2021	2022	Average	Standard Deviation (+/-)	2021	2022	Average	Standard Deviation (+/-)
Sherman Lake B	Fine	Fine	25	11.3	15	6.7	20115.0	589.1	10352	10492	12	4	7.8	4.3
Sherman Lake L	Fine	Fine	19	13.7	11	8.1	2356.3	186.8	1272	1625	5	2	3.3	2.8
Sherman Lake K	Fine	Fine	20	11.3	12	6.5	9123.7	387.9	4756	6712	10	3	6.8	5.6
Alpha Lake	Fine	Fine	7	2.6	4	1.5	4267.3	330.5	2270	2188	6	3	4.3	2.1
Beta Lake	Fine	Fine	4.8	7.6	2.8	4.4	6652.3	373.6	3513	3566	7	3	3.2	1.2
Gamma Lake	Fine	Fine	17	34.7	9.7	20	3189.7	675.3	1932	2279	5	4	4.5	1.5
Lake A	Fine	Fine	34	24.3	20	14.3	301.7	344.8	323	140	3	3	2.8	0.9
Kwetsǫ̀tia	Fine	Fine	39	31.7	23	18.3	15216.0	1120.7	8168	7360	11	4	8.7	5.1
Dlah Lake	No Data	Fine	No Data	45	No Data	26.3	No Data	287.4	287	73	No Data	2	2.3	0.5
New Control Lake	Fine	Fine	17	33.3	10	19.3	4669.7	1925.3	3297	2427	7	3	4.7	2.3
Alternate Reference Lake	Course	Fine	53	28	31	16	3506.0	143.7	1825	2116	6	2	4.3	2.2
Lake B	Fine	Fine	18	32.3	11	19	22859.3	775.9	11818	11217	8	3	5.3	2.6

Notes: The baseline values for average Density (per m^2) and average number of Distinct Taxa (Family) were calculated as the average of the samples collected in 2021 and 2022.

Based on the variability in data between 2021 and 2022 the proposed Response Framework Action Levels for benthic invertebrates is the baseline value (average) +/- one standard deviation. The effectiveness of this approach will be revisted in each annual report and changes or alternatives will be put forward as required.

Table B-5 - Benthic Tissue Baseline Results and Action Levels (2021 and 2022; Metals - mg/kg wet weight; Radionuclides - Bq/g dry weight)
Rayrock AEMP Design Plan V 1.2
Kwetıı̨ǫà (Rayrock) Remediation Project
Public Services and Procurement Canada

Parameters		New Control Lake (n=2)			Alternative Reference Lake (n=1)			Lake A (n=1)			Lake B (n=1)		
Years Included		**2021, 2022 ***	**Low (+10%)**	**High (+40%)**	**2022**	**Low (+10%)**	**High (+40%)**	**2022**	**Low (+10%)**	**High (+40%)**	**2022**	**Low (+10%)**	**High (+40%)**
Moisture	%	87	-	-	83	-	-	86	-	-	85	-	-
Metals (Wet Weight)													
Aluminum	mg/kg	201	221.1	281.4	175	192.5	245	303	333.3	424.2	223	245.3	312.2
Antimony	mg/kg	0.018	0.020	0.025	0.003	0.0037	0.0048	0.004	0.0041	0.0052	0.004	0.0040	0.0050
Arsenic	mg/kg	0.64	0.70	0.89	0.599	0.66	0.84	0.433	0.48	0.61	0.432	0.48	0.60
Barium	mg/kg	15	16.5	21	20.3	22.33	28.42	29.4	32.34	41.16	25.8	28.38	36.12
Beryllium	mg/kg	0.0072	0.0079	0.0101	0.007	0.0074	0.0094	0.01	0.0110	0.0140	0.009	0.0095	0.0120
Bismuth	mg/kg	0.0043	0.0047	0.0060	0.003	0.0029	0.0036	0.004	0.0045	0.0057	0.004	0.0042	0.0053
Boron	mg/kg	0.97	1.07	1.36	0.33	0.36	0.46	1.4	1.54	1.96	0.84	0.92	1.18
Cadmium	mg/kg	0.019	0.021	0.027	0.040	0.044	0.056	0.017	0.019	0.024	0.019	0.021	0.027
Calcium	mg/kg	14100	15510	19740	13500	14850	18900	12200	13420	17080	8120	8932	11368
Chromium	mg/kg	0.50	0.55	0.70	0.50	0.55	0.69	0.582	0.64	0.81	0.54	0.59	0.76
Cobalt	mg/kg	0.14	0.16	0.20	0.18	0.20	0.25	0.199	0.22	0.28	0.22	0.24	0.30
Copper	mg/kg	12.10	13.31	16.94	6.87	7.56	9.62	13.70	15.07	19.18	7.78	8.56	10.89
Iron	mg/kg	344	378.4	481.6	527	579.7	737.8	344	378.4	481.6	377	414.7	527.8
Lead	mg/kg	0.914	1.005	1.280	0.109	0.120	0.153	0.108	0.119	0.151	0.142	0.156	0.199
Magnesium	mg/kg	359.0	394.9	502.6	450	495	630	441	485.1	617.4	410	451	574
Manganese	mg/kg	21.7	23.9	30.4	64.1	70.5	89.7	13.2	14.5	18.5	24.1	26.5	33.7
Mercury	mg/kg	0.017	0.018	0.023	0.0052	0.0057	0.0073	0.0036	0.004	0.005	0.0040	0.0044	0.0056
Molybdenum	mg/kg	0.119	0.131	0.167	0.149	0.164	0.209	0.124	0.136	0.174	0.196	0.216	0.274
Nickel	mg/kg	0.316	0.348	0.442	0.327	0.360	0.458	0.485	0.534	0.679	0.459	0.505	0.643
Phosphorus	mg/kg	1550	1705	2170	1540	1694	2156	1470	1617	2058	1370	1507	1918
Potassium	mg/kg	1450	1595	2030	1360	1496	1904	1350	1485	1890	1500	1650	2100
Selenium	mg/kg	0.12	0.13	0.17	0.083	0.091	0.116	0.093	0.10	0.13	0.063	0.069	0.088
Silver	mg/kg	0.03	0.033	0.042	0.023	0.025	0.032	0.011	0.012	0.016	0.014	0.015	0.019
Sodium	mg/kg	1250	1375	1750	917.0	1008.7	1283.8	981	1079.1	1373.4	1050	1155	1470
Strontium	mg/kg	26.6	29.3	37.2	41.0	45.1	57.4	60.6	66.7	84.8	43.0	47.3	60.2
Thallium	mg/kg	0.0054	0.0059	0.0075	0.004	0.0043	0.0055	0.006	0.0061	0.0077	0.0046	0.0050	0.0064
Tin	mg/kg	0.117	0.129	0.164	<0.020	0.022	0.028	0.096	0.022	0.028	0.089	0.0979	0.1246
Titanium	mg/kg	9.0	9.9	12.6	7.69	8.459	10.766	11.9	13.09	16.66	11.1	12.21	15.54
Uranium	mg/kg	0.11	0.12	0.16	0.12	0.13	0.17	0.267	0.29	0.37	0.131	0.14	0.18
Vanadium	mg/kg	0.51	0.56	0.72	0.49	0.54	0.69	0.67	0.73	0.93	0.66	0.72	0.92
Zinc	mg/kg	13.4	14.74	18.76	13.8	15.18	19.32	8.62	9.48	12.07	11.9	13.09	16.66
Radionuclides (Dry Weight)													
Radium 226	Bg/g	0.020	0.022	0.028	<0.010	0.011	0.014	0.044	0.0484	0.0616	<0.010	0.011	0.014
Lead-210	Bg/g	<0.10	0.11	0.14	<0.10	0.11	0.14	0.12	0.132	0.168	<0.10	0.11	0.14
Uranium-238	Bg/g	0.010	0.011	0.014	<0.010	0.011	0.014	0.03	0.033	0.042	<0.010	0.011	0.014
Polonium-210	Bg/g	0.24	0.26	0.34	0.078	0.086	0.109	0.11	0.121	0.154	0.069	0.076	0.097
Thorium-230	Bg/g	0.06	0.066	0.084	<0.010	0.011	0.014	<0.01	0.011	0.014	<0.01	0.011	0.014

Notes: All datasets were based on one or two sampling seasons (2021 and 2022 or 2022 only). Therefore the maximum value was used for all datasets (n≤2).
* Radionuclide data from 2022 only (n=1)
Response Framework Action Levels were set using the baseline value (Maximum) +10% (Low) and 40% (High).

Table B-5 - Benthic Tissue Baseline Results and Action Levels (2021 and 2022; Metals - mg/kg wet weight; Radionuclides - Bq/g dry weight)
Rayrock AEMP Design Plan V 1.2
Kwetıı̨ǫà (Rayrock) Remediation Project
Public Services and Procurement Canada

Parameters		Sherman Lake B (n=1)			Sherman Lake K (n=2)			Alpha Lake (n=1)			Gamma Lake (n=1)		
Years Included		**2022**	**Low (+10%)**	**High (+40%)**	**2021, 2022 ***	**Low (+10%)**	**High (+40%)**	**2022**	**Low (+10%)**	**High (+40%)**	**2022**	**Low (+10%)**	**High (+40%)**
Moisture	%	84	-	-	85	-	-	82.0	-	-	82.0	-	-
Metals (Wet Weight)													
Aluminum	mg/kg	316	347.6	442.4	393	432.3	550.2	477	524.7	667.8	222	244.2	310.8
Antimony	mg/kg	0.013	0.0139	0.0176	0.0082	0.0090	0.0115	0.018	0.0198	0.0252	0.022	0.0237	0.0301
Arsenic	mg/kg	0.39	0.43	0.55	0.433	0.48	0.61	0.348	0.38	0.49	1.47	1.62	2.06
Barium	mg/kg	10.1	11.11	14.14	20.2	22.22	28.28	7.92	8.712	11.088	12.70	13.97	17.78
Beryllium	mg/kg	0.012	0.013	0.017	0.0166	0.0183	0.0232	0.044	0.0487	0.0620	0.019	0.0212	0.0270
Bismuth	mg/kg	0.007	0.0075	0.0095	0.0076	0.0084	0.0106	0.0899	0.0989	0.1259	0.025	0.0279	0.0356
Boron	mg/kg	0.64	0.70	0.90	0.46	0.51	0.64	0.97	1.07	1.36	0.22	0.24	0.31
Cadmium	mg/kg	0.024	0.027	0.034	0.033	0.036	0.046	0.027	0.030	0.038	0.0068	0.0075	0.0095
Calcium	mg/kg	10200	11220	14280	7910	8701	11074	12300	13530	17220	16800	18480	23520
Chromium	mg/kg	0.906	1.00	1.27	0.96	1.06	1.35	1.360	1.50	1.90	1.35	1.49	1.89
Cobalt	mg/kg	0.295	0.32	0.41	0.40	0.44	0.56	0.365	0.40	0.51	0.25	0.27	0.35
Copper	mg/kg	6.66	7.33	9.32	9.56	10.52	13.38	27.70	30.47	38.78	45.60	50.16	63.84
Iron	mg/kg	585	643.5	819	529	581.9	740.6	745	819.5	1043	1130	1243	1582
Lead	mg/kg	0.205	0.226	0.287	0.193	0.212	0.270	0.569	0.626	0.797	0.882	0.970	1.235
Magnesium	mg/kg	388	426.8	543.2	466	512.6	652.4	486.0	534.6	680.4	269	295.9	376.6
Manganese	mg/kg	28.1	30.9	39.3	25.2	27.7	35.3	41.0	45.1	57.4	28.10	30.9	39.3
Mercury	mg/kg	0.0026	0.0029	0.0036	0.0069	0.0076	0.0097	0.0038	0.0042	0.0053	0.0012	0.0013	0.0017
Molybdenum	mg/kg	0.091	0.100	0.127	0.164	0.180	0.230	0.113	0.124	0.158	0.178	0.196	0.249
Nickel	mg/kg	0.597	0.657	0.836	0.683	0.751	0.956	0.774	0.851	1.084	0.559	0.615	0.783
Phosphorus	mg/kg	1180	1298	1652	1570	1727	2198	1050	1155	1470	820	902	1148
Potassium	mg/kg	1320	1452	1848	1600	1760	2240	1350	1485	1890	777	854.7	1087.8
Selenium	mg/kg	0.144	0.16	0.20	0.115	0.127	0.161	1.03	1.13	1.44	0.64	0.71	0.90
Silver	mg/kg	0.005	0.0052	0.0066	0.0156	0.017	0.022	0.019	0.021	0.027	0.007	0.0081	0.0104
Sodium	mg/kg	998.0	1097.8	1397.2	999.0	1098.9	1398.6	866.0	952.6	1212.4	719.0	790.9	1006.6
Strontium	mg/kg	23.8	26.2	33.3	38.0	41.8	53.2	16.4	18.0	23.0	24.8	27.3	34.7
Thallium	mg/kg	0.005	0.0059	0.0075	0.0073	0.0081	0.0103	0.008	0.0092	0.0117	0.008	0.0090	0.0114
Tin	mg/kg	0.032	0.0352	0.0448	0.02	0.022	0.028	0.14	0.154	0.196	0.047	0.0517	0.0658
Titanium	mg/kg	17.4	19.14	24.36	20.4	22.44	28.56	19.5	21.45	27.3	8.96	9.856	12.544
Uranium	mg/kg	0.59	0.65	0.83	0.681	0.75	0.95	3.1	3.41	4.34	3.99	4.39	5.59
Vanadium	mg/kg	1.16	1.28	1.62	1.21	1.33	1.69	1.24	1.36	1.74	1.60	1.76	2.24
Zinc	mg/kg	13.2	14.52	18.48	15.0	16.50	21.00	15.1	16.61	21.14	9.77	10.75	13.68
Radionuclides (Dry Weight)													
Radium 226	Bg/g	0.074	0.081	0.104	0.024	0.026	0.034	2.6	2.86	3.64	5.7	6.27	7.98
Lead-210	Bg/g	<0.10	0.11	0.14	<0.10	0.11	0.14	4.4	4.84	6.16	6.3	6.93	8.82
Uranium-238	Bg/g	0.04	0.044	0.056	0.02	0.022	0.028	0.27	0.30	0.38	0.33	0.36	0.46
Polonium-210	Bg/g	0.15	0.165	0.210	0.095	0.105	0.133	4.20	4.62	5.88	7.50	8.25	10.50
Thorium-230	Bg/g	0.09	0.013	0.017	0.01	0.016	0.020	3.0	3.30	4.20	21.0	23.10	29.40

Notes: All datasets were based on one or two sampling seasons (2021 and 2022 or 2022 only). Therefore the maximum value was used for all datasets (n≤2).
* Radionuclide data from 2022 only (n=1)
Response Framework Action Levels were set using the baseline value (Maximum) +10% (Low) and 40% (High).

Table B-5 - Benthic Tissue Baseline Results and Action Levels (2021 and 2022; Metals - mg/kg wet weight; Radionuclides - Bq/g dry weight)
Rayrock AEMP Design Plan V 1.2
Kwetıı̨ǫà (Rayrock) Remediation Project
Public Services and Procurement Canada

Parameters		Beta Lake (n=1)			Kwetsǫ̀tia (n=2)			Dlah Lake (n=1)		
Years Included		**2022**	**Low (+10%)**	**High (+40%)**	**2021, 2022 ***	**Low (+10%)**	**High (+40%)**	**2022**	**Low (+10%)**	**High (+40%)**
Moisture	%	86.0	-	-	86	-	-	89	-	-
Metals (Wet Weight)										
Aluminum	mg/kg	392	431.2	548.8	400	440	560	104	114.4	145.6
Antimony	mg/kg	0.006	0.0068	0.0087	0.0147	0.0162	0.0206	0.0025	0.0028	0.0035
Arsenic	mg/kg	0.24	0.27	0.34	0.125	0.14	0.18	0.26	0.29	0.37
Barium	mg/kg	5.01	5.511	7.014	4.5	4.95	6.3	17.5	19.25	24.5
Beryllium	mg/kg	0.014	0.015	0.019	0.0132	0.0145	0.0185	0.005	0.0053	0.0067
Bismuth	mg/kg	0.009	0.0102	0.0130	0.0061	0.0067	0.0085	0.0017	0.0019	0.0024
Boron	mg/kg	0.34	0.37	0.48	0.36	0.40	0.50	0.21	0.23	0.29
Cadmium	mg/kg	0.013	0.015	0.018	0.0079	0.0087	0.011	0.013	0.014	0.018
Calcium	mg/kg	5160	5676	7224	2950	3245	4130	25100	27610	35140
Chromium	mg/kg	0.97	1.07	1.36	0.90	0.99	1.27	0.24	0.26	0.33
Cobalt	mg/kg	0.237	0.26	0.33	0.23	0.25	0.32	0.126	0.14	0.18
Copper	mg/kg	6.03	6.63	8.44	3.21	3.53	4.49	3.09	3.40	4.33
Iron	mg/kg	572.0	629.2	800.8	570	627	798	366	402.6	512.4
Lead	mg/kg	0.159	0.175	0.223	0.123	0.135	0.172	0.066	0.073	0.092
Magnesium	mg/kg	312.0	343.2	436.8	297	326.7	415.8	312	343.2	436.8
Manganese	mg/kg	20.4	22.4	28.6	18.2	20.0	25.5	18.9	20.8	26.5
Mercury	mg/kg	0.0033	0.0036	0.0046	0.0078	0.0086	0.0109	0.0029	0.0032	0.0041
Molybdenum	mg/kg	0.082	0.090	0.115	0.0847	0.093	0.119	0.108	0.119	0.151
Nickel	mg/kg	0.669	0.736	0.937	0.647	0.712	0.906	0.287	0.316	0.402
Phosphorus	mg/kg	974	1071.4	1363.6	1150	1265	1610	922	1014.2	1290.8
Potassium	mg/kg	1250	1375	1750	1450	1595	2030	1060	1166	1484
Selenium	mg/kg	0.61	0.68	0.86	0.113	0.12	0.16	0.070	0.077	0.098
Silver	mg/kg	0.005	0.0053	0.0067	0.006	0.0066	0.0084	0.012	0.013	0.017
Sodium	mg/kg	905	995.5	1267	1020	1122	1428	1020	1122	1428
Strontium	mg/kg	5.25	5.8	7.4	4.97	5.5	7.0	46.2	50.8	64.7
Thallium	mg/kg	0.006	0.0071	0.0090	0.00556	0.0061	0.0078	0.002	0.0025	0.0032
Tin	mg/kg	0.097	0.1067	0.1358	0.182	0.2002	0.2548	0.081	0.0891	0.1134
Titanium	mg/kg	20.2	22.22	28.28	19.2	21.12	26.88	4.93	5.423	6.902
Uranium	mg/kg	3.02	3.32	4.23	2.41	2.65	3.37	0.075	0.082	0.104
Vanadium	mg/kg	0.97	1.07	1.36	0.874	0.96	1.22	0.25	0.28	0.35
Zinc	mg/kg	12.6	13.86	17.64	14.1	15.51	19.74	10.4	11.44	14.56
Radionuclides (Dry Weight)										
Radium 226	Bg/g	0.27	0.297	0.378	<0.010	0.011	0.014	0.013	0.014	0.018
Lead-210	Bg/g	0.3	0.33	0.42	<0.10	0.11	0.14	<0.10	0.11	0.14
Uranium-238	Bg/g	-	-	-	0.17	0.187	0.238	0.023	0.025	0.032
Polonium-210	Bg/g	0.44	0.48	0.62	0.108	0.119	0.151	0.068	0.075	0.095
Thorium-230	Bg/g	0.77	0.85	1.08	0.02	0.022	0.028	<0.01	0.011	0.014

Notes:
All datasets were based on one or two sampling seasons (2021 and 2022 or 2022 only). Therefore the maximum value was used for all datasets (n≤2).
* Radionuclide data from 2022 only (n=1)
Response Framework Action Levels were set using the baseline value (Maximum) +10% (Low) and 40% (High).

Table B-6: Historical Summary - Fish Tissue Baseline Results and Action Levels (Metals - mg/kg wet weight; Radionuclides - Bq/g dry weight)
Rayrock AEMP Design Plan V 1.2
Kwetıı̨ʔaà (Rayrock) Remediation Project
Public Services and Procurement Canada

Parameter	Units	Sherman Lake Muscle Tissue						Sherman Lake - Liver						Sherman Lake - Bone					
		n	ND	Average	95th Percentile	Low (+10%)	High (+40%)	n	ND	Average	95th Percentile	Low (+10%)	High (+40%)	n	ND	Average	95th Percentile	Low (+10%)	High (+40%)
Moisture	**%**	30	-	79.6	-	-	-	30	-	72.03	-	-	-	10	-	69.8	-	-	-
Aluminum	**mg/kg**	30	1	0.72	1.47	1.62	2.06	30	0	2.11	4.35	4.79	6.09	10	0	2.50	4.68	5.15	6.55
Antimony	**mg/kg**	30	20	0.0015	0.0024	0.0026	0.0033	30	14	0.00165	0.00331	0.002	0.0023	10	0	0.0055	0.0107	0.012	0.015
Arsenic	**mg/kg**	30	0	0.038	0.049	0.054	0.068	30	0	0.029	0.044	0.048	0.062	10	0	0.04	0.07	0.073	0.094
Barium	**mg/kg**	30	0	0.146	0.263	0.289	0.368	30	1	0.033	0.065	0.07	0.09	10	0	7.01	14.22	15.64	19.91
Beryllium	**mg/kg**	30	30	0.0010	N/A	0.0011	0.0014	30	30	0.0010	N/A	0.0011	0.0014	10	10	0.0010	N/A	0.001	0.0014
Bismuth	**mg/kg**	30	2	0.002	0.002	0.0022	0.0028	30	0	0.006	0.009	0.0098	0.0124	10	3	0.0013	0.0017	0.0019	0.0024
Boron	**mg/kg**	30	30	0.20	N/A	0.22	0.28	30	30	0.20	N/A	0.220	0.2800	10	9	0.032	0.200	0.220	0.280
Cadmium	**mg/kg**	30	30	0.0010	N/A	0.0011	0.0014	30	0	0.027	0.043	0.047	0.060	10	0	0.002	0.004	0.004	0.005
Calcium	**mg/kg**	30	0	579.0	1011.0	1112.1	1415.4	30	0	61.97	116.40	128.04	162.96	10	0	30990	39270	43197.0	54978.0
Chromium	**mg/kg**	30	25	0.030	0.057	0.063	0.080	30	22	0.015	0.024	0.027	0.034	10	0	0.049	0.095	0.10	0.13
Cobalt	**mg/kg**	30	2	0.0021	0.0028	0.0031	0.0040	30	0	0.035	0.048	0.05	0.07	10	0	0.007	0.011	0.012	0.015
Copper	**mg/kg**	30	0	0.19	0.28	0.310	0.395	30	0	42.81	111.40	122.54	155.96	10	0	0.36	0.47	0.52	0.66
Iron	**mg/kg**	30	0	3.08	6.34	6.97	8.87	30	0	178.68	481.60	529.76	674.24	10	0	8.50	10.95	12.05	15.33
Lead	**mg/kg**	30	3	0.0023	0.0047	0.0051	0.0066	30	3	0.0039	0.0087	0.010	0.012	10	0	0.0088	0.0156	0.02	0.02
Magnesium	**mg/kg**	30	1	314.7	339.7	373.7	475.6	30	0	176.90	236.00	259.60	330.40	10	0	601.7	747.9	822.69	1047.06
Manganese	**mg/kg**	30	0	0.47	0.86	0.94	1.20	30	0	1.40	2.25	2.47	3.14	10	0	15.82	20.78	22.86	29.09
Mercury	**mg/kg**	30	0	0.22	0.35	0.39	0.49	30	0	0.104	0.224	0.25	0.31	10	0	0.076	0.121	0.13	0.17
Molybdenum	**mg/kg**	30	30	0.004	N/A	0.004	0.0056	30	0	0.187	0.278	0.31	0.39	10	1	0.005	0.007	0.007	0.009
Nickel	**mg/kg**	30	26	0.018	0.024	0.0264	0.0336	30	3	0.023	0.039	0.043	0.055	10	0	0.024	0.041	0.04	0.06
Phosphorus	**mg/kg**	30	1	2582.8	2878.0	3165.80	4029.20	30	0	3166	4358	4793.8	6101.2	10	0	16630	20355	22390.5	28497.0
Potassium	**mg/kg**	30	0	4112.4	4351.0	4786.10	6091.40	30	0	3097.3	3731.0	4104.1	5223.4	10	0	2135	2382	2620.2	3334.8
Selenium	**mg/kg**	30	0	0.13	0.15	0.16	0.21	30	0	1.45	2.07	2.27	2.89	10	0	0.12	0.14	0.16	0.20
Silver	**mg/kg**	30	30	0.0010	N/A	0.0011	0.0014	30	0	0.14	0.29	0.31	0.40	10	10	0.0010	N/A	0.001	0.0014
Sodium	**mg/kg**	30	0	286.86	331.30	364.43	463.82	30	0	669.53	831.70	914.87	1164.38	10	0	1613.0	1943.0	2137.3	2720.2
Strontium	**mg/kg**	30	0	0.68	1.26	1.39	1.77	30	0	0.09	0.18	0.195	0.248	10	0	43.99	61.61	67.77	86.25
Thallium	**mg/kg**	30	0	0.0015	0.0019	0.0021	0.0026	30	0	0.0032	0.0048	0.005	0.007	10	0	0.0011	0.0013	0.0015	0.0019
Tin	**mg/kg**	30	29	0.020	0.036	0.022	0.0280	30	30	0.02	N/A	0.022	0.0280	10	10	0.02	N/A	0.022	0.0280
Titanium	**mg/kg**	30	0	0.26	0.37	0.41	0.52	30	0	0.35	0.61	0.669	0.851	10	0	0.69	0.90	0.99	1.26
Uranium	**mg/kg**	30	10	0.0016	0.0044	0.0048	0.0061	30	0	0.0042	0.0071	0.008	0.010	10	0	0.01	0.02	0.020	0.025
Vanadium	**mg/kg**	30	30	0.02	N/A	0.022	0.0280	30	0	0.18	0.42	0.458	0.582	10	1	0.04	0.07	0.079	0.100
Zinc	**mg/kg**	30	0	4.35	5.42	5.96	7.59	30	0	47.18	67.42	74.16	94.39	10	0	39.40	45.78	50.36	64.09
Radionuclides (Dry Weight)																			
Radium-226	**Bq/g**	30	10	0.01	N/A	0.011	0.014	30	30	0.01	N/A	0.011	0.014	10	9	0.011	0.011	0.0121	0.0154
Lead-210	**Bq/g**	30	10	0.10	N/A	0.110	0.140	10	10	0.10	N/A	0.110	0.140	10	10	0.10	N/A	0.110	0.140
Uranium-238	**Bq/g**	30	10	0.01	N/A	0.011	0.014	10	10	0.01	N/A	0.011	0.014	10	10	0.01	N/A	0.011	0.014
Polonium-210	**Bq/g**	30	10	0.01	N/A	0.011	0.014	30	20	0.028	0.060	0.066	0.085	10	10	0.01	N/A	0.011	0.014
Thorium-230	**Bq/g**	30	10	0.01	N/A	0.011	0.014	30	30	0.01	N/A	0.011	0.014	10	10	0.01	N/A	0.011	0.014

Notes: The 95th Percentile of the baseline dataset for each lake was calculated in ProUCL 5.2 using all of the baseline data collected in 2021, 2022, and 2023. In cases where non detects were present in the dataset values were derived using ProUCL 5.2 Statistics for Data Sets with Non-Detects. Response Framework Action Levels were set using the baseline value (95th percentile) +10% (Low) and 40% (High).

Fish sampling information, size measurements, and health assessments are reported in the AEMP annual reports
All data was less than the laboratory method detection limit. Baseline average is based on highest detection limit represented in the dataset.
At least one lab was result was less than the method detection limit. Baseline averages for datasets with three or more detected concentrations were derived using ProUCL 5.2 - UCL Statistics for Data Sets with Non-Detects. ProUCL 5.2 provides Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs.

Table B-6: Historical Summary - Fish Tissue Baseline Results and Action Levels (Metals - mg/kg wet weight; Radionuclides - Bq/g dry weight)
Rayrock AEMP Design Plan V 1.2
Kwetıı̨ʔaà (Rayrock) Remediation Project
Public Services and Procurement Canada

Parameter	Units	Alternate Reference Lake Muscle Tissue						Alternate Reference Lake - Liver						Alternate Reference Lake - Bone					
		n	ND	Average	95th Percentile	Low (+10%)	High (+40%)	n	ND	Average	95th Percentile	Low (+10%)	High (+40%)	n	ND	Average	95th Percentile	Low (+10%)	High (+40%)
Moisture	**%**	13	-	78.2	-	-	-	13	-	72.1	-	-	-	10	-	68.1	-	-	-
Aluminum	**mg/kg**	13	0	0.86	1.87	2.05	2.62	13	0	0.82	1.58	1.74	2.21	10	0	5.79	9.52	10.47	13.32
Antimony	**mg/kg**	13	0	0.004	0.011	0.012	0.016	13	4	0.0025	0.0037	0.004	0.005	10	0	0.018	0.037	0.04	0.05
Arsenic	**mg/kg**	13	0	0.057	0.072	0.08	0.10	13	0	0.023	0.035	0.04	0.05	10	0	0.045	0.054	0.06	0.08
Barium	**mg/kg**	13	0	0.15	0.45	0.50	0.63	13	0	0.054	0.102	0.11	0.14	10	0	7.52	14.89	16.38	20.85
Beryllium	**mg/kg**	13	13	0.0010	N/A	0.001	0.0014	13	13	0.002	N/A	0.002	0.003	10	10	0.001	N/A	0.001	0.001
Bismuth	**mg/kg**	13	0	0.0044	0.0075	0.008	0.011	13	0	0.009	0.017	0.02	0.02	10	1	0.0031	0.0046	0.01	0.01
Boron	**mg/kg**	13	13	0.20	N/A	0.22	0.2800	13	13	0.20	N/A	0.22	0.280	10	10	0.20	N/A	0.22	0.280
Cadmium	**mg/kg**	13	12	0.0011	0.0011	0.0012	0.0015	13	0	0.014	0.024	0.03	0.03	10	0	0.0029	0.0046	0.01	0.01
Calcium	**mg/kg**	13	0	500.1	904.0	994.4	1265.6	13	0	53.49	75.58	83.14	105.81	10	0	34380	47950	52745.0	67130.0
Chromium	**mg/kg**	13	10	0.027	0.030	0.03	0.04	13	4	0.018	0.0276	0.0304	0.0386	10	0	0.088	0.209	0.23	0.29
Cobalt	**mg/kg**	13	1	0.002	0.00284	0.00312	0.00398	13	0	0.023	0.0291	0.0320	0.0407	10	0	0.009	0.014	0.02	0.02
Copper	**mg/kg**	13	0	0.17	0.26	0.29	0.37	13	0	18.58	48.60	53.46	68.04	10	0	0.427	0.743	0.82	1.04
Iron	**mg/kg**	13	0	2.85	4.13	4.55	5.79	13	0	194.97	348.20	383.02	487.48	10	0	11.276	14.90	16.39	20.86
Lead	**mg/kg**	13	0	0.0045	0.0104	0.011	0.015	13	0	0.006	0.012	0.013	0.017	10	0	0.022	0.038	0.04	0.05
Magnesium	**mg/kg**	13	0	313.4	340.8	374.9	477.1	13	0	134.66	187.00	205.7	261.8	10	0	621.20	785.50	864.05	1099.70
Manganese	**mg/kg**	13	0	0.38	0.58	0.64	0.81	13	0	0.99	1.45	1.59	2.03	10	0	14.10	26.99	29.69	37.79
Mercury	**mg/kg**	13	0	0.17	0.35	0.39	0.49	13	1	0.072	0.161	0.18	0.23	10	0	0.066	0.152	0.17	0.21
Molybdenum	**mg/kg**	13	13	0.004	N/A	0.004	0.0056	13	0	0.128	0.187	0.21	0.26	10	1	0.010	0.016	0.02	0.02
Nickel	**mg/kg**	13	9	0.015	0.017	0.019	0.024	13	8	0.015	0.017	0.019	0.024	10	0	0.036	0.067	0.07	0.09
Phosphorus	**mg/kg**	13	0	2556.4	2810.0	3091.0	3934.0	13	0	2393.1	3442.0	3786.2	4818.8	10	0	18230	24810	27291.00	34734.00
Potassium	**mg/kg**	13	0	4110.9	4338.0	4771.8	6073.2	13	0	2659.2	3208.0	3528.8	4491.2	10	0	2163	2430	2673.00	3402.00
Selenium	**mg/kg**	13	0	0.071	0.092	0.10	0.13	13	0	0.960	1.142	1.26	1.60	10	0	0.074	0.087	0.10	0.12
Silver	**mg/kg**	13	13	0.0010	N/A	0.0011	0.0014	13	0	0.098	0.258	0.28	0.36	10	10	0.0010	N/A	0.0011	0.001
Sodium	**mg/kg**	13	0	290.2	361.6	397.8	506.2	13	0	719.23	851.40	936.54	1191.96	10	0	1572	1753	1928.30	2454.20
Strontium	**mg/kg**	13	0	0.56	1.17	1.29	1.64	13	0	0.081	0.143	0.16	0.20	10	0	44.40	63.50	69.85	88.90
Thallium	**mg/kg**	13	0	0.0029	0.0051	0.0056	0.0071	13	0	0.004	0.006	0.007	0.008	10	0	0.0025	0.0038	0.004	0.005
Tin	**mg/kg**	13	13	0.02	N/A	0.0220	0.0280	13	12	0.02	0.024	0.022	0.028	10	6	0.034	0.040	0.04	0.06
Titanium	**mg/kg**	13	0	0.17	0.31	0.34	0.43	13	0	0.16	0.37	0.41	0.52	10	0	0.82	1.01	1.11	1.41
Uranium	**mg/kg**	13	11	0.00077	0.00075	0.00082	0.00104	13	4	0.00066	0.00094	0.00103	0.00131	10	0	0.0036	0.0062	0.007	0.009
Vanadium	**mg/kg**	13	13	0.02	N/A	0.022	0.0280	13	3	0.18	0.394	0.433	0.552	10	5	0.125	0.164	0.18	0.23
Zinc	**mg/kg**	13	0	4.27	5.27	5.80	7.38	13	0	43.72	89.50	98.45	125.30	10	0	38.15	46.15	50.77	64.61
Radionuclides (Dry Weight)																			
Radium-226	**Bq/g**	13	13	0.01	N/A	0.0110	0.0140	13	13	0.01	N/A	0.0110	0.014	10	10	0.01	N/A	0.0110	0.014
Lead-210	**Bq/g**	13	13	0.10	N/A	0.1100	0.1400	13	13	0.10	N/A	0.1100	0.140	10	10	0.10	N/A	0.1100	0.140
Uranium-238	**Bq/g**	13	11	0.012	0.012	0.0127	0.0161	13	5	0.023	0.035	0.0253	0.032	10	10	0.01	N/A	0.0110	0.014
Polonium-210	**Bq/g**	13	10	0.0114	0.0140	0.0125	0.0160	13	3	0.0718	0.0946	0.0790	0.101	10	7	0.0136	0.0193	0.0150	0.019
Thorium-230	**Bq/g**	13	13	0.01	N/A	0.0110	0.0140	13	13	0.01	N/A	0.0110	0.014	10	10	0.01	N/A	0.0110	0.014

Notes:
The 95th Percentile of the baseline dataset for each lake was calculated in ProUCL 5.2 using all of the baseline data collected in 2021, 2022, and 2023. In cases where non detects were present in the dataset values were derived using ProUCL 5.2 Statistics for Data Sets with Non-Detects. Response Framework Action Levels were set using the baseline value (95th percentile) +10% (Low) and 40% (High).

Fish sampling information, size measurements, and health assessments are reported in the AEMP annual reports
All data was less than the laboratory method detection limit. Baseline average is based on highest detection limit represented in the dataset.
At least one lab was result was less than the method detection limit. Baseline averages for datasets with three or more detected concentrations were derived using ProUCL 5.2 - UCL Statistics for Data Sets with Non-Detects. ProUCL 5.2 provides Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs.