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Public Services and Procurement Canada

Remedial Action Plan

Kwetı̨ı̨ʔaà (Rayrock) Remediation Project

Prepared by:

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Date: August, 2020

Project #: 60608868

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Revision History

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Project Manager
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Dear Rebecca:

Subject: Remedial Action Plan
Kwetı̨ı̨ʔaà (Rayrock) Remediation Project

AECOM Canada Ltd. (AECOM) is pleased to provide Public Services and Procurement Canada (PSPC) this report detailing the advancement of the remedial action plan for the former Rayrock Mine Site.

Thank you for this opportunity to be of continued service to PSPC.

Sincerely,
AECOM Canada Ltd.

Joël Nolin, P.Eng.
Senior Project Manager
joel.nolin@aecom.com

XX:xx
Encl.
cc:

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AECOM: 2015-04-13

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Aug 21, 2020
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Kwetı̨ı̨ʔaà (Rayrock) Remediation Project: Plain Language Summary

After many years of studying the Rayrock site, the Government of Canada understands that there are contaminants at the site that are unsafe for people, the land and the water. Canada now understands where the contaminants are, how much contamination remains, how water flows on and off the Rayrock site, how to clean up the contaminants, and how to repair the damage done from past mining operations.

Rayrock Mine

The parts of Rayrock that will be cleaned up or repaired are:

- **Mine Openings:** Mine openings are the holes in the rock that the miners made to get to the metals they were mining, and they include five vent raises and one adit. Vent raises are holes made in the rock to get fresh air to the miners, and the five vent raises are on top of the Marian Ridge. An adit is a hole in the side of a hill that miners use to go underground and to send out the rocks they are mining.

  Remediation: *Install covers. Vent raises will be closed with covers made of polyurethane foam and rock, concrete, or stainless steel – any of which will keep people or animals from falling in the hole. All fences will be removed.*

- **Former Mine Camp and Mill Areas**: The buildings at Rayrock were removed in the 1980s. Asbestos, a rock that can make you sick, was in the materials used in the construction of the buildings and was left in the soil that was near these buildings.

  Remediation: *Dig out this soil and bury it in a better location. All soil that might contain asbestos will be dug out and moved to Mill Lake after the lake is drained. The soils will be buried in the area where the lake used to be.*

- **Mill Pad and Mine Building Concrete:** The concrete that the mill and other buildings at Rayrock sat on is dangerous for people visiting Rayrock.

  Remediation: *Break up and bury in a better location. Concrete will be broken up and moved to Mill Lake after the lake is drained. The concrete and steel will be buried in the area where the lake used to be. Steel that was put in the bedrock to hold the concrete in place will be cut at the bedrock.*

- **Soil around the Mill:** The soil around the former mill contains metals and oil. Studies performed on this soil determined that there was not enough metal or oil in the soil to hurt people or animals in the area. This soil is near Mill Lake, so it can be used to build the area where the more contaminated soils are being buried in Mill Lake.

  Remediation: *Dig out this soil and use it to bury more contaminated soil. All soil that was near the mill will be dug out and moved to Mill Lake after the lake is drained. The soil will be used to bury more polluted soil in the area where the lake used to be. Since this soil was shown to not hurt people or animals, areas where the soil supports larger plants or where it cannot be easily dug out will be left in place.*

- **North and South Tailings Containment Areas:** Tailings are the ground-up rocks that are left over after the mine has taken all the metals it wanted out of the rock. These Tailings Containment Areas, or areas where tailings were capped (buried under clean soil), were built in 1996 and are still in good shape. Minor repairs of the two tailings caps are needed around the edges of the capped areas and in areas constructed to drain off water. If these repairs are not made, tailings may become uncovered and move into the surrounding lakes. The Canadian Nuclear Safety Commission (CNSC) has ordered Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) to repair these caps.

  Remediation: *Repair caps. Clean soil will be used to fix all areas of the tailings caps. Larger rocks may also be used to protect areas where water drains. All repaired areas will be planted over with local plants, known as revegetation.*

- **Spilled Tailings:** Spilled tailings can be found in some areas on the former Rayrock Mine site, such as near the former mill site and between the mill and the tailings containment areas where the tailings were dumped. Studies performed on the spilled tailings determined that the amount of these spilled tailings were small, so there is not enough metal in the tailings to hurt people or animals in the area.

  Remediation: *Dig out these spilled tailings and use them to bury more contaminated soil. These tailings will be dug out and moved to Mill Lake after the lake is drained. The tailings will be used to bury more contaminated soil in the area where the lake used to be. Since these tailings were shown to not hurt people or animals, areas where spilled tailings support larger plants or where they cannot be easily dug out will be left in place.*

- **Waste Dump:** The waste dump contains metal, wood, and plastic waste. It was capped with clean soil in 1996. Studies of the waste dump since then found no concerns. All water from the dump would flow to Gamma Lake, and the water at Gamma Lake was shown to not hurt people or animals.

  Remediation: *Repair cap. Clean soil will be used to fix areas of the waste dump. Larger rocks may also be used to protect areas where water drains. All repaired areas will be planted over with local plants, known as revegetation.*

- **Borrow Areas (areas where clean soil was taken):** Areas where clean soil was removed to build the Tailings Containment Areas include north of the North Tailings Containment Area and at the former airstrip. These areas were left without repair, allowing large muddy areas and muddy ponds to form.

  Remediation: *Fill in holes with clean soil. Areas where clean soil was already taken and any area used to get clean soil for future repairs, will be made level with any remaining clean soil. Clean soil that is left in the area will be used to fill in holes to allow water to flow away from the area and will be planted over with local plants (revegetation).*

- **Non-Hazardous Waste:** Non-hazardous waste is any waste that, when left on the ground, would not cause harm to people or animals because of chemicals coming from the waste, although they can cause harm from cuts, trips, or other interactions. Examples of non-hazardous wastes are: metals; wood that has not been treated with chemicals; and plastics. A large amount of non-hazardous waste at Rayrock has already been picked up and was stored in piles in an area set aside for waste storage. All non-hazardous waste at Rayrock that has not been picked up will be brought to this area.

  Remediation: *Store until waste can be trucked off-site. All non-hazardous waste will be picked-up, sorted into piles of similar waste types, and stored at the storage area. They will then be trucked to a facility in the south that accepts and processes this waste. Clean wood may be burned on site.*

- **Hazardous Waste:** Hazardous waste is waste made of chemicals or other materials that, when left on the ground, could harm people or animals. Canada has a list of types of waste that it considers hazardous, and this list includes materials like asbestos and lead-painted metals that can be found at Rayrock. Hazardous waste at Rayrock has already been collected and is stored at the storage area in closed wooden boxes. Any remaining hazardous waste at Rayrock will be picked up.

  Remediation: *Safely store and contain hazardous waste until it can be trucked off-site. All hazardous waste will be picked up and stored in secured containers at the storage area. They will then be trucked to a facility in the south that accepts and processes this waste.*

- **Mill Lake:** The water in Mill Lake is up to 3.9 metres (m) deep, and soft sediment covers the lake bottom. High amounts of uranium, the metal that was mined at Rayrock, have been found in this sediment and in the water of Mill Lake. Below this sediment with uranium is a layer of clay with low amounts of uranium. Bedrock is found under this clay. There are no fish in Mill Lake. Very few plants grow in the water of Mill Lake.

  Remediation: *Clean up the water and bury the sediment under clean soil. Water from Mill Lake will be pumped out, treated to remove the metals in the water, and then placed in Sherman Lake. Sediment from Mill Lake will be put into synthetic bags located in one area of the former lake so that the water can drain out. Once most of the water has been drained from the sediment, the sediment will be covered with soil, tailings, concrete and rock, and then capped with clean soil. All capped areas and the bottom of the lake will be made to drain into Sherman Lake through Mill Creek, which is the same place that the Mill Lake drains now. This will stop Mill Lake from refilling. The bedrock will be blasted at Mill Creek to make the area drain. All areas with clean soil will be planted over with local plants (revegetation).*

- **Mill Creek:** Studies of Mill Creek found that the soils near the creek in the area close to Mill Lake have high amounts of uranium. Studies performed on this soil determined that the metal in the soil did not get into the plants in the area, so it cannot hurt people or animals in the area. If the Mill Creek soil was dug out, some of the soil with high amounts of uranium could flow down the creek into Sherman Lake, causing more harm than good.

  No work is needed at Mill Creek.

Sun Rose

Sun Rose is another place that will be cleaned up as part of the Kwetı̨ı̨ɂaà (Rayrock) Remediation Project. Several studies of the Sun Rose site have been done. The parts of Sun Rose that will be cleaned up or repaired are:

- **Mine Shaft:** A mine shaft is an opening in the ground that goes straight down, and is usually made large enough to allow an elevator to be built on top of it. The mine shaft opening is located on the northwest side of the dome at Sun Rose. The building that contained the elevator is gone. The shaft is protected by a chain-linked fence with warning signs, and it is covered with loosely-placed metal bars and wooden boards. Humans and/or animals could fall into the opening.

  Remediation: *Install covers. The shaft will be closed with a cover made of polyurethane foam and rock, concrete, or stainless steel – any of which will keep people or animals from falling in the hole. The fence will be removed.*

- **Waste Rock Piles:** Waste rock is the rock taken from an area being mined that is dug out because it is between the surface and the rock that has the metal. The waste rock at Sun Rose appears to have been mixed with the rock with high amounts of uranium. The waste rock has radiation levels high enough that it needs to be buried.

  Remediation: *Bury the waste rock under clean soil. All waste rock would be moved into the main waste rock pile. The pile would be sloped so water would drain, and the rock would be capped with clean soil. The capped area would be planted over with local plants (revegetation).*

- **Blasted Areas:** Blasted areas, called exploration workings, can be found southeast of the shaft. The area was blasted to check the rock for uranium, so these areas have high radiation.

  Remediation: *Bury these blasted areas under concrete or clean soil. The blasted areas would be capped with concrete or clean soil.*

- **Soils with Metals:** Soils at Sun Rose have been found to have high amounts of metals; however, studies performed on this soil determined that the metal in the soil cannot hurt people or animals in the area.

  Remediation: *Place soils with waste rock. Soil with metals could be moved to the main waste rock pile to reduce the amount of clean soil needed for the cover.*

- **Non-Hazardous Waste:** Non-hazardous waste, including items like oil drums, wood debris, and metal debris, are located near the shaft, Chico Lake, the former camp, and the former access roads. All non-hazardous waste at Sun Rose will be picked up.

  Remediation: *Pick up and store any non-hazardous waste safely until it can be trucked off-site. All non-hazardous waste will be picked up, sorted into piles of similar waste types, and stored either at Sun Rose or at the Rayrock storage area. They will then be trucked to a facility in the south that accepts and processes this waste. Clean wood may be burned on site.*

Horn Plateau – Rex Showing

The Horn Plateau – Rex Showing, usually called REX, is a former uranium exploration site that is part of the Kwetįį̨ʔaà (Rayrock) Remediation Project. Based on the studies that have occurred so far, the parts of REX that will be cleaned up or repaired are the following:

- **Blasted Areas**: Blasted areas, called “exploration workings” can be found at REX where they checked the rock for uranium. Some areas have high radiation.

  Remediation: *Bury areas that have unsafe radiation under concrete or clean soil. Blasted areas that may be dangerous for falling and hurting or trapping people or animals will be filled to a safe level.*

- Non-Hazardous Waste – Non-hazardous waste at REX will be picked up.

  Remediation: *All non-hazardous waste will be picked up and moved to Rayrock, where it will be sorted with the Rayrock waste.*

Other Locations

The remaining places that will be cleaned up as part of the Kwetı̨ı̨ʔaà (Rayrock) Remediation Project are the barge landing site at Marian Lake, the Rayrock power lines, and three small exploration areas called MK, GS, and TED. These sites were associated with the development of the mine, mine operations, mine exploration and transportation.

When the mine was operating, an all-weather road was used to move materials and supplies from Rayrock to the barge landing on the shore of Marian Lake. If wastes from the mine are found along the road during remediation, they will be picked-up.

The barge landing was on Marian Lake at the end of the road from Rayrock. Non-hazardous waste and a small amount of hazardous waste can be found at the barge landing site.

The Rayrock power line was used to provide electricity to Rayrock. The area consists of power poles and wires. The poles may have been treated with hazardous chemicals that would make them a hazardous waste.

The three exploration sites, TED, MK, and GS have non-hazardous waste, while GS has a small amount of hazardous waste. The parts of these sites that will be cleaned up or repaired are the following:

- **Soils with Chemicals:** Soils with hazardous chemicals may be found at the barge landing site or along the power line.

  Remediation: *Bury soil at Rayrock or truck south with hazardous waste. Soil with chemicals can either be buried in Mill Lake or trucked south with the hazardous waste.*

- **Non-Hazardous Waste:** All of these sites contain non-hazardous waste. All non-hazardous waste will be picked up.

  Remediation: *Pick up, take to Rayrock, and store safely until waste can be trucked off-site. All non-hazardous waste will be picked up and moved to Rayrock, where it will be sorted with the other Rayrock waste. Clean wood may be buried on site.*

- **Hazardous Waste:** Hazardous waste was identified at the barge landing site, and may be found along the power line if the poles were chemically treated. All hazardous waste will be picked up and removed.

  Remediation: *Move waste to Rayrock and store safely until it can be trucked off-site. All hazardous waste will be picked up, moved to Rayrock, and stored in secured containers at the Rayrock storage area. They will then be trucked to a facility in the south that accepts and processes this waste.*

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List of Acronyms and Abbreviations

Term	Definition
Entities/Organizations	
CARD	Contaminants and Remediation Division
CIRNAC/ AANDC/ INAC/ DIAND	Crown-Indigenous Relations and Northern Affairs Canada (formerly Aboriginal Affairs and Northern Development Canada) (formerly Indian and Northern Affairs Canada) (formerly Department of Indian Affairs and Northern Development)
CCME	Canadian Council of Ministers of the Environment
CEC	Tłı̨chǫ Chief's Executive Council
CNSC	Canadian Nuclear Safety Commission
DIAND	Indian Affairs and Northern Development Canada
FE	Fielding Environmental
GNWT	Government of the Northwest Territories
KBWG	Kwe Beh Working Group
KEC	Kwetį̨ɂaà Elders Committee
MVLWB	Mackenzie Valley Land and Water Board
NWT	Northwest Territories
PSPC/ PWGSC	Public Services and Procurement Canada (formerly Public Works and Government Services Canada)
TG	Tłı̨chǫ Government
DCLP	Tłı̨chǫ Government Department of Cultural and Lands Protection
WLWB	Wek'èezhìi Land and Water Board
WSCC	Workers' Safety and Compensation Commission
Documents	
AEMP	Aquatic Effects Monitoring Program
MVFAWR	Mackenzie Valley Federal Areas Waters Regulations
MVRMA	Mackenzie Valley Resource Management Act
ESA	Environmental Site Assessment
RAP	Remedial Action Plan
WNSL	Waste Nuclear Substance Licence
CLCA	Tłı̨chǫ Comprehensive Land Claims Agreement
LCH	Licence Condition Handbook
HHERA	Human Health and Ecological Risk Assessment
HHPQRA	Human Health Preliminary Quantitative Risk Assessment
SLERA	Screening Level Ecological Risk Assessment
LUP	Land Use Permit
WMMP	Wildlife Management and Monitoring Plan
Technical Terms	
ACM	Asbestos-Containing Materials
AEC	Area of Environmental Concern
ALARA	As Low as Reasonably Achievable
APEC	Area of Potential Environmental Concern
ARD	Acid Rock Drainage
CDF	Confined Disposal Facility
COPC	Constituents of Potential Concern
DWL	Derived Working Limits
ISQG	Interim Sediment Quality Guideline
LBP	Lead-Based Paint
LEL	Lowest Effect Level

Term	Definition
LLRW	Low Level Radioactive Waste
MAA	Multiple Accounts Analysis
MASL	Metres Above Sea Level
ML	Metals Leaching
NORM	Naturally Occurring Radioactive Materials
NPR	Neutralization Potential Ratio
OMS	Operation, Maintenance and Surveillance
PAG	Potentially Acid Generating
PUF	Polyurethane Foam
QA/QC	Quality Assurance/Quality Control
SEC	Sediment and Erosion Control
SEL	Severe Effect Level
TCA	Tailings Containment Area
TCLP	Toxicity Characteristic Leaching Procedure
Elements/Chemicals	
As	Arsenic
B	Boron
Cd	Cadmium
Cr	Chromium
Cu	Copper
Hg	Mercury
Mo	Molybdenum
Ni	Nickle
Pb	Lead
PHC	Petroleum Hydrocarbons
Se	Selenium
Sn	Tin
U	Uranium
V	Vanadium
Zn	Zinc
Units of Measurement	
μSv/a	microsievert/annum
μSv/hr	microsievert/hour
Bq/cm^2	Becquerel per square centimetre
cm	centimeter
kg	kilogram
km	kilometre
l	litre
m	metre
m^2	square metres
m^3	cubic metres
mg/kg	milligram/kilogram
mm	millimetre
mSv/a	milliSievert/annum
°C	degrees Celsius

Tłįcho Translations

Tłįcho Language	English Language	Meaning
Kwetıįʔaà	Rayrock Mine	Where the rock meets the river
Kwetįįɂaà tì	Sherman Lake	Below water is there
Kwetįįɂaà tłàa	Alpha Lake	The Bay
Tsà tìa	Beta Lake	Little beaver lake
Shìzì tì whetǫ	Mill Lake	Lake below big hill
Shìzì tì whetǫ kwetįįɂaà xįlį	Mill Creek	Connecting big lake below hill
Kwetsǫ̀tìa	Jan’s Pond	Small dirt pond
Kwetįįɂaà dèk’e nıhtł’et’a nagowho k’è	Airstrip	Place where airplane lands on land
Asìı łąnìzhe k’è	Hazardous Waste Piles	Things accumulate in this place
Nahagotsìk’ǫ k’è	Outdoor camp (fire pit)	Place of camping
Kwetįįɂaà Nǫts’eede k’è	Rayrock camp (today)	Place where you return to

1. Introduction

1.1 Purpose and Scope

AECOM Canada Ltd. (AECOM) was retained by Public Services and Procurement Canada (PSPC) to develop a Remedial Action Plan (RAP) for the Rayrock Remediation Project (the 'Project'). The Project's physical scope includes several locations, including:

- the former Rayrock Uranium Mine site (Rayrock),
- the Sun Rose Claim Group,
- two exploration sites at the Horn Plateau (GS and REX),
- a former powerline connecting the Rayrock mine to a hydroelectric power station on Big Spruce Lake,
- an historical barge landing on the northeastern shore of Marian Lake,
- two related satellite exploratory sites (MK and TED), and
- a former all-season road to Rayrock.

This RAP was developed considering existing information available for the affected areas including results from previous environmental site assessments (ESAs) and investigations, historical remedial activities, and the results from community work out sessions with the Tłı̨cho Government (TG) in February 2018 (50% RAP Work Out), February 2019 (75% RAP Work Out) and June 2020 (90% RAP Work Out).

Figures referenced in this report are provided in **Appendix A**. Photographs relating to the Project elements are provided in **Appendix B** and Tables of laboratory analytical results are provided as **Appendix C**. **Figure 1 (Appendix A)** depicts the Project work locations.

1.2 Project Objectives

The Project scope includes addressing legacy impacts associated either directly or indirectly with uranium mining, milling and exploration activities. Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) has identified that the Project's remedial objectives are as follows:

- Minimize public and worker health and safety risks.
- Minimize the environmental impact of the sites.
- Maximize the potential for future traditional use of the land.
- Reduce the Government of Canada's environmental liability while protecting Tłı̨cho land and water.
- Implement remedial approaches that are cost-effective and robust over the long term.
- Incorporate traditional and local knowledge, obtained through Elder guidance, into remedial design, implementation and monitoring.
- Maximize socio-economic benefits to the Tłı̨cho (per Chapter 26.3 of Tłı̨cho Final Agreement).

- Comply with all legal/regulatory obligations and Federal, Territorial, and Departmental policies (including procurement policies, procedures and best practices).
- Remediate the sites in a manner that instills Tłı̨chǫ confidence and increases public awareness of remedial activities in the North.

1.3 Remedial Planning Team

The Project execution team is as follows.

Table 1-1: Project Execution Team

Organization	Primary Roles	Reports to	Key Responsibilities
Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC)	Owner		• Project Proponent • Regulatory Applications and Relationships • Community Engagement • Enforcement of Land Use Permit on Federal Lands
Public Services and Procurement Canada (PSPC)	Project Manager	CIRNAC	• Procurement and Management of Design and Remediation Consultant • Procurement and Management of Remediation Contractor • Departmental Representative
AECOM Canada Ltd. (AECOM)	Design Engineer Construction Manager	PSPC	• Civil and Environmental Engineering • Design Drawings and Specifications • Construction Quality Assurance/Quality Control • Departmental Representative's Authorized Personnel
General Contractor (To be Procured)	Project Implementation	PSPC	• Prime Contractor • Remediation Execution • Regulatory Compliance

As the Owner, CIRNAC (The Government of Canada) will have ultimate responsibility from project inception through remediation and post-Project monitoring.

1.4 Engagement

This RAP has been shaped by ongoing engagement throughout its development. Through regular engagement, design decisions have been made in a way that incorporates the feedback and preferences of those who have historically been most affected by the past operations of Rayrock Mine and the sites that are included in the Rayrock Remediation Project.

The Rayrock Remediation Project Team is committed to effective engagement and consultation, such that affected parties are well informed and feel that their input, including Traditional Knowledge, has been adequately and effectively integrated into the project. It is important that the affected parties have opportunities for collaboration and participation in the Project which will result in increased influence on the future of the site.

Considerable engagement has been conducted as part of the development of this RAP. The following subsections provide details on the CIRNAC-Tłı̨cho partnership, a summary of communication methods and key highlights of the engagement to date.

1.4.1 Engagement Methods

1.4.1.1 CIRNAC-Tłı̨cho Partnership

Rayrock sits within the traditional lands of the Tłı̨chǫ, who call the site “Kwetı̨ı̨ɂaà” or “rocks projecting outward and into the water that flows by”. The Tłı̨chǫ have expressed concerns over Rayrock since mine operations. The TG Chief’s Executive Council (CEC) has directed the Contaminant and Remediation Division of CIRNAC to work with the Department of Cultural and Lands Protection (DCLP) on the Rayrock Remediation Project and since 2006, CIRNAC has met regularly with Tłı̨chǫ Elders and representatives.

With the mandate for land management within their region, the TG DCLP has a responsibility to communicate land use activities to their community members and leadership and other interested parties. Representatives are selected within the organization and may include Technical Advisors as standing committee members. The DCLP members share information and concerns related to the Rayrock site with CIRNAC-CARD and report outcomes back to their members.

The Kwetı̨ı̨ɂaà Elders Committee (KEC) was initiated in 2010/11, with the objective of facilitating the sharing of scientific and Traditional Knowledge. The committee consists of members from CIRNAC, the TG and Tłı̨chǫ Elders. The KEC provides Elders and community members that are familiar with the Rayrock area and that are committed to seeing the sites in the Rayrock Remediation Project returned to a state that permits future use by the Tłı̨chǫ. The KEC is actively involved with the Rayrock Remediation Project.

The Mines Liaison Coordinator with the TG, who is responsible for maintaining relationships with the mining industry, has implemented the Kwe Beh Working Group (KBWG) as a technical steering committee to advise the Chiefs Executive council on all mining matters within the Tłı̨chǫ (Mǫwhì Gogha Dè Nı̨ı̨tłèè) area. CIRNAC communicates updates on the Rayrock Remediation Project to the KBWG.

The principal engagement bodies for the Rayrock Remediation Project are summarized in the following table. The specific membership and timing of the meetings may change over time.

Table 1-2: Principal Engagement Bodies for the Rayrock Remediation Project

Engagement Body	Primary Purpose	Primary Participants	Primary Methods
TG Department of Cultural and Lands Protection (DCLP)	To share information and concerns related to the Rayrock site with CIRNAC and report outcomes back to community members and Tłı̨chǫ leadership	TG Representatives and their Contractors.	Face-to-Face Meetings, Workshops, Site Tours
K’wetiia’a Elders Committee (KEC)	To facilitate the sharing of scientific information and Traditional Knowledge between CIRNAC and the Tłı̨chǫ.	CIRNAC-CARD, TG DCLP, Tłı̨chǫ Elders	Face-to-Face Meetings, Workshops, Site Tours
Kwe Beh Working Group (KBWG)	To advise the Chiefs Executive council of matters related to the Rayrock Remediation Project	TG Representatives	Face-to-Face Meetings, Site Tours
Tłı̨chǫ Chief's Executive Council (CEC)	To update the CEC on the progress on the Rayrock Remediation Project.	Tłı̨chǫ CEC, CIRNAC-CARD, TG DCLP, Tłı̨chǫ Elders	Face-to-Face Meetings
Tłı̨chǫ Communities	To update the Tłı̨chǫ public on work completed and planned for their region by CIRNAC.	Community Members	Community Public Meetings

The Rayrock site remains Crown land; the site was excluded from land selection in the Comprehensive Land Claim Agreement (CLCA) process and not transferred to the Government of the Northwest Territories as part of

Devolution. Therefore, the TG is exclusively engaged by CIRNAC. Other Indigenous groups are provided informal project updates but are not regularly included in correspondence. The North Slave Métis Alliance and the Yellowknife Dene First Nation have been informed of CIRNAC's intent to remediate the Rayrock Remediation Project sites.

1.4.1.2 Communications

Regular communications form an important part of ongoing engagement. The communication methods that the Rayrock Remediation Project currently undertakes as a part of ongoing engagement are outlined in the following table.

Table 1-3: Communication Methods

Types of Communication	Activity	Timing	Comments
Written Notification or Radio/Video Broadcast	Reporting on regulatory activities, social media, pro-active/responsive media relations, site-related public service announcements	As required	Includes media interviews, media briefings, web postings, direct communication with key partners
Face-to-Face Meetings	In-person meetings or telephone calls (if appropriate) with representatives of affected parties, communities, interest groups, etc.	Regularly/As required Biweekly meetings with TG DCLP Annual Project Updates to KEC, TG DCLP, CEC, KBWG	Topics vary and are dependent on the participants and the issues being discussed
Community Public Meetings	Community forums; informal public meeting where everyone in the community is encouraged to discuss the project; broad community input desired	Annual Project Updates	Are often accompanied by print materials (e.g. maps, photos, factsheets).
Workshops	Focus workshops; discuss technical issues or when information needs to be shared and feedback solicited from large groups of people	As required	The format of workshops will vary based on the focus and interest of participants.

1.4.2 Key Engagement to Date

The following table provides an overview of key engagement events and outcomes through the recent history of the Rayrock Remediation Project. A comprehensive Engagement Plan and Engagement Log have been prepared by CIRNAC and are provided under separate cover. These engagement activities and regular communications provide direct opportunities for the Tłı̨chǫ to voice their concerns, identify their priorities and provide overall input into remedial planning.

Table 1-4: Summary of Key Engagement Activities

Activity	Date	Purpose of Engagement	Outcome
Rayrock Site Risk Workout	November 2014	To provide a project update and to complete a Concerns Ranking Exercise for the risks identified at the Rayrock site.	The Tłı̨chǫ expressed satisfaction with the information presented and noted that they were now more comfortable with using the Rayrock area for traditional land use. A few Elders were not convinced and stated that they thought the land was ruined forever.

Activity	Date	Purpose of Engagement	Outcome
Remedial Strategy Review	March 15, 2017	To provide an overview of contamination and hazards at the Rayrock site and to review the remedial strategy for each component of the future remediation project.	
Remedial Strategy Review	March 2017	A workshop was held to review the remedial strategy for each component of the future remediation project.	The Tłı̨chǫ government, Elders and community members were actively engaged in the decision-making process for determining the remedial strategies to be used to address the risks at the Rayrock site.
Remedial Options Analysis	February 20, 2018	To provide an overview of the contamination and hazards at the Rayrock site and select preferred and potential remedial options for the remediation.	Most remedial options were selected for the Rayrock site. Similar approaches were agreed to be used at the other sites in the Remediation Project. The option for remediation of Mill Lake was not confirmed. The Elders felt more information was necessary in the nature of the contamination in order to confirm the remedial approach.
Remedial Options Analysis	March 12, 2018	To review and discuss the selected remediation methods with additional detail provide on how the work will be completed for each area of contamination or hazard.	
75% RAP Technical Review Meeting	January 23, 2019	A Technical Review of the 75% RAP was completed with Expert Support. Firelight and Fielding participated on behalf of the Tłı̨chǫ Government. This review included detailed plans for the remediation of the remedial components decide in 2018, and reviewed the factors affecting the Mill Lake remediation.	
75% RAP Workout	February 19-20, 2019	The 75% RAP was reviewed with the TG and Elders. This review presented detailed plans for the remedial components discussed in 2018 and reviewed the information gathered in 2018 to understand the issues with Mill Lake.	The Elders wanted work to determine the effect of climate change on remediation, they wanted to see the site at different times of the year and they wanted continued monitoring and archaeological studies. A commitment to including climate change in remedial planning was made, a site visit during freshet was confirmed and continuation of the Elder monitoring and sampling (as completed in 2018) was organized. Warning signs will be erected for Sun Rose.
90% RAP Technical Review Meeting	June 25, 2020	Technical presentations provided by AECOM to describe the remedial action proposed for the Rayrock Remediation Project. TG provided an overview of recommendations for Rayrock and Sun Rose. Technical aspects of the remedial plan were discussed.	TG wanted to discuss the approach to the remediation of Mill Lake and the selection of a remedial technology in more detail.
90% RAP Workout	June 29-30, 2020	Technical presentations provided by AECOM to describe, in more detail, the remedial action proposed for the Rayrock Remediation Project and to address questions posed by the Tłı̨chǫ during the Technical Meeting. PSPC and CIRNAC completed an options review exercise where the remedial options where reviewed for all project aspects and the preferred options were selected with the TG.	Remedial options were confirmed for all sites and all work except for Mill Lake. TG wanted to discuss the approach to the remediation of Mill Lake in more detail with Elders. AECOM provided participants to answer technical questions.
Mill Lake Remedial Option Review	July 2, 2020	TG review of the remedial action proposed for the Rayrock Remediation Project, especially with respect to Mill Lake. AECOM and PSPC representatives participated to provide technical input.	The TG determined it had no objections to the proposed Mill Lake remedial approach.

1.4.3 Ongoing Engagement

The Rayrock Remediation Project Team will continue to work with the Tłı̨chǫ to inform them of the schedule for proposed remedial activities, respond to questions and concerns about these activities, and provide opportunities for suggestions from the Tłı̨chǫ to be considered in the detailed design process. The Rayrock Remediation Project Team will continue to work with the Tłı̨chǫ to gather updated traditional and local knowledge to support detailed engineering and to help design monitoring activities. Ongoing engagement activities are summarized in the following table.

Table 1-5: Ongoing Engagement Plan

Engagement Trigger	Purpose	Groups Involved	Engagement Method
Annual KEC Update	To update Committee members on the work completed in the previous year and receive feedback on the approaches taken and those proposed for the coming year. (Annually)	KEC, KBWG, TG	Face-to-face meeting
Annual Community Update	To update the Tłı̨chǫ public on work completed and planned for their region by CIRNAC-CARD. (Annually)	Tłı̨chǫ Government, Community Members	Community Public Meeting
Tłı̨chǫ CEC	To Update the CEC on the project in conjunction with the DCLP (Annually, during November or December CEC Meeting).	Tłı̨chǫ CEC, DCLP, KEC	Face-to-face meeting
Water Licence	To address general public questions about the Rayrock Remediation Project (During Water Licence Processing – if requested or deemed necessary by WLWB).	Tłı̨chǫ DCLP, KEC, WLWB, general public.	Community Public Meeting
Site Observations	To walk the Rayrock Site to observe work completed, to show work to be done and to obtain feedback and suggestions on site features. (Minimum of once every two years)	Tłı̨chǫ DCLP, KEC, KBWG	Site Tour
Post-Remediation Monitoring Observations and Review	To review the requirements for monitoring after remediation and receive feedback on scope and schedule.	Tłı̨chǫ DCLP, KEC, KBWG	Face-to-face meeting/Site Tour

Modifications and updates to engagement activities will be documented in an Engagement Plan and Engagement Log, provided under separate cover.

2. Regulatory Framework

This regulatory framework identifies stakeholders, required permits and approvals, and applicable remediation guidelines. This involves not only compliance to regulations but identifying stakeholders and maintaining open dialogue.

2.1 Regulatory Jurisdictions

Table 2-1 provides a breakout of the Project sites versus jurisdiction as it pertains to land and water management.

Table 2-1: Regulatory Jurisdiction for Land and Water Management

Location	Federal	Territorial	Tłı̨chǫ
Rayrock Mine Site	√		√
Rayrock Powerline (Within Exclusion Zone)	√		√
CA Satellite Site			√
Sun Rose Claim Group	√		√
Horn Plateau (REX and GS Locations)		√	√
Rayrock Powerline (Outside Exclusion Zone)		√	√
Barge Landing		√	√
MK and TED Satellite Sites		√	√
All Season Road		√	√

2.2 Regulatory Framework

For the Project, there are regulatory requirements from both the territorial and federal levels that are applicable. The pertinent acts and regulations and their requirements are summarized in the table below and were considered during the development of the RAP. Guidelines under these acts and regulations were used to further develop the RAP.

Table 2-2: Regulatory Requirements for Project

Jurisdiction	Authorization/ Requirement Requirement	Requirement	Regulation/ Act/ Reference	Regulatory Body
Federal	Waste Nuclear Substance Licence	Remain compliant with Waste Nuclear Substance Licence and its conditions Licence Number: WNSL-W5-3208.0/2027 Licence Conditions Handbook LCH-WNSL-W5-3208.0/2027 Record of Decision, Including Reasons for Decision, Application from Indian Affairs and Northern Development Canada (DIAND) for renewal of a Waste Nuclear Substance Licence	*Nuclear Safety and Control Act S.C. 1997, c. 9*	Canadian Nuclear Safety Commission

Jurisdiction	Authorization/ Requirement Requirement	Requirement	Regulation/ Act/ Reference	Regulatory Body
	Type A Land Use Permit	Remain compliant with existing Land Use Permit (LUP), seek new LUP though end of Project	*Mackenzie Valley Resource Management Act* *S.C. 1998, c. 25* Mackenzie Valley Land Use Regulations	Wek'èezhii Land and Water Board
	Type A Water Licence	Obtain Water Licence and remain compliant	*Mackenzie Valley Resource Management Act* *S.C. 1998, c. 25* Mackenzie Valley Federal Areas Waters Regulations SOR/93-303	Wek'èezhii Land and Water Board
	Quarry Permit	Obtain Quarry Permit and remain compliant (where borrow source is located on federal land)	*Territorial Lands Act* *R.S.C., 1985, c. T-7* Territorial Quarrying Regulations C.R.C., c. 1527	Wek'èezhii Land and Water Board
	Various	Remain compliant with provisions	*Canadian Environmental Protection Act, 1999 (S.C. 1999, c. 33)* Interprovincial Movement of Hazardous Waste Regulations (SOR/2002-301)	Environment and Climate Change Canada
		Remain compliant with provisions	*Canadian Environmental Protection Act, 1999 (S.C. 1999, c. 33)* Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations (SOR/2008-197)	Environment and Climate Change Canada
		Remain compliant with provisions Consider Species at Risk when implementing remedial activities	*Canadian Environmental Protection Act, 1999 (S.C. 1999, c. 33)* Species at Risk Act (S.C. 2002, c. 29)	Environment and Climate Change Canada
		Remain compliant with provisions Must receive approval and authorization if any remedial activity is identified to violate Fisheries Act.	*Fisheries Act* *R.S.C., 1985, c. F-14*	Fisheries and Oceans Canada
		Remain compliant with provisions For materials not covered under CEPA. Proper TDG training to all persons involved in transporting dangerous goods Meet containerization and shipping requirements	*Transportation of Dangerous Goods Act, 1992 (S.C. 1992, c. 34)* Transportation of Dangerous Goods Regulations (SOR/2001-286)	Transport Canada
Territorial	Quarry Permit	Remain compliant with provisions Obtain Quarry Permit and remain compliant (where borrow source is located on GNWT land)	*Northwest Territories Lands Act* *S.N.W.T. 2014,c.13* Quarrying Regulations (R-017-2014)	Environment and Natural Resources GNWT
	Various	Remain compliant with provisions Remain compliant with provisions Gain approval of controlled releases Notify if a spill occurs	*Environmental Protection Act* *R.S.N.W.T. 1988,c.E-7*	Environment and Natural Resources GNWT

Jurisdiction	Authorization/ Requirement Requirement	Requirement	Regulation/ Act/ Reference	Regulatory Body
		Remain compliant with provisions	*Safety Act R.S.N.W.T. 1988,c.S-1* Occupational Health and Safety Regulations R-039-2015 Asbestos Abatement Code of Practice	Workers' Safety and Compensation Commission
		Remain compliant with provisions	*Explosives Use Act R.S.N.W.T. 1988,c.E-10* Explosives Regulations R.R.N.W.T. 1990, c. E-27	Workers' Safety and Compensation Commission
		Remain compliant with provisions Approval from Mine Inspector for mine closure plans Be compliant with all site safety requirements for mines	*Mine Health and Safety Act (S.N.W.T, 1994, c. 25)* Mine Health and Safety Regulations (R-125-95)	Workers' Safety and Compensation Commission
		Remain compliant with provisions	*Guidelines for Safe Ice Construction 2015*	Northwest Territories Transportation

In addition to the above, the Tłįchǫ Land Claims and Self-government Agreement provides provisions for access to Tłįchǫ lands and water rights and management. Specifically, Chapter 18.3 describes how the Government of Canada can clean impacted sites, and Chapter 19.6 describes how the Government of Canada can access Tłįchǫ Lands to complete the remedial works.

CIRNAC, as project owner, will submit applications to the Wek'èezhìi Land and Water Board (WLWB) for a new Land Use Permit (LUP) and a Water Licence. The RAP will be submitted as part of the regulatory package, along with all plans necessary to demonstrate that the land and water will be managed in accordance with applicable Acts. Once the applications are duly processed, the WLWB will provide the LUP and Water Licence with all necessary conditions to verify the protection of land and water during operations.

2.2.1 Waste Nuclear Substances Licence

The Rayrock Mine is licenced by the Canadian Nuclear Safety Commission (CNSC) to CIRNAC under Licence Number Waste Nuclear Substance Licence (WNSL) WNSL-W5-3208.0/2027 (CNSC 2017a). This licence authorizes the licensee, CIRNAC - under the legal title of the Department of Indian Affairs and Northern Development, to possess, manage, and store, subject to the conditions of the licence, the nuclear substances that are associated with remediation of historic uranium mine and mill wastes.

The licensed area is shown on **Figures 1 and 2 (Appendix A)**. The area shown is the surveyed exclusion zone for the Rayrock site and represents the area of Crown Land excluded from the Tłįchǫ CLCA. This boundary also reflects the area around Rayrock that has remained in Federal Government jurisdiction following devolution of land management to the Government of the Northwest Territories. All areas of WNSL activities are captured within the boundaries of the exclusion zone. The boundary encompasses an area of about 206.5 hectares (ha). All activities at the Rayrock Site must be in compliance with the WNSL licence.

The WNSL is accompanied by a Licence Condition Handbook (LCH) that provides guidance on an acceptable compliance strategy that will be used by CNSC staff to assess CIRNAC compliance with the licence conditions for Rayrock.

2.2.2 Land Use Permit

LUP No. W2015X0006 was granted to CIRNAC-CARD by the WLWB in accordance with the Mackenzie Valley Resource Management Act. The LUP is valid through August 13, 2022. The LUP entitles CIRNAC to conduct the following activities associated with the assessment and remediation of the abandoned Rayrock mine site:

- Assessment Activities:
  - Use of machinery for site assessment and identification of borrow sources.
  - Storage of fuels.
- Remediation Activities:
  - Use of machinery for site remediation.
  - Quarry operations.
  - Construction of a winter road connecting the Rayrock site to winter road alignments with crossings at either the Emile (north of Wek'weeti/Gameti junction) or Marian River.
  - Upgrade of existing on-site roads and trails.
  - Storage of fuel.
  - Establishment of camp.

The permit provides conditions relating to site activities relating to the above. In 2020 CIRNAC will be applying to the WLWB for a new LUP to replace the existing permit and support the final remediation of the Rayrock Remediation Project sites. The existing LUP will allows for continued work at the site until the start of the Remediation Contract which will extend beyond the current permit's expiry date.

2.2.3 Water Licence

The Mackenzie Valley Federal Areas Waters Regulations (SOR/93-303) apply to undertakings with respect to the use and/or modifications relating to surface water, groundwater and watercourses in the Territory. Specific to the Project, with activities involving the use of surface water and modifications in Mill Lake and downstream actions relating to Sherman Lake, CIRNAC will be applying to the WLWB for a Water Licence for the Project in 2020 and 2021. The Regulations identify that a Type A Water Licence is required when the direct water use will be in excess of 100 cubic metres (m^3) or more per day.

The scope of the water licence is expected to cover:

- Withdrawing of water for use in camp operations.
- Dewatering of Mill Lake for the purpose of consolidating and capping impacted sediments from the Lake.
- Depositing contaminated materials, including sediments, tailings, waste rock and soil in a containment cell.
- Constructing, operating, and maintaining ice bridges to cross the Emile River and/or the Marian River.
- Constructing, operating and maintaining culverts to allow winter road passage.
- Remediating and monitoring of the Project sites.

2.2.4 Mine Site Decommissioning

In the Northwest Territories, the governing guideline for decommissioning mine sites is the Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the Northwest Territories published by the Mackenzie Valley Land and Water Board (MVLWB) and Aboriginal Affairs and Northern Development Canada

(AANDC) in November 2013. This guideline outlines the mine closure and reclamations expectations for activities including, but not limited to:

- Building and equipment including concrete foundations.
- Mine opening closures.
- Waste rock.
- Post-closure monitoring.
- Landfills and other waste disposal areas.

Additional and pertinent information respecting site closure can be found in:

- Cold Regions Cover System Design Technical Guidance Document, AANDC, July 2012
- Mine Site Reclamation Guidelines, for the Northwest Territories, INAC, January 2007
- Remediation Guidelines for Abandoned Mine Openings in Northern Canada, June, 2011
- Health Canada, Remediation Checklist, March 2013

2.2.5 Remediation Guidelines and Criteria

For this Project, potential impacts exist in multiple media. The previously-determined environmental quality guidelines for each parameter and media are listed below. Historical reports should be consulted for the determination and selection rationale for the specific parameters. We note that the assessment findings were expanded upon for further site evaluation through Human Health and Ecological Risk Assessments (HHERAs, discussed further Section 4.2 of this RAP).

2.2.5.1 Soil

Impacted soil will be removed from selected locations as part of the Project. Soil quality will be compared to the following soil quality guidelines.

- Canadian Council of Ministers of the Environment (CCME) Canadian Environmental Quality Guidelines (CCME, 1999 and as updated)
- CCME Guidelines (Canada-Wide Standards for Petroleum Hydrocarbons in Soil, 2008; Canadian Environmental Quality Guidelines for the Protection of Environmental and Human Health)
- Government of the Northwest Territories (GNWT) Guidelines (Environmental Guideline for Contaminated Site Remediation, 2003)
- Alberta Tier 1 Soil Remediation Guidelines, January 2019 (Radionuclides)

The residential/parkland land use guidelines in a coarse-grained soil condition have been applied in the interpretation of the analytical results. Site-specific findings during remediation may identify a need to use fine-grained soil guidelines.

2.2.5.2 Sediment

For reference, the CCME Sediment Quality Guidelines for the Protection of Aquatic Life (freshwater criteria) were primarily used during sediment assessments. These guidelines publish both an Interim Sediment Quality Guideline (ISQG) as well as a Probable Effects Level (PEL) for metals in sediment. Both have historically been used in the assessment of site conditions.

The Rayrock HHERA (and other screening assessment work) further uses Sediment Quality Guidelines derived by P.A. Thompson, J. Kurias and S. Mihok (Thompson, et. al., 2005), referred to as the Thompson Guidelines. Both a Lowest Effect Level (LEL) and Severe Effect Level (SEL) are derived for a select group of metals and radionuclides by two methods, the closest observation method and the weighed method (see Thompson, et. al, 2005 for details).

For radionuclide analyses in sediment, the following guidelines were used for comparison purposes:

- The Alberta Tier 1 Guidelines for soil samples, as described above.
- The Thompson Guidelines (LEL and SEL) for both Lead-210 and Radium-226 in sediment.

The theoretical toxicity benchmarks from Thompson et al. (2005) are specific to uranium-bearing regions of Canada (e.g., northern Saskatchewan and northern Ontario). The HHERA identifies the benchmarks to be considered CNSC working reference values.

2.2.5.3 Surface Water

For assessment and reference purposes, surface water quality data is compared to the CCME Water Quality Guidelines for the Protection of Freshwater Aquatic Life (CCME, 1999, updates available online). Radionuclide results (e.g. lead-210) have been compared to the Provincial Water Quality Objectives (Ontario Ministry of the Environment and Energy, 1994).

2.2.5.4 Rock

Total concentration of metals in rock samples, determined via aqua regia digestion, are compared to Appendix 3 of Price (1997) which allows comparison of concentrations of selected metals with average crustal abundance data for similar rock types (reference Price, W.A. 1997. Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia. MEND Report).

Acid-Base Accounting results are compared to the Standard Sobek Neutralization Potential document (1978) Std Sobek Neutralization Potential - Field and Laboratory Methods Applicable to Overburdens and Minesoils, (EPA 600 / 2-78-054, March 1978) MEND Project 1.16.1b (pages 6.2-11 to 17), March 1991.

MEND Shake Flask Extraction Results for inorganics and dissolved metals are compared to CCME Water Quality Guidelines for the Protection of Freshwater Aquatic Life for both short- and long-term effects.

2.2.6 Radiological Guidance

2.2.6.1 Health Canada Guidelines

Naturally Occurring Radioactive Materials (NORM) includes radioactive elements found in the environment. This includes uranium, thorium, potassium and their decay products. NORM does not include radioactive substances included in the nuclear energy fuel cycle. As such, sites with potential exposure to NORM radiation are not under legislative control of the CNSC. Therefore, jurisdiction over the use and radiation exposure to NORM rests with individual provinces and territories.

NORM is ubiquitous in the environment and the concentration of NORM is low in most natural substances. There are, however, natural substances where concentrations of NORM may be high, or substances where concentrations of NORM are elevated as a result of human activities. Despite the fact that NORM is not part of the nuclear fuel cycle, the Federal Provincial Territorial Radiation Protection Committee (FPTRPC) recognizes that the potential radiation hazards from NORM are no different than those from radioactive materials controlled by the CNSC, and workers or members of the public should be subject to the same radiation protection standards as for CNSC regulated activities. To that end, the Canadian NORM Working Group has, on behalf of the FPTRPC, produced the *Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials (NORM)* (Health Canada, 2014). A major defining principle of the guidelines is that doses should be as low as reasonably achievable (ALARA), economic and societal factors being considered.

Radiation dose limits for incidentally exposed workers and members of the general public are based on annual effective dose (mSv), exclusive of natural background and medical exposures. The radiation dose limits for protection of incidentally exposed workers or members of the general public are set by Health Canada at 1 millSieverts (mSv) per year. Health Canada and the International Commission on Radiological Protection recommend that for incidentally exposed workers and members of the general public, that a dose constraint of 0.3 mSv per year be applied. A dose constraint is defined as an upper bound on the annual dose that members of the public or incidentally exposed workers should receive from work activity, which would allow for exposures from other sources without the annual limit being exceeded.

Derived working limits (DWLs) for gamma radiation dose rates are presented in Health Canada (2014) and have been determined based on the annual radiation dose constraints and dose limits. The DWLs provide an estimate of radiation dose from quantities of NORM that may be directly measured in the environment.

Table 2-3: Health Canada Derived Working Limits

Derived Working Limit [1]	Gamma Radiation Dose Rate[2]
Investigation Threshold – Occupational dose rate that will give an incremental gamma dose of 300 µSv/a (0.3 mSv/a)	0.15 µSv/hr
Dose Management Threshold – Occupational dose rate that will give an incremental gamma radiation dose of 1000 µSv/a (1 mSv/a)	0.5 µSv/hr

Notes:
1. DWLs are derived assuming a site occupancy factor of 0.25 (i.e. a person spends 25% of the year on site).
2. Gamma radiation dose rates are expressed as incremental dose rate above background.
µSv/hr = microSieverts/hour

2.2.6.2 Remedial Objectives for Uranium Mine Sites

While the Health Canada (2014) dose constraint is applicable to the protection of human health, the DWLs from which they are derived are based on an annual exposure duration to be protective of chronic exposure. These values are not representative of the likely exposure at a remote uranium exploration site. As such, remedial objectives for remote uranium exploration and mining sites have been developed.

Remedial objectives for uranium exploration and mining sites are derived in consideration of human site use following a risk-based approach. For example, the risk-based remediation/rehabilitation objective for gamma dose rate at the Rayrock Mine site is 2.5 micro Sieverts per hour (µSv/hr). This objective is referenced in several Rayrock mine study reports from a document titled *Short-Term Environmental Monitoring Program, Rayrock Uranium Mine*, 2000 prepared by the Low-Level Radioactive Waste Management Office for Indian and Northern Affairs Canada.

A common remedial objective for gamma dose rate at remote uranium exploration and mining sites is 1 μSv/h averaged over a 1 hectare [ha] surface area above local background, or a maximum spot dose in excess of 2.5 μSv/h above local background. This remedial objective is based on the Health Canada (2014) incremental dose threshold of 1 mSv/a and in consideration of:

- Estimated radiological health risks, in terms of excess cancer estimates.
- Typical background exposures of the Canadian public to various forms of ionizing radiation.
- The ALARA principle ("As Low as Reasonably Achievable").

The gamma radiation remedial objective has been adopted for use at several now-remediated Canadian uranium mines and mills, including Port Radium, NWT; and the Cluff Lake Decommissioning Project (CNSC, 2003) and Beaverlodge Mine sites in northern Saskatchewan and the Gunnar Site Remediation Project (RSC, 2013).

The Rayrock Project Team considers the established remedial objectives of 1 μSv/h averaged over a 1 hectare [ha] surface area above local background, or a maximum spot dose in excess of 2.5 μSv/h above local background valid.

2.2.6.3 Waste Screening

Since Rayrock is a former licenced uranium site, CNSC considers mine-generated tailings and waste rock as low level radioactive waste (LLRW) since these materials were part of the nuclear fuel cycle. These materials are not considered to be NORM. Since other Project sites (Sun Rose, satellite sites, etc.) were not historical licenced uranium production sites, waste materials such as blasted rock that may have low levels of radioactivity are considered to be NORM.

NORM-impacted waste should not be disposed of at a regular landfill if it exceeds the release limits published in the *Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials* (Health Canada, 2013). The Guidelines identify that "limits for surface radioactive contamination on equipment, tools or scrap surfaces intended for unconditional release are based on the analysis of personal radiation exposure pathways to a maximum annual dose of 0.3 mSv. Discrete NORM sources with surface contamination less than the Table 5.3 Surface Contamination Unconditional Derived Release Limits can be released without further investigation."

Table 5.3 of the Guidelines identify these Surface Contamination Unconditional Derived Release Limits for Discrete NORM Sources to be as follows:

- Dose Rate Limit: 0.5 micro-Sieverts per hour (μSv/h) at 50 centimetres (cm).
- Surface Contamination Limit: 1 Becquerel per square centimetre (Bq/cm^2) averaged over a 100 cm^2 area.

The above release limits are only applicable to fixed surface contamination. Loose surface contamination must be completely removed, or all accessible surfaces stripped to ensure complete removal; therefore, in order for waste exhibiting elevated measured equivalent dose rates to be classified as not being "contaminated" by NORM, it will have to be cleaned to remove loose surface materials and then meet the Table 5.3 guidelines.

2.2.7 Waste Management

2.2.7.1 Hazardous Waste

Hazardous waste that has been identified at the Project sites includes, but is not limited to the following:

- Asbestos and asbestos-containing materials (ACMs),
- Creosote treated wood (if encountered),
- Lead-amended paint, and
- Lead acid batteries.

For hazardous materials, the following guidelines are considered in the RAP development:

- Guideline for the Management of Waste Asbestos, published by GNWT in 2004,
- Guideline for the Management of Waste Batteries, published by GNWT in 1998,
- Guideline for Hazardous Waste Management, revised by GNWT in 2017, and
- Guidelines for the Management of Waste Lead and Lead Paint, revised by GNWT in 2017.

As identified in Section 2.3.5.3 Waste Screening, wastes will need to be screened for NORMs prior to being shipped from site to ensure appropriate transportation and disposal practices are followed.

2.2.7.2 Non-Hazardous Waste

Non-hazardous waste is any form of waste that is considered non-hazardous according to the Canadian Environmental Protection Act (CEPA). Non-hazardous debris that was encountered on the Project sites includes, but is not limited to the following:

- Wooden debris, such as structural remnants and wharf timber.
- Scrap metal, such as metal sheets, tins, pails, nails, cans, structural metal frames, steel rollers, wire and miscellaneous metal debris.
- Domestic-type materials, such as stoves, toys, milk pitchers, dishes, water jugs, bed springs, ammunition boxes, wire reels and wash basins.
- Plastic and domestic refuse.
- Wooden power poles and metal powerline.
- Miscellaneous plastic.
- Discarded barrels.
- Concrete structures.

The Mine Site Reclamation Guidelines, for the Northwest Territories (INAC, 2007) have several clauses that reflect the need to reclaim the former mine to a state that leaves the lands compatible with surrounding lands. Sites should not be left in a condition that pose a hazard to humans, wildlife or environment health and safety.

2.2.8 Waste Transportation

All hazardous material to be transported to an off-site facility must be packaged and transported in accordance with the Interprovincial Movement of Hazardous Waste Regulations under CEPA and the Transportation of Dangerous Goods (TDG) regulations. For both hazardous and non-hazardous material, should the waste be transported off site, the waste must be segregated and tested to meet the requirements of the chosen off-site disposal facility.

2.2.9 Occupational Health and Safety

All work completed at any of the Project sites must comply with the Northwest Territories Safety Act, Occupational Health and Safety Regulations and the Mine Health and Safety Act and Regulations. Given the remote nature of the project work, the project must ensure that a robust and practical Site-Specific Health and Safety Plan (HASP) is developed. Apart from remote work and other considerations, items to be included will be:

- Radiation Protection Measures: As there is known radioactivity at the project sites, precautions for gamma exposure must be taken under the Canadian Nuclear Safety Act, such as monitoring the external radiation exposure of each person on the Project sites using dosimeters. As workers wear the dosimeters, the gamma exposure levels are measured and then can be compared to the maximum exposure levels for non-nuclear energy workers in the Radiation Protection Regulations. Additional radiation protection measures will need to include the designation of qualified Radiation Safety Officer and the development of a comprehensive Radiation Protection Plan
- Additional safety precautions required by CNSC are detailed in the site's CNSC WNSL. Depending on the works required, a Radiation Safety Officer will need to be designated by the remediation contractor to monitor worker radiation exposure duration and intensity. Heightened attention will be required for personnel working at Mill Lake and on the TCAs, waste rock and exploration workings.
- Asbestos Protection Measures: The Asbestos Safety Regulations set the requirements for any work with materials containing asbestos. The Workers' Safety and Compensation Commission (WSCC) Asbestos Abatement Code of Practice provides current standards for work involving asbestos materials in the NT and must be complied with on the Project sites. This includes that only workers with asbestos removal training and qualifications can participate in asbestos abatement, which includes demolition, renovation, or salvage work where asbestos is present.
- Weather/Temperature Effects: Workers at the site will have the potential to be exposed to hot and cold weather effects. Cold weather impacts will be obvious given ambient temperatures; however, heat exhaustion given the physical labour that will be required and the potential that workers may be in protective clothing (e.g., Tyvek suits) will have a strong effect with respect to heat and hydration.
- Ice Safety: Ice safety will be a priority for work activities at Mill Lake and winter road works.

Contractors working on the Project will be required to prepare a Project-Specific HASP that complies with the applicable NT acts and regulations as well as CIRNAC's HASP requirements.

3. Project Environment

3.1 Site Overview and History

3.1.1 Rayrock Mine

3.1.1.1 Rayrock Mine

Rayrock is a former underground uranium mine located approximately 145 kilometres (km) northwest of Yellowknife, NT, along the western edge of the Marian River Fault. The Kwetıı̨ʔaà (Rayrock) mine is situated on Tłı̨chǫ traditional territory and is surrounded entirely by Tłı̨chǫ Lands per the Tłı̨chǫ Comprehensive Land Claim Agreement.

The main mine site was located along the southwestern shore of Mill Lake (Shìzìtìwhetǫ), a water body perched along the side of the fault known as the Marian River Fault. Mill Lake drains via Mill Creek and subsequently into Kwetsǫ̀tìa (formerly known as Jan's Pond) and Sherman Lake. Other proximate water bodies include Alpha, Beta, and Gamma Lakes and Lake A, as shown on **Figure 2 (Appendix A)**.

The Rayrock mine is located in a designated area of Crown land referred to as a Crown Land exclusion zone within the larger Tłı̨chǫ CLCA. This exclusion zone, shown on **Figures 1 and 2 (Appendix A)**, was excluded from the Agreement due to the impacted lands associated with the former mine site. The co-ordinates of the four corners of the exclusion zone are:

- Northwest: 63° 27' 54.200" N, 116° 34' 45.983" W
- Northeast: 63° 27' 53.515" N, 116° 31' 08.906" W
- Southwest: 63° 25' 43.168" N, 116° 34' 47.904" W
- Southeast: 63° 25' 42.487" N, 116° 31' 11.102" W

As identified, the Rayrock mine site is regulated by the CNSC and licenced to CIRNAC-CARD under a Waste Nuclear Substance Licence. Under current regulatory requirements, the site is expected to be licenced by CNSC as long as residual radioactive materials remain at the site.

Milling operations commenced in June 1957 and the mine closed in July 1959 (Silke, 2009). During operation, the mine produced 207,754 kilograms (kg) of uranium concentrate powder and discharged 70,903 tonnes of tailings into two areas, now known as the North and South Tailings Containment Areas (TCAs) (CIRNAC, 2019a).

Approximately 135 employees plus associated family members were stationed at the mine site during its operation. Site infrastructure included the main mine buildings (crushing plant, mill, conveyor systems), various machine shops and warehouses, as well as a "town site" with residences, a cook house, a small schoolhouse and a recreation room. Electricity to the mine was supplied via a power line from a hydroelectric plant on Big Spruce Lake.

Prior to, and during mine development, Tłı̨chǫ people and their families camped and traveled through the mine area. The Tłı̨chǫ Government has identified that Elders recall living at the mine and at camps along Kwetı̨ı̨ʔaàtì (Sherman Lake).

The following photos (Plates 1 and 2) illustrate site development in 1956 and 1957. Plate 3 is a recent (2018) photo of the former Mill Site and Mill Lake. Of note in the review of Plates 1, 2 and 3 is that the water levels in Mill Lake from the 1950s appear similar to that of today. **Figures 3, 4 and 5 (Appendix A)** illustrate current site conditions and features.

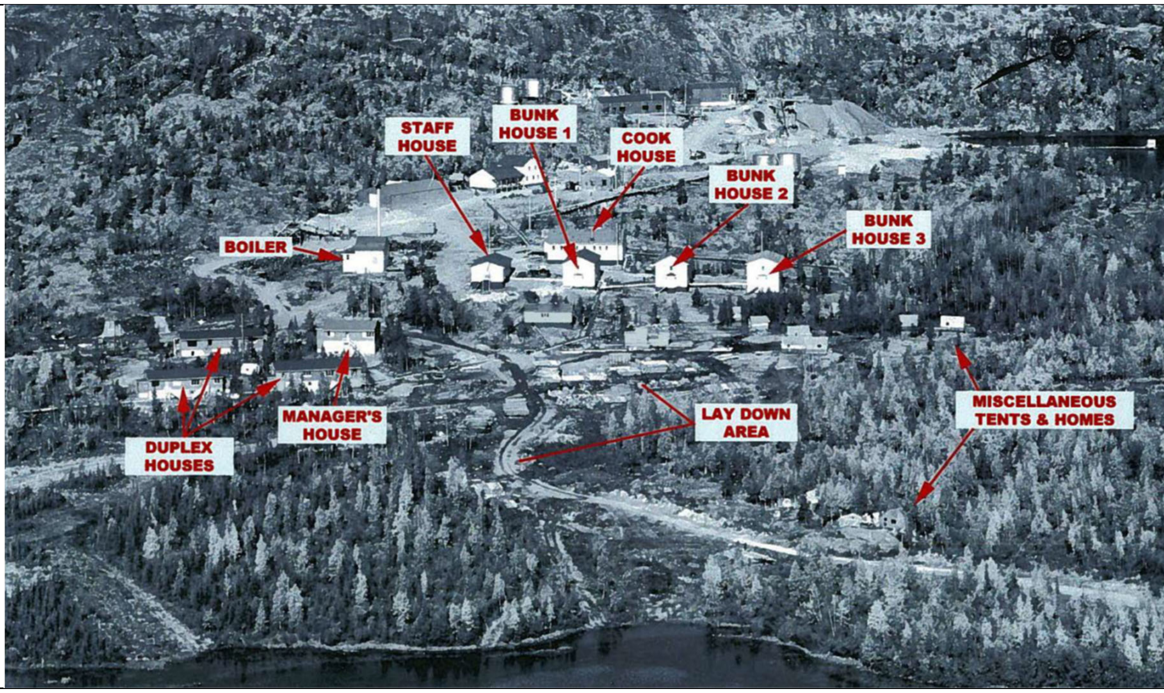

Plate 1: Aerial View of Camp Site, circa 1956 (SENES, 2010)
Note: Mill Lake is located to the top right of the photo, Sherman Lake is in the foreground

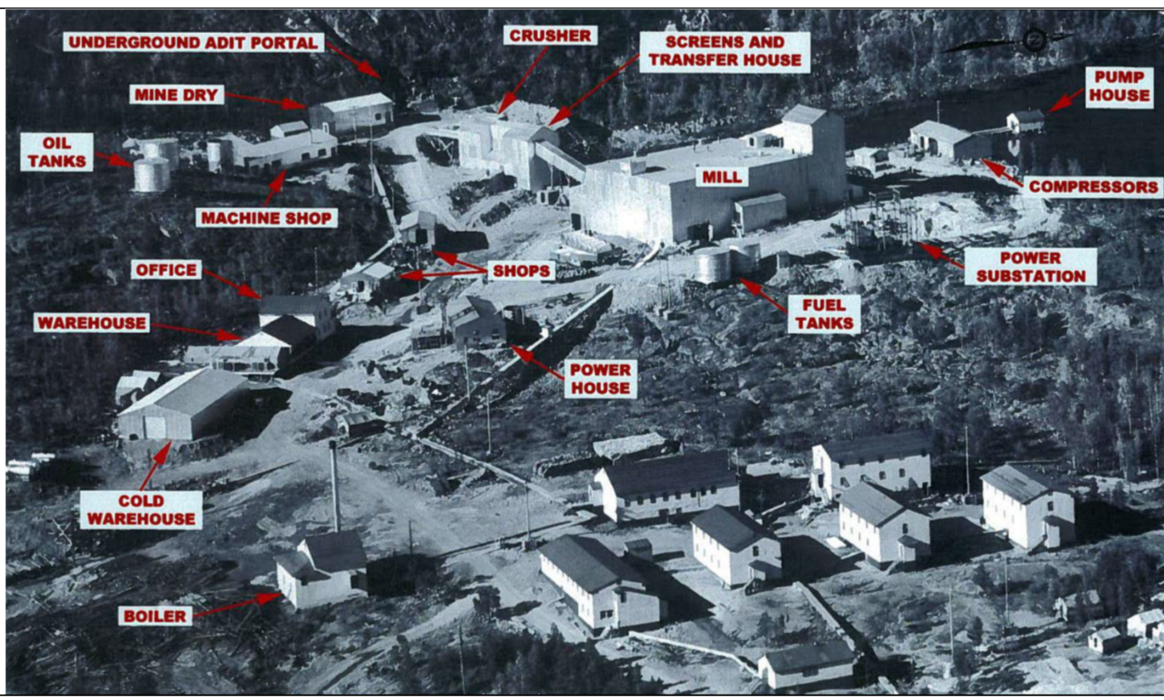

Plate 2: Aerial View of Main Mine Site, circa 1957 (SENES, 2010)
Note: Mill Lake is located to the top right of the photo

Plate 3: Aerial View of Mill Lake, 2018
View looks northeast with the Marian Ridge located to the left of Mill Lake. The former mill foundation is visible in the foreground. The outlet of Mill Lake, where it drains to Mill Creek and subsequently to Sherman Lake is shown by the red arrow.

The Conceptual Site Model for Rayrock (CIRNAC, 2019a) identifies that building demolition occurred in 1987, reportedly by DIAND. No records are available for the work completed.

Site remedial activities completed by Public Works and Government Services Canada (PWGSC) in 1996 included:

- Placement of waste, including drums, into the south TCA and capping the two TCAs with 900 millimetre (mm) of silty-clay soil obtained from the former air strip and a North Borrow Area, placement of 100 mm of a growth medium (peat and silt loam) atop the silty clay cap and revegetation of the cap.
- Armouring drainage courses on the TCAs with waste rock.
- Regrading of waste rock.
- Closure of the site dump, which included the removal and consolidation of debris and the covering of the waste dump with 1.0 metre (m) thick of silty clay.
- Sealing of the mine raises, vents and adit (PWGSC, 1997). Mine opening locations are shown on **Figure 4, Appendix A**.

Additional work conducted by PSPC in 1999 included conducting repairs on the TCAs, including surface grading and armouring drainage courses using waste rock obtained from the mine site (PWGSC 1999).
Subsequent site stabilization activities in 2015 and 2016 included widening the existing trail network to their original footprint, installing a dock in Sherman Lake for float plane access and collecting and consolidating hazardous and

non-hazardous debris. Hazardous material at site, ACMs and lead-amended painted materials, was segregated and stored in wooden crates on-site. Creosote-treated wood remains to be collected at site. Non-hazardous material, including scrap metal, drums, wooden debris and domestic-type debris, was sorted into discrete open piles (i.e., not covered).

Current (2020) site features include concrete foundations at the former mill and camp area, the two TCAs, an on-site waste dump, two former borrow areas, a former airstrip, a trail network connecting Rayrock to two satellite sites, and a former powerline leading to a hydroelectric station at Big Spruce Lake.

On the southeastern shore of Sherman Lake, there is a second camp known as the Sherman Lake Camp Site, which housed Tłı̨chǫ mine and support staff and their families **(Figure 5, Appendix A)**. This site has been assessed as an ancillary site to Rayrock, and was found to have non-hazardous debris scattered across the site, including wooden building frames, domestic-type debris (such as food cans, toys and stoves), drums (some containing unknown liquids), pails, tar paper, ammunition box, wash basins, cable and roof shingles that may be asbestos-containing.

Numerous environmental investigations have occurred at Rayrock in recent years. These investigations have identified impacts in various media across the site, including impacted soil, sediment and water; spilled tailings; non-hazardous debris; hazardous debris and physical hazards. As many of the environmental issues at Rayrock are associated with radioactive materials, gamma surveys have been utilized to delineate impacts and to monitor the effectiveness of containment structures. **Table C1** in **Appendix C** of this report provides a listing of historical investigation reports for the site.

3.1.1.2 Rayrock Powerline (Within Exclusion Zone)

A former 30 km powerline extends from the Rayrock site to a hydroelectric station at Big Spruce Lake. Approximately 2 km of the 28 km powerline is located within the Exclusion Zone. **Figure 6 (Appendix A)** shows the approximate location of the Rayrock Powerline.

Power poles are suspected of having been treated with wood preservative chemicals at the Barge Landing prior to installation along the corridor (unverified).

During a July 2018 helicopter reconnaissance of the corridor, it was noted that most of the power poles and line appeared to have been cut down, and that wire and some localized areas of debris were visible from the air. The terrain along the powerline route was rolling and vegetation overgrowth obscured the ability to easily identify the line location in some spots. Power poles were identified lying down in various states (cut-up or still whole) along the north/south main line. Two additional standing poles were located at approximately 50 to 80 m to the east of the main transmission line, suspected to be associated with another (second) powerline corridor. Various non-hazardous debris (stove, loose wire and wire reels) were slightly visible from the air during the helicopter reconnaissance; however, an estimation of the amount of the debris was not possible from the air. Some powerline wire may have been removed along portions of the powerline. Twelve power poles were located along the transmission path, including the identified two poles to the east of the main transmission line.

Two additional power poles were located to the east of Kwetsǫ̀tìa during the ground evaluation and mapping of Mill Creek. The identified power poles were standing upright and set into the bedrock. There was blast rock around at least one pole that was recessed into what appeared to be a blast hole. Based on the direction of the poles, the line ran from Sherman Lake shore to the northwest and intersected the main transmission line running from Mill Lake to the Snare River hydroelectric plant.

3.1.1.3 CA Satellite Site

The CA satellite site is located to the southwest of the Rayrock mine, as shown on **Figures 1 and 7 (Appendix A)**. A direct road to CA exists as a spur road off the main road leading to the former airstrip. CA is located within the Rayrock exclusion zone, considered part of the Rayrock mine site, and is accessible by all-terrain vehicles (ATVs).

Arcadis (2016b) identified no historical documents to be available for review relating to CA. Their report identified that exploration of CA occurred in 1955, the same time as the Rayrock Mine. It was unknown if further exploration or development occurred at CA.

The CA site is located within the depression of the Marian trench south of the Rayrock site. Inspections of CA in 2016 (Arcadis, 2016b) and 2018 (AECOM, 2019a) revealed the site to be covered with sparse trees intermixed with a landscape that resembled a quarry or aggregate stockpile including small stockpiles of stones. An old bridge that connected the road from the main Rayrock mine to the aggregate area was present. High rock ridges are present to the north and south of CA. Uneven rock and trees are located east of the site. No evidence of staining or stressed vegetation were observed by field personnel during the site visits.

3.1.2 Sun Rose Claim Group

The Sun Rose Claim Group is located on the northern side of Chico Lake, approximately 35 km north of Behchokǫ̀ **(Figures 1 and 8, Appendix A)**. The Group is divided into three areas: Rose, Sun East and Sun Main. Sun Main and Sun East, located adjacent to each other, was an advanced exploration site which included a two-compartment shaft and a complete mining plant at Sun Main; however, due to a fire that burnt down the power plant in 1956, the facility never went into production. A forest fire burned down remaining buildings in the 1970s and the site was remediated in the 1980s (Silke, 2009).

Historical exploration activities at the Sun Main, Sun East and/or Rose exploration properties have consisted of diamond drilling, geochemical sampling (sediment and water), bedrock mapping, radiometric and ground geophysics, trenching (hand/blasting) and underground development (Rescan, 2006). Each of the three exploration properties is represented by a separate Showing ID in the Normin Database, though, as identified, Sun Main and Sun East are co-located with no differentiating geographic coordinates separating the two having been formally identified during recent environmental investigations. Rose, located approximately 3 km to the north-northeast of Sun Main, was an exploration site that was never developed to include any infrastructure or underground mining.

Further details respecting the historical exploration activities at the Site are summarized in **Table 3-1**.

Table 3-1: Summary of Historic Exploration Activities

Working	Development	Activities
Sun Main	Advanced Exploration	Diamond Drilling Geochem Sampling - Sediment Geochem Sampling - Water Bedrock Mapping Geophysics - Radium (Alpha Particle (e.g., Radon Cups)) Geophysics - Radiometric Trenching - Hand/Blasting Underground Development

Working	Development	Activities
Sun East	Advanced Exploration	Diamond Drilling Geochem Sampling - Sediment Geochem Sampling - Water Bedrock Mapping Geophysics - Radium (Alpha Particle (e.g., Radon Cups)) Geophysics - Radiometric

Note: Above table adapted from Rescan, 2006 Table 2-2 (data obtained from NORMIN database, 2005)

The combined Sun Main and Sun East site is approximately 15 ha in area, consisting of the ruins of burned down structures, waste rock, and miscellaneous scattered metal debris. The site is adjacent to the winter road route between Marian Lake and the Snare Hydro junction. This route was also used for a brief time as an all-weather road to the Rayrock Mine. Current access to the property is by helicopter or float plane. Remnants of historical roads or trails remain at Sun Main/Sun East; however, these trails have been overgrown with vegetation at many locations.

Site remediation activities have included placement of a temporary cap on top of the mine shaft. A perimeter fence was further erected around the shaft opening, likely at the same time as temporary cover placement. The date of these activities is unknown; however, they may have been undertaken during the referenced 1980s remediation (Silke, 2009). Currently, Sun Rose claims are active until 2023.

The Sun Main/Sun East site is located within the Crown Land Exclusion zone within the larger Tłı̨chǫ Comprehensive Land Claim Agreement. The lands are currently managed by CIRNAC-CARD. The approximate co-ordinates of the four corners of the Sun Rose exclusion zone are as follows:

- Northwest: 63° 08’ 08.65” N, 116° 20’ 47.15” W
- Northeast: 63° 07’ 56.54” N, 116° 18’ 21.56” W
- Southwest: 63° 07’ 07.46” N, 116° 21’ 16.57” W
- Southeast: 63° 06’ 53.59” N, 116° 18’ 56.90” W

The Sun Main/Sun East site is characterized by a steeply sloped dome-shaped bedrock outcrop (Plate 4), with smaller ravines and valleys throughout the outcrop. The site is approximately 5 ha in size, and can be divided into four areas:

- The shaft and tank area, consisting of the enclosed shaft and some wood debris around the former tank location.
- A central waste rock dump to the north of the shaft.
- Former exploration pits to the southeast of the shaft.
- A former camp area and dock approximately 1 km to the southwest of the main mine site along the north shore of Chico lake.

There are no on-site buildings. Various non-hazardous waste items including drums, wood debris and some metal debris are located in the vicinity of the former camp and former oil tank areas.

Plate 4: Dome-shaped bedrock outcrop at Sun Main/Sun East

Sun East is located to the southeast of Sun Main and essentially comprises the east side of the bedrock dome referenced above. Features at Sun East include the former camp area, a dock on the shores of Chico Lake, four identified explorations workings (small trenches advanced to expose unweathered bedrock) and piles of blast rock (shown in further detail on **Figure 9, Appendix A**).

3.1.3 Ancillary Sites

3.1.3.1 Horn Plateau – REX

The former Horn Plateau – REX Showing (SM371) uranium exploration site is located approximately 19.5 km southwest of Rayrock, along the Marian River Fault and on the southeastern shoreline of Sheldon Lake as shown on **Figures 1 and 10 (Appendix A)**. Geographically, the property is not associated with the Horn Plateau, despite its name, and is therefore also referred to as the REX Showing (Columbia, 2013).

No access roads exist for REX. Access is by helicopter, or boat in the summer or over ice via snowmobile or ski equipped aircraft in the winter. Sheldon Lake may be too small and shallow for float equipped fixed-wing aircraft.

Exploration activities began at REX in 1948 with the staking of mineral claims. Diamond drill holes were advanced on the main showing in 1956. In 1974, additional claims were staked over the property, with trenching activities reported. Uranium mineralization at this property occurs in hematite stained quartz and pitchblende deposits associated with the Marian River fault and fractures at Sheldon Lake. Exploration details were identified to be vague, with no further works reported (Columbia, 2013).

The REX area is surrounded by small ponds and marshlands to the east of the ridge, and by Sheldon Lake to the west of the ridge. There are no drainages identified within the Site itself, but a small intermittent stream is noted at the south end of Sheldon Lake, draining to the marsh to the east. Tree growth is sparse and consists of tamarack, birch, and dwarf spruce (Columbia, 2013).

Unconsolidated surficial soils at the exploration showings were limited to small pockets of thin soils over bedrock, generally consisting of dark silty sands. At the former REX campsite the soils were observed to be highly organic silty sands in between muskeg and sphagnum moss near the shoreline of Sheldon Lake.

The property consists of three primary areas:

- A campsite on the shoreline of Sheldon Lake.
- The Southern Exploration Workings located to the south of the camp.
- The Northern Exploration Workings (historically referred to as the “Main Showing”) north of the camp.

The exploration workings are areas of excavated bedrock created during site exploration with the intent of exposing unweathered geologic material.

3.1.3.2 Horn Plateau – GS Satellite Site

The GS satellite site is located approximately 3.6 km northeast of Rayrock on the southeast side of the Marian River Fault and on the northwest shore of GS Lake **(Figures 1 and 11, Appendix A)**. The site is characterized as undulating bedrock with sparse vegetation (burnt/dead trees, mosses and lichens).

Few historical documents have been identified for review that relate to the history of GS. Exploration diamond drilling occurred at the site in 1955 and 1956. Other activities at the site included airborne and ground geophysics and rock sample collection. It is unknown if further exploration or development occurred at GS.

3.1.3.3 Rayrock Powerline (Outside Exclusion Zone)

The former powerline is described in Section 3.1.1.2. Approximately 26 km of this 28 km powerline is located outside of the Exclusion Zone **(Figure 6, Appendix A)**. Abandoned wire, power poles and localized areas of debris are present along this length of line.

3.1.3.4 Barge Landing

During mining operations, a barge landing along the northeastern shore of Marian Lake was constructed to transport uranium from Rayrock to Port Hope, Ontario for refinement. An all-season road from Rayrock to the barge landing was constructed to truck the uranium product throughout the year without relying on winter road access. Use of the barge landing ceased once operations at Rayrock ended. The locations of both the barge landing and the all-season road are shown on **Figure 1, Appendix A**. A site plan of the barge landing is provided as **Figure 12, Appendix A**. Plates 5 and 6, below illustrate the change in site conditions between 1956 and 2018.

The barge landing is currently overgrown with trees and brush. Bedrock outcrops are present in the area and along the shoreline. No buildings or structures are present. Recent environmental investigations completed at the barge landing have identified the presence of non-hazardous debris (drums, scrap metal, metal cans, dock anchors, wharf timber, wooden skids and gasket material) and a minimal amount of hazardous material (used vehicle batteries) (Arcadis 2017b, AECOM, 2019a).

Plate 5: Southern End of All-Weather Road at Navigation terminal on Marian Lake, 1956 (CIRNAC, 2019a)

Plate 6: View of Barge Landing from Helicopter (2018, AECOM)

3.1.3.5 MK Satellite Site

The MK satellite site is located approximately 3.6 km southeast of the former Rayrock mine along the Marian River Fault (**Figures 1 and 13, Appendix A**). The site is characterized as having undulating bedrock with limited/sparse vegetation intermixed in the rock (few trees, mosses and lichens). The site, being located on the fault, is at an elevation significantly higher than proximate lands.

Limited historical documents are available for review that relate to MK. Exploration of MK occurred in 1955 at the same time as exploration of the Rayrock Mine. Exploration activities included the advancement of 24-26 diamond drill holes and rock sampling. It is unknown if further exploration or development occurred at MK. The majority of MK comprises bare rock ground surface with lines of pine trees intermixed in the rock.

3.1.3.6 TED Satellite Site

TED is located at the southeast side of Treasure Lake, approximately 5.5 km no-northwest of the Rayrock mine. The site is located in a somewhat dense pine forest (**Figures 1 and 14, Appendix A**). To the west the landscape slopes up towards the peak of a large hill.

Like the other satellite sites, few historical documents are available for review that relate to the site. Exploration at TED likely occurred between 1953 and 1956. A former camp area containing at least one burnt structure is located on bare rock surrounded by the forest.

3.1.3.7 All-Season Road

The former all-season road is no longer in operation, though portions of this former road are currently used as part of the alignment of the Tłı̨chǫ Winter Road system. The location where the current Tłı̨chǫ winter road leaves the ice of Marian Lake to go overland is located approximately 3 km northwest of the Barge Landing. The Barge Landing is not located on the current Tłı̨chǫ winter road route and the section of road between the landing and the winter road is overgrown. The Tłı̨chǫ Government will continue to use the Tłı̨chǫ winter road system in the future subsequent to the Rayrock site remediation." Plate 7 is an historical photograph of the all-weather road from 1955.

Plate 7: Rayrock All-Weather Road at Marian Lake, Photo Date Not Available (CIRNAC, 2019a)

3.2 Physical Environment

3.2.1 Ecoregion

The Project sites are located in the Taiga Shield High Boreal Ecoregion. This area is described as a gently sloping bedrock plain with silty discontinuous till and lacustrine deposits between bedrock outcrops. Between the rock outcrops, mixed conifer and deciduous forests are present which consist of black spruce, jack pine and paper birch. Shallow bays, marshes, lakes, and peat plateaus are also common features in this ecoregion (Ecosystem Classification Group (ECG), 2008).

The Taiga Shield High Boreal Ecoregion has short, cool summers followed by cold winters. The annual mean temperature ranges from -3˚Celsius (C) to -6˚C. The coldest month is January, with an average temperature ranging from -26˚C to -28˚C, while June is the warmest month, with an average temperature ranging from 15˚C to 16˚C. This ecoregion experiences an annual precipitation ranging from 280 to 360 millimetres (mm), with approximately half of the precipitation as rain and the other half as snow (ECG, 2008).

Climate statistics are not available specifically for the individual Project sites; however, the following table provides an indication of climate averages for locations relevant to the project site. Weather information is beneficial to the Project in assisting with the planning of field work and site operations.

Table 3-2: Regional Climate (Weather) Data

Aspect	Location	J	F	M	A	M	J	J	A	S	O	N	D	Years
Temperature Average Temperature (°C)	Yellowknife[1]	-26	-22	-16	-5	+5	+14	+17	+15	+8	-1	-11	-21	1992-2017
	Whati[1]	-26	-20	-19	-6	+6	+14	+17	+13	+7	-3	-12	-23	1994-2017
	Rae Lakes (Behchokǫ̀)[1]	-26	-23	-17	-4	+6	+14	+18	+15	+7	-2	-14	-23	2004-2017
Average Precipitation (mm)	Yellowknife Airport[2]	14	14	14	11	18	29	41	39	36	30	25	16	1981-2010

Notes: [1] ftp://ftp.ncdc.noaa.gov/pub/data/noaa/

[2] http://climate.weather.gc.ca/climate_normals/results_1981_2010_e.html?stnID=1706&autofwd=1

3.2.2 Geology/Geomorphology

3.2.2.1 Rayrock

The geology encountered at the Project sites is consistent with its ecoregion: bedrock outcrops with occasional deposits of till and lacustrine material. Bedrock is composed of metamorphosed dolomites intruded by porphyritic rocks and have compositional variations that are emphasized by weathering (Arcadis 2017c). A number of faults occur in the vicinity of these sites including the primary one of relevance to this assignment, the Marian River Fault.

The overburden consists of discontinuous lacustrine and till deposits. Till found at the sites consist of poorly-sorted silt to gravel and are usually less than 2 m thick. The lacustrine deposits are sand and gravel deposits of variable thickness at various locations across Rayrock and may be a result of the Glacial Lake McConnell (Arcadis 2017c). Silty clay soils are available in low-lying areas in the vicinity of the mine site. With a predominance of exposed bedrock at grade, there are few potential borrow areas at the Rayrock site due to the limited amount of overburden soil.

3.2.2.2 Sun Rose Claim Group

The topography at Sun Main/ Sun East is characterized by steep slopes of bedrock outcrop, interspersed with ravines and valleys and surrounded by low lying areas of a thin veneer of soil, peat and muskeg (i.e., lowlands). The elevation of the Sun/Rose exploration site was reported as approximately 600 metres above sea level (masl) (Franz 2013a, AMEC 2015a).

Much of the terrain around the Sun/Rose Mine site is generally moderate relief with low ridges found throughout the site. Local terrain consists mainly of bare rocky outcrops with intervening muskeg flats, glacial deposits and talus slopes. In general, the ground slopes towards the perimeter of the bedrock dome. Slopes are generally moderate (> 5 degrees), except for the margin of bedrock outcrop areas where steeper slope sections exist, such as in the northwest and eastern portions. The location of the highest elevation is south of the exploration pits at the peak of the bedrock dome (Franz 2013a).

Surficial geology of the site consists of the following stratigraphy units; (a) surficial topsoil (organic), (b) shallow native soils (coarse sands and silts to silty clay) and (c) bedrock (outcropping and assumed depths at investigated borehole locations). The surficial topsoil consists of sand, gravel and organic-rich peat material. The underlying native soil typically consists of coarse sand and silty sand to silty clay underlain by bedrock. At discrete locations, gravelly sands were reported to be encountered at the bedrock interface.

The geology of Sun/Rose Exploration site is described by Ryan Silke (2012), as follows:

"Sun/Rose Mine site is within the Bear Geologic Province and is underlain by Precambrian rocks consisting of an andesite volcanic/feldspar porphyry, granite, and a quartz stockwork, the principle host for radioactive mineralization. The controlling regional structure is the Chico Fault (striking N15ºE), which permitted the intrusion of the original rocks by the quartz stockwork. This stockwork is 600 feet wide and bounded on the west side by the fault."

"A stockwork is defined as a mineral deposit consisting of a three-dimensional network of planar to irregular veinlets closely enough spaced that the whole mass can be mined" (Bates and Jackson, 1984). According to Silke, the large hill in the centre of the site was characterized as follows in the Northern Miner (1954): *"The mineralized zone outcrops on the top of a prominent hill on the north side of Chico Lake. This hill is composed of a large quartz stockwork, which rises about 250 feet above the surrounding terrain. The hill is approximately 3,600 feet long and 200 feet wide".*

The quartz formation is referred to as the principle host for radioactive mineralization, and the site was explored as a prospect for uranium mining in the 1950s through the 1970s. The property was characterized as having low uranium levels in the 1970s; however, no further exploration records for the site were found during Silke's review (AMEC 2015a).

3.2.2.3 Horn Plateau - REX

The REX geology is described in Columbia, 2013. *"The Rex Showing is located within the Bear geological province and is dominated by the Marian River fault and subsidiary fault lines. The bedrock surrounding the Marian River fault and Sheldon Lake at this location consists of even grained granodiorite and quartz monzonite stock works along the main and subsidiary faults (McGlynn 1968).*

Minor uranium mineralization is associated with veins of specular hematite which occupy fractures within the porphyry and quartz stock work, with some silicification at the contacts of granite and quartz. The exploration workings were reported to contain narrow hematite filled fractures with weak radioactivity (Silke 2012).

Host rock observed on-site consisted of highly fractured granodiorites with large quartz veins and small stringers at the main showing, and small hematite stringers with minor sulphide mineralization at the southern explorations."

3.2.2.4 Ancillary Sites

The physiology of the other project sites (Rayrock Powerline, satellite sites, Barge Landing) is consistent with that of Rayrock, Sun Rose and REX. The locations are characterized by bedrock outcrops with occasional deposits of till and lacustrine material. Bedrock is composed of metamorphosed dolomites intruded by porphyritic rocks, and have compositional variations that are emphasized by weathering (Arcadis 2017c).

The overburden is very limited in thickness at the ancillary sites and at many locations a large portion of the sites are characterized as being only exposed bedrock. Silty clay soils are expected to be present in low-lying areas.

3.2.3 Hydrology

3.2.3.1 Rayrock

Surface water drainage occurs as sheet flow, rivulets, streams, creeks, and lakes. The sheet flow occurs over the bedrock outcrops until it accumulates in low areas, which in turn become rivulets, streams, and creeks that drain into depressions, creating lakes. The table below summarizes the lakes in the vicinity of Rayrock.

Table 3-3: Lakes Associated with Rayrock Project Sites

Lake	Inflow Route	Outflow Route
Mill Lake	Sheet flow	Sherman Lake via Mill Creek
Gamma Lake	Sheet flow and groundwater flow from Dump and South TCA	Lake B via creek
Beta Lake	Sheet flow and groundwater flow from North TCA	Alpha Lake via creek
Kwetsǫ̀tìa	Channel flow from Mill Lake via Mill Creek branch	Sherman Lake via Mill Creek branch
Alpha Lake/ Sherman Lake	Channel flow from Mill Lake, Kwetsǫ̀tìa and Beta Lake via creeks; Surficial runoff from North TCA	Lake A via creek
Lake A	Hydraulically connected to Alpha Lake/ Sherman Lake	Lake B via creek

The lakes in the above table drain into the Mackenzie River Watershed which ultimately discharges to the Arctic Ocean. At Rayrock, the surficial flow of water is generally towards Sherman Lake. In 2017 a hydrology study was conducted at Rayrock, which included various flood studies. Mill Lake connects to Sherman Lake via Mill Creek, which splits into two routes: one that drains directly into Sherman Lake, and one that flows through Kwetsǫ̀tìa before draining into Sherman Lake. The lake locations associated with Rayrock are shown on **Figure 2, Appendix A**. Further information on the hydrology study can be found in the Hydrologic Study of Beta and Gamma Lakes (Arcadis, 2016c) and the 2017 Data Gap report (Arcadis, 2018c).

The surface water elevation of Mill Lake is approximately 34 m higher than that of Sherman Lake. This elevation difference is important to the conceptual remedial strategy. Mill Lake is perched on the south side of the Marian River Fault with a precipitation catchment area (watershed) of approximately 33 ha. Reference elevations are approximately as follows:

Table 3-4: Relative Mill Lake and Sherman Lake Elevations

Location	Elevation	Elevation Difference
Top of Marian River Fault (A)	315 masl	
		100 m (A to B)
Mill Lake Surface Water (B)	215 masl	
		34 m (B to C)
Sherman Lake Surface Water (C)	181 masl	

The following plates illustrate the relative size and surface topography of the Mill Lake area.

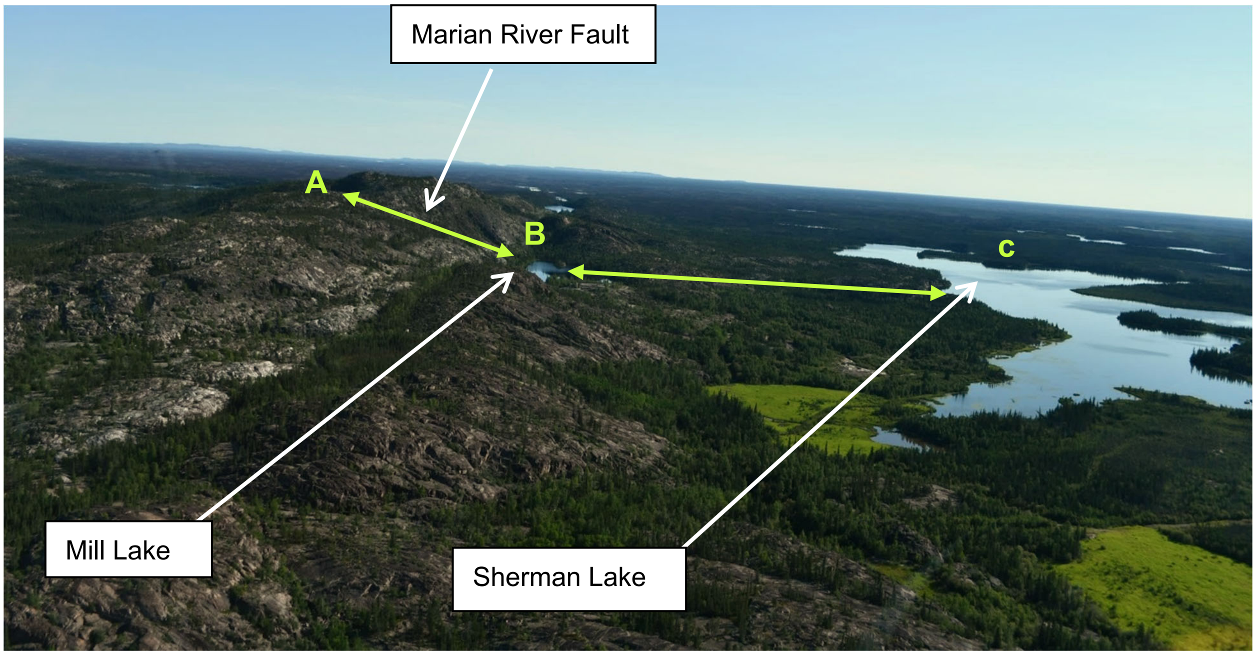

Plate 8: This photo, looking northeast illustrates the position/location of Mill Lake relative to the Marian River Fault (to the left) and Sherman Lake (to the right).

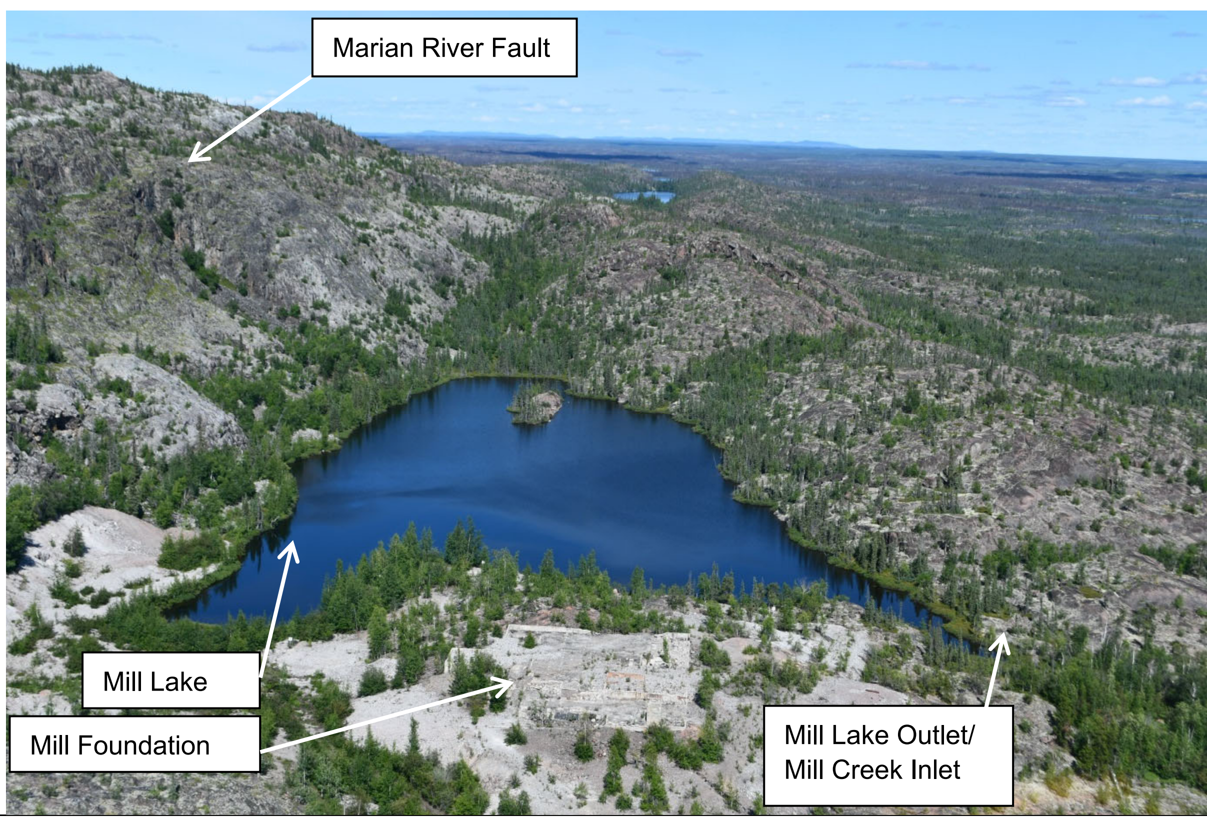

Plate 9: This photo, looking northeast illustrates the position/location of Mill Lake relative to the Marian River Fault (to the left) and the outlet to Mill Creek (to the right).

Mill Lake is a small perched headwater lake with no inflow channels. Inputs to the Lake appear to be limited to meteoric inputs to the catchment area (precipitation) and surface runoff reporting the lake. There are no known water flows (e.g., creeks, streams) entering this catchment area apart from what will accumulate in low-lying areas between the folded bedrock. A conceptual cross section showing the flow from Mill Lake to Sherman Lake is provided as **Figure 15, Appendix A**.

Site Hydrology is further discussed in the following reports:

- Hydrologic Study of Beta and Gamma Lakes, Rayrock Mine, Northwest Territories, Arcadis Canada Inc., March 30, 2016
- Delineation of Contamination of Mill Lake and the Associated Drainage Area, Former Rayrock Mine, Northwest Territories, Arcadis Canada Inc., January 13, 2017
- Hydrogeologic Study, Rayrock Mine, Northwest Territories, Arcadis Canada Inc., March 29, 2017
- Rayrock Freshet Observations and Data Collection Program, Arcadis Canada Inc., October 31, 2017

3.2.3.2 Sun Rose Claim Group

Five main surface water bodies exist on Site located around the bedrock dome; Northeast Pond, East Lake, Chico Lake, Background Lake and Northwest Pond as shown on **Figure 9, Appendix A**. Additional small depressions (likely seasonal) containing water can be found in the area. Site hydrology is described in the AMEC Phase III ESA (AMEC, 2015a) as follows:

"Overland flow from the main portion of the Site (i.e., former exploration area) would follow the slope of the bedrock to the low lying areas where it would either continue as overland flow into NW Pond and/or infiltrate into the ground, depending on the magnitude of actual flows; some of this overland flow would be directed toward NE Pond as well. The portion of the Site on the south side of the bedrock dome would contribute overland flow and/or subsurface flow from infiltration to Chico Lake."

A detailed study of the surface water hydrology at Sun Rose has not been completed. A review of aerial photos does not identify clear connectivity (e.g., streams) between the water bodies. However, given the relatively flat, marshy landscape there may be some minor hydraulic connectivity.

3.2.3.3 Horn Plateau - REX

The REX hydrology is described in Columbia, 2013. *"Based on a review of the local topographic contours and visual observations, overall surface flow is anticipated to run west from the campsite into Sheldon Lake; and east from the southern explorations, and southeast from the northern explorations on the ridge to the down gradient marsh. Sheldon Lake appears to drain into the vast marshland located to the east at a lower elevation."*

3.2.3.4 Ancillary Sites

The physiology of the other project sites (Rayrock Powerline, satellite sites, Barge Landing) is consistent with that of Rayrock, Sun Rose and REX. The locations are characterized by bedrock outcrops with occasional deposits of till and lacustrine material.

- Horn Plateau – GS: Surface water is expected to primarily flow to the southeast as sheet flow over bedrock and into GS Lake, located adjacent to the site.

- Rayrock Powerline (Outside Exclusion Zone): The powerline traverses rolling Canadian Shield bedrock in many places with little to no overburden soil. Surface water flow will be along the topographic gradients ultimately discharging to the numerous small lakes and streams in the area.

- Barge Landing: The Barge Landing is located on a peninsula of land into Marian Lake. Surface water flow will be overland and directly into Marian Lake.

- MK: MK is located high atop outcropping bedrock on the Marian River Fault. Surface water will flow radially over the bedrock towards low lying areas. A small lake/pond is located 250 m to the north of MK and the Marian River is located approximately 500 m south of MK. Surface water could eventually reach these surface water bodies.

- TED: TED is located at the southeast side of Treasure Lake. Surface water will flow along the bedrock gradients and into Treasure Lake.

3.2.4 Hydrogeology

3.2.4.1 Rayrock

A hydrogeological assessment of Rayrock was completed in 2017, which involved completion of a LIDAR survey, site visit, and hydrologic model (Arcadis, 2017c).

Bedrock within the mine site area generally slopes in a southeasterly direction towards Sherman Lake. However, this bedrock undulates significantly and is characterized by numerous “highs” with exposed bedrock and “lows”, typically filled with a thin veneer of overburden soil (lacustrine clay or glacial till).

A continuous overburden aquifer is not present at the site due to the undulating bedrock disturbances which isolate pockets of the overburden soil. Groundwater contained within this overburden will typically flow in the downgradient direction of the specific topography or vertically towards the bedrock surface, where again, the water will typically flow downgradient over the bedrock surface or into the bedrock if fractures or fissures facilitate infiltration. Given the low porosity of the bedrock, groundwater flow over the bedrock surface is expected to prevail.

The potential exists for soils closer to the Marian River Fault to have longer periods of frozen soil or permafrost due to the shadow cast by the high fault.

3.2.4.2 Sun Rose Claim Group

The hydrogeologic regime at the Site is described in the AMEC Phase III ESA (AMEC, 2015a) as follows:

“Local groundwater flow, based on topographic features, is expected to be in an outward radial pattern away from the local topographic high near the centre of the Site. The dome-shape outcrop feature is generally void of surficial deposits thus groundwater is expected to reside within the bedrock. Groundwater flow within the bedrock will be dominated by secondary porosity features such as fractures, joints and faults. Groundwater recharge across the exposed bedrock areas would be dependent on several factors including surface slope and runoff potential, precipitation intensity, density and aperture of secondary porosity features reaching the bedrock surface. Local groundwater flow in the main portion of the Site (i.e., former exploration area) is inferred to be towards NW Pond (to the northwest) and local groundwater flow on the southern portion of the Site is inferred to be towards Chico Lake (to the south). Regional groundwater flow direction is inferred to be toward Marian Lake (to the south).”

Surface water body elevations measured in 2014 (AMEC, 2015b) were as follows:

- Chico Lake 167.46 masl
- NW Pond 166.70 masl
- NE Pond 168.60 masl
- East Lake 168.65 masl

These elevations would indicate a general north-northwest surface water gradient, though there is no clear indication that these lakes are or are not hydraulically connected.

3.2.4.3 REX

The REX hydrogeology is described in Columbia, 2013. *"Groundwater in unconsolidated deposits is anticipated to be at relatively shallow depths at the campsite, given the proximity and low elevation difference between the former tent frames and Sheldon Lake. The camp area was observed to consist of muskeg over shallow bedrock. From the exploration workings, groundwater is expected to flow from ridge topographic highs toward a lower elevation marsh to the east. Sheldon Lake eventually drains into the marsh. For both areas, groundwater recharge is anticipated to be through infiltration of thin surface soils into bedrock fractures.*

The presence of a continuous groundwater system within fractured bedrock is not known at this time, nor is the influence of permafrost. Permafrost was not encountered within any of the shallow test holes. According to Natural Resources Canada map - a region defined as having permafrost present in 50-90% of the land cover."

3.2.4.4 Other Project Locations

The hydrogeology of the various satellite sites is not well known; however, it is expected to be similar to that of the Rayrock site. The sites are all located in locations with shallow or exposed bedrock. Limited groundwater is expected in the surficial deposits and groundwater is expected to flow from topographic highs towards lower elevations. Groundwater recharge is anticipated to be through infiltration of thin surface soils into bedrock fractures or direct into bedrock fractures.

3.3 Chemical Environment

The Project entails remedial work to be undertaken at several locations over a broad geographic area. As identified, Table C1 is a list of over 80 reports that pertain to these project sites, most of which discuss the chemical condition of soils, rock, sediments, surface water, groundwater and vegetation. Several hundred laboratory tests have been undertaken during the Project history.

Each of the mining and exploration sites were originally selected as locations for potential resource development due to the presence of actual or potential highly mineralized bedrock. Therefore, it is not unusual for elevated concentrations of Contaminants of Potential Concern (COPCs) to be present in these locations – metals in particular. Most of the historical assessments recognize this potential and many of the assessments include the collection of background samples when assessing areas of potential environmental concern given the strong potential for some COPC concentrations to be naturally occurring.

Laboratory results have confirmed locations of concern respecting physical media (soil, rock (acid rock drainage [ARD]/metals leaching [ML], sediment and surface water); however, have also identified that natural conditions either do exist or potentially contribute to the presence of elevated metals.

Assessments have therefore also sought to assess the likelihood that the identification of elevated metals is anthropogenic as opposed to being a natural condition. Further details are summarized in Section 5 and the reader is referred to original reports for further detail respecting the analytical history and site-specific characterizations.

With respect to radiation, investigations at Rayrock and Sun Main have identified that uranium and its decay products are naturally-occurring, which means that radioactivity at these locations is naturally-occurring as well. At Rayrock, since radioactivity emanates from tailings in the TCAs and waste rock these materials are considered part of the fuel cycle and therefore not considered NORM. At Sun Main and REX waste rock and rock at exploration workings was not processed, is not considered as part of the fuel cycle and is therefore considered to be NORM.

3.4 Biological Environment

3.4.1 Terrestrial Ecology

3.4.1.1 Rayrock

The Project sites and surrounding lands provide a variety of habitats for both mammal and avian species. Habitats, which include forests, wetlands, meadows, lake shores, ponds, and rock cliffs, may be frequented by wildlife for a variable length of time. Additionally, the Project sites provide both water and food sources for many of these animals, such as berries, rosehips and other vegetation.

Arcadis (2018b) identifies that “*although the site has been disturbed by mining activities in the past, the site provides ample habitat for feeding, nesting and bedding down. Shelter is provided by numerous trees and shrubs as well as the revegetated, grassed areas which have developed into meadows over the years….. There was evidence of Site use by larger mammals such as bear (Ursus arctos), moose (Alces alces) and wolf (Canis lupus), and smaller mammals such as porcupine (Erethizon dorsatum),red squirrel (Sciurus vulgaris) and snowshoe hare (Lepus americanus). It is likely that other small mammals such as marten (Martes americana), muskrat (Ondatra zibethicus), river otter (Lontra canadensis), short-tailed weasel (Mustela erminea), , beaver (Castor canadensis), Northern bog lemming (Synaptomys borealis), common shrew (Sorex cinereus), dusky shrew (S. monticolus), meadow vole (Microtus pennsylvanicus), long-tailed vole (M. longicaudus), North American deer mouse (Peromyscus maniculatus) and Western jumping mouse (Zapus princeps) may also be present on site, although habitat was present, evidence of presence was not found.*

Bird species observed during the site visit were peregrine falcon (Falco peregrinus), ptarmigan (Lagopus muta) and sharp-tailed grouse (Tympanuchus phasianellus). The site is likely also used by many other bird species, including other raptors and waterfowl…

The site and surrounding lands provide many different types of habitat for mammal and bird species such as forest, shrub thickets, meadows, wetlands, creeks, ponds and rock cliffs. Large and small mammals and birds use the site as it provides sources of food, shelter and nesting sites. Depending on their home ranges, different species may traverse the site on occasion for foraging or spend considerable time on it.”

3.4.1.2 Sun Rose Claim Group

The physical habitat for the Sun Main/ Sun East location is described in a 2014 Screening Level Ecological Risk Assessment (AMEC, 2015b). The report identifies the site topography to be characterized by steep slopes of bedrock outcrop, interspersed with ravines and valleys and characterized by two distinct types of habitat:

- Bedrock uplands with patchy lichen, mosses, grasses, sedges and rushes. Woodlands and shrub species observed included white birch, white spruce and alders. Ground cover was a combination of gravel, bedrock outcrops, grass, lichens and trees.
- Bogs and fens which had dominant forest species of black spruce, larch, white birch, and shrub species of Labrador tea, bog cranberry, red bearberry, cloudberry, sedges, and peat mosses.

3.4.1.3 Ancillary Sites

Detailed assessments have not been undertaken of the other Project sites. The general physiography is described for the various locations in Section 3.2 of this RAP. The project sites are all located in the Canadian Shield and have similar terrain with forests and wetlands interspersed amongst rolling bedrock. As with Rayrock, the Project sites and surrounding lands provide a variety of habitats for both mammal and avian species common to the area.

3.4.2 Aquatic Ecology

3.4.2.1 Rayrock

The lakes summarized in the table below provide habitat, food and water for a variety of fish, avian, and mammal species (Arcadis 2016a, Arcadis 2018c). Results of previously conducted aquatic assessments are summarized in **Table 3-5**.

Table 3-5: Aquatic Life in Rayrock Lakes

Lake	Fish Bearing?	Benthic Simpson's Diversity Index[a]
Mill Lake	No	0.37
Gamma Lake	No	0.77
Beta Lake	No	0.81
Kwetsǫ̀tìa	No	0.81
Sherman Lake	Yes	0.83
Lake A	Yes	0.80

Notes: a) Simpson's diversity index is a measure of species diversity within a community, which takes into account species richness (total number of species), as well as the relative abundance of each species present (species evenness).

Aquatic species identified in fish-bearing lakes (exclusive of benthos) include lake trout, lake whitefish, northern pike and walleye, as well as muskrat and beaver.

Attempts to catch fish in Mill Lake during a field program in 2017 were unsuccessful (Arcadis 2018c). Videos collected underwater during a September 2018 surface water sampling program in Mill Lake did not show visible indications of vegetation or aquatic life. Very few organisms/ insects were observed in the water when collecting surface water samples in Mill Lake in 2018. These observations have some correlation to the Simpson's Diversity Index numbers presented in **Table 3-5** above, which show Mill Lake to have a markedly lower index, signifying a lower species diversity than the other lakes. Traces of benthic organism were observed in the sediment during the February 2020 sediment sampling program.

3.4.2.2 Other Project Sites

Detailed aquatic assessments have not been undertaken at lakes associated with other project sites. Major lakes such as GS Lake (adjacent to the GS satellite site), Sheldon Lake (adjacent to REX), Marian Lake (adjacent to the

Barge Landing), Treasure Lake (adjacent to TED) are all expected to be fish-bearing lakes with high levels of biodiversity.

3.4.3 Species at Risk

Numerous species of mammals, fish, and birds exist or have the potential to exist at the Project sites. A search (August 2020) search of the Canada Species at Risk database identified the following of these species to be of note.

Table 3-6: Northwest Territories Species at Risk

Taxonomic Group	COSEWIC Common Name	Scientific Name	COSEWIC Status
Amphibians	Northern Leopard Frog	Lithobates pipiens	Special Concern
Amphibians	Western Toad	Anaxyrus boreas	Special Concern
Arthropods	Gypsy Cuckoo Bumble Bee	Bombus bohemicus	Endangered
Arthropods	Yellow-banded Bumble Bee	Bombus terricola	Special Concern
Birds	Eskimo Curlew	Numenius borealis	Endangered
Birds	Ivory Gull	Pagophila eburnea	Endangered
Birds	Red Knot rufa subspecies	Calidris canutus rufa	Endangered
Birds	Whooping Crane	Grus americana	Endangered
Birds	Bank Swallow	Riparia riparia	Threatened
Birds	Barn Swallow	Hirundo rustica	Threatened
Birds	Canada Warbler	Cardellina canadensis	Threatened
Birds	Red Knot roselaari type	Calidris canutus roselaari	Threatened
Birds	Buff-breasted Sandpiper	Tryngites subruficollis	Special Concern
Birds	Common Nighthawk	Chordeiles minor	Special Concern
Birds	Evening Grosbeak	Coccothraustes vespertinus	Special Concern
Birds	Horned Grebe	Podiceps auritus	Special Concern
Birds	Olive-sided Flycatcher	Contopus cooperi	Special Concern
Birds	Red Knot islandica subspecies	Calidris canutus islandica	Special Concern
Birds	Red-necked Phalarope	Phalaropus lobatus	Special Concern
Birds	Rusty Blackbird	Euphagus carolinus	Special Concern
Birds	Short-eared Owl	Asio flammeus	Special Concern
Birds	Yellow Rail	Coturnicops noveboracensis	Special Concern
Fishes (freshwater)	Bull Trout	Salvelinus confluentus	Special Concern
Fishes (freshwater)	Dolly Varden	Salvelinus malma malma	Special Concern
Mammals (terrestrial)	Caribou	Rangifer tarandus	Endangered
Mammals (terrestrial)	Little Brown Myotis	Myotis lucifugus	Endangered
Mammals (terrestrial)	Northern Myotis	Myotis septentrionalis	Endangered
Mammals (terrestrial)	Caribou	Rangifer tarandus	Threatened
Mammals (terrestrial)	Peary Caribou	Rangifer tarandus pearyi	Threatened
Mammals (terrestrial)	Collared Pika	Ochotona collaris	Special Concern
Mammals (terrestrial)	Grizzly Bear	Ursus arctos	Special Concern
Mammals (terrestrial)	Polar Bear	Ursus maritimus	Special Concern
Mammals (terrestrial)	Wolverine	Gulo gulo	Special Concern
Mammals (terrestrial)	Wood Bison	Bison bison athabascae	Special Concern

Taxonomic Group	COSEWIC Common Name	Scientific Name	COSEWIC Status
Vascular Plants	Hairy Braya	Braya pilosa	Endangered
Vascular Plants	Mackenzie Hairgrass	Deschampsia mackenzieana	Special Concern
Vascular Plants	Nahanni Aster	Symphyotrichum nahanniense	Special Concern

Notes: Data Source: https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html

The NW Species at Risk Committee (SARC) completed an assessment which identified the Barren-ground Caribou, Peary Caribou, Boreal Caribou, Wood Bison Hairy Braya as threatened; and the Dolphin and Union Caribou, Polar Bear, Western Toad, Northern Leopard Frog, Little Brown Myotis and Northern Myotis as being of special concern.

3.5 Cultural Environment

3.5.1 Traditional Knowledge

Traditional land use, history and knowledge of the Kwetı̨ı̨ʔaà environment and ecosystem have been documented through the capture of oral narratives from Elders familiar with Kwetı̨ı̨ʔaà from a period prior to mine development, through operations in the 1950s and post development. Key documents containing this information include:

- "The Trees all Changed to Wood", prepared by the Dogrib Renewable Resources Committee Dogrib Treaty 11 Council in 1997 (Dogrib, 1997).
- "Like a Sick Person Sleeping", a Traditional Knowledge study for Aboriginal Affairs and Northern Development Risk Assessment of Kwetı̨ı̨ʔaà Contaminated Mine Site in 2015 (TG, 2015).
- Kwetı̨ı̨ʔaà Traditional Monitoring Program Summary Report prepared by The Firelight Group for the Tłı̨chǫ Government in 2018 (TG, 2018).
- 2019 Kwetı̨ı̨ʔaà Traditional Monitoring Program: Summary Report, The Firelight Group and Fielding Environmental (Firelight, 2019).

The reports provide a unique insight into the traditional uses of the land and water by the Tłı̨chǫ for hunting, fishing, harvesting and gathering. They describe site activities and practices that have impacted the environment in more detail than what is available in the limited historical "technical" data available for the site. Information presented is a narrative of the human and ecological impacts due to mining operations.

The Kwetı̨ı̨ʔaà Traditional Monitoring Program Summary Report (TG, 2018) is an effort conducted between the TG and the Kwetı̨ı̨ʔaà Elders Committee (KEC) "to document traditional knowledge about water, land and animals at the Kwetı̨ı̨ʔaà mine site". With respect to pre-mine development, the following report excerpt provides a good pre-development overview:

"Prior to the 1950's, Kwetı̨ı̨ʔaà was a beautiful, resourceful land (Tłı̨chǫ Research & Training Institute [TRTI] 2015). Kwetı̨ı̨ʔaà was named after its rocks that projected outwards of the flowing river. Tłı̨chǫ citizens would gather at Kwetı̨ı̨ʔaà several times a year, arriving by canoe or dogsled. It was common for Tłı̨chǫ travellers to set up camp on the rocks, and several families lived in cabins along the shorelines (Kwetı̨ı̨ʔaà Elders Committee [KEC] 2018a). The Tłı̨chǫ would hunt annually for beaver pelt, muskrats, moose, lynx, fox, duck, geese, and fish. Hunters would use the land's high hills and high rocks to sit and listen for moose. In those days, the animals were large and fat in size, a good indicator of the health of the land. Berries and medicinal plants were plentiful at Kwetı̨ı̨ʔaà and utilized by traditional harvesters (TRTI 2015). The resources gathered and gained were used as a social, cultural, and economic resource to Tłı̨chǫ families."

Likewise, the following excerpt provides insight into a post-mining viewpoint:

"Since the mine was abandoned, Kwetı̨ı̨ɂaà is widely regarded by Tłı̨chǫ citizens as an area that is contaminated and unsafe for use. Some elders feel that the mining activities "destroyed part of their dè" (TRTI 2015, p. 2) (part of their land), noting that the Tłı̨chǫ were never told about the serious nature and potential implications of uranium mining. Furthermore, the Tłı̨chǫ were never asked to monitor the area after the mine was abandoned (TRTI, p. 3)."

3.5.2 Archaeological Features

At Rayrock, an archeological impact assessment (EcoFor 2015) identified three potential archeological areas (see **Figure 3, Appendix A**). These areas were thought to be two prehistoric camp areas and a potential bluff shelter area. Additionally, EcoFor noted that this study was limited due to time constraints and that any areas outside the 2014 assessment zone should be assessed prior to any ground disturbance from remedial or reclamation activities.

An archeological impact assessment of the all-season road and potential winter road locations is anticipated prior to construction. This assessment will aid in deciding which winter road route will be used for mobilization efforts. An archeological impact assessment of the proposed borrow soil location will be required prior to ground disturbance.

AECOM notes that the Tłı̨chǫ Government has not completed an archaeological assessment specific to the Rayrock remediation project. An archaeological assessment is required prior to conducting the major works.

4. Project Description

4.1 Environmental Site Assessments

Over 80 reports have been prepared since 1984 that describe the history and environmental investigations pertaining to the Project sites (summarized as **Table C1 in Appendix C**). This RAP has been prepared in consideration of the information contained within these documents.

4.2 Human Health and Ecological Risk Assessments

Environmental concerns at the Rayrock Mine and Sun Main/ Sun Rose have been the most significant Project items. Due to their significance, additional study through HHERA has been undertaken to assist with understanding the site-specific environmental risks rather than relying on generic guidelines as provided in the literature. Key findings from this risk assessments are presented below.

4.2.1 Rayrock Human Health and Ecological Risk Assessment

A detailed HHERA for the Rayrock Mine Site was undertaken by Canada North Environmental Services (CanNorth, 2018) for the purpose of determining whether constituents of potential concern (CoPCs) in various media (soil, sediment, surface water, fish) may have an adverse effect on humans or animals that either use or may potentially use the Rayrock mine site. The HHERA used a screening process to develop a list of CoPCs for detailed evaluation.

During the screening, CoPCs with 95th percentile concentrations above pre-established baseline concentrations (based on historical site data) were compared to published environmental quality guidelines based on the appropriate environmental receptor pathway (e.g. aquatic life, human health, ecological, etc.). When CoPCs were found to exceed these guidelines (or constituents that did not have applicable CCME guidelines but existing toxicity data) were carried through the assessment. Based on this screening, the following CoPCs were identified as being the key parameters of concern:

- Terrestrial Environment: Arsenic, beryllium, boron, chromium, copper, lead, molybdenum, nickel, selenium, uranium, zinc, and PHC F2-F4.
- Aquatic Environment: (Water): Copper, fluoride, iron, lithium and uranium.
- Aquatic Environment: (Sediment): Copper, nickel, uranium and zinc.

Additionally, due to the history of uranium mining at the site, radioactivity was also identified as an issue of potential concern. The HHERA concluded:

- *"Ecological Risks (Aquatic):*
  - *While elevated concentrations of selected CoPC in water and sediment are above benchmarks, negative impacts on the aquatic populations in Alpha and Sherman Lake, Beta Lake, Gamma Lake, Jan's Pond* [Kwetsǫ̀tìa]*, and Lake A were not indicated. Weight of evidence from benthic community assessments completed in these waterbodies indicates that the benthic communities are not significantly impaired.*

- *Mill Lake has high uranium concentrations in water and sediments and the benthic survey conducted in 2017, suggests that high uranium concentrations in the sediments may be affecting the benthic community;*
- *The assessment of radiological dose to aquatic receptors from radionuclides present in water and sediment at the site indicated that calculated doses are well below the applicable reference dose benchmarks for aquatic receptors; and,*
- *Inputs from the Rayrock Mine site are not impacting the Marian River.*

- *Ecological Risks (Terrestrial):*
  - *Exposure to radionuclides in the aquatic and terrestrial environment at the Rayrock Mine site does not represent a risk;*
  - *Large terrestrial receptors are not at risk;*
  - *Species at risk with large home ranges (short-eared owl and woodland caribou) are not at risk;*
  - *Exposures at Alpha and Beta Lakes does not represent a risk for terrestrial receptors with an aquatic based diet;*
  - *Uranium concentrations in the sediments in Mill Lake are elevated and result in some exceedances of toxicity benchmarks for terrestrial receptors who consume large amounts of sediments such as beaver, muskrat, and diving ducks as well as the little brown bat;*
  - *Uranium concentrations in the soils in Mill Creek drainage area exceed toxicity benchmarks for small terrestrial mammals; however, weight of evidence from hare and grouse collected from the site indicates that uranium is not transferring in the terrestrial environment; and*
  - *Waste rock and tailings samples at the mill workings have copper concentrations that result in toxicity benchmarks being exceeded for the hare and the rusty blackbird. These are localized "hot-spot" areas at the site; however, weight of evidence from hare and grouse collected from the site indicates that COPC are not transferring in the terrestrial environment…*

- *Human Health Risks:*
  - *The evaluation determined that no adverse effects were expected from the identified COPC.*
  - *With respect to the human health risk assessment, the radiological dose estimates were below the Canadian Nuclear Safety Commission regulatory incremental dose limit of 1000 µSv/y for members of the public for the exposure scenario assessed (e.g. a hypothetical camper onsite for 90 days per year who consumes wild game and fish from the site for an additional three months.).*
  - *Exposure to non-radioactive COPC are not predicted to result in adverse effects to individuals present at the site for 90 days per year who consume wild game and fish from the site for an additional three months."*

4.2.2 Sun Rose Human Health and Ecological Risk Assessment

4.2.2.1 Preliminary Assessments

Environmental risks at Sun Rose were examined by AMEC Environment & Infrastructure in their 2015 reports titled Screening Level Ecological Risk Assessment (SLERA – AMEC, 2015b) and Human Health Preliminary Quantitative Risk Assessment (HHPQRA – AMEC 2015c) with an assessment of remedial options presented in a Remedial Options Analysis (AMEC, 2015d). The reports were based on a Phase III of the site (AMEC, 2015a) and previous work by others.

4.2.2.2 Detailed Radiological Human Health and Ecological Risk Assessment

A Detailed Radiological Human Health and Ecological Risk Assessment (HHERA – AECOM, 2020a) on the radiation impacts at Sun Rose was completed in 2020. The human health exposure model was to reflect input provided by the Tłı̨chǫ, similar to the model developed for the Rayrock site and recognized new site data collected since the SLERA and HHPQRA. The report addresses human health and ecological risks from residual natural radioactive materials at the Sun Main and Sun East properties only. No remediation or risk drivers have been identified at Rose.

The radiological HHERA emphasizes the environmental concern associated with waste rock and exploration workings; areas identified as being of high concern based on the elevated radiation levels at these locations. The main waste rock pile (identified herein as WR1) is comprised of rock excavated during sinking of the shaft and end dumped over the rock slope adjacent to the shaft. WR1 is estimated to include approximately 1,200 cubic metres (m^3) of rock. Two smaller rock piles (WR2 and WR3, less than 200 m^3 combined) are also present at the Site.

Four exploration workings (denoted as BP1 to BP4) are also located at the Site. The exploration workings are small excavations made into bedrock outcrops used for sampling and examination of unweathered surfaces. In some cases, there is an exposed area of less-weathered rock where a bedrock knob was removed (presumably by blasting). In these locations there is no depression, and the working is identified by the presence of unweathered bedrock. In other instances, the workings are small furrows or depressions excavated into bedrock. Workings BP1, BP2 and BP3 are small, estimated to be 2 m^3, 1 m^3 and 2 m^3 in size respectively, while BP4 estimated to be in the order of 16 m^3. Data reviewed for this HHERA indicates that the blast pits were advanced at locations of naturally high bedrock radioactivity.

Key report conclusions are as follows:

- The radiation levels and radionuclide activity concentrations at the main waste rock stockpile and exploration workings exceed the established thresholds in the Canadian Guidelines for the Management of Naturally Occurring Radioactive Material (NORM) with the largest radiation concern being at workings BP1, BP2 and BP3.
- Overall, the Site is considered to present negligible risk to individually assessed ecological receptors.
  - Calculated risk quotients infer negligible risk associated with exposure to radionuclides for all terrestrial wildlife receptors.
  - Sensitive avian receptors of concern (i.e., Species at Risk) were specifically assessed. Calculated risk quotients infer negligible risk associated with exposure to radionuclides for all for all assessed avian species.
  - Potential risk to aquatic receptors (fish) was assessed for all on-site waterbodies based on results of the AECOM 2019 field investigation. Calculated risk quotients in all waterbodies indicate negligible risk.
  - Potential risks to mobile ecological receptors which may encounter the waste rock or blast pit areas within their foraging range have been assessed using an area-weighted approach. Calculated risk quotients for all receptors assessed using the area-weighted approach, including Species at Risk, indicate negligible risk.
- When considering the Site as an ecological system there is little evidence to suggest impairment of ecological function at the Site. Radiation benchmarks are intended to be protective of mortality (i.e. long-term survival) and reproduction endpoints, and as adverse effects to the populations of valued ecological receptors are considered to be negligible, potential impacts to wildlife abundance are also expected to be negligible.
- Based on the quantitative assessment of human health risks and in consideration of the likelihood of long-term exposure to areas of acute gamma radiation, it was concluded that the Site likely represents a low-to-moderate risk to human receptors. Predicted intake of Site-derived fish accounts for a substantial proportion of total predicted incremental effective dose.

4.3 Remediation Summary

The following table presents an overview of the proposed remedial action strategy for the Project.

Table 4-1: Remedial Strategy Outline

Location	Risk Driver	Chosen Remedial Strategy
Rayrock	Mill Lake - Impacted Organic Sediments	• Excavate and place into containment cell (confined disposal facility (CDF). The CDF for the Rayrock site will be the Mill Lake Containment Cell, situated in the drained basin of the former Mill Lake.
	Mill Lake - Impacted Surface Water	• Pump and treat water and discharge into Sherman Lake
	Waste Rock	• Excavate and relocate waste rock to Mill Lake CDF • Leave well-vegetated waste rock as is • Leave waste rock as adit cover
	Spilled Tailings	• Excavate and relocate spilled tailings to Mill Lake CDF • Leave well-vegetated tailings as is
	Impacted Soil (Mine Site)	• Excavate and relocate to Mill Lake CDF • Leave well-vegetated impacted soil as is
	Impacted Soil (Mill Creek)	• Do nothing
	Concrete Foundations	• Dispose of in Mill Lake CDF
	Mine Adit	• Leave as-is and contact WSCC to confirm that current closure is acceptable
	Mine Vents	• Contact WSCC to determine if current closure is acceptable (since sealed with concrete during original remediation) • Construct either foam plugs with rock cover, concrete plugs or steel cap if deemed necessary
	Tailings Containment Areas	• Conduct required maintenance
	Waste Dump	• Conduct required maintenance
	Hazardous Waste	• Consolidate and dispose off-site
	Non-Hazardous Waste	• Consolidate and dispose off-site
	Borrow Area	• Regrade for positive drainage • Reclaim/restore, revegetate to the extent practicable
	Power Poles	• Assess potential for impacts due to historical treatment • Dispose of as hazardous or non-hazardous waste based on laboratory analytical testing
Sun Rose Claim Group	Mine Shaft	• Construct Permanent Cover
	Waste Rock	• Consolidate and Cap
	Impacted Soils	• Hybrid: Relocate to the waste rock containment stockpile/ leave in place
	Exploration Workings	• Move loose rock to covered waste rock stockpile/ cover exposed work areas exhibiting elevated gamma radiation with concrete
	Access Roads	• Leave as is
	Hazardous Waste	• Consolidate and dispose off-site
	Non-Hazardous Waste	• Consolidate and dispose off-site
	Surface Water and Sediments	• No action required
	Borrow Area	• Regrade for positive drainage • Reclaim/restore, revegetate to the extent practicable

Location	Risk Driver	Chosen Remedial Strategy
Horn Plateau - REX	Exploration Workings	• Confirm depth at time of remediation. Workings with depths greater that 1.5 m and representing a physical hazard to be backfilled with rock to a level at least meeting the minimum 1.5 m depth. • Due to elevated radiation measurements at one location at the Northern Exploration Workings, this trench will be covered with concrete.
	Impacted Soil	• No action required
	Non-hazardous Waste	• Consolidate and dispose off-site
Horn Plateau - GS	Hazardous Waste	• Consolidate and dispose off-site
	Non-hazardous Waste	• Consolidate and dispose off-site
	Impacted Soil	• Remove soil and place into Mill Lake CDF at Rayrock
Rayrock Powerline (outside of Exclusion Zone)	Hazardous Waste	• Consolidate and dispose off-site if encountered
	Non-hazardous Waste	• Consolidate and dispose off-site
	Impacted Soil	• Remove soil and place into Mill Lake CDF at Rayrock if encountered
Barge Landing	Impacted Soil	• Remove soil and place into Mill Lake CDF at Rayrock if encountered
	Hazardous Waste	• Consolidate and dispose off-site if encountered
	Non-hazardous Waste	• Consolidate and dispose off-site
MK Satellite Site	Non-hazardous Waste	• Consolidate and dispose off-site
TED Satellite Site	Non-hazardous Waste	• Consolidate and dispose off-site

5. Remediation Strategy

5.1 Project Closure Objectives and Criteria

Section 1.2 of this RAP presents nine objectives for the Project. To facilitate achieving these objectives, closure criteria and activities relating to Project monitoring, maintenance and inspection have been developed as provided in **Table C2** in **Appendix A**.

5.2 Community Work Out Sessions

This RAP has been developed based on a technical evaluation of numerous investigations and studies that have occurred at the Project sites since the 1990s. The technical data has been provided to technical and community stakeholders at several meetings over the last three years, including community work out sessions with the Tłı̨cho Government in February 2018 (50% RAP Work Out), February 2019 (75% RAP Work Out) and June 2020 (90% RAP Work Out). Proceedings from the June 25, 2020 Technical Briefing Session are provided as **Appendix D** to this RAP.

Section 5 of this RAP describes the main environmental concerns at each Project site requiring management during site remediation. **Tables C3 and C4 (Appendix C)** summarize these issues by Project location and present the preferred management approaches as confirmed during the "90%" Remedial Options Work-out Session held in June 2020 as generally agreed upon between the community representatives, technical team, and CIRNAC during the meetings.

The most complex environmental issue relating to this RAP is the management of uranium-impacted sediments in Mill Lake. Discussed further in Section 5.3.1, the proposed management approach to address these impacted sediments is to dewater the lake and the lake sediments, to encapsulate the sediments in a clay containment cell, and to restore the lake basin to resemble the adjacent bedrock and forested lands. A surface water body would no longer be present at this location. The concept had originally been introduced during the February 2019 (75% RAP Work Out) session and again in June 2020 (90% RAP Work Out) following further assessment of the impacted sediments.

Given the significance of this remediation strategy, a web-based workshop was held on July 2,2020 to confirm that the recommended remedial approach for Mill Lake meets the TG Socio-Economic, Environmental and Traditional Use, and Technical objectives. The workshop was led by TG's technical Advisors Firelight and Fielding Environmental (FE) and included members of the TG Lands and Regulatory departments and community members, as well as members of the AECOM design team and a PSPC representative.

During the workshop AECOM presented the approach to TG and provided additional information and clarifications on the design and sequencing of the construction activities. At the conclusion of the workshop, the TG technical advisory group asked TG to confirm their support of the remedial approach, which was described in a simplified manner as: Synthetic bag dewatering, excavate frozen sediment, and place in cell. The TG confirmed they support the approach; however, recommended that the synthetic bag dewatering be field tested prior to implementing the full-scale application.

5.3 Rayrock Mine

The scope of work for remedial activities at the Rayrock mine includes actions at:

- The former mill site and adjacent areas
- Mill Lake,
- The north and south TCAs,
- The waste dump,
- Sherman Lake camp,
- Powerline (within the Exclusion Zone), and
- Satellite site CA.

The remedial strategies for these areas are provided below, by remedial component.

5.3.1 Mill Lake Sediment

5.3.1.1 Description

The largest component of the Project pertains to the remediation of Mill Lake sediments. The Rayrock HHERA (CanNorth, 2018) identified that high uranium concentrations in the Mill Lake sediments may be affecting the benthic community and exceed toxicity benchmarks for terrestrial receptors that may consume large amounts of sediments. Based on these findings, CIRNAC-CARD has committed to the remediation of these sediments.

Mill Lake Hydrology

Mill Lake can be characterized as having a “fill and spill” hydrologic character, whereby the lake intermittently fills, and discharges based on meteoric input and a stage storage curve. Hydrogeological investigations carried out in February 2020 (AECOM 2020e) indicate that the lake is neither gaining nor losing groundwater inputs. The Mill Lake catchment area is primarily composed of bare bedrock slopes and the lake is primarily fed by surface runoff from these bedrock surfaces.

The potential exists for mine drainage to exit from the adit and enter Mill Lake. From a flow quantity perspective, these inflows would be expected to be minimal as compared to inflows due to precipitation. No evidence of adit drainage has been identified in AECOM’s reviews of historical reports. A Conceptual Site Model of the Mill Lake basin is provided as **Figure 16, Appendix A**.

Field verified water depths at 40 lake locations in 2019 found Lake water depths to range from 0.8 m to 3.6 m, averaging 2.6 m from water surface to the top of sediment. An additional six measurements made in 2020 revealed the water depth (top of ice to top of sediment) to range from 2.3 m to 3.7 m, averaging 3.0 m. Discussions with persons familiar with the site indicate that the water depths may be deeper in some locations near the island. A map of Mill Lake showing water depth measurements is provided as **Figure 17, Appendix A**. A preliminary contour drawing of the Mill Lake bottom and cross sections is provided as **Figure 18, Appendix A**.

Sediment Physical Composition

Sediment cores advanced in February 2020 identified the following lake bottom stratigraphy:

- **Loose Organic Sediment:** Dark brown hydrous organic sediments with a very soft "oozing" quality and a very high-water content. The material had an average thickness of 1.3 m and was not cohesive.
- **Consolidated Organic Sediment:** The same material as above, but with a gradual increase in compactness and competence. The material had an average thickness of 1.4 m.
- **Clay:** Grey, medium stiff-to-stiff glaciolacustrine clay – some silt, trace gravel.
- **Sand:** Only encountered in one core located near the former mill and adit, this sand was angular and appeared unweathered.

A general schematic illustrating the findings at each core is provided as Plate 10.

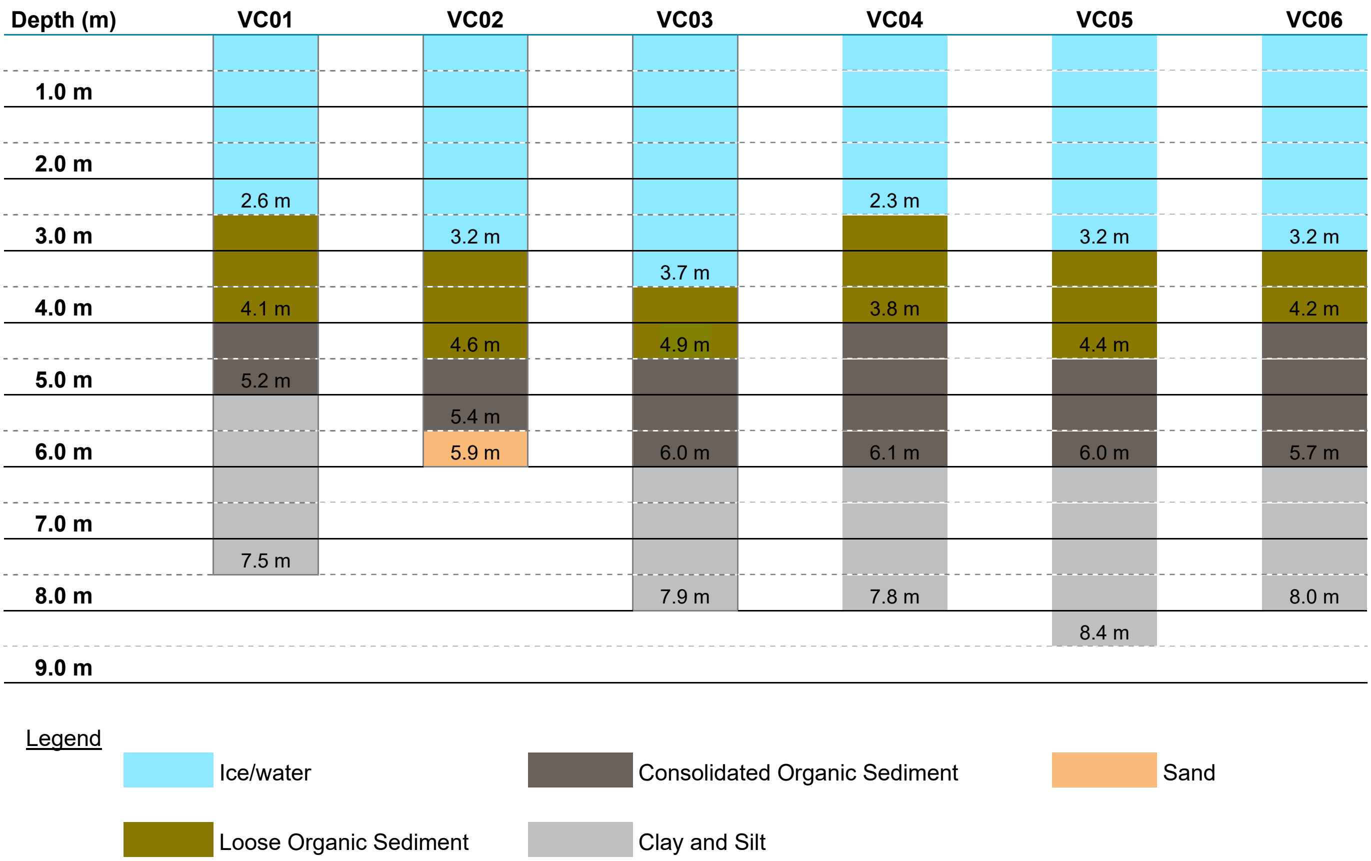

Plate 10: Graphical Representation of Sediment Core Results (AECOM, 2020)

In 2018 AECOM collected underwater video of the lake bottom. Observations from these videos include:

- The sediment surface is a very loose, easily disturbed surface.
- No significant vegetation growth at the sediment surface was observed on the video.
- The bottom was very flat in most locations; however, occasional bedrock, boulders and cobbles are evident. An irregular lake bottom surface can be expected.
- Minor wood debris (likely tree matter that has fallen into the lake) can occasionally be observed.

These observations are significant with respect to remediation planning, since laboratory analyses indicate that these observable sediments (those within the uppermost 0.2 m) have the highest uranium concentrations and are a targeted remediation zone. A photograph of the sediment surface is provided as Plate 11.

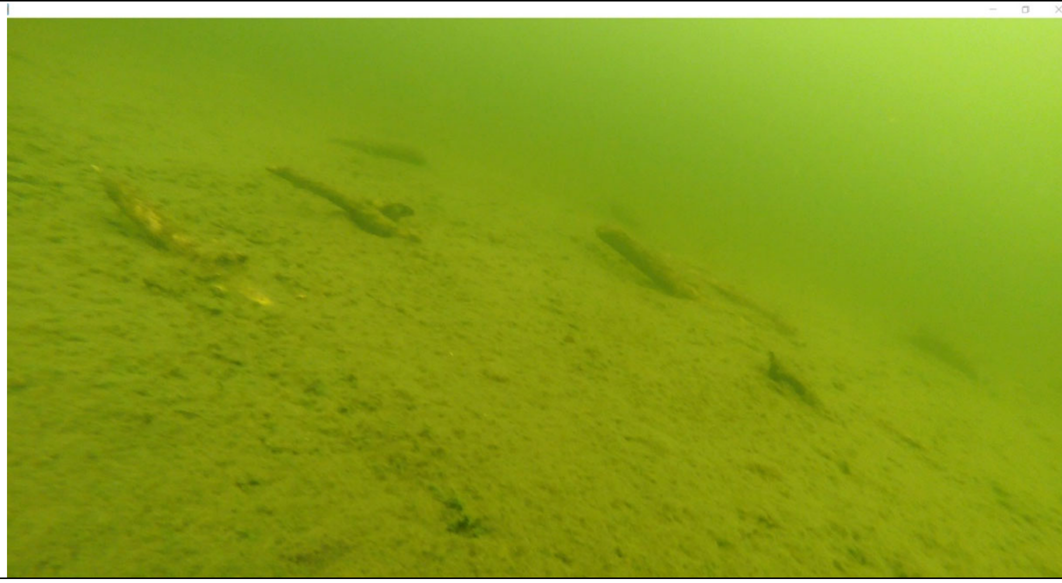

Plate 11: View of Sediment Surface (note woody debris)

Sediment Chemical Constituents - Metals

Tables C5 and C6 (Appendix C) are summary tables of all historical sediment test results for metals in Mill Lake, as well as sediment test results for three reference background lakes (Control Lake, New Control Lake, and Neghoa Lake). **Table 5-1** below summarizes the concentration profiles of selected metals with sediment depth. **Figure 19 (Appendix A)** is a map of Mill Lake showing uranium concentrations in sediment samples collected form the lake.

Table 5-1: Average Metal Concentrations in Sediment (mg.kg)

Location	N	Metals Assessed to CCME Guidelines (ISQG)[1]							Metals Assessed to Thompson Guidelines (LEL)[2]				
		As	Cd	Cr	Cu	Pb	Hg	Zn	Mo	Ni	Se	U	V
CCME ISQG	-	5.9	0.6	37.3	35.7	35	0.17	123	-	-	-	-	-
CCME PEL	-	17	3.5	90	197	91.3	0.486	315	-	-	-	-	-
Thompson LEL	-	-	-	-	-	-	-	-	8.3/ 13.8	21/ 23.4	0.9/ 1.9	32/ 104.4	27.3/ 35.2
Thompson SEL	-	-	-	-	-	-	-	-	540/ 1238.5	170/ 484	4.7/ 16.1	3410/ 5874.1	77/ 160
Background													
Control Lake, New Control Lake & Neghoa Lake	6	**8.9**	0.9	26.1	**118**	8.4	0.088	**193**	6.2	**23**	1.2	**89**	**30**

Location	N	Metals Assessed to CCME Guidelines (ISQG)[1]							Metals Assessed to Thompson Guidelines (LEL)[2]					
		As	Cd	Cr	Cu	Pb	Hg	Zn	Mo	Ni	Se	U	V
Loose Organic Sediment													
0.0 m to 0.1 m	26	4.9	**1.1**	14	**383**	23	0.16	**351**	4.4	15	**7.0**	**2363**	15
0.1 m to 0.2 m	2	4.9	**0.95**	-	**250**	18	0.15	**370**	4.2	17	**3.9**	**1395**	18
0.2 m to 0.3 m	5	2.5	**1.0**	19.5	**184**	6.3	0.13	**386**	2.8	16.8	**3.2**	**358**	17
0.3 m to 0.4 m	3	2.4	**0.9**	-	**136**	5.0	0.09	**323**	2.2	18.3	**2.4**	**127**	23
0.4 m to 0.7 m	11	3.0	**1.2**	16	**201**	6.8	0.10	**417**	2.9	16	**3.8**	**341**	19
Consolidated Organic Sediment	14	2.7	**1.1**	15	**222**	4.8	0.09	**363**	2.9	17	**4.0**	**220**	15
Silt and Clay	5	3.7	**0.11**	**42**	28	7.9	<0.250	108	0.49	**27**	<0.250	3.7	**44**
Sand	1	1.8	0.06	9	15	2.7	<0.050	**260**	<0.40	6.9	<0.50	4.5	15

Notes:
N = Number of Sample in Category
*Values in **BOLD FONT** indicate exceedances of the CCME ISQG or Thompson LEL (Closest Observation Method)*
[1] CCME Sediment Quality Guidelines for the Protection of Aquatic Life, CEQG Online, accessed April 26, 2020
[2] Derivation and Use of Sediment Quality Guidelines for Ecological Risk Assessment of Metals and Radionuclides Released to the Environment (from Uranium Mining and Milling Activities In Canada), P. A. Thompson, J.Kurias and S. Mihok, 2005, lower value represents data derived using "Closest Observation Method" (used in preliminary ESAs for Rayrock and the higher value represents data derived using "Weighted Method" as used in the Rayrock HHERA
- = No Data Available

A review of this data indicates that highest uranium concentrations can be found in the upper 0.2 m of the organic sediments. Given the marked decrease in uranium concentration below this zone of surficial enrichment, it is possible that the underlying uranium concentrations (order of 100 to 400 mg/kg) may be reflective of background concentrations, unimpacted by anthropogenic activities within the Mill Lake watershed though this cannot be confirmed in the absence of pre-development data for the Mill Lake sediments.

The Rayrock Conceptual Site Model (CSM, CIRNAC, 2019a) identifies that the source of the sediment contamination is believed to primarily be dust from the ore rock extracted from the mine that was deposited into Mill Lake by spills, surface runoff, or wind transport).

Mill Lake Summary

Based on the available information, the likely sources, and fate and transport mechanisms controlling inorganic contaminants within Mill Lake have been determined. Based on the information contained in the various site studies, the following conclusions have been made:

- The HHERA for Rayrock identified that "Mill Lake has high uranium concentrations in water and sediments and the benthic survey conducted in 2017, suggests that high uranium concentrations in the sediments may be affecting the benthic community" (CanNorth, 2018).

- Waste rock present in the Mill Lake catchment area contains high concentrations of readily leachable metals, particularly copper and uranium. Based on catchment topography, it is estimated that 30% of surface runoff will interact with waste rock prior to reporting the Mill Lake. The potential exists that waste rock which remains in the Mill Lake catchment may represent a significant ongoing source of dissolved cationic metals to Mill Lake.
- A potential source of the sediment contamination is believed to primarily be dust from the ore rock extracted from the mine that was deposited into Mill Lake by spills, surface runoff, or wind transport. Mill Lake may have received periodic effluent release from milling operations; however, it primarily acted as a source of clean process water.
- Dissolved metals within the water column of Mill Lake are the most likely source of metals to the sediments of Mill Lake.
- Discharge from Mill Lake into Mill Creek has resulted in measurable concentrations of some metals in soils along the flow pathway; however, effects appear to be ameliorated prior to discharge to Sherman Lake.

5.3.1.2 Consideration of Remedial Options and Selection of Remedial Activities

A Mill Lake Sediment Remediation Feasibility Study was completed in 2020 (AECOM, 2020h). The Study was undertaken to identify and evaluate remediation alternatives to address the uranium-impacted sediments in Mill Lake. The objectives of this report were to present a summary of the known physical and chemical properties of the Mill Lake sediments and Lake water, and to identify remedial alternatives that have the potential to be applied to the lake sediments.

The remedial alternatives were evaluated using criteria considering socio-economic, environment and sustainability, technical and economic elements of the project. These criteria formed the basis to support remedial alternative evaluation through a Multiple Accounts Analysis (MAA) and allowed for the development of a feasibility level cost estimate (Class 4) for each remedial alternative. From this analysis, a preferred course of sediment remediation was recommended for engineering and design. The reader is referred to this Study for a detailed discussion of the remedial alternatives summarized below.

5.3.1.3 Sediment Remediation Alternatives

Various technologies are considered appropriate for management and remediation of impacted sediments. The sediment management remedy selected for a project is based on numerous factors that consider site-specific characteristics, type of contaminants, site logistics, regulatory requirements and ability of technology to achieve remedial objectives. The technologies are grouped into four general categories those being:

- Monitored natural recovery/natural attenuation,
- Removal through excavation and dredging,
- Capping (and consolidation) in place, and
- In-situ treatment.

The alternatives assessment commenced with the identification of several sediment management alternatives from which to start evaluating. Each alternative was assumed (preliminarily) to have the potential to achieve the remediation targets for surface water and sediments in Mill Lake. These alternatives included:

- Alternative 1: In-situ solidification of contaminated sediment with onsite disposal
- Alternative 2a: Surcharge sediments and construct barrier cover (summer construction)
- Alternative 2b: Surcharge sediments and construct barrier cover (winter construction)

- Alternative 3: Chemical/physical treatment to consolidate sediment with onsite disposal
- Alternative 4a: Hydraulic sediment pumping with sediment solidification and onsite disposal (summer construction)
- Alternative 4b: Hydraulic sediment pumping with sediment solidification and onsite disposal (winter construction)
- Alternative 4c: Excavate the Upper 0.5m of Frozen Sediments and Onsite Disposal
- Alternative 5: Hydraulic dredging/pumping, dewatering and solidification within geotextile tubes and onsite disposal
- Alternative 6: Hydraulic dredging/pumping with mechanical dewatering and solidification with onsite disposal
- Alternative 7: Monitored natural attenuation/long-term monitoring

Each alternative (with the exception of alternative 7) assumes that, upon completion of remediation, Mill Lake will no longer be a lake, rather the lake basin will drain towards Mill Creek and eventually Sherman Lake through engineered swales and ditches with minimal standing water remaining in the Mill Lake basin.

Water treatment was assumed for all alternatives to mitigate the potential for offsite migration of contaminated surface water leaving the remediation area. This water could/would include: 1) Mill Lake surface water that requires testing and potentially treatment prior to discharge, and 2) water produced from sediment dewatering or treatment that also requires treatment. During remedial activities, at a minimum a series of turbidity curtains, aqua-barriers, booms and other types of protective measures will be used within Mill Lake prior to contain water prior to treatment and off-site discharge.

5.3.1.4 Sediment Removal Depth

Remedial planning initially considered removal of only the uppermost portion (top 0.2 m) of the sediments since this was the zone having the highest uranium concentrations and to comprise those sediments likely affected by anthropogenic activities (mining processes).

Removed sediments were anticipated to be transferred into a containment cell (Confined Disposal Facility or CDF) for subsequent dewatering, solidification and construction of a cover system constructed atop the solidified material. Sediments remaining in the lakebed would either:

- remain in place and the lake allowed to reform,
- remain in place with the lake drained and not allowed to reform, or
- a cover could be constructed atop the remaining sediments.

Leaving residual sediments in the lake presented the following Project challenges:

- Due to the very loose nature of the sediment, removal to only 0.2 m depth would be difficult and removal to at least 0.5 m was anticipated given the difficulties with removal of such a thin layer of material and verification that impacts would be addressed. Any work in the lake would result in massive suspension of the sediment in the lake water. Achieving desired depths would be a challenge and the resulting settlement of the suspended sediments could result in a return of elevated uranium concentrations in the sediment surface – a condition which would render the removal efforts having gained minimal benefit.

- There is only sediment data at six locations at depth within the lake. There is insufficient vertical delineation data to say with certainty that the highest concentrations are only in the top 0.2m of sediment and therefore, elevated and anthropogenic uranium could be present at deeper depths.
- There is insufficient information to know if the suspended high concentration sediments float and/or would sink deeper into the sediments, causing them not to be excavated.
- The extreme hydraulic nature of the sediments provides no assurance that the elevated uranium would be captured and isolated with this type of removal given the dynamics of the material. Determination of residual uranium concentrations in remaining sediment would be complex as partial sediment removal would result in the likelihood of a high level of suspended solids in the water that could take a long time to settle and potentially re-contaminate the remaining sediments.
- The hydrous and very soft nature of the sediments would make it very difficult to target a thin layer of material. The material has very little structure and is largely comprised of water. Excavation/removal methods will quickly disturb and mobilize the sediments both vertically and laterally. Excavating sediments in one location will quickly mobilize contaminants to another.
- The cost of full depth sediment excavation was compared to partial remediation and found to be of a similar order of magnitude.

Based on the above, a strategy of full depth sediment excavation was selected to based on the anticipated effectiveness of the option to fully remove the impacted sediments and uncertainty associated with the recontamination of the remaining sediments and the technical uncertainty (constructability).

The organic sediments will be removed to the clay or bedrock surface as best as practical. This method will remove the material with the highest uranium concentrations. Residual uranium concentration at the base of excavation (clay/silt subgrade) are expected to be low and are associated with natural background condition based on the pre-remediation data collected.

5.3.1.5 Multiple Accounts Analysis

MAA is an evaluation and scoring method that considers multiple factors when evaluating remedial options. It provides a transparent method for remedial options evaluation that also largely removes personal bias, numerically scoring remedial options relative to one another according to set criteria. The system is comprised of tiered evaluation, set up as a matrix. The first tier is comprised of categories, with each category then broken out into a second tier of individual criteria selected to be appropriate to the specific area/element being evaluated.

The four categories considered in the analysis included:

1. Socio-Economic (30% Weighting): This category evaluates such items as community/stakeholder preferences or perceptions, socio-economic benefits, research opportunities of the project, regulatory considerations, and issues relating to future land use and aesthetics.
2. Technical (30% Weighting): This category considers various technical issues related to remedial design, design uncertainty, constructability, and considers health and safety to workers (or the public) during construction.
3. Environment and Sustainability (20% Weighting): This category is intended to evaluate potential environmental impacts of each proposed remedial option relative to existing and post-remediation conditions. It considers the effect the option has on the greater environment and how protective the technologies applied to the option are for fuel usage (carbon signature), air quality, the remedial footprint of the method and the quality of the final media as being protective of the receiving environments.

4. Economic (20% Weighting): This category evaluates relative costs of the remedial options and considers this across multiple stages of the work, as applicable.

As presented in Section 5.2, the Tłı̨cho Government met to discuss the alternatives presented in the MAA. The remediation alternatives were reviewed with Government representatives, and representatives of PSPC and AECOM. The meeting concluded that the Tłıchǫ Government did not have an objection to the proposed Mill Lake remediation approach (described in Section 5.3.1.6 below). It was noted that the Tłıchǫ Government did still have some questions about the approach which would continue to be asked and answered during the summer 2020 field season.

5.3.1.6 Selected Alternative

The MAA identified the highest rated alternatives to be 4b and 5. Through further evaluation of these methods, the selected remediation approach became a hybrid of these two and includes the hydraulic removal and transfer of sediments into geosynthetic sediment bags followed by ultimate disposal in a CDF.

This involves the following remedial activities:

- Installation of a water treatment system to draw down a portion of the lake water prior to remediation.
  - The surface water from Mill Lake will be pumped and treated to reduce metals concentrations to a level meeting the CCME Water Quality guidelines for the Protection of Freshwater Aquatic Life.
  - Following treatment, the water will be discharged to Sherman Lake.
- Construction of a sediment management unit/confined disposal facility within Mill Lake that would include:
  - Isolation of the selected sediment management area/confined disposal facility within Mill Lake using temporary cofferdam type structures (i.e., temporary water filled dams or portable dam structures).
  - Pumping of the surface water and organic sediment from within the isolated area.
  - Construction of an engineered base to facilitate water drainage and environmental protection.
  - Construction of a sediment management area for geosynthetic sediment bags used to dewater sediments pumped into the bags.
  - Water/sediment distribution infrastructure including piping manifolds, valves, metering pumps and polymer distribution piping, etc.

The selected remediation alternative contains the impacted sediment within the footprint of Mill Lake and minimizes the ponding and accumulation of surface water in the Mill Lake basin by promoting continuous overland flow and drainage to the Mill Creek inlet and on to Sherman Lake.

Figures 20 through 22 (Appendix A) illustrate the above concept with further details of each of the above steps described below.

5.3.1.7 Confined Disposal Facility Location

Several factors were considered when identifying potential locations for the CDF to be constructed. The potential locations are described in the table below.

Table 5-2: Confined Disposal Facility Location Comparison

Location	Advantages	Disadvantages
Mill Lake	• Low requirement for borrow soil (2019) vs capping lake (pre-2019) plan • Least distance for sediment transport, waste rock transport • Lake basin structure provides structural (sidewall) support for the CDF • Lake basin provide secondary containment during construction • Lake removal reduces long-term monitoring requirements • Cell can be constructed to blend into landform • Furthest location away from Sherman Lake	• Removes lake (limited aquatic habitat) • Currently unconfirmed base structure (soil/rock) • Longest haul for borrow soil
Former Mill Footprint	• Cell footprint is already a known area of impact • Cell construction could commence earlier than lake location • Cell base condition is known • Adjacent to lake	• The required cell size would consume most of the available space next to Mill Lake – which reduces work area. Would create construction logistics issue. • will require long term monitoring of Mill Lake • Larger volume of borrow required for cell construction (compared to lake location) • Cell landform will be readily apparent (aesthetics)
TCAs	• Cell footprint is already a known area of impact	• Will require long term monitoring of Mill Lake • Cell base could be unstable (mix of tailings and wastes) • Longer distances for sediment and waste rock transport (500 – 1,000 m) • Larger volume of borrow required for cell construction (compared to lake location) • Cell landform will be readily apparent (aesthetics) • Cell location closer to Sherman Lake – concern for failure/incidents/ releases • Disturbs effort of last 25 years of reclamation/ revegetation
Former Airstrip	• Cell footprint is already a known area of disturbance • Storage area can help with reclamation of airstrip location • Cell base condition is known, cell construction could commence early in project • Cell would be constructed adjacent to borrow area • Cell could be constructed to blend with landscape	• Longest distance for sediment and waste rock transport (1,200+ m) • Will require long term monitoring of Mill Lake • Cell location closer to Sherman Lake – concern for failure/incidents/ releases

5.3.1.8 Surface Water Management

The sediment dewatering will result in elevated suspended solids in the water and potentially concentrate contaminants of concern. An initial step in conducting the remedial works at Mill Lake is treating the lake water prior to discharge into Sherman Lake. Water treatment is considered necessary to mitigate against potential penalties if the water is considered a “Deleterious Substance” under the Fisheries Act or if Administrative Monetary Penalties could be applied under the Nuclear Safety Control Act. Treatment to CCME Freshwater Aquatic Life Guidelines is the current expectation for first level screening. The historical water quality of Sherman Lake will further be considered. In a situation where the concentration of a substance in Sherman Lake may be higher than the CCME Guideline, using the Sherman Lake water quality value would be a more appropriate target.

The Project will have a requirement for real time analytical capacity with regular analytical laboratory confirmation. Northern project examples are available for such a purpose (e.g., the existing quality assurance/quality control (QA/QC) Plan for the Tundra water treatment project).

Process Flow

Preliminary design work has included an assessment of the volume of water requiring treatment so the water treatment system can be sized for an appropriate flow rate given the volume of water to be treated and the operating window for treatment. The approximate volume of water in Mill Lake is estimated to be 93,600 m^3 when full to the current Mill Creek outlet level. In addition to the base water (excluding sediment porewater), the water treatment system must be able to accommodate precipitation during the operational period.

The volume of surface water in Mill Lake was estimated using LIDAR data previously-obtained for the Rayrock area. The volume of precipitation was also estimated using LIDAR data to determine the catchment area for Mill Lake and precipitation data from Yellowknife to estimate the quantity of accumulated rainfall.

Preliminary calculations based on the 75% RAP were that the total volume of water to be treated was in the order of 112,000 m^3 (84,000 m^3 plus 28,000 m^3) which would be treated from a period of approximately June 1 to August 31 (90 days) or an average of 1,244 m^3/day. For the purposes of this project we had assumed that one treatment train to be 1,500 m^3/day. A longer operational season and a larger water component from sediment dewatering are anticipated based on the current RAP which will have an effect on flow rates. These rates will be determined during detailed design. However, the flow rates and the rate of flow are expected to be of the same order of magnitude as the 75% RAP and remain to have negligible impact on lake levels in Sherman Lake.

The impact on lake levels in Sherman Lake when pumping water from Mill Lake was examined. The Sherman Lake footprint is estimated to be approximately at 178.5 ha in size as compared to Mill Lake's size of 3.6 ha. The impact of the Mill Lake discharging at 1,500 m^3/day or 3,000 m^3/day will have a negligible depth increment (less than 1 mm/day) on lake levels in Sherman Lake.

Water is expected to be discharged to Sherman Lake through a hose/pipe and not via Mill Creek. Outlet considerations include dispersing the water energy by ejecting the water onto the bedrock shore (a potentially suitable location is present to the east of Kwetsǫ̀tìa). The flow energy could further be reduced through the use of a diffuser. Another consideration would be to affix, mount or float the discharge directly in Sherman Lake in a manner that does not disturb the sediments. Again a diffuser could be used to reduce the energy of the discharge.

Process Waste

Since the water treatment process wastes will contain concentrated uranium, they will need to be managed on-site and disposed of by placing them in the Mill Lake CDF.

Water Treatment System Design and Construction Considerations

Detailed design of the water treatment system will need to consider the following:

- Laboratory Testing: Additional water and sediment quality data will be collected to refine the water quality treatment strategy and to provide information to future bidders.
- Equipment Mobilization: The equipment container proposed by the vendor will be heavier that the maximum weight for regular helicopter transport. In addition, a building/enclosure is required to be brought to site to house the treatment equipment. Therefore, winter road is expected to be the main method of equipment mobilization.
- Treatment Building: A heated treatment building will be required to house the water treatment equipment.
- Power Supply: The water treatment plant will likely operate 24 hours/day and will need a constant power source. This power source will need to be reliable and have sufficient fuel to operate at least through one treatment season along with some contingency.

- Pumping: Raw influent and treated discharge water streams will need to be pumped to and from the treatment system, respectively.
- Operation: The treatment plant has to be designed to operate 20 hours a day and 7 days a week. (4 hours a day for planned maintenance)
- Maintenance: Regular maintenance needs to be scheduled for the fuelling, power and treatment system. Plans need to be in place for an ability for “emergency” servicing of the system. A maintenance schedule will be provided by the equipment supplier. The requirement for spare parts to be readily available on site should also be considered.
- Automatic Emergency Shut Off: The system will be equipped with an automatic emergency shutoff system for equipment and safety protection purposes.
- Weather Considerations: The treatment building needs to be insulated and heated due to the local climate. Weather considerations for all equipment (fuelling, pumping, water treatment, discharge) need to be considered. In addition, the equipment will be required for two treatment seasons. Therefore, the equipment will need to be able to accommodate a seasonal shut down.
- Waste Management: Handling of waste generated from a treatment system is a challenge for this site, given that uranium-impacted materials cannot be hauled offsite. Waste will need to be buried on site within the CDF.
- Contingency plans will need to be developed for system stoppage, failure, and maintenance work. Back-up equipment may need to be brought to site on winter road in the event of failure.

CDF Design and Construction

The constructed CDF will initially function as a location for sediment dewatering. Once the sediments have initially been dewatered by processing through geosynthetic bags, waste site materials (tailings, waste rock, concrete, etc.) will be placed atop the sediments to enhance the dewatering, engineered soil (clay) walls will be constructed and the cell capped. Activities will include:

- Installing temporary cofferdams (i.e., temporary water-filled dams and portable dams) to isolate the sediment management area/confined disposal facility.
- Pumping of surface water and organic sediment from within the isolated sediment management area/confined disposal facility.
- Constructing an engineered base to facilitate water drainage and environmental protection within the isolated area.
- Constructing the sediment management area for the geosynthetic sediment bags that will be used to dewater sediments pumped into the bags.
- Installing water/sediment distribution infrastructure including piping manifolds, values, metering pumps and polymer distribution piping, etc.
- The CDF may be constructed adjacent to the steep southeast edge of the Marian Fault. The interface of the clay cell and the bedrock requires further analysis. The concern being that freeze/thaw and wetting/drying conditions between the bedrock and the clay could create opportunities for water infiltration into the cell. This could be alleviated by either constructing a clay layer adjacent to the bedrock, placing a flexible membrane liner (e.g. bituminous geomembrane) at this interface or by not building the cell directly against the rock face and allowing for surface water runoff to drain around the cell.

Project considerations include:

- Cell Location: The specific cell location within Mill Lake has not yet been determined. Sub bottom profiling using acoustics is proposed for late 2020 to assist with further defining the lake bottom to understand the nature of the sediments, the depths to clay and bedrock. This information will be required to find the most practical location of the cell within the lake.
- Design Drawings: Engineering drawings will be developed prior to cell construction; however, since the exact quantities of sediment, and to a lesser degree waste rock and tailings, will not be known until construction, some field engineering will need to occur to accommodate actual volumes. Field adjustments will be necessary to manage the actual pad footprint size and height, ensuring adequate drainage and allowing for equipment to work safely on the ultimate landform.
- Cell Design: Additional geotechnical work is required to advance the cell design.
  - Permafrost and Freeze/Thaw Impacts: The impact of freeze/thaw cycles on the clay soils to be used in cell construction will be reviewed during the detailed design phase. Key considerations include: an assessment of the likelihood of permafrost setting into the cover over time; the impact of freeze/thaw cycles on the cover including an examination of the need for a frost protection layer; and the potential that a hybrid soil and geosynthetic cover provides a more optimal level of protection.
  - Cap Thickness: The thickness of the clay cap will need to be developed with the following considerations: reducing infiltration, performance through freeze/thaw cycles, radiation protection, physical stability, need to incorporate a geosynthetic liner; constructability and possibly other items.
  - Cell Construction: The underlying bedrock or clay at the selected location will be evaluated to determine if any areas need to be graded, leveled or enhanced to provide stability and or reduce differential settling.
  - Porewater Pressure: New cell design will need to account for porewater pressure within the cell and whether or not an underdrain system is required. This analysis will also address the metal concentration of the captured drainage water.
  - Cell Stability: An examination of the material properties of the cell constituents (clay, sediment, waste rock, sediment, etc.) requires and engineering evaluation to assess slope stability (slope failures, failures at interfaces, liquefaction, etc.), potential settlement; and potential drainage layers to be incorporated into design.
  - Erosion: Cell design will minimize erosion by channeling runoff to selected locations and minimize long-term cell maintenance.
  - Climate Change: Cell design will consider the possible impacts of climate change and how these impacts may affect long term stability and function
  - Sediment Characteristics: A project data gap is how the sediment will perform during remediation, including the excavation process, the dewatering process, freeze/thaw effects and workability and settlement in the CDF. Future work will include field and laboratory testing of sediments for geotechnical properties and geosynthetic sediment bag dewater tests. The potential to mix the dewatered sediments with the drier, more stable spilled tailings and waste rock in the CDF will further be reviewed.

Sediment Removal

Sediment removal will include the following steps:

- Installation of floating pumps within Mill Lake to remove surface water/sediment slurry.
- Addition of a polymer to the slurry to facilitate dewatering.
- Pumping of slurry into geosynthetic bags.

- Capturing the discharge water from the synthetic bags and transferring to storage tanks prior to processing through the water treatment system.
- Synthetic sediment bags would be stacked two rows high with an intent to decrease the space required and to facilitate physical loading of the bags to increase dewatering.
- The remedial plan is to pump the sediments above the underlying clay/bedrock in the first year (May though September/early October).
  - Synthetic liners would be placed atop the synthetic dewatering bags upon completion of pumping.
  - It is expected that 0.3 m to 0.5 m of residual slurry/sediment would remain at the lake bottom at the end of pumping.
  - This residual material would be allowed to freeze in the winter months.
  - Winter construction would include the removal of this frozen sediment, rocks, debris and placement of this material into the sediment dewatering unit atop the synthetic liner.
  - Sumps would be excavated into the underlying clay at select locations around the lake during the winter to facilitate surface water collection upon spring thaw. Water would be pumped from these sumps into either the CDF or water treatment system (depending on solids content) in the spring.
- Upon the best practical dewatering in the spring, light equipment will be utilized to grade the Mill Lake basin to promote positive drainage and continue water drainage. Saturated clays will take some time to dry and be able to hold up to heavy equipment and allow additional grading.

Considerations and challenges anticipated with sediment removal include:

- Worker Health and Safety: All workers must be protected from the dust generated during sediment removal operations. This not only includes workers in the Mill Lake area, but also any workers on-site that may be exposed to wind-blown particulate. Workers will likely be required to wear Tyvek work suits, respirators and individual dosimeters amongst other personal protective equipment.
- Undulating Bedrock Surface/Folds, Faults and Cracks: The lake bottom surface will be irregular. Machine cleaning will be used as best as practical; however, some locations will require potentially difficult manual labour to remove sediments. The exact surface condition may not be known until the lake is pumped out.
- Deep locations or crevices in bedrock may be difficult or unsafe to facilitate complete organic sediment removal. In the event that a location is not practical to clean (primarily due to safety reasons), the depression may be capped with onsite material followed by blast rock.
- Level of “Clean”: Despite the efforts outlined in the workplan, there will be residual amounts of sediments left following cleaning. The amount of residual sediments will, however, be less than the current condition of the site and the final lake bottom condition would be similar to “cleaned” areas after tailings and waste rock removal at other locations on site. The residual dust/ soil atop the bedrock is not expected to have a much different soil quality than residual dust and soil across the wider Rayrock site (i.e., outside of Mill Lake).
- Soil Handling: The time duration for sediment dewatering is currently unknown. Sampling and testing will occur in 2020 to facilitate the understanding of this process for design incorporation.
- Weather: Weather (cold, wet, hot, dry) will all impact how the above activities are executed and strategies to conduct the work in different types of weather will need to be detailed prior to execution. These considerations will need to be taken into account for both construction processes and worker health and safety. A review of the historical PWGSC construction reports (Section 6.2 of this report) identifies some of the site challenges that can be expected due to inclement weather.

Bedrock Swale/Mill Creek Inlet (Blasting)

A drainage swale, ditch or gradual grading will be constructed in the lake bed to facilitate drainage into Mill Creek with a minimal amount of ponding in the former lake area. **Figures 21 and 22 (Appendix A)** show this swale in conceptual plan and profile views. While preliminary engineering drawings can be prepared for this design based from LIDAR and bathymetric data, the design will need to be reviewed in detail subsequent to both a review of the 2020 sub bottom profiling, draining of the lake and confirmation of the lake bottom surface topography.

All blasting will need to be low energy to not impact on underlying mineworks or features (such as the ice plug in the adit).

Design considerations with the lowering of the Mill Creek inlet include:

- The potential for creek flows to change since they are currently moderated by Mill Lake. While net flow to Mill Creek is not expected to change, the rates of flow may change.
- Mill Lake attenuates the Mill Creek flow when the water level is below that of the outlet. This attenuation will be lost at times of low lake levels.
- At times of high lake levels, when water currently flows into Mill Creek, flows will be similar to current conditions
- Groundwater flow is not expected to be a significant component of the water balance to Mill Creek; however, there should be no impact to the flow based on the proposed remedial activities.
- Energy diffusion will need to be considered for the new blasted chute at the new Mill Creek inlet to protect against erosion of the peats and natural landscape of Mill Creek.

5.3.1.9 Restoration/Reclamation

Upon completion of the works, reclamation activities will be required for the former Mill Lake basin. For the most part, the basin will be exposed clay/bedrock surface, the same as the land surrounding the former lake. Bedrock depressions are expected within the lake area. Some of these depressions may be left open to collect surface water and some depression would be filled with soil and organics, possibly with transplanted trees. The combination of small natural pools of water and vegetation will assist in the former lake having the appearance of the surrounding landscape.

5.3.2 Mill Lake Water

5.3.2.1 Description

Surface water sampling has been ongoing at Rayrock since 1979. This sampling has identified various metals at concentrations exceeding the referenced water quality guidelines. The Tłı̨chǫ government has expressed a concern that metal-impacted water from Mill Lake flows into Sherman lake and consequently into the downstream Marian River. Environmental sampling conducted in 2017 concluded that there was no evidence that contaminants from Rayrock were reaching the Marian River (CanNorth 2018).

Appendix C contains tables summarizing the historical water quality analytical results, including:

- Table C6 Historic Sediment Analytical Results - Radionuclides
- Table C7 Historical Surface Water Analytical Results - Select Metals and Isotopes
- Table C8 Historic Surface Water Analytical Results - General Metals
- Table C9 Historical Laboratory Analytical Results - Physical Anions

A review of the data identifies two chemical elements within the Mill Lake water that are consistently present at concentrations greater than the CCME Freshwater Aquatic Life surface water guidelines: uranium and copper. Other metals have also occasionally been identified at concentrations greater than the CCME guidelines (lead, aluminum, iron, nickel and zinc); however, these exceedances tend to be isolated and do not demonstrate a consistent pattern of exceedances. As identified, the 2018 HHERA identifies uranium to be the primary element of environmental concern/risk associated with the lake. Historical analyses show uranium concentrations at levels greater than the referenced guidelines in all Mill Lake surface water samples, as summarized in the following table.

Table 5-3: Uranium Concentrations in Surface Water (post 2000)

Location	Number of Samples	CCME Freshwater Aquatic Life Guideline (mg/L)	Lowest Uranium Concentration (mg/L)	Average Uranium Concentration (mg/L)	Maximum Uranium Concentration (mg/L)
New Control Lake	10	0.015	0.00029	0.00042	0.00074
Sherman Lake	39	0.015	0.00039	0.00075	0.0032
Alpha Lake	25	0.015	0.00090	0.0058	**0.035***
Lake A	6	0.015	0.00020	0.00028	0.00037
Mill Lake	21	0.015	**0.065**	**0.093**	**0.19**

Note: Data excludes analytical results prior to 2000, since anomalies within this data affect the data interpretation.
***Bold** numbers are analytical results greater than the CCME Freshwater Aquatic Life Guideline.*
** Exceedance found in Alpha Lake of 0.035 mg/L was a singular occurrence from a water sample collected in 2000 with no other water samples undertaken since showing an exceedance.*

A review of the water quality data from Mill Lake indicates reasonably consistent concentrations of uranium and other metals over time. Uranium concentrations primarily remain within one order of magnitude over the 20 years of monitoring data. The potential for dissolved uranium concentrations to increase is expected to be low or negligible without a new contaminant source being introduced to the lake basin.

In assessing human health risks at the mine site, the Rayrock HHERA calculations assumed that drinking water for persons temporarily residing at the mine site would be obtained from Sherman Lake and not Mill Lake and the report conclusions are based on this assumption.

The Rayrock HHERA identifies that *“Mill Lake has high uranium concentrations in water and sediments and the benthic survey conducted in 2017, which suggests that high uranium concentrations in the sediments may be affecting the benthic community.”*

The HHERA references benthic work completed by Arcadis (Arcadis, 2018b) that “Mill Lake continues to exhibit low numbers of species, densities, and diversity and concluded that these results are likely the result of sediment contamination (primarily high uranium concentrations) at this location.”

5.3.2.2 Consideration of Remedial Options and Selection of Remedial Activities

The HHERA findings support remedial actions at Mill Lake. No detailed examination of remedial options for Mill Lake was undertaken since the Mill Lake Sediment Remediation Feasibility Study identifies that water treatment will be an inherent component of the sediment remediation process. Prior to initiating sediment treatment, the majority of Mill Lake water will be treated to reduce metals concentrations to CCME Freshwater Aquatic Life guidelines prior to discharge to Sherman Lake (as described in Section 5.3.1.8). Remaining lake water and water emanating from the dewatered sediments will further be treated to meet these guidelines prior to discharge to Sherman Lake.

5.3.3 Waste Rock

5.3.3.1 Description

Waste rock from the underground workings extends to the north and south of the adit portal area. The waste rock was dumped at angle of repose and shows no signs of instability. Reclamation of the waste rock surface, involving re-sloping, placement of soil cover and re-vegetation, has not been carried out, although there is some evidence that the waste rock was graded as part of the 1996 remedial activities. This re-grading was likely necessary as part of the capping of the adit (CIRNAC, 2019a). Locations of waste rock and spilled tailings are shown on **Figure 23, Appendix A**.

According to information presented in the 2019 CSM (CIRNAC, 2019a) ore consisting of ~0.4% uranium oxide (U_3O_8) was temporarily stored at the location of the former waste rock pad adjacent to the mine adit and Mill Lake. It is unclear how long the material remained exposed to the elements and potential effects of weathering. In addition, previous investigations (AECOM, 2020a) have documented a significant volume (estimated to be > 2,000 m^3) waste rock (and potentially tailings) located within the Mill Lake catchment area.

Assessment of the Acid Rock Drainage (ARD) potential of the waste rock suggests that this material is unlikely to be acid generating (10/11 samples tested) (Senes, 2010). Waste rock samples assessed as part of the 2010 investigations (Senes, 2010) were reported to have high concentrations of total copper, uranium and other metals:

- Concentrations of copper in waste rock samples collected from the margin and up-slope of Mill Lake range from 77 to 350 mg/kg, relative to an average crustal abundance of 10 mg/kg for low calcium granitic rocks (an enrichment factor of 7x to 35x).
- Concentrations of uranium in waste rock samples collected from the margin and up-slope of Mill Lake range from 37 to 166 mg/kg, relative to an average crustal abundance of 3 mg/kg in low calcium granitic rocks (an enrichment factor of 12x to 55x).

Waste rock samples collected from within the Mill Lake catchment area (Senes, 2010) were subject to shake flask extraction (SFE) analysis as well as Tessier sequential leaching analysis. Detectable concentrations of some metals in excess of CCME water quality guidelines for the protection of freshwater aquatic life (FAL) were noted in the SFE results. Notably, concentrations of copper and uranium were measured in SFE extracts at concentrations in exceedance of CCME FAL suggesting that these elements may be readily leachable from the waste rock present in the Mill Lake catchment.

Concentrations of uranium measured in SFE supernatant were reported between 0.01 and 0.07 mg/L. These reported concentrations in the SFE extracts are approaching the average concentration of uranium measured in surface water collected from Mill Lake (0.08 mg/L, AECOM 2020a). Results of Tessier sequential extraction indicate that the majority of total uranium content of the waste rock samples (55%) is uranium bound to carbonates and can be readily leached during carbonate weathering.

The Mill Lake catchment areas has been divided into two sub catchments based on the surface runoff flow pathways, and the requirement of surface runoff to interact with waste rock prior to reporting to Mill Lake. The total area of the Mill Lake catchment is in the order of 33 ha, of which 10.5 ha (~30%) will require surface runoff and shallow groundwater to interact with waste rock prior to reporting the Mill Lake.

It should be noted that the result of the SFE and sequential extraction tests described above do not necessarily provide a means for determining the concentration of uranium in surface water within Mill Lake; however, they do point to waste rock within the Mill Lake catchment as a potentially significant long-term source of copper, uranium, and other metals to the aquatic environment.

CIRNAC (CIRNAC, 2019a) identifies that re-grading of the waste rock around the mill was completed as part of either the 1980's building demolition or as part of the 1996 Remediation that capped the tailings. Given the likelihood that waste rock was recovered in the area and the grades that are observed today, it is likely that some regrading of the waste rock in the mill area occurred in 1996. Metal contamination in the soil around the mill would likely originate from a combination of ore dust, ore spills and tailings spills. Any grading of the waste ore would have mixed the ore dust and ore spills into the coarse waste rock.

An assessment of the leaching potential of bedrock samples collected from the native bedrock areas located near the outlet of Mill Lake was presented in the AECOM 2019 Field Program Summary report (AECOM, 2020d). Bedrock samples collected from areas adjacent to the lake, but not suspected of being impacted by waste rock or tailings indicate very low metals leaching potential. SFE results of native bedrock exhibit very low concentration of uranium in the supernatant. Concentrations of uranium in the SFE extracts of native bedrock are generally an order of magnitude lower than those measured in waste rock in 2010.

5.3.3.2 Consideration of Remedial Options and Selection of Remedial Activities

The scope of waste rock management includes:

- Waste rock stockpiled alongside the west side of Mill Lake at the base of the Marian River Fault.
- Comingled waste rock and soil around the former mill pad.
- Comingled waste rock and soil present along internal site roads.

Remedial options considered included:

Table 5-4: Considered Waste Rock Management Options

Option	Description	Details	Selected
1	Leave As-is	• Does not address potential for metals leaching into Mill Lake	No
2	Cover in Place	• Feasible, adds some complexity • Requires more borrow soil than other options • Requires ongoing Operation, Maintenance and Surveillance (OMS)	No
3	Excavate and Dispose On Site	• Supports sediment remediation strategy • Consolidates site wastes • Supports the sediment dewatering process • Requires ongoing OMS	**Yes**
4	Excavate and Dispose Off Site	• Deemed part of the fuel cycle by CNSC and considered low level radioactive waste • Cannot be shipped off-site • Costly to ship off-site	No

The selected remedial option is to contain the waste rock in the sediment CDF. Project considerations include:

- All visible waste rock will be removed to the extent practical as deemed by the site engineer.

- Waste rock will be removed to the bedrock surface. Locations beneath waste rock will be broom swept and it is recognized that some residual particulate will remain atop the bedrock surface. This residual rock/soil is not expected to represent a significant environmental concern.
- Waste rock will be left at the adit cover. The material currently rests at what appears to be a steady state angle of repose.
- Waste rock and/or waste rock/soil mixes located within well-vegetated areas will remain in place (as deemed practical by the site engineer).

5.3.4 Spilled Tailings

5.3.4.1 Description

Spilled tailings were identified below the former powerhouse in the mill area, the base of a large outcrop by the former tailings pipeline and at multiple small locations along the tailings pipeline. Locations of spilled or stockpiled tailings and waste rock are depicted on **Figure 23 (Appendix A)** along with estimated volumes by area. According to the 2018 HHERA (CanNorth, 2018), the spilled tailings do not pose a threat to the wildlife or human health.

Site work completed in 2018 included a walk-through of the internal roadways within the mine site. Most of these roadways showed indications of spilled tailings and/or waste rock placement. Soil samples were obtained from this rock material on the main roadway between the mill and the camp in 2018. The results identified the concentrations of selected metals above the CCME residential parkland guidelines, including chromium, copper, molybdenum, nickel, selenium and uranium.

5.3.4.2 Consideration of Remedial Options and Selection of Remedial Activities

The scope of spilled tailings management includes:

- Spilled tailings below the former powerhouse in the mill area, the base of a large outcrop by the former tailings pipeline and at multiple small locations along the tailings pipeline.
- Potential comingled spilled tailings, waste rock and soil present along internal site roads.

Remedial options considered included:

Table 5-5: Considered Spilled Tailings Management Options

Option	Description	Details	Selected
1	Leave As-is	• Feasible since HHERA did not identify a significant environmental concern	No
2	Control and Monitor	• Feasible, requires ongoing OMS	No
3	Cover in Place	• Feasible, but impractical given widespread distribution and small locations to be covered • Requires ongoing OMS	
4	Excavate and Dispose On Site	• Supports sediment remediation strategy • Consolidates site wastes • Supports the sediment dewatering process • Requires ongoing OMS	**Yes**
5	Excavate and Dispose Off Site	• Deemed part of the fuel cycle by CNSC and considered low level radioactive waste • Cannot be shipped off-site • Costly to ship off-site	No

The selected remedial option is to contain the spilled tailings in the sediment CDF. Project considerations include:

- All visible spilled tailings will be removed to the extent practical as deemed by the site engineer.
- Spilled tailings will be removed to either the bedrock surface or "natural" soils. It is recognized that some residual particulate will remain. These residues are not expected to represent a significant environmental concern.
- Spilled tailings located within well-vegetated areas will remain in place (as deemed practical by the site engineer).

Since the 2018 HHERA identified that the spilled tailings do not pose a threat to the wildlife or human health, CIRNAC and the Tłı̨chǫ government agreed upon a hybrid option of leaving a portion of the tailings in place and excavating the remaining soil and placing it within the Mill lake encapsulation.

During the RAP work out sessions it was agreed that spilled tailings in mature vegetation stands or are otherwise inaccessible will be left in place, while the remaining tailings that are accessible will be excavated to bedrock and placed within the Mill Lake CDF.

Project specifications for removal will require development; however, considerations for removal at this time include maintaining 0.5 m from of existing established vegetation (the intent being vegetation at the edges of pathways and not occasional growth found in open areas).

5.3.5 Impacted Soil

5.3.5.1 Description

There is a widespread distribution of soils at the former mill workings and along Mill Creek that are impacted by various metals and PHCs (Arcadis 2018a). The scope of impacted soil management includes:

- Impacted soil at the Mill workings.
- Impacted soil at Mill Creek.

Impacted soils were identified surrounding the Mill Area during the 2010 assessment, and volumes were estimated to be in the order of 30 m^3 and 20 m^3 of metal and PHC-impacted soil (SENES, 2010); however, based on the findings during the site assessment by Rescan (Rescan, 2012b), additional PHC-impacted soil volumes were identified and found primarily in two areas: 1,200 m^3 north of the former mill and 150 m^3 by the former petroleum, lubricants, and oils area (SENES 2013). Delineation of these PHC impacts have not been reached, as the natural hydrocarbon content of the organic material in this area has made it difficult to separate the PHC impacts from what is natural biogenic hydrocarbons. The 2018 HHERA confirmed that the PHC and metals-impacted soils in the Mill Area do not pose a risk to human health, vegetation or wildlife.

Impacted soil within Mill Creek was mapped for the site during 2016 delineation activities. Both metal and PHC-impacted soil were identified along Mill Creek; however, it was difficult to distinguish between natural biogenic and anthropogenic (human caused) hydrocarbons. As such, two areas were identified as a concern: 4,900 m^2 (estimated volume of 1,900 m^3) at the inlet of Mill Lake, and 5,100 m^2 (estimated volume of 2,500 m^3) further along the main channel to Sherman Lake. The 2018 HHERA confirmed that the impacted soils alongside Mill Creek do not pose a risk to human, vegetative or wildlife health.

5.3.5.2 Consideration of Remedial Options and Selection of Remedial Activities

Remedial options considered included:

Table 5-6: Considered Impacted Soil Management Options

Option	Description	Details	Selected
1	Leave As-is	• Feasible since HHERA did not identify a significant environmental concern	No
2	Control and Monitor	• Feasible, requires ongoing OMS	No
3	Cover in Place	• Feasible, but impractical given widespread distribution and small locations to be covered • Requires ongoing OMS	
4	Excavate and Dispose On Site	• Supports sediment remediation strategy • Consolidates site wastes • Supports the sediment dewatering process • Requires ongoing OMS	**Yes**
5	Excavate and Dispose Off Site	• Deemed part of the fuel cycle by CNSC and considered low level radioactive waste • Cannot be shipped off-site • Costly to ship off-site	No

The selected remedial option is to contain the impacted soils in the sediment CDF. Project considerations include:

- Impacted soil will be removed to the extent practical as deemed by the site engineer.
- Impacted soil will be removed to either the bedrock surface or "natural" soils. It is recognized that some residual particulate will remain. These residues are not expected to represent a significant environmental concern.
- Impacted soil located within well-vegetated areas will remain in place (as deemed practical by the site engineer).

Since the 2018 HHERA identified that the impacted soils do not pose a threat to the wildlife or human health, CIRNAC and the Tłı̨chǫ government agreed upon a hybrid option of leaving a portion of the soil in place and excavating the remaining soil and placing it within the Mill lake CDF.

During the RAP work out sessions it was agreed that impacted soil in mature vegetation stands or are otherwise inaccessible will be left in place, while the remaining tailings that are accessible will be excavated to bedrock and placed within the Mill Lake CDF.

Project specifications for removal will require development; however, considerations for removal at this time include maintaining 0.5 m from of existing established vegetation (the intent being vegetation at the edges of pathways and not occasional growth found in open areas).

The 2018 HHERA confirmed that the impacted soils alongside Mill Creek do not pose a risk to human, vegetative or wildlife health. Mill Creek is heavily vegetated and underlain by peat soils along most of its length. The peat and natural soil conditions along Mill Creek have taken thousands of years to develop. The disturbance of this area through excavation and removal is expected to not meet the intent of site rehabilitation.

Therefore, in accordance with the work out sessions, the soils along Mill Creek will not be removed. Only those soils and vegetation requiring removal for the lowering (blasting) of the Mill Creek inlet will be removed. The overburden soils from this blasting area will be of "high-value" to the Project for use in reclamation activities and will be separated and maintained for this purpose. Soils anticipated to be used for revegetation purposes will require laboratory analytical testing for metals content prior to repurposing. Only soils meeting the remediation criteria will be repurposed.

5.3.6 Concrete Foundations

5.3.6.1 Description

Buildings at Rayrock were demolished by CIRNAC around 1987; however, several concrete foundations remain. These foundations have poor aesthetics and do not meet the Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the Northwest Territories (MVLWB/AANDC) or the WNSL. At Rayrock, there is an approximate volume of 650 m^3 of concrete on-site that requires disposal, with the majority located in the former mill area.

The Project anticipates that concrete structures will be completely removed. However, in the event that ground level pads are anticipated to remain, inspection and sampling activities will be undertaken to verify that there are no impacts beneath the concrete (consistent with the mine Reclamation Guidelines).

Testing of select pieces of concrete in 2018 did not identify petroleum hydrocarbon or asbestos concentrations in the samples tested. Field gamma radiation testing further did not identify any radiation concerns with the concrete.

5.3.6.2 Consideration of Remedial Options and Selection of Remedial Activities

The scope of concrete management includes:

- Former concrete building foundations at Rayrock.
- Miscellaneous concrete, if found, during remediation activities.

Remedial options considered included:

Table 5-7: Considered Concrete Management Options

Option	Description	Details	Selected
1	Leave As-is	• Not in compliance with site closure requirements • Poor aesthetics	No
2	Control and Monitor	• Not in compliance with site closure requirements • Requires ongoing OMS • Poor aesthetics	No
3	Cover in Place	• Not practical • Requires ongoing OMS	No
4	Excavate and Dispose On Site	• Compliant with site closure requirements • Consolidates site wastes	**Yes**
5	Excavate and Dispose Off Site	• Compliant with site closure requirements • Costly to ship off-site	No

The selected remedial option is to break the concrete foundations into small pieces and to place into the Mill Lake CDF.

5.3.7 Mine Adit

5.3.7.1 Description

The mine adit is currently covered with waste rock. PWGSC's 1997 Construction Management Report (PWGSC 1997) identifies that the adit was sealed with waste rock, though no technical details of that sealing are provided in the report. The portal area of the underground adit was filled with waste rock to seal the entrance and prevent access (CIRNAC, 2019a). A geotechnical investigation of the adit in 2001 (Knight Piésold; 2001A) identified that the adit could not be inspected due to the thick cover of waste rock placed over the opening. The report identified no concerns with the stability or integrity of the adit; however, recommended on-going inspections to ensure that the adit does not become exposed due to waste rock settlement. Site inspection by AECOM in 2019 confirmed that such exposure was not evident at that time.

No records of mine water adit discharge have been identified during RAP preparation.

- The *Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the NWT* require that concrete seals meet the design criteria outlined in the Consolidation of Mine Health and Safety Regulations R-125-95, which require among other things:
  - Reports to be under a professional engineer's seal and signature (#1.03)
  - Shafts or raises, unless exempted by the chief inspector (see #17.03 (4)), must ensure that the stopping is:

    (a) secured to solid rock or to a concrete collar secured to solid rock; and

    (b) capable of supporting a uniformly distributed load of 12 kPa or a concentrated load of 24 kN, whichever is the greater load (#17.03 (3)).

As these requirements are not all fulfilled for the adit (which may or may not have a concrete seal), the basis for exemption is that the chief inspector is of the opinion that an opening presents no greater hazard than the local natural topographic features (#17.03 (4)).

5.3.7.2 Consideration of Remedial Options and Selection of Remedial Activities

Remedial action for the adit is to communicate the adit history and status to the NWT Chief Inspector of Mines and seek either regulatory closure or any required actions as may be stipulated by the Chief Inspector. No other options were evaluated for the adit.

A detailed report will be prepared documenting the known adit history and current condition for submission to the Chief Inspector of Mines. The report will further detail actions to be undertaken around the mine adit during site remediation. These actions will include:

- Removal of waste rock near, but not extending to, the adit (as detailed in Section 5.3.3). The covered adit will remain as is.
- A geotechnical engineer will detail the safe proximity of waste rock removal without disturbing the adit cover.
- Waste rock covering and immediately adjacent to (distance to be confirmed by geotechnical engineer) will not be touched during excavation. Careful consideration will be needed to ensure that any waste rock removal in the vicinity of the adit does not compromise the stability of the waste rock covering the adit.

The engineering report to the Chief Inspector will seek closure with a basis for exemption being that the opening presents no greater hazard than the local natural topographic features. An expected inclusion in this report will be a method of monitoring the mine adit for mine leakage.

5.3.8 Mine Vents

5.3.8.1 Description

Five mine vents were sealed in 1996 with limited detail of these activities provided in PWGSC's 1997 Construction Management Report (PWGSC 1997). The report identifies that the vent raises were sealed with concrete and upon completion were successful at mitigating the escape of radon gas from the vents. Chain link fences were further installed around these caps. The report contains photos of the vent cap construction that show the caps to comprise reinforced concrete, with the rebar appearing to be anchored into the bedrock. Conversations between CIRNAC and the PWGSC Engineer who led the 1996 work identified that the reason the concrete caps sit below grade is that they had to go to that depth to find competent bedrock to key into. Mine opening locations are shown on **Figure 4, Appendix A**.

A ground penetrating radar (GPR) survey of the vents was completed in 2019 to assess the condition of the vents. The survey confirmed the presence of a concrete cover/cap at Vents 1-4. Vent 5 was unsafe to access and thus the state of the cap (if any) could not be confirmed. The thickness of the concrete varied between approximately 25 cm and 40 cm. A number of diffractions were identified, but not all of them could be concluded to be the result of rebar.

In order to provide regulatory authorities with proof of closure, the regulatory requirements identified in Section 5.3.7.1 above must also be met.

Based on field inspections and the GPR scanning, the current closure status is summarized in this regulatory context in the following table.

Table 5-8: Rayrock Mine Vent Status

Vent Raise	Reinforced concrete (~24 years old)	Secured to Solid Rock	Withstand Loads of UDL12kN or CL24kN	Source / Comment
1	Yes: 25 cm thick, rebar depth 7-21 cm	Concrete well bonded to irregular rock	Not available	GPR Survey Report
2	Yes: 25 cm thick, rebar depth 8-11 cm	Concrete well bonded to irregular rock	Not available	GPR Survey Report Construction Report Photo 24: ~12cm diameter grid ~25x~25cm
3	Yes: 40 cm thick, rebar depth 30 cm	Concrete well bonded to irregular rock	Not available	GPR Survey Report
4	Yes: 27 cm thick, rebar depth: n/a	Concrete well bonded to irregular rock	Not available	GPR Survey Report
5	Yes: no GPR data, photos show rebar during construction	Concrete well bonded to irregular rock	Not available	GPR Survey Report Construction Report Photo 29:~12cm diameter grid ~30x~30cm

Although intuitively these five vents can be considered closed, there are distinct caveats, such as:

- The regulatory requirement for the cap to be "secured to solid rock" can be considered to be generally met in that although the rebar is not specifically anchored into surrounding bedrock:

- 1996 construction photos show some rebars extending over rock ledges and the concrete is interlocked with the irregular rock walls providing some 'keying-in' capability;
- A ground penetrating radar (GPR) study of the vents was undertaken in 2019 (AECOM, 2019a). The investigation identified that in general that "the concrete was well bonded to the bedrock and no evidence of defects in the concrete structure were observed".

- The 1996 construction report notes that radon gas leakage from two of the vent caps was initially an issue requiring a second pour of concrete to seal these. To-date no field measurements for radon gas around the vent caps have been undertaken.
- The Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the NWT notes that concrete has a working life of approximately 50 years – this concrete is now at approximately its half-life as defined in the guidelines.
- The closure status in the above table does not meet the regulatory requirements for calculations of potential loading which would require critical assumptions of key elements such as: rebar size, strength and grid pattern.
- Meeting the Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the NWT require that concrete seals meet the design criteria outlined in the Consolidation of Mine Health and Safety Regulations.

As these requirements are not all fulfilled for the Vents the basis for exemption would be that the chief inspector is of the opinion that an opening presents no greater hazard than the local natural topographic features (#17.03 (4)). However, CIRNAC has had discussions with WSCC and the current state of closure is not acceptable since there are no construction drawings detailing the concrete cover installation.

5.3.8.2 Consideration of Remedial Options and Selection of Remedial Activities

The scope of mine vent management includes:

- Seeking regulatory closure for the five mine vents.

Remedial options considered included:

Table 5-9: Considered Mine Vent Management Options

Option	Description	Details	Selected
1	Leave As-is	• Not practical, vent fences are damaged • Fences may present a wildlife hazard • No current regulatory closure	No
2	Control and Monitor	• Feasible, requires ongoing OMS • Fences may present a wildlife hazard • No current regulatory closure	No
3	Construct Foam Covers	• Feasible • Will support regulatory closure	**Possible**
4	Construct Concrete Covers	• Feasible • Will support regulatory closure	**Possible**

As a next step to bring the vents to formal closure, a letter will be sent to the Chief Inspector of Mines for the NWT requesting a written exemption from Regulation 17.03. The letter would summarize the supporting evidence for closure, making a case that the vents are considered effectively closed and "present no greater hazard than the local natural topographic features". The existing fences and any debris would be removed if this is approved.

Should the Chief Inspector of Mines require additional work for closure, the selected remedial option is to create new covers on top of the existing concrete seals at Rayrock. These covers can either be composed of polyurethane foam (PUF) or concrete, which are both accepted practices by the CNSC and the NWT Mines Safety. If the PUF method is chosen a rock cover would be required, as PUF is sensitive to sunlight. This rock cover would be placed on top of the PUF layer, which would be composed of similar material to the immediate area surrounding the mine openings. These rock covers would be graded into the natural landscape to promote positive drainage and blend in with the surrounding area.

5.3.9 Tailings Containment Areas

5.3.9.1 Description

During the 1996 remediation, the northern and southern TCAs were capped with silty clay obtained local borrow sources. The purpose/intent of the low permeability clay caps is to reduce surface water infiltration and in turn reduce the potential for contaminant mobilization. Erosion and cracking of the caps can defeat this purpose. Once erosion or cracking has started, the severity of the compromise can accelerate quickly with time. The TCA locations are shown on **Figure 3, Appendix A**.

Therefore, it is important that monitoring be undertaken regularly, and repairs be completed promptly to mitigate these impacts before environmental damage occurs. The inspection and maintenance of the tailings caps is a CNSC licence requirement for the site. Features to be examined during monitoring and maintenance include: condition of the vegetative cover (which provides protection from clay cap erosion); removal of larger shrubs and trees (brushing, to prevent large root penetration into the cap); evidence of eroded soil (rills or gullies formed by flowing water); condition of the rip rap in drainage ditches and along the shorelines.

The covers have proven to be robust and the vegetation cover largely become established. However, some areas along the perimeters of both the northern and southern caps have eroded and exposed the tailings underneath. Radiation levels are detectable at an unacceptable level in these locations. The potential for erosion on the Alpha Lake shoreline has also been noted. If not addressed, the eroded areas and the eroding processes may ultimately lead to the release of solids or leachate into the surrounding area and water bodies (Beta and Gamma Lakes).

A June 2016 TCA inspection by the CNSC resulted in the identification that *"The tailings area (north and south tailings deposits) between Alpha and Gamma lakes was overall in a good state with a good dry vegetative cover. However, there were exposed tailings around the perimeter". This finding resulted in an action to CIRNAC requiring that "The licencee shall provide a response with their plan to ensure that all covers are maintained and that tailings are covered. A response to this action notice is required by November 30, 2016."* CIRNAC responded to CNSC in May 2018 identifying that corrective actions at Rayrock would be undertaken as part of the Rayrock Remediation Project (as described in this RAP).

5.3.9.2 Consideration of Remedial Options and Selection of Remedial Activities

The scope of TCA management includes:

- Rehabilitation of the north and south TCAs.

Remedial options considered included:

Table 5-10: Considered Tailings Containment Area Management Options

Option	Description	Details	Selected
1	Leave As-is	• Does not comply with CNSC requirement	No
2	Repair Caps	• Feasible • Conduct repairs, including but not necessarily limited to localized clay cap repairs, drainage and erosion control improvements, rip rap installation and vegetation management.	**Yes**

The option agreed upon by the TG and CIRNAC is that the TCA caps will be repaired as needed using the on-site borrow source from the former airstrip, and then regraded to promote positive drainage. An expected additional 0.5 m of clay will be added to the areas that require maintenance with field-fitting undertaken as necessary. Consideration will further be given to armouring the shorelines to mitigate the potential for erosion. Remedial activities will include the placement of small stockpiles of clay and rock in the vicinity of the TCAs to facilitate future cap repairs.

Considerations when detailing the tailings cap repair will consider those areas most susceptible to erosional forces, and how to best counter fluctuating water levels in Gamma Lake or conversely, drying and cracking within drainage swale structures. This will include a consideration of life cycle costs to assess to what extent the cover (by adding gravel layers) and the drainage ditches (adding rip-rap or equivalent) should be made more robust to minimize long-term maintenance requirements.

5.3.10 Decommissioned Waste Dump

5.3.10.1 Description

During the 1996 remediation at Rayrock, hazardous materials were removed from the waste dump. A cap of similar design to the TCA caps was constructed at the waste dump and is now visually assessed as part of the regular monitoring process. During the 2017 site activities, run-off or discharges from the waste dump were not noted during the freshet site assessment. Limited erosion has been observed at the upper north end of the dump by the access road. A cap walkthrough in 2018 identified some waste (metal, wood) on and around the cap. Maintenance of the cap is a requirement of CIRNAC’s Long Term Monitoring Program for Rayrock. The waste dump location is shown on **Figure 3, Appendix A**.

5.3.10.2 Consideration of Remedial Options and Selection of Remedial Activities

The scope of waste dump management includes:

- Rehabilitation of eroded areas on the waste dump surface.
- Removal and appropriate disposal of debris.

Remedial options considered included:

Table 5-11: Considered Waste Dump Management Options

Option	Description	Details	Selected
1	Leave As-is	• Does not comply with CIRNAC monitoring and maintenance requirements	No
2	Repair Caps, Remove Waste	• Feasible • Conduct repairs, including but not necessarily limited to localized clay cap repairs, drainage and erosion control improvements, rip rap installation and vegetation management.	**Yes**

The option agreed upon by the TG and CIRNAC is that the waste dump cap will be repaired as needed using the on-site borrow source from the former airstrip, and then regraded to promote positive drainage. Remedial activities will include the placement of small stockpiles of clay and rock (if needed) in the vicinity of the dump to facilitate future cap repairs. Waste will be disposed of in accordance with Sections 5.3.11 and 5.3.12 of this RAP.

5.3.11 Hazardous Waste

5.3.11.1 Waste Screening and Segregation

Project wastes are intended to largely be consolidated at Rayrock, sorted, tested, classified and then managed according to the regulatory requirements for each waste stream. The wastes may arrive at Rayrock from all Project sites. Primary waste streams are expected to include:

- Hazardous Wastes
  - Metals (painted) – likely to be coated with lead-based paint.
  - Treated wood (if identified).
  - Shingles – while largely collected, some remain and will be assumed to be ACM.
  - Other: Miscellaneous wastes like batteries.

- Non-hazardous Wastes
  - Metals (unpainted).
  - Wood (unpainted/ uncoated).
  - Other general debris.

The General Contractor will need to appoint a waste manager in charge of waste sorting, storage, screening, classification, and shipping. The expectation is that the general contractor will identify a temporary waste storage area in accordance with the applicable regulations. Wastes will likely be stockpiled according to the above-noted streams and then screened through a combination of visual, laboratory (bulk sample testing and TCLP (toxicity characteristic leaching procedure) and/or swab) and field instrumentation (radiation). Wastes would then further be sorted as required based on this screening. Waste with elevated levels of radiation will be sorted from non radiated wastes to mitigate the potential for cross-contamination.

The most efficient method of waste removal from remote sites (e.g., satellite sites) is expected to be by helicopter. Wastes can be placed into soil bags and air lifted to Rayrock for sorting and consolidation. This method would also be a safe alternative in collecting powerline waste and waste from the Sherman Lake camp and Barge Landing. Wastes from the Barge Landing may be taken directly to Behchokǫ̀. The option to do so will be identified in the project specifications.

5.3.11.2 Description

Remedial activities at Rayrock will require the management of hazardous waste, notably:

- Crated ACM and lead-based paint (LBP): Site stabilization activities at Rayrock included the collection of ACMs and items painted with LBP (ARCADIS 2016a, 2017a). Approximately 80 bags (or an estimated 2,050 kg) filled with ACM, lead-painted materials (e.g. nuts and bolts) and creosote treated wood were placed into 20 site-constructed wooden crates.
- Residual ACMs: Field observations indicate that some ACMs (including some high-risk material) are still disbursed at site.
  - The Rayrock CSM (CIRNAC, 2019a) identifies that with respect to building demolition, “records are not available from this operation, but it is suspected that the buildings were torn down, the non-combustible materials were taken off of the building and the wood was burned." The methods of which any ACM management was undertaken during building demolition are unknown.
  - Friable ACM may further be scattered on the ground around the mill/camp area as a result of building demolition activities. A significant amount of burn residue on the mill foundation may further be ACM.
  - ACMs are further identified as being present in small quantities (primarily shingles, but other potential ACMs as well) the Sherman Lake Camp and possibly at two satellite sites.
- Power Poles: Sampling of Power Poles in 2020 may identify the presence of chemically-treated wood poles (potentially creosote).
- Investigations of the satellite sites, power line and Barge Landing have further identified a minimal amount of scattered hazardous debris was identified on-site at the TED site (~0.5 kg of ACM), GS site (small quantity of potential asbestos shingles) and the barge landing (one car battery). Roof shingles were identified at the Sherman Lake camp which have the potential to be ACM.

5.3.11.3 Consideration of Remedial Options and Selection of Remedial Activities

The primary options for waste management include leaving “as-is” or off-site disposal. Leaving waste as-is was not deemed to be an acceptable option.

The option agreed upon by the TG and CIRNAC is that all hazardous materials, including ACMs and metals with LBP encountered during the Project would be collected and consolidated at Rayrock in a temporary hazardous waste contained processing area. Once all hazardous waste is consolidated (per Section 5.3.11) and appropriately packaged for transport, it will be transported off-site via the winter road for disposal at an approved facility. If any buried hazardous waste is encountered during excavations or other remedial activities, it will be treated in the same manner.

Due to the potential risk posed by disturbance of surficial soils/ rock/fill containing potential ACM, the Project HASP will need to reflect worker protection in this regard.

While not anticipated, should wastes with elevated radiation levels be found at Rayrock that cannot be accepted at an off-site disposal facility, these wastes will be placed in the CDF.

5.3.12 Non-Hazardous Waste

5.3.12.1 Description

A significant amount of non-hazardous materials were cleaned up during the site stabilization activities in 2015 and 2016 and were consolidated at the former borrow area for temporary storage. Non hazardous waste is further present at all of the Project sites considered under this RAP.

The stockpiled non-hazardous waste requires screening to identify if suspect ACM may be present in the material. Should suspect ACMs be identified, the suspect material should be sampled and analyzed for ACM prior to disposal. Anny identified ACMs should be removed from the non hazardous wastes and managed appropriately.

Some additional effort is required to complete the non-hazardous waste cleanup. Non-hazardous waste is further present at the Sherman Lake camp, several of the satellite sites and Sun Main. The remaining non-hazardous waste and debris (including domestic-type materials, scrap metal, drums and wooden debris) represents a physical hazard, a potential environmental concern (deterioration of metal debris), as well as an aesthetic concern.

5.3.12.2 Consideration of Remedial Options and Selection of Remedial Activities

The primary options for waste management include leaving “as-is” or off-site disposal. Leaving waste as-is was not deemed to be an acceptable option.

The preferred remedial option of both CIRNAC and the TG is to consolidate all non-hazardous waste identified within the Project in the current storage location, and then dispose the waste at an off-site facility. If any buried non-hazardous waste is encountered during excavations or other remedial activities, it will be treated in the same manner. Waste will be screened as per Section 5.3.11.

5.3.13 Borrow Soil

Clay borrow soils for CDF construction will be obtained from the former air strip location, the same location where soil was obtained to cap the TCAs and waste dump. Internal haul roads will need to be constructed to bring borrow soil to Mill Lake.

Test pits and boreholes were excavated at locations to the northwest and southeast of the airstrip in 2018 and 2019. The soils in these test pits were found to primarily comprise silty clay soils present as a thin veneer of overburden (up to 2.5 m thick in the deepest test pit) atop the undulating (rolling) bedrock. Some areas of coarse material (sand) can be found in the silty clay, as well as large cobbles and boulders that will need to be removed or worked around (some boulders are very large) in order to access suitable soil.

A soil borrow excavation plan will need to be developed prior to construction to ensure sequencing that facilitates both all-weather access to borrow soil excavation locations, and expansion of the borrow pit to reach suitable soils if needed during construction. The 1996 remediation program identified these to be items of concern during that construction, as well as the presence of frost in the ground (possibly permafrost) during early summer construction.

A site plan showing borehole and test pit locations is provided as **Figure 24, Appendix A**. This figure further illustrates set-back distances from surface water bodies as required by the LUP and outlines potential future borrow areas. An option exists to excavate borrow soil within these off-set areas with the written authorization of a CIRNAC inspector.

Reclamation of the borrow source locations will be required as described in Section 5.11 of this RAP.

5.4 Sun Rose Claim Group

A site plan showing the areas of environmental concern at Sun Main/ Sun East is provided as **Figure 25, Appendix A**. A conceptual site model for the site is provided as **Figure 26, Appendix A**.

5.4.1 Mine Shaft

5.4.1.1 Description

The former mine shaft appears to have been abandoned in place with no clear records identifying the shaft cover or closure. The shaft is encircled by a perimeter chain-link fence. The shaft opening has loosely placed metal and wood across the top of the opening. Historical concerns with the shaft opening included that there are no reports or indications that there is a structurally-sound cover below this material, though previous reports identify the potential presence of a collar. If this material is the only cover or seal to the opening, then the seal is inadequate from a safety and regulatory compliance perspective. Humans and/or animals can access the opening by either climbing over or burrowing under the fence. The fence is a deterrent but not an absolute safeguard preventing access to the opening.

Mine history documentation (Silke 2009) identifies that the opening of the two-compartment shaft measured 2 m by 3 m. The shaft completion depth was 83.5 m. Two lateral ore shoots were advanced from the shaft: one at the 36.5 m depth level and one at the 73.2 m depth level. These lateral tunnels initially measured 1.5 m by 2.1 m in size. The 36.5 m depth lateral was extended to a length of 265 m and the 73.2 m lateral was extended to a length of 533 m.

The Rayrock Transportation Route Enhanced Phase I Assessment (Rescan, 2006) identifies that a paper titled "Northland Mine – Abandoned Prospect Operation (1955-1956)" stated that a *"government cleanup was conducted on a few of the remains of the mine in the early 1990's"* and that the mine shaft was sealed. No technical information relating to this cleanup and sealing appear to have been identified to substantiate and detail the scope and results of the clean-up and sealing.

To further assess the integrity of the shaft opening, the shaft was inspected in 2019 by DMT Geosciences (DMT) using a remotely operated camera (AECOM, 2019a). A graphical representation of the shaft opening is provided as Plate 12. Findings included:

- The inspection revealed that one of the vent pipes extending outside of the shaft is open to at least 26 m below grade (the maximum length of the camera equipment).
- DMT's interpretation of the inspection revealed that debris (metal, timber) appear to fill the shaft opening to a depth of about 6.3 m where gravel and rock prohibited further investigation. Based on DMT's video interpretation, the upper 6.3 m of the shaft (at least) is open and is a fall hazard.
- The presence of standing water within this opening would suggest the potential for a) the shaft to be sealed which prevents water from migrating vertically downward, or b) the shaft is flooded to this level.

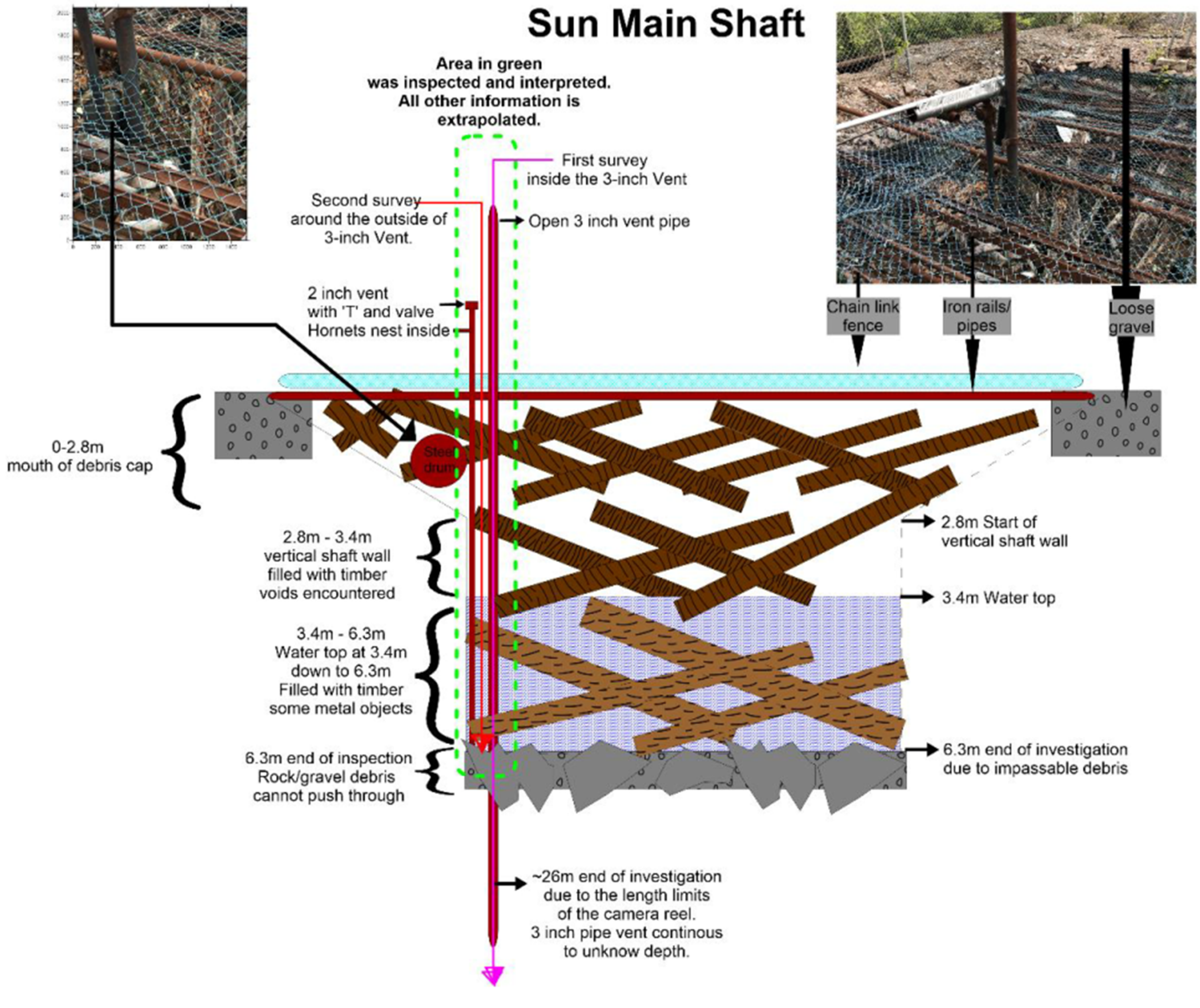

Plate 12: Illustrated Cross Section of Sun Main Shaft

Figure obtained from Rayrock Mine - Sun Main 2019 Geophysics Investigation, August 26, 2019

Therefore, based on available information, there is no supporting evidence to confirm that the mine shaft has been adequately decommissioned in conformance with regulatory standards and may represent a safety hazard.

5.4.1.2 Consideration of Remedial Options and Selection of Remedial Activities

The scope of mine vent management includes:

- Decommission opening.
- Seeking regulatory closure for the mine shaft.

Remedial options considered included:

Table 5-12: Considered Mine Vent Management Options

Option	Description	Details	Selected
1	Leave As-is	• Not practical, vent fences are damaged, cover is in poor condition and is a safety hazard • Fences may present a wildlife hazard • No regulatory closure	No
2	Control and Monitor	• Feasible, requires ongoing OMS • Opening still requires actions to make more safe • Fences may present a wildlife hazard • No regulatory closure	No
3	Construct Foam Covers	• Feasible • Will support regulatory closure • Not as practical as concrete cover	No
4	Construct Concrete Covers	• Feasible • Will support regulatory closure	**Yes**

An engineered plan will be prepared to close the mine shaft opening at Sun Main in accordance with the applicable regulations. Impacted soils from the vicinity of the shaft opening as well as site debris may be placed into the shaft void, assuming it has the volume capacity needed (a determination will be made once the current cover is removed). A concrete perimeter knee-wall is anticipated around the opening followed by the placement of pre-cast concrete panels atop the cover. Engineering design of the cover is required to ensure compliance with the applicable regulations and guidelines, and to ensure that the design considers the appropriate cover longevity. Regulatory closure will be sought during the process.

5.4.2 Exploration Workings

5.4.2.1 Description

Four main exploration workings are located at Sun Main, historically referenced as BP1 to BP4 **(see Figure 25, Appendix A)**. The workings (particularly BP1 and BP2) have been identified as the areas of greatest radioactivity on Site.

The workings are not well-defined pits, rather they are locations showing evidence of blasting in the form of disturbed and fragmented rock (gravel, cobble and boulder sized). Side slopes are shallow and poorly defined and the area (m^2) of physical disturbance is small. Access to the workings is along steeply sloping rock faces and difficult to access by foot. Mechanical equipment (e.g. all terrain vehicle, truck, excavators, etc.) would have a difficult if not impossible time accessing these points. Photographs of the characteristics of the exploration workings are presented in Appendix B. Geographic coordinates and approximate dimensions of the workings are presented in the following table.

Table 5-13: Location and Dimensions of Exploration Workings

Exploration Working	Easting (UTM mE)	Northing (UTMmN)	Approximate Area	Approximate Depth	Approximate Volume
BP1	533922	6999841	3 m^2	0.7 m	2 m^3
BP2	533937	6999850	2 m^2	0.5 m	1 m^3
BP3	533948	6999879	4 m^2	0.5 m	2 m^3
BP4*	533938	6999669	32 m^2	0.5 m	16 m^3

Source: Phase III Environmental Site Assessment - MS290 - Sun Rose Claim, AMEC, March 2015

** Assumed based on description of 100-foot trench (Silke, 2009) and reported volume of 16m^3 in AMEC (2015a) Phase III ESA*

A gamma radiation survey of Sun Main was undertaken in 2019 (AECOM, 2020f). The survey covered an area of approximately 21.6 ha. Gamma radiation levels were averaged based on a 10 x 10 m grid (blocks) overlaying the surveyed areas. Key survey findings included:

- Radioactivity in the vicinity of the quartz stockwork which hosts the targeted uranium bearing minerals is elevated relative to the regional background.
- Working BP1: The external gamma dose rates in the vicinity of blast pit BP1 were measured to reach a maximum single measurement of 17.5 µSv/hr, with block averages ranging from 0.4 to 7.96 µSv/hr. Four blocks at this location were measured to have an average external gamma dose rate in exceedance of the remedial objective (2.5 µSv/hr).
- Working BP2: The external gamma dose rates in the vicinity of blast pit BP2 were measured to reach a maximum single measurement of 4.35 µSv/hr, with a block average of 2.34 µSv/hr. BP2 is located approximately 40 m to the northeast of blast pit BP-1, with no areas of baseline gamma radiation separating BP-1 and BP-2.
- Working BP3: The external gamma dose rates in the vicinity of blast pit BP3 were measured to reach a maximum single measurement of 3.35 µSv/hr, with a block average of 0.89 µSv/hr. BP-3 is located approximately 150 m northeast of BP1 and is separated from blast pit BP-1 by an area of external gamma radiation dose rates of less than 0.5 µSv/hr.
- Working BP4: BP4 was not identified to be a radiological concern due to lower measured radiation readings in the area.

Figures 27, 28 and 29 (Appendix A) provide graphical overviews of the survey data. **Figure 27** illustrates the 10 m x 10 m survey blocks. **Figures 28 and 29** illustrate the spatially interpolated survey results which graphically highlight the areas of concern identified (BP1, BP2, BP3 and WR1).The 2020 Detailed Radiological HHERA (AECOM, 2020g) concluded that the radiation levels and radionuclide activity concentrations at the exploration workings exceed the established thresholds in the Canadian Guidelines for the Management of Naturally Occurring Radioactive Material (NORM) with the largest radiation concern being at workings BP1, BP2 and BP3.

Two waste rock samples collected from the exploration workings during the Phase III ESA (AMEC, 2015a) indicated that the waste rock is potentially acid generating (PAG). The report identified that if the two samples collected are considered representative of all four exploration blast pits the exposed exploration blast pit rock (21 m^3 total) would be PAG. The report identified that the exploration blast pits were considered to be potentially metal-leaching, based on elevated levels of the following parameters as compared to screening criteria: copper, lead, selenium and uranium. No signs of potential significant adverse impacts to vegetation in the vicinity of exploration workings BP1 to BP4 were observed during the Phase III ESA field work program (AECOM 2019,a).

Rock sampling in 2019 (AECOM, 2020a) showed patterns in metal leaching across the area studied. Sampling locations in workings BP1, BP 2 and BP3 (closest to the mineralized zone) demonstrated higher metal leaching potential with reduced metal leaching potential as you move away from the mineralized zone. However, the leachability of metals is influenced by the smaller grain size used in the SFE tests which have much greater surface area than naturally exposed rock surfaces. SFE tests identified metal leaching as a potential concern for rock samples collected from BP1, BP2 and BP3.

5.4.2.2 Consideration of Remedial Options and Selection of Remedial Activities

The scope of exploration working management includes:

- Management of broken rock at the exploration workings.

- Capping of exposed rock at exploration workings.

Remedial options considered included:

Table 5-14: Considered Exploration Working Management Options

Option	Description	Details	Selected
1	Leave As-is	• Does not address environmental concerns	No
2	Control and Monitor	• Feasible, requires ongoing OMS • Does not address environmental concerns, administrative controls required (signage not a preferred approach) • Fences may present a wildlife hazard	No
3	Capping with Soil	• Not technically feasible given steep slopes at workings	No
4	Construct Concrete Covers	• Feasible	**Yes**

Remedial actions will include:

- Removal of loose rock at exploration workings BP1-BP4 for placement in the WR1 containment area (discussed further in Section 5.4.3).
- Construction of engineered concrete caps at BP1, BP2 and BP3.

Remedial activities will include provisions for monitoring exposure of Site workers and conditions at the Site commensurate with the Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials (NORM) published by Health Canada in 2011, as well as follow-up monitoring to evaluate the performance of the engineered gamma shield.

5.4.3 Waste Rock

5.4.3.1 Description

Overview

Waste rock is located at three locations at Sun Main (referenced as WR1 (~1,200 m^3), WR2 (~50-100 m^3) and WR3 (~50-100 m^3). WR1 appears to be rock that was pulled from the mine shaft and dumped to the north/northeast on the slope of the bedrock dome. The waste rock appears to have been dumped from three main points forming three lobes against the rock face. The pile is approximately 6 m to 10 m high and primarily made-up of 30-60mm-sized material with some cobble, boulders and drill core. The pile is well-packed and appears to be stable, though has been identified as “flowing” underfoot. There are no water courses surrounding the piles and no evidence of subsidence or bulging has been noted.

The Phase 1 ESA for Sun Rose (Rescan, 2006) identifies that the WR1 material includes both a “waste dump” and an “ore dump”. Site materials (rock) looks similar and the waste dump is expected to represent low grade rock whereas the ore dump likely contains ore as obtained from the mine laterals into he ore bodies during exploration.

There are two additional waste rock piles in a gully area west of the Former Oil Tank and the Former Powerhouse. The piles appear to be in locations where waste rock was placed on the uneven (hummocky) bedrock surface, possibly to fill in a depression or void to facilitate traffic (foot or equipment). The top of the waste rock is flush with the surrounding grade.

Rock Characterization (ARD/ML Rock Assessment)

A 2013 *Phase II Environmental Site Assessment Sun-Rose Mine Northwest Territories* (Franz, 2013) included the assessment of one sample from waste rock pile WR1 for ARD potential. The report findings were that “the waste rock is “Non-PAG” (not potentially acid generating) material, but some metals, notably uranium, silver and copper, are likely being contributed to drainage from the waste rock pile.” A subsequent Phase III Environmental Site Assessment of the property (AMEC 2015a) included additional ARD assessment work. The report identified that:

- Four waste rock samples collected from the main Waste Rock Pile WR1 indicated the material to be Non-PAG, but potentially metals-leaching.
- Two waste rock samples collected from the exploration/blast pits indicate that the waste rock is PAG.
- No signs of potential significant adverse impacts to vegetation in vicinity of waste rock were observed during Phase III ESA field work.

Fifteen rock samples were collected from across the site for geochemical analysis in 2019 (AECOM, 2020a). The waste rock, broken rock from blast pits and rock used to construct the road were sampled and characterized for ARD and metal leaching (ML) potential. Selected conclusions from the work included:

1. Using a neutralization potential ratio (NPR) classification, most of the samples tested are classified as Non-PAG. One sample from waste rock pile WR3 had uncertain acidifying potential.
2. SFE results indicated that the rock types have varied metal leaching potential. The program identified metal leaching as a potential concern for the samples collected at BP1, BP2 and BP3, one of the samples collected at WR3, and samples collected on the road. Visual observations on site through the 2018 and 2019 Field Program noted orange and yellow bedrock staining down-gradient of BP1 up to a distance of approximately 5 m. BP2 also had suspected leachate bedrock staining downgradient; however, this was minimal compared to BP1. One road sample had yellow staining, but no downgradient colouring was noted. The remaining sites with leaching potential had no evidence of downgradient staining, and none of these sites had evidence of impacted soils or vegetation.
3. This investigation showed patterns in metal leaching across the area studied. Sampling locations at BP1, BP2 and BP3 (closest to the mineralized zone) demonstrated higher metal leaching potential with less metal leaching potential in samples from the areas away from the mineralized zone. However, the leachability of metals is influenced by the smaller grain size used in the SFE tests which have much greater surface area than naturally exposed rock surfaces.

Radiation Survey

The 2019 gamma radiation survey (AECOM, 2020f) identified external gamma dose rates in the vicinity of WR1 to have a measured maximum single measurement of 4.62 µSv/hr, with a block average of 0.9 µSv/hr (**see Figure 27, Appendix A**). In addition, a single block had an average reported external gamma dose rate of greater than 1 µSv/hr, located to the northeast of the shaft and adjacent to WR1. The maximum individual gamma dose rate measurement of 2.56 µSv/hr was made in this location. These levels are above the 2.5 µSv/h (above natural background) action level for Site rehabilitation planning. Elevated radiation levels were not identified at WR2 or WR3.

5.4.3.2 Consideration of Remedial Options and Selection of Remedial Activities

The scope of waste rock management includes:

- Management of broken rock at the exploration workings (as discussed in Section 5.4.2).

- Management of the waste rock stockpiles.

Remedial options considered included:

Table 5-15: Considered Waste Rock Management Options

Option	Description	Details	Selected
1	Leave As-is	• Does not address environmental and safety concerns	No
2	Control and Monitor	• Feasible, requires ongoing OMS • Does not address environmental and safety concerns, administrative controls required (signage not a preferred approach) • Fences may present a wildlife hazard	No
3	Consolidate and Cap with Soil	• Collect waste rock from small sources (WR2, WR3 and exploration workings) and contain within a clay-capped containment structure at WR1.	**Yes**

Remedial actions will include:

- Clearing and salvaging organics from ravine below WR1 and clay soil borrow areas.
- Pushing the WR1 rock downslope into the cleared ravine, compacting the rock in place.
- Placing loose rock from BP1, BP2, BP3, BP4, WR2 and WR3 onto the rock pile and compacting in place.
- Placing any impacted soil from the mine shaft area that will not fit into the shaft atop the rock pile and compacting in place.
- Placement of a graded clay soil cap atop the rock pile and creating a clay containment area. The soil cap design is to consider freeze/ thaw effects, cap longevity, potential climate change impacts, and radiation protection, amongst other items.
- The clay cap to be covered with salvaged organics with a reclamation strategy established.

5.4.4 Impacted Soil

5.4.4.1 Description

Soils in the vicinity of the Sun Main and Sun East typically comprise a thin veneer of soil located either in low-lying areas in bedrock lows or surface depressions. Where present, the soil has been characterized as being sand with some silt/clay and gravel, along with organic matter. Soil in the bedrock lows (valleys) has been described as being peaty. Various soils around the site have been identified as containing contaminants of concern at concentrations greater than past-referenced environmental quality guidelines.

The HHPQRA (AMEC, 2015c) identifies that the Phase III ESA (AMEC, 2015a) indicated measured concentrations of metals (arsenic, boron, cadmium, chromium, copper, lead, molybdenum, nickel, tin, uranium and zinc) at 12 out of 21 locations exceeded the soil guidelines for agricultural land use. In addition, PHC F3 was above the soil guidelines for agricultural land use at five out of nine locations. Benzo(a)anthracene was above the soil guidelines for agricultural land use at two out of seven locations.

A summary of the known impacted soils is provided in the following table.

Table 5-16: Summary of Impacted Soil Locations – Sun Main/East

Locations	Description	Contaminants Identified at Concentrations Greater than Referenced Guidelines	Approximate Quantity (m^3)
Area of Environmental Concern (AEC) 1: Mine Shaft Opening	Minimal soil is present at this location. Six soil samples have been collected from this area, three of which have identified exceedances for metal and/or low pH.	Metals (Cr, Mo, U) and radionuclides; low pH	275 m^3
AEC 2: Waste Rock Pile WR1	Little soil has been identified in this area and is limited to small accumulations (<0.15 m) above bedrock. Some soil may be present beneath the waste rock pile. Seven soil samples have been collected and analyzed and found to have one or more metals concentrations at levels greater than the referenced guidelines.	Metals (Cr, Sn, U) and radionuclides; low pH	
AEC 8: Former Powerhouse (Northeast)	Limited soil present, soil that is present is interconnected with AEC1 and AEC 2.	Metals (Cr, Mo)	
AEC 2: Waste Rock Piles WR2 and WR3	Only one soil sample collected (beneath a drum). Extent of impacts not delineated.	Metals (As, Cu, Mo, Sn, U, Zn); low pH	0.5 m^3 to 60 m^3
AEC 9: Gulley Waste Rock Piles (proximate to WR2 and WR3)	One soil sample collected downgradient to the southwest of AEC 9 to assess for the presence/absence of potential impacts associated with an abandoned drum and run-off from the Gully Waste Rock Piles.	Metals (As, Cu, Mo, Sn, U, Zn); PHC F3	
AEC 3: Blast Pits BP1-BP4	Little-to-no soil at this location	Metals (Cd, Zn); low pH	5 m^3
AEC 4: Chico Lake Wharf	Soil was present along the shoreline off the dome-shaped outcrop and in select depressions at the Chico Lake Wharf. Two soil samples collected in this area – one along shoreline and one beneath a can dump	Metals (B, Cr, Ni, Pb, Sn, U) and radionuclides; low pH	130 m^3
AEC 5: Site Roads	Waste rock surfacing on the access road between the main exploration area and AEC 6 is estimated to be PAG and potentially metal leaching (840 m^3). Concentrations of copper, molybdenum and selenium have been identified at concentrations greater than the referenced soil guidelines. No physical hazards have been identified (road relatively flush with surrounding terrain); no radiological concerns have been identified.	Metals (Cu, Mo, Se)	840 m^3
AEC 6: Former Camp	Soil was present south and west off the dome-shaped outcrop and in select depressions at the Former Camp. Two soil samples collected. One had low pH. The second, collected beneath an abandoned drum reported an exceedance for boron only.	Metals (B) ; low pH	7.5 m^3
AEC 7/8: Former Oil Tank/ Former Powerhouse (SW AEC 8)	Little to no soil was present in the vicinity of the Former Oil Tank (AEC 7). Soil at AEC 7 was limited to minor amounts of sporadic accumulations (<0.3 m in thickness) and was only present in select depressions around the former base (no soil was present to the east). The former tank base consisted of wood timbers on a leveled waste rock pad placed directly on bedrock.	PHC F3; benzo(a)anthracene; low pH	5 m^3
NE Pond	Soil sample collected on the southwest side of the NE Pond as part of the Phase II ESA. No information available on soil conditions.	Metals (Cr, Mo)	Not Available

The metal and PHC-impacted soil was classified as being low-risk in the 2015 Remedial Options Analysis (AMEC, 2015a).

The HHPQRA (AMEC, 2015c) examined each of the contaminants of potential concern against human health screening guidelines and found three metals (arsenic, cadmium and uranium) to exceed the referenced guidelines. Arsenic and cadmium were not identified to represent a human health risk, though the maximum soil concentrations of uranium were identified to pose a risk to Toddler and Adult visitors at the Site. No other chemical parameters exceeded their human health guidelines in soil. PHC F3 and benzo(a)anthracene were not identified to be above the human health screening guidelines for the limited amount of soil (< 5 m^3) identified at the former fuel tank location.

The SLERA (AMEC, 2015b) identified that soil impacts were limited in area and in the number of contaminants of concern. Tin, F3 and uranium had exceedances of the screening benchmarks; however, the associated areas of impact and peak concentrations were deemed to be of low environmental significance. The peak concentration of uranium was below the CCME guideline for plants and soil invertebrates and a caribou exposure model indicated that the risk to caribou grazing at the Site is low. The peak concentrations of uranium at the Site were associated with the waste rock piles which had very little soil and vegetation for ingestion by potential terrestrial receptors.

Based on the above conclusions, the SLERA (AMEC, 2015b) identified that further investigation and risk management for ecological protection were not recommended for the Site. The SLERA did not identify potential risks associated with uranium to terrestrial ecological receptors. Soil chemistry, rock chemistry and ScanPlot data from the Phase II ESA indicated most of the radiation on-site to be associated with the exposed bedrock and not soil. Photographs of the plant communities across the Site appeared to have vegetation which did not show signs of toxicity.

The preliminary HHPQRA (AMEC, 2015c) further indicated that the lower portion of the site (those areas excluding the waste rock piles and exploration workings (blast pits)) did not pose an unacceptable risk. The AECOM risk assessment (AECOM, 2020g) also does not suggest unacceptable ecological risks associated with this material.

The yellow staining sometimes referred to in the reports is considered to be due to intermittent flooding and associated dissolved organic matter such as humic substances typical of the wetland environments of the local Site setting. While a potential has been identified for the rock in the road to be metal-leaching (AECOM, 2020g), the results of the risk assessments suggest that this is not resulting in an unacceptable risk.

5.4.4.2 Consideration of Remedial Options and Selection of Remedial Activities

Given the assessment findings that the impacted soils do not represent a human health and/or ecological risk, the identified soils will be left as is, with the exception of loose soils atop the bedrock surface near the mine shaft. Soils that show visible hydrocarbon staining or the presence of waste rock in the vicinity of the mine shaft will be excavated to bedrock and the placed within the new covered/capped WR1 stockpile. As per Section 5.3.4 any residual soil that extends under mature vegetation will be left in place.

5.4.5 Hazardous Waste

5.4.5.1 Description

Environmental investigations have identified the presence of hazardous waste at Sun Main/ Sun East, including the identification of a decaying vehicle battery and a small quantity of roof shingles. These items require appropriate removal and disposal.

5.4.5.2 Consideration of Remedial Options and Selection of Remedial Activities

The primary options for hazardous waste management include leaving "as-is" or off-site disposal. Leaving waste as-is was not deemed to be an acceptable option.

Hazardous wastes from Sun Main/Sun East will be consolidated at Rayrock and managed as described in Section 5.3.11. Wastes will be screened for gamma radiation prior to being removed from site. Given the small quantity of shingles, they will be treated as being ACM and disposed of with other ACMs collected for the project.

5.4.6 Non-Hazardous Waste

5.4.6.1 Description

Various non-hazardous waste items including drums, wood debris and some metal debris are located at the mine shaft, Chico Lake Wharf, former camp, former oil tank area and/or access roads. A concrete slab building foundation is also present at the site. The debris pose physical and safety hazards and is aesthetically unappealing; however, the degree of environmental concern is considered low. The 2015 Phase III ESA (AMEC 2015a) contains a detailed debris inventory. The total estimated volume of non-hazardous debris at the Site is approximately 180 m^3 (AMEC 2015a).

5.4.6.2 Consideration of Remedial Options and Selection of Remedial Activities

The scope of exploration working management includes the management of non-hazardous wastes. Remedial options considered included:

Table 5-17: Considered Exploration Working Management Options

Option	Description	Details	Selected
1	Leave As-is	• Does not address environmental concerns • Regulatory noncompliant	No
2	Control and Monitor	• Feasible, requires ongoing OMS • Does not address environmental concerns • Regulatory noncompliant	No
3	Consolidate and Dispose On-site	• Feasible	No
4	Consolidate and Dispose Off-site	• Feasible • Promotes recycling and more complete site cleanup	**Yes**

With the exception of the concrete slab, wastes will be disposed of off-site in accordance with the applicable regulations. Due to its mass, the on-site concrete slab will be broken and either placed in the mine shaft as fill or placed in the waste rock containment area.

Wastes are expected to be hauled to Rayrock for consolidation; however, given the more southern location of Sun Rose, the remediation contractor will be permitted to haul waste direct to disposal facilities with proper waste screening and transportation methods employed. All materials should be checked for gamma radiation prior to handling. If asbestos is suspected, the waste should be sampled for asbestos content analysis and handled and disposed of accordingly based on these results.

Remedial activities will include provisions for monitoring exposure of Site workers and conditions at the Site commensurate with the Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials (NORM) published by Health Canada in 2011, as well as follow-up monitoring to evaluate the performance of the engineered gamma shield.

5.4.7 Surface Water and Sediments

Historical site assessment activities have not identified the need for sediment or surface water management at the lakes in the vicinity of Sun Main/Sun East.

5.4.8 Borrow Soil

Borrow source investigations at Sun Main/East have been conducted by hand auger in the low-lying lands surrounding the Sun Rose bedrock dome to depths between 0.6 m and 1.1 m below grade in 2018 and 2019 (AECOM, 2019a; AECOM 2020a). Soils have largely been found to comprise medium plastic clays below a thin organic veneer. Geotechnical analytical results suggest that the all clay soil samples at the locations tested meet either the Alberta “Preferred” or “Marginal” Clay Liner Material requirements and are generally considered suitable for use as borrow source material.

Borrow soil is limited in the Sun Main/Sun East area. Where present, the soil is located in low lands near the surface water bodies or can be found in low-lying bedrock valleys or gullies. Most of the low-lying areas are wet and heavily vegetated. The ground level in lower elevations appears to be close to the lake levels, which would infer that the soils could be heavily saturated (though free water was not encountered in the boreholes advanced in 2019).

Obtaining small amounts of borrow material will be possible by scraping soil from the bedrock, though it is expected that these soils will have a high organic (peat/muskeg) content and will likely be saturated or possibly even flooded at depth, which will, therefore, have constructability issues that need to be considered. Efforts to use soils proximate to the Site for use as borrow may require extensive or widespread disturbance to the heavily vegetated and wet landscape depending on the volume required.

Figure 30 (Appendix A) identifies two potential borrow soil locations (labelled as 1 and 2). Borrow area 1 is expected to be a preferred area due to the presence of historical trails that may be used to haul soil to the work location at WR1. Location 2, while also being a potential location, may be more challenging of a route to haul soil.

Organics and sand lenses should be first stripped and salvaged to be used for reclamation activities both at the borrow and destination locations. Vegetation requiring removal should also be salvaged for this purpose. Any larger pieces of wood could be chipped to facilitate decomposition and used for reclamation purposes.

Soil excavation will need to consider frozen soil. We note that frozen soil was found at depths ranging from 0.5 m to 1.5 m depth during the August 2019 investigations. It is unknown if the locations were frozen as a result of the time of year or due to conditions such as local shading preventing thawing of the ground. As a result, once material is stripped and left to thaw, additional soil may become available. The presence of frozen soil in the borrow areas is a factor that need to be considered when planning future remedial efforts and when communicating excavation requirements to contractors.

Site regrading and rehabilitation subsequent to borrow soil excavation would largely comprise the recontouring of soil adjacent to excavations. The base of the excavations is expected to be either soil and/or bedrock.

Excavation plans will include a strategy for final drainage of the work areas and site reclamation strategies incorporated into the Project design (see Section 5.11).

5.5 Horn Plateau – REX

5.5.1 Exploration Workings

5.5.1.1 Description

At least eight Exploration Workings have been identified at REX. Most of the workings comprise limited to shallow trenching of bedrock with broken cobble and boulder sized rock associated with the workings. One of the workings is cut into the side of a bedrock hillside and approximately 3.5 m deep.

The trenches may pose a physical fall hazard if they are inconsistently deeper than the surrounding topography. As a result, a 1.5 m deep threshold was recommended by CIRNAC as a general guideline for the possible remediation of these trenches. This threshold was based on CIRNAC's discussions with WSCC. There are three locations which were near or exceeded this threshold. Two of these trenches are on or close to the edge of the ridge. While they measure 1.5 m and 3.5 m deep, the natural topography also has similar drops. All other discovered trenches were at or below 1 m deep. As a result, the trenches are not expected to represent a physical hazard.

The current (2019) risk-based remediation/rehabilitation objective for gamma dose rate at the Rayrock Mine is 2.5 µSv/hr above background. This objective is referenced in several Rayrock Mine study reports from a document titled Short-Term Environmental Monitoring Program, Rayrock Uranium Mine, 2000 prepared by the Low-Level Radioactive Waste Management Office for Indian and Northern Affairs Canada.

One of the blast trenches located at the Northern Exploration Workings was measured to have elevated gamma radiation in exceedance of the remedial action level of 2.5 µSv/h (maximum gamma dose rate between and 4.2 µSv/h and 6.3 µSv/h from 2019 and 2012, respectively). This trench was measured to be approximately 24 m x 2 m x 0.5 m deep.

5.5.1.2 Consideration of Remedial Options and Selection of Remedial Activities

Current data indicates that the currently-identified exploration workings do not present a physical hazard according to the CIRNAC/WSCC guidance. All working depths will be confirmed at the time of remediation. Should these or any newly identified workings be identified to exceed this depth guidance, they will be backfilled with rock obtained from the REX area to a level at least meeting the minimum 1.5 m depth.

Due to the elevated radiation measurements at the larger blast trench at the Northern Exploration Workings, this trench will be covered with concrete as per Section 5.4.2 (Exploration Workings at Sun Rose). Any other trenches identified to demonstrate elevated gamma radiation in exceedance of the remedial action level of 2.5 µSv/h above background will be treated the same.

Remedial activities will include provisions for monitoring exposure of Site workers and conditions at the Site commensurate with the Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials (NORM) published by Health Canada in 2011, as well as follow-up monitoring to evaluate the performance of the engineered gamma shield.

5.5.2 *Impacted Soil*

5.5.2.1 Description

Seven soil samples were analyzed for a suite of environmental parameters during a Phase I and II ESA completed at REX (Columbia, 2013a). Results included:

- Radionuclides – One sample collected from an exploration working was reported to have an activity concentration of Lead-210 in exceedance of the Alberta Tier 1 (AEP 2019) soil quality guidelines. Since there is no overland flow in the area of the sample and since the radionuclide was not found in Sheldon Lake downstream nor within other down gradient soil samples, it was concluded that the elevated Lead-210 concentration was localized to the one working and further radionuclide migration was not expected.

- Metals – Four soil samples were found to exceeded the referenced soil quality guidelines. However, since the maximum metal concentrations were found in the inferred background sample the assessment concluded that the that exceedances were not likely due to anthropogenic activities. Follow-up sampling was attempted in 2019; however, due to historic forest fires and lack of available material, the only available samples were primarily burnt, dry, mossy organics. Very little soil was present atop the bedrock in this location, while samples of this material were collected they were not submitted for laboratory analysis given the limited soil content.

Columbia noted that *"In weighing all lines of evidence of this assessment, and considering the watershed scale and naturally occurring mineralization of the bedrock, the metals inputs attributable to the historical exploration workings are likely insignificant and low risk."*

AECOM notes that samples of rock from the exploration workings were further analyzed. Acid Based Accounting analysis indicated the rock was not PAG. SFE analysis suggested the potential for iron, aluminum and uranium impacts. Uranium was not detected in Sheldon Lake, down gradient. Given the large clast of the limited volume of waste rock material and non-PAG conditions, metals leaching from the trenches was anticipated to be limited. The In weighing the lines of evidence of the assessment, and considering the watershed scale and naturally occurring mineralization of the bedrock, the metals inputs attributable to the historical exploration workings were deemed to likely be insignificant and of low risk (Columbia, 2013a).

5.5.2.2 Consideration of Remedial Options and Selection of Remedial Activities

No evidence of significant environmental impact to soils has been confirmed. Based on current findings, and the very limited amount of soil present atop bedrock in the areas investigated, no remedial actions are proposed with respect to soil management.

5.5.3 *Non-Hazardous Waste*

5.5.3.1 Description

Debris was found at the northern exploration workings as well as the camp area, but not at the southern exploration workings. Debris at the northern exploration is scattered and includes tin cans, dimensional wood, and wire. Structures include two collapsing core racks (with core) and a plywood structure. Debris at the camp is generally limited to household wastes and metals with a volume of up to 3 cubic metres (m^3). This area also includes a tin can cache within the wetted foreshore of Sherman Lake. The camp structures include five dilapidated tent frames and one unknown structure. No hazardous materials were identified.

5.5.3.2 Consideration of Remedial Options and Selection of Remedial Activities

The remedial plan for the debris is to burn the timber on site. Timber would be inspected prior to burning to ensure there are no impacts (such as creosote or petroleum hydrocarbons). If present, impacted timber would be collected separately and brought to the Rayrock disposal area. The remaining Non-hazardous debris would also be gathered and brought to the Rayrock disposal area as per Section 5.3.12.

5.6 Horn Plateau – GS

5.6.1 Non-Hazardous Waste

5.6.1.1 Description

Six separate wooden structures have been observed at GS, including five structures at a main camp area. Four areas of drilling have also been identified. A large blast area has been identified to the north of the main camp. Debris at the site included a small volume of asbestos shingles (3-5 kg); multiple metal drill rods, an old stove and sheet metal; a large volume of metal cans (300-400); and small, empty 5 L fuel cans in drilling areas.

5.6.1.2 Consideration of Remedial Options and Selection of Remedial Activities

The primary options for waste management include leaving “as-is” or off-site disposal. Leaving waste as-is was not deemed to be an acceptable option. Non hazardous waste will be collected at Rayrock and managed as described in Section 5.3.12.

5.6.2 Hazardous Waste

5.6.2.1 Description

As described above, a small volume of asbestos shingles (3-5 kg) has been identified at GS.

5.6.2.2 Consideration of Remedial Options and Selection of Remedial Activities

The primary options for hazardous waste management include leaving “as-is” or off-site disposal. Leaving waste as-is was not deemed to be an acceptable option. The shingles will be treated as hazardous waste (ACMs), collected at Rayrock, and managed as described in Section 5.3.11.

5.6.3 Petroleum-Impacted Soil

5.6.3.1 Description

Soil sampling (Arcadis, 2016b) identified two areas of impact:

- Abandoned Fuel Can Area: Approximately 3 m^2 of soil with PHC F3 and metals concentrations greater than the referenced soil quality guidelines.
- Sandy Soil: A small area (1 m^2) of unusual sandy soil containing metals concentrations greater than the referenced soil quality guidelines.

Arcadis (Arcadis, 2016b) identified that since GS is located in a mineralized zone, the elevated metal concentrations were not unexpected and were possibly attributable to natural sources. However, the PHC impacts were identified to likely of anthropogenic origin.

5.6.3.2 Consideration of Remedial Options and Selection of Remedial Activities

Only one remediation option has been considered for this location. The PHC F3-impacted soil from the abandoned fuel can area will be excavated by hand, placed into bags for helicopter transport and disposed of in the Rayrock CDF.

5.7 Rayrock Powerline (Outside Exclusion Zone)

Aerial reconnaissance of the former Rayrock Powerline has identified the presence of non-hazardous debris (stove, loose wire, wire reels) along the line corridor. Portions of the corridor have been burnt in forest fires. In 2020 it was identified that some of the wooden power poles may have been treated with wood preservatives at the Barge Landing in the 1950s.

5.7.1 Non-Hazardous Waste

5.7.1.1 Description

Non hazardous wastes that may be encountered along the power pole corridor include wooden power poles, metal and possibly other debris.

5.7.1.2 Consideration of Remedial Options and Selection of Remedial Activities

The primary options for waste management include leaving “as-is” or off-site disposal. Leaving waste as-is was not deemed to be an acceptable option. Wood power poles will be inspected for indications of wood preservative. Power poles found to not be impacted by significant levels of wood preservative will be disposed of at Rayrock as per Section 5.3.11 along with any other non-hazardous wastes identified.

5.7.2 Hazardous Waste

5.7.2.1 Description

Sampling of wooden power poles and soils adjacent to wooden power poles has the potential to identify impacts from wood preserving chemicals.

5.7.2.2 Consideration of Remedial Options and Selection of Remedial Activities

The primary options for hazardous waste management include leaving “as-is” or off-site disposal. Leaving waste as-is was not deemed to be an acceptable option. Any hazardous waste encountered, including all or portions of power poles and potentially any impacted soil will be treated as hazardous waste, collected at Rayrock and managed as described in Section 5.3.11. Impacted power poles would be shipped off-site and any impacted soils disposed of in the CDF.

5.8 Barge Landing

5.8.1 Non-Hazardous Waste

5.8.1.1 Description

Investigations at the Barge Landing have identified the presence of non-hazardous debris (drums, cans, metal, timbers, cans, miscellaneous other waste).

5.8.1.2 Consideration of Remedial Options and Selection of Remedial Activities

The primary options for non-hazardous waste management include leaving “as-is” or off-site disposal. Leaving waste as-is was not deemed to be an acceptable option. Non-hazardous wastes are expected to be hauled to Rayrock for consolidation as per Section 5.3.12; however, given the more southern location of the Barge Landing, the remediation contractor will be permitted to haul waste direct to disposal facilities with proper waste screening and transportation methods employed.

5.8.2 Hazardous Waste

5.8.2.1 Description

Hazardous material (one battery) was found at the site. Additional hazardous items may be fond during site clean-up. Historical data identified in 2019/2020 further indicated the potential for power poles to have been chemically treated at the Barge Landing. Soil sampling will be undertaken to assess potential soil impacts due to these activities.

5.8.2.2 Consideration of Remedial Options and Selection of Remedial Activities

The primary options for hazardous waste management include leaving “as-is” or off-site disposal. Leaving waste as-is was not deemed to be an acceptable option. Any hazardous waste encountered, including any impacted soil will be treated as hazardous waste, collected at Rayrock and managed as described in Section 5.3.11.

5.9 MK Satellite Site

5.9.1 Non-Hazardous Waste

5.9.1.1 Description

One former wood structure is present at the northern portion of the rock face. Two rock core piles are present along with multiple locations of drill holes and rock piles along the ridge running in a south-westerly direction from the structure. An old teepee frame is present adjacent to a stockpile of cut timbers. Southwest of the former structure area was a large area where blasting had occurred. Site debris includes two empty, intact 205 L drums; hosing and one piece of sheet metal; sparse metal cans (100 or less); and small quantities of plastic refuse and general waste (1 to 2 garbage bags).

One soil sample was found to contain metals concentrations in excess of the referenced soil quality guidelines. The zinc concentration of this sample was found to be significantly higher than the results of other samples collected during that assessment (Arcadis, 2016b). The report identified that it could not be determined if the source of the zinc was natural or anthropogenic. The soil with elevated zinc was expected to be localized to pockets of soil within the bedrock outcrop, given the rocky nature of the site.

5.9.1.2 Consideration of Remedial Options and Selection of Remedial Activities

The primary options for non-hazardous waste management include leaving "as-is" or off-site disposal. Leaving waste as-is was not deemed to be an acceptable option. Non-hazardous wastes will be hauled to Rayrock for consolidation as per Section 5.3.12.

The presence of zinc in a localized portion of soil at this remote location is not deemed to warrant remediation and this soil will be left in place.

5.10 TED Satellite Site

5.10.1 Non-Hazardous Waste

5.10.1.1 Description

A former camp area containing at least one burnt structure is located on bare rock surrounded by the forest. Evidence of drilling and blasting is present to the west of the former camp area. Site debris includes one 205 L drum (intact with no contents inside), two small rusted fuel containers (~20 L volume), several stoves and pieces of stove pipe, general metal debris, small quantity of asbestos shingles (0.5 kg or less), sparse metal cans (100 or less), small quantities of plastic refuse and general trash (3-4 garbage bags) and a small pile of rusty nails.

One soil sample was found to contain a uranium concentration in excess of the referenced soil quality guidelines. The sampling report identified that this elevated concentration was likely natural, rather than anthropogenic though this could not be confirmed.

5.10.1.2 Consideration of Remedial Options and Selection of Remedial Activities

The primary options for non-hazardous waste management include leaving "as-is" or off-site disposal. Leaving waste as-is was not deemed to be an acceptable option. Non-hazardous wastes will be hauled to Rayrock for consolidation as per Section 5.3.12. The presence of uranium in a localized portion of soil at this remote location is not deemed to warrant remediation and this soil will be left in place.

5.11 Reclamation

The RAP requires the physical disturbance of land at several areas, mainly:

- Rayrock Mine:
  - Soil borrow areas (historical and current).
  - Trails and former building locations.
  - Mill Lake.
  - Mill Creek.
  - TCAs (repaired and disturbed locations).
  - Waste dump (disturbed locations).

- Sun Rose:
  - Waste rock piles.
  - Exploration workings.
  - New waste rock containment cell.
  - New borrow area.
  - Trails.

- Possible soil excavation locations:
  - Barge landing.
  - GS.

An important Project component is to rehabilitate or reclaim these disturbed areas as best as practical to encourage land rehabilitation to pre-disturbance uses. Site reclamation requirements will be detailed in the remediation contract design drawings and specifications which will consider:

- Build on knowledge gained from lessons learned from the 1996 TCA and waste dump revegetation efforts and vegetation test plots constructed in 2019.
- Incorporate Tłı̨chǫ local and Traditional Ecological Knowledge with respect to outcomes, vegetation types and planting practices.
- Incorporate existing site knowledge about soil types and availability.
- Incorporate knowledge and lessons learned from rehabilitation and reclamation efforts at other mine sites in the NWT, (e.g., bio-engineering practices used in the Colomac Mine remediation).

Prior to commencing remedial activities that involve earthworks, the airstrip borrow source will be developed which will include activities such as stripping and salvaging any organics or topsoil found near surface to proactively prepare for restoration activities. Re-seeding or transplanting will be methods to promote vegetation growth.

Consideration may be given to commencing reclamation work early in the project. With reclamation for complex work not occurring for a few years there may be time to complete simple field studies to examine the viability of different reclamation strategies. In addition, consideration could be given to early planting of vegetation to facilitate transplanting at later stages of the project.

6. Implementation Strategy

6.1 Overview/Approach

Site remediation and rehabilitation for the Project will involve numerous tasks, some of which are of low complexity (debris pick-up and stockpiling) through to those of high complexity (water treatment, sediment removal and cell construction). AECOM identifies that there are potential benefits in staging the work – completing the low complexity work first followed by the high complexity work. These benefits include:

- Early Reduction of the Project footprint. By completing the low complexity operations first, the overall footprint of the remediation project can be reduced. Instead of having the Project scope entail Rayrock, the satellite sites, Sherman Lake Camp, the Barge Landing and the powerline, by completing the low complexity work first the physical footprint of the Project could be reduced to only the main mine site with all other sites completed.
- Safety: By completing the low complexity work first, the execution of the higher complexity work can then proceed at a later date with heavy equipment unencumbered by other site operations making the site a safer place to work due to fewer opportunities for work activities to overlap.
- Camp Size: Completing all of the operations at once requires a large camp size, at a site where there is limited space. By breaking the work into separate components, the camp size can be better-managed.
- Training/Education: Conducting the simpler activities ahead of the program may provide training opportunities for workers that might potentially become engaged in the more complex future works.
- Scope Refinement Efficiencies: By having personnel stationed at site during low complexity operations, data needs for the higher complexity work can be obtained cost-effectively.
- Education: Education opportunities may present themselves through the course of the work. For example, there may be an educational opportunity for the development of a revegetation strategy ahead of the complex work. Vegetation test plots were constructed in 2019 that can be evaluated and possibly expanded to incorporate site-specific conditions with Traditional Ecological Knowledge in a manner where the results could not only be used for this project, but others as well.

Added benefits include the potential to stage work with available funding and an ability to demonstrate physical progress on the remediation file.

6.2 Lessons Learned

6.2.1 1996 Rayrock Construction

Relevant to this RAP are construction observations from the 1996 site rehabilitation activities undertaken by PWGSC, as summarized in the 1997 Construction Management Report. Selected construction aspects are detailed in the following two tables. The purpose of documenting these observations in this RAP is to incorporate these learnings into future work.

Table 6-1: 1996 Construction Schedule

Timeline	Construction Activities	Notable Observations/Comments
March, 1996	• Camp and equipment mobilized to site	• Camp location cleared
May, 1996	• Camp established • Primary borrow pit location cleared • Waste rock haul routes established	• Camp construction included a decontamination trailer equipped with showers, washer, dryer and clean changing room
July 2, 1996	• Personnel mobilized to site	•
July 1996	• Excavation and hauling of borrow material (28,000 m^3 in July)	• Warm temperatures and little rain in July
August 1996	• Weather delays	• Report identifies 18 days and “atrocious: working conditions • Contractor tried to 11 hour/day working shifts with limited success
September 5, 1996	• Work suspended due to wet weather • Work to resume when sufficient frost was present in ground to allow free movement of trucks and equipment	• Majority of site personnel sent home
October 1996	• Earthworks	• October 8: Initial mechanical crew mobilized to site to prepare equipment. Weather included light rain and snow, one truck “sank to axles” in soil and operations ceased on October 10. • October 27: Contractor remobilized and the majority of work completed • Some final grading and clean-up noted to be required for 1997.
Camp Set-up	• Camp not ready for construction start	• Food, water, supplies and sleeping quarters not ready for the date of construction start
Weather	• 18 days of rain in August 1996 • Significant rain in October 1996	• Slippery conditions and difficulties placing clay TCA caps • Inability to maintain haul roads in a good condition • Borrow soil froze in truck boxes
Equipment Break-downs	• Equipment repairs required	• Slowed construction progress
Borrow Soil Excavation	• Locating Borrow Soil	• Borrow soil required for TCA caps (900 mm thick) and waste dump (1000 mm thick) • Borrow area frozen in June which did not allow for excavation • Permafrost encountered during excavation which required the contactor to continually change set-up locations due to the frozen soil • Borrow pit required expansion to find adequate soil
Reclamation	• Plant Growth Medium	• Growth material was stripped from the surface of the borrow area and site access routes • A growth medium and seed were placed atop the final TCA covers • Frozen conditions did not allow placement to specified 100 mm; therefore, additional material was required • Material could not be graded as well as desired due to frozen conditions

A review of the above information highlights the need to schedule field work around weather, in particular understanding the implications of wet weather and planning work in a manner that reduces wet-weather risks.

6.2.2 Other Projects

Lessons learned from other projects that may apply to Rayrock include:

- Borrow Source Assessment:
  - Incomplete assessment of potential borrow sources can lead to shortages in both the volume and type of soil required.
  - Borrow investigations should be completed with the use of drill rigs or other heavy equipment to determine the depth of identified borrow sources and locate areas of high bedrock.
  - Heavy equipment (excavator) can be used to excavate test pits in the proposed borrow areas immediately after surface stripping of organics to obtain an early indication/ confirmation of borrow soil and information gathered used to adjust the borrow excavation plan if necessary.

- Mine Openings: The use of PUF for highly fractured bedrock collars and pre-fab concrete bridge deck panels has been found to be highly effective as compared to pour-in-place concrete.

- Sediment and Erosion Control (SEC): Drainage at Rayrock all leads to Sherman Lake. Robust SEC measures will need to be planned ahead of time for the project to manage this concern.

- Archaeological Impact Assessment: Requesting support from Tłı̨chǫ early in the project to review the AIA findings and pre-construction survey to facilitate the identification of active trap lines, cabins or areas of cultural sensitivity along the route may benefit the project.

6.3 Schedule

The following approximate project schedule is assumed. Actual project activities will be dictated by project funding, regulatory approvals and technical readiness.

- 2020: Year 1
  - Confirm RAP acceptance amongst stakeholders.
  - Identify locations that will accept hazardous and non-hazardous waste from Rayrock.
  - Confirm contracting strategy for general contractor for low complexity work.
  - Confirm contracting strategy for general contractor for winter road and high complexity work.
  - Conduct detailed quantity survey measurements (if and where needed).
  - Complete final pre-design field work.
  - Develop contract specifications and drawings for Project.
  - Develop Class B/A cost estimate

- 2021: Year 2
  - Obtain Water Licence and new LUP.
  - Conduct all or a portion of low complexity work.
  - Tender and award winter road and high complexity work (including bidder's conference and site tours).
  - Pre-mobilization site tour, winter road track survey.

- 2022: Year 3
  - Construct winter road access
  - Mobilize equipment to site
  - Waste Removal

  - Water treatment
    - Assemble water treatment operation
    - Treat and discharge Mill Lake water
  - Earthworks
    - Prepare borrow area access road
    - Demolish concrete foundations
    - Consolidate waste rock and tailings
    - Partial excavation and movement of clay from airstrip to lake area
    - Conduct repairs to the TCAs
  - Construct Mill Lake CDF
    - Isolate CDF location from surface water and sediments using Aqua-Dams or Port-a-Dams
    - Pump existing sediments within the disposal area into the main lake
    - Prepare the clay bottom and install a geosynthetic liner
  - Commence placement of sediments into CDF to include as needed:
    - Summer phase: Install, commission and operate hydraulic dredge/pump and/or
    - Winter phase: excavate frozen sediments and move into the disposal area

- 2023: Year 4
  - Construct winter road access
  - Replenish supplies and equipment via winter road
  - Borrow pit reclamation
  - Water treatment
  - Treat and discharge Mill Lake water and process water
  - Earthworks
    - Complete placement of tailings into Mill Lake CDF
    - Place waste rock, tailings and soils atop sediments in CDF
    - Construct CDF cap
    - Blast bedrock swale
    - Complete clay cap atop CDF
    - Place blast rock atop CDF
    - Backfill low-lying areas of Mill Lake bottom with clay, place organics

- 2024: Year 5
  - Construct winter road access
  - Complete outstanding work if needed (contingency year)
  - Demobilize equipment from site
  - Reclamation inspection

- 2025: Year 6 (Contingency Year for Demobilization)
  - Construct winter road access
  - Demobilize equipment from site (required completion by March 31, 2025)
  - Reclamation inspection

Lessons learned from previous site construction should be shared with the contractors in order that project execution risks can be managed better, in particular understanding and planning for weather-impacts on earthworks. Notable items include frozen soils in the borrow area in June and the possibilities of construction delays created by rainfall.

6.4 Permits/Environmental Management Plans

As part of both the land use permit and water licence for the Project, several environmental management plans will be required. Requirements for many of the plans are identified in the Rayrock LUP and it is expected that the developed plans will apply to the Project as a whole. The plans to be developed include but are not limited to those described below.

The General Contractor will be required to develop detailed management plans in sufficient time for them to be reviewed and accepted prior to mobilization. This requirement has a long lead time that needs to be accounted for in the overall project schedule. A description of select plans is provided below.

6.4.1 Waste Management Plan

An existing Waste Management Plan for Rayrock has been developed by CIRNAC that covers operational wastes, (wastes generated during contracted work that is completed on the site) and legacy wastes (wastes left over from previous mine operations) (CIRNAC, 2020a). Wastes to be managed will include solid wastes (soil, rock, debris) and liquid waste (process water, blackwater and greywater).

The successful Remediation Contractor will be required to submit an updated Waste Management Plan as part of their project submittals. The CIRNAC Waste Management Plan will be the minimum standard that the Remediation Contractor's Waste Management Plan will be measured against. The current Rayrock LUP requires that a revised Waste Management Plan be submitted to the WLWB Board for approval a minimum of 90 days prior to the commencement of remediation. Further, the Waste Management Plan will need to capture all waste management aspects, including cradle-grave disposal under the transportation of dangerous goods requirements.

6.4.2 Spill Contingency Plan

CIRNAC has developed a Spill Contingency Plan (CIRNAC, 2020b) in support of the new LUP and Type A Water Licence applications. This plan is to be applied to all activities where potential contaminants are used. Contractors and Consultants are required to submit Site-Specific or Activity-Specific Spill Contingency Plans that must meet or exceed the standards outlined in the CIRNAC plan. The Rayrock LUP requires an updated Project-specific spill contingency plan to be developed and submitted to the WLWB Board a minimum of 90 days prior to the commencement of remediation activities.

6.4.3 Sediment and Erosion Control Plan

Earthworks are planned at both Rayrock and Sun Rose as part of this RAP. The Rayrock LUP requires that erosion be minimized by installing erosion control structures as the land-use operation progresses. Similarly, the project will require these measures at Sun Rose.

CIRNAC has developed a Sediment and Erosion Control Plan (CIRNAC, 2020c) as guidance for SEC measures to be implemented prior to, during and after remediation activities. The plan is intended to represent the baseline effort required for SEC. Prior to the beginning of site remediation, the Remedial Contractor will be required to present a Contractor SEC Plan that will meet or exceed the guidance provided in the CIRNAC SEC Plan.

6.4.4 Emergency Management and Fire Protection Plan

CIRNAC's September 2019 Emergency Management and Fire Prevention Plan (EMFPP) (CIRNAC-CARD, 2019b) was developed for use by federal employees, contractors and their employees, and all other visitors to sites included in the remediation and monitoring field programs for the Rayrock Remediation Project. This Plan is the minimum standard for all emergency management and fire prevention activities for the Project.
The Remedial Contractor will be required to develop their own similar plan for the Project. The CIRNAC-CARD plan will require regular (at least annual) updates through the course o the project.

6.4.5 Aquatic Effects Monitoring Program Design Plan

CIRNAC has further developed a Rayrock Remediation Project Aquatic Effects Monitoring Program (AEMP) Design Plan (CIRNAC-CAARD, 2020d) in accordance with the "Guidelines for Aquatic Effects Monitoring Programs" (MVLWB) 2019. The AEMP Design Plan will be submitted in support of the Type A Water Licence application.

The primary purpose of the AEMP is to gather analytical data on the aquatic environment of Sherman Lake and the down-gradient Lake A to monitor changes in water quality, benthic communities or fish and fish habitat. Additional Lakes in the Rayrock area will be monitored to ensure other civil works on the site do not cause impacts. The AEMP will monitor water quality, benthic communities and fish and fish habitat before, during and after remediation to determine if any statistically significant change occurs during the execution of the project.

The Remediation Contractor's Environmental Manager is responsible for the collection of all hydrology and water quality data for the Project and will compile all collected data for review by the Departmental Representative. Benthic communities and fish and fish habitat assessments will be completed directly by the Departmental Representative or their designates. The Departmental Representative will analyse the AEMP data on an on-going basis to provide timely analysis of trends and recommendations for mitigative responses to changes.

Aquatic monitoring under the AEMP will be governed by the Rayrock Remediation Project Water Licence (anticipated for issuance in the summer of 2021), the CNSC WNSL and the Rayrock LUP.

6.4.6 Wildlife Management and Monitoring Plan

The Rayrock LUP requires that reasonable measures be undertaken to prevent damage to wildlife and fish habitat during site activities. Given the remote nature of the sites and the locations being inherent natural habitat a well thought out plan for wildlife protection will be necessary for both wildlife and worker protection.

The CIRNAC Wildlife Management and Monitoring Plan (WMMP) for the Rayrock Remediation Project (CIRNAC-CARD, 2020e) outlines mitigation that will be implemented to reduce Project impacts on wildlife and wildlife habitat, the monitoring proposed to understand the impacts of the Project on wildlife, the verification methods that will be used to show the efficacy of the mitigation and inform adaptive management, and the procedures that will be employed to meet all applicable legislation and guidelines. The WMMP will be implemented prior to, during and after remediation activities are completed at Project sites and is intended to represent the baseline effort required for wildlife management and monitoring. Prior to the beginning of site remediation, the Remedial Contractor will be required to present a Contractor WMMP that will meet or exceed the guidance provided in the CIRNAC WMMP.

6.4.7 Quality Assurance/Quality Control Plan

A QA/QC Plan will need to be developed for construction. This plan will detail the construction QA/QC requirements and can also be expanded to include environmental compliance requirements as may be required by the design and regulatory approval requirements.

6.4.8 Operation, Maintenance and Surveillance Plans

A Project Operation, Maintenance and Surveillance (OMS) plan will require development to ensure that construction performance meets design life. Elements of this plan will include:

- Rayrock Mine:
  - Mill Lake CDF.
  - Mill Lake drainage features.
  - Mine adit drainage monitoring.
  - Mine vents.
  - Reclaimed lands.
  - TCAs.
  - Waste dump.
- Sun Rose:
  - Waste rock containment cell.
  - Exploration workings.
  - Reclaimed lands.
  - Mine shaft cover.

Elements of these OMS activities may be included in other existing plans; however, RAP execution will mean new items to include and potential modifications to plans already in place.

6.5 Preliminary Activities

6.5.1 Regulatory Approvals

Prior to the start of work, certain licences and permits must be obtained for the Project, which include the following:

- CNSC Requirements and Licence Amendments.
- Type A Water Licence: Use of water for winter road construction, camp facilities, wastewater discharge and Mill Lake discharge.
- Land Use Permit under the Mackenzie Valley Resource Management Act: to use and occupy the land.
- Quarry Permit: Access and ability to develop borrow sources.
- Archaeological Impact Assessment Permit.
- Chief Inspector of Mines’ Direction on formal closure of Mine Adit and Mine Vents.

Approximately one year should be planned for to obtain the necessary permits and licences. Public consultation meetings are part of the permit and licence approval process. Currently, there is an LUP available for Rayrock; however, it will expire in August 2022 and require amendments based on the final RAP.

6.5.2 Health and Safety

The Remediation Contractor will have Prime Contractor responsibilities on the work sites. The prime contractor is responsible for compliance with all NWT Occupational Health and Safety Regulations.

A radiation protection safety manual has been prepared by CIRNAC and its implementation will be required prior to any remedial activities. The successful Contractor will also be required to produce a health and safety program for all work undertaken that complies with the Northwest Territories Occupational Health, Safety Regulations and the Mine Health and Safety Act and Regulations, and the site-specific requirements as dictated by the Water Licence, Land Use Permit and Quarry permits. Further, a worker radiation protection program will comprise an important part of the HASP. The relevant contractor plans will be submitted to CNSC by CIRNAC.

6.6 Environmental Monitoring

6.6.1 Pre-Remediation Environmental Monitoring

Pre-remediation environmental monitoring activities will include:

- Preparation of a baseline Rayrock surface water quality monitoring program and associated sampling (2020 and 2021) – see Section 6.4.5.
- Collection of baseline radon sampling at the Rayrock adit and vent locations, as well as at the Sun Main vent shaft.

6.6.2 Construction Environmental Monitoring

Regular environmental monitoring data will be required during construction to ensure that environmental control measures implemented during construction are effective, and that remedial efforts do not create unintended environmental concerns. Elements of the construction monitoring plan will include:

- Air quality monitoring (potentially including Radon).
- Surface water quality monitoring.
- Waste tracking.
- Personnel radiation monitoring plan.
- Waste radiation monitoring.
- LUP compliance.
- Water licence compliance.

A Post-Remediation Monitoring Plan will further be required (discussed in Section 6.6.3).

Environmental Monitoring and Verification measures will be required for the environmental remediation, geotechnical and other construction aspects of the Project. The following table provides a preliminary environmental verification program. Modifications to this program are anticipated as the engineering design of the project is developed.

Table 6-2: Preliminary Remediation Environmental Monitoring and Verification Program

Location	Action/ Description	Media						
		AIR	S/T/WR	BM/G	SED	SW	TW	BIO
Pre-Remediation Monitoring & Sampling	Baseline surface water, sediment and aquatic life as per water quality monitoring program				X	X		X
	Baseline radon testing at mine vents and adit	X						
	TCLP and bulk testing for metals (uranium in particular) for wastes destined for off-site disposal to determine disposal requirements and acceptability at disposal facilities		X					
	Baseline asbestos testing in soils proximate to former buildings		X					
	Air quality testing for particulate matter and metals	X						
	Adit seepage monitoring should ice plug degrade					X		
Rayrock Mill Lake Sediment Remediation	Treated Mill Lake surface water to be tested daily during discharge – program to comprise field testing with confirmatory laboratory testing						X	
	Residual organic sediment to be tested (if present) to document final metals concentrations				X			
	Soils underlying the removed organic sediment (silt, sand and/or clay) to be tested to document metals concentrations		X					
	Clay borrow soils to be tested for metals content to document quality of soil used in cell construction and lake bottom grading soil		X					
	Air quality testing for particulate matter and metals	X						
	Blast rock from Mill Creek swale/ditch construction to be tested for ARD/ML post blasting and pre-placement as rip/rap		X					
	Materials placed in CDF to be screened for gamma radiation to document radiation levels of materials being placed into the cell		X	X	X			
	Waste materials from water treatment testing to be tested to document environmental quality of material placed in waste cell		X		X			
	Adit seepage monitoring				X			

Location	Action/ Description	Media						
		AIR	S/T/WR	BM/G	SED	SW	TW	BIO
All Locations Non-hazardous Waste	TCLP testing for metals for wastes destined for off-site disposal			X				
	Radiation testing			X				
	Other testing as may be required by waste receiving facility			X				
All Locations Hazardous Waste	Possible testing for asbestos (only small quantity of ACMs not previously categorized). Suspect ACMs will be disposed of as ACM. ACM testing as required.			X				
	Radiation testing			X				
	Other testing as may be required by waste receiving facility			X				
All Locations Spilled Tailings/ Impacted Soil	Spilled tailings, waste rock and intermixed granular material and road surfacing to be tested for metals content to document condition of material being placed in CDF		X					
	PHC and PAH (if encountered)-impacted soil to be tested to document condition of material being placed in CDF		X					
	Impacted soil (HHERA No Risk) will be left in place. Samples of soil left in place will be sampled for metals and/or PHCs to document residual site condition.		X					

Notes:
AIR: Air
S/T/WR: Soil/Tailings/Waste Rock
BM/GD: Building Materials/General Debris
SED: Sediment
SW: Surface Water
TW: Treated Water
BIO: Biota (aquatic, terrestrial)

The above plan will be refined as the engineering design progresses and may need to further consider/incorporate requirements put forth by the WNSL, the community, and other project stakeholders.

The general contractor HASP will further need to address occupational health and safety issues as it relates to the hazards/ potential hazards to be encountered during construction.

6.6.3 Post-Construction Environmental Monitoring

To confirm that remedial efforts were effective, and to ensure compliance with all licences and permits for the specific project and overall site (CNSC), a long-term monitoring program will need to be developed. This long-term monitoring program may include, but not necessarily be limited to:

- Monitoring of the TCAs, Waste Dump and Mill Lake CDF.
- Monitoring of groundwater monitoring wells.
- Monitoring of the mine adit base for signs of water outflow.

- Monitoring of Mill Lake basin and drainage features, including outflow.
- Monitoring of reclamation activities.
- Monitoring of the adit and vent raises.
- Surface water quality monitoring.
- Radon monitoring (limited to first two years to demonstrate that remediation did not increase the rate of Radon release).

The post-remediation monitoring components, including monitoring locations, will be further developed during detailed design and will include post-construction aquatics monitoring as described in the AEMP and geotechnical monitoring of constructed facilities.

6.7 Mobilization

6.7.1 Winter Roads

Winter roads will be needed to mobilize heavy equipment and project supplies to the site. Two GNWT winter roads are anticipated to be constructed in the vicinity of the Rayrock Mine. One road to the west provides winter road access to Gamèti. Access to Rayrock through a spur road (the Marian River Route) would be in the order of 14 km long. A second winter road is located to the east of Rayrock, towards the former Colomac Mine (the Wekweètì Road). Access to Rayrock through a spur road (the Emile River Route) would be in the order of 15 km long. There are advantages and disadvantages to the use of both routes (e.g., river crossings at the Emile and Marian Rivers, freshwater supply for winter road construction, etc.) that will be examined in further detail as the Project progresses. Only one route to the mine site is expected to be constructed.

As these spur roads have not been used in a considerable amount of time, the timeframe for construction would be significantly longer than normal winter roads for the first year of construction.

Appropriate signage will be posted during operational phases of the remediation program to warn Winter Road travellers that the Rayrock site is closed to the public.

6.7.2 Access Roads

Given the nature of the project no significant work efforts are anticipated for internal road improvements. The only road requiring detailed consideration will be the haul route between Mill Lake and the airstrip. While waste rock and tailings from this road will be relocated to the Mill Lake CDF, there may be some merit in leaving the removal of these soils until all borrow soil has been obtained based on past lessons learned regarding haul challenges during wet weather. Careful consideration will need to be given to the planning of the haul road within the borrow area. This road will need to be elevated and well-graded in order to dry properly during rain events. Other field road construction considerations include ensuring that the TCAs do not become damaged and the ability for two-way traffic exists (though this may not be possible at all locations given the site’s physical restrictions).

Given difficulties with wet haul roads, there may be some benefit in using waste rock in temporary haul roads at the borrow pit. Once the borrow source requirements have been met, the waste rock can be excavated and returned to the CDF.

6.8 Site Access

6.8.1 Off-site Access

Rayrock is expected to be the primary base of all remedial activities and can be accessed by float plane and helicopter during the summer months. During mining operations an on-site airstrip was used for transportation. This airstrip was, however, used as a borrow source during the 1996 remediation and is no longer useable for airplanes. Float access was also established on Lake A in 1996 and could be re-established if needed for borrow source work or re-vegetation. A dock that was installed during the 2016 construction activities can be utilized to service float plane transport. The dock is small and consideration should be given to enlarging the dock for safety purposes during future remedial efforts. The current dock location is shown on **Figure 3, Appendix A**.

Mobilization of heavy equipment (excavators, bulldozers, dump trucks, compactors, water treatment equipment, etc.), fuel and possibly other supplies will be required via winter road for remediation. The current Tłı̨chǫ winter road route follows a portion of the former all-season road that connected Rayrock to the Barge Landing. This road is further proximate to Sun Main. As such, spur roads from the winter road to Rayrock and Sun Main would need to be constructed. As these spur roads have not been utilized for some time, a significant amount of work to rehabilitate the roads is anticipated.

Sun Main and Sun East are adjacent to the winter road route between Marian Lake and the Snare Hydro junction (the Wekweètì junction). This route was also used for a brief time as an all-weather road to the Rayrock Mine. Access to the property is by helicopter or float plane, or by boat to the north shore of Marian Lake and then over a 14 km seasonal road. The potential exists for work at Sun Main to be completed using equipment mobbed in by helicopter rather than constructing a winter spur road. The cost/benefit of this option needs to be examined.

The winter road access route into Rayrock will be decided once an archeological assessment is completed by CIRNAC (anticipated 2021). The Marian River spur was last used during site operations in the 1950s and the Emile River spur was used during the 1996 remedial activities. The Contractor will ultimately decide which route will be used to access the site, so both options will be assessed.

The Tłı̨chǫ Land Claims and Self-government Agreement provides provisions for access to Tłı̨chǫ lands. Under this, there may be a requirement for the Crown to obtain an Access Agreement from TG for site access for assessment and remediation activities. CIRNAC will seek an Agreement for the selected road.

6.8.2 On-site and Satellite Site Access

Transportation methods considered for debris collection and the transport of small volumes of impacted soil transport from satellite sites include helicopter, possibly float plane, utility task vehicles (UTVs), and combinations of these transports. No water crossings are required.

All sites are accessible by helicopter. Any work to be completed on top of Marian Ridge will need to be accessed by foot or helicopter as there is currently no safe access across the entire distance for heavy equipment. Work activities atop the ridge in particular will need to consider personnel safety due to the elevated work location, ground conditions and access restrictions.

The Sherman Lake camp is located on the eastern side of Sherman Lake directly across from Rayrock and is accessible by boat from Rayrock. While a boat could be used to transport waste from the camp site (metal, wood, etc.) across to the main mine site for waste consolidation, moving the waste by helicopter using a sling and bag system would likely be a safer method of doing so.

Trails at Rayrock were cleared and widened during work completed in 2015 and 2016. These trails can facilitate heavy equipment traffic to complete remedial activities at Rayrock. Clearing and widening of these trails may again be required. Additionally, there are trails that connect to the CA satellite site which could be utilized to complete required work at these locations. These trails may require grading prior to commencing remedial activities if a helicopter is not used for waste removal.

For the powerline, a combination of helicopter and UTV transportation methods are anticipated to complete the necessary work with a helicopter expected to be the most practical method for waste removal.

Trails are further present at Sun Main. As previously-identified, remnants of historical roads or trails remain at Sun Main/Sun East; however, these trails have been overgrown with vegetation at many locations. Due to the steepness of the bedrock dome and irregular terrain, movement within the site is challenging and nonstandard equipment may be required including smaller equipment that may have an easier time navigating the landscape.

6.8.3 Camp Facilities

Camp facilities will be set up at Rayrock over extended periods during construction. Limited camp facilities were established at the site (tent bases, lavatory building) for 2018/2019 field work. This location can be re-used for future short-term camps (e.g., the low complexity work) as it is located away from the main work area and thus provides a change of environment and a safe distance from work activities.

The camp for complex construction (Mill Lake) will be in operation for several months at a time. These camps will likely comprise a network of trailers hauled in on winter road. A decontamination room/building for workers will be required. The current camp location will not likely be able to accommodate trailers of this size and the contractor will need to determine a preferred camp location. A camp may be able to be situated to the southwest of Mill Lake near the former warehouse and office with some tree clearing. A location near the former airstrip may be another option available for a larger camp site. Camp facilities, if mobilized to the site by a contractor (large trailers, etc.) will need to be located in a manner that does not interfere with work activities yet remains a safe distance from active, dust-generating work activities.

Should a camp need to be established at Sun Rose, it is anticipated that the former camp site location would be used for this purpose. Works at Sun Rose are not anticipated to require a long time at site and a camp similar to that established by AECOM at Rayrock in 2018/2019 would likely serve the project site well.

All camps will need to comply with the applicable permits, licences and regulations during set-up and operation.

6.8.4 Fuel and Power

Fuel will be required for the project and bulk fuel storage will be required at the mine site.

Fuel for the low complexity work is likely best flown-in via fixed wing aircraft as-needed for the work. Fuel (helicopter fuel, diesel fuel for heat and gasoline for equipment) will be transported in drums and stored in portable berms. Fuel may further be best flown in drums via fixed wing aircraft for work at Sun Rose.

A substantial quantity of fuel will be required for the heavy equipment and water treatment power system during complex operations. These needs will need to be planned for carefully in order that a sufficient supply is present at the site. Should fuel run out during the execution of major project work, work could shut down.

All fuel use and storage will need to be conducted in accordance with the applicable federal legislation – in particular the Federal Registration of Storage Tank Systems for Petroleum Products and Allied Petroleum Products on Federal Lands or Aboriginal Lands Regulations.

6.9 Staging Facilities

Currently, the old borrow source area at Rayrock is used to store the non-hazardous and hazardous debris that has been consolidated so far. It is expected that this debris consolidation location will remain the same as debris from the mine site and satellite sites is taken to Rayrock.

A flat and stable location will be required for the water treatment plant. Given that the plant will be established near Mill Lake, which is an area of undulating bedrock and has existing mill infrastructure, waste rock and tailings, the area should likely be cleared of these materials prior to plant set-up. The waste rock and tailings piles could be used to establish a flat working area for the treatment plant with these soils moved to the CDF upon completion of the water treatment work. The logistics of managing the rock post-water treatment would need to be thought through in advance.

Power generation will be required for the work camp, sediment slurry pumping and water treatment system. The contractor will further need to identify an appropriate location for the generator that is close enough to support the facilities it serves yet is away from key work activities.

Locations for the camp and power generator may require some preliminary cleaning (waste, waste rock and tailings removal) prior to locating this infrastructure.

6.10 Uncertainties

Project uncertainties remain that will require further assessment prior to remediation as part of the development of detailed engineering drawings and specifications. The following table lists currently know Project Uncertainties undergoing evaluation. Additional uncertainties may be identified as design is advanced and rectification will occur as the Project progresses.

Table 6-3: Summary of Known Uncertainties

Location	Uncertainty/ Project Element	Description/ Resolution
General	Archeological Impact Assessment (AIA)	An AIA of the spur roads into the Project sites from the main Tłı̨chǫ winter road alignment is required as are AIAs of the soil borrow areas at Rayrock and Sun Rose. Early completion of the AIAs will assist in providing sufficient time for project adjustments should items of Archaeological importance be identified that could have an impact on construction.
General	Water Balance	Water balance is required for the Mill Lake catchment area. Data is required to examine precipitation and flows that can be expected during construction for water treatment. Data will further be required for the civil design of site drainage.
Mill Lake	CDF Location	Limited information is available to assist in siting the CDF in Mill Lake. Refined information pertaining to the sediment thickness and the grade/location/topography of the underlying clay and bedrock will facilitate locating the CDF. Obtaining refined information of the sediment quantity will further assist in refining the cell design and minimizing design adjustments during construction and assist in understanding the ability to dewater these sediments by knowing expected topographic gradients. Sub-bottom profiling will be undertaken to collect this information.

Location	Uncertainty/ Project Element	Description/ Resolution
	Clay Quality/ Properties	Geotechnical testing of the clay is required to determine the bearing capacity and consolidation of the clay below the lake bottom sediments (consolidation/Swedish cone testing) on undisturbed clay samples.
	Sediment Dewatering Efficiency	The lake sediments are unique in nature. Bench scale testing of the sediment through placement/filtration into geosynthetic bags will assist in the understanding of pumping characteristics, rates and bag sizing; and examining the percentage of solids achievable through this process. Freeze thaw testing of the dewatered sediment will help in determining the effect on dewatering following a cycle of freezing. Sediment freeze testing will assist in determining the characteristics of the sediment under frozen excavation activities. Bench scale testing of the samples are to be subjected to refined mixtures of polymers to better predict the dewatering and flocculation consolidation in the bags to assess the reduction of the sediment solids volume after dewatering, as will geotechnical/filter and consolidation testing of the dewatered sediments.
	Mill Lake Bedrock Blasting	The logistics and feasibility of blasting the swale in a controlled manner requires further investigation.
	Mill Lake Bedrock Quality	Additional data respecting the ARD/ML properties of the Mill Lake bedrock is required for due diligence purposes to confirm suitability that the rock can be used for armouring and rip rap without ARD/ML concerns.
	Process Water	Polymers will be injected into the sediments during dewatering. The potential impact of these polymers on water treatment and receiving water bodies requires review.
	Mill Creek Inlet	The physical make-up of the Mill Creek inlet is required to determine if the inlet is comprised of rock, soil and/or other matter.
Confined Disposal Facility (Rayrock) **and** **Clay Containment Cell (Sun Rose)**	Detailed Design Elements	Assessment of the potential impacts to the CDF with respect to freeze/thaw cycles and climate change resilience is required.
		The thickness of clay cap requires detailed design. The requirement will optimize having sufficient cap thickness to ensure protection from the elements and to mitigate radiation from the waste, while not over constructing the cap which would result in the excess soil disturbance at the borrow area and unnecessarily increase cost. The final physical appearance of the clay cap is further to be considered.
		The method of how to tie the CDF cover into the adjacent bedrock to mitigate surface water infiltration at this interface needs to be designed. The need to potentially install a geosynthetic membrane at this location is to be examined.
Borrow Soil (Rayrock and Sun Rose)	Soil Quality and Availability	Refinement of borrow soil locations and engineering to consider variabilities in soil condition and contingency plans for soil collection is required. Test pits may be advanced in Year 1 construction at Rayrock to assist in reducing uncertainties.
Rayrock Mine Adit	Mine Drainage	Little information is known about drainage from the mine adit. No seepage water has historically been identified. The mine base requires further examination and consideration made for adit water flow management in the future (should it occur).
Rayrock Mine	Quantity of waste rock, spilled tailings and impacted soil	Reliable, accurate volume estimates for these materials are not available. Quantity survey of these materials is required.
Rayrock TCAs	Rehabilitation Scope of Work	Specific details are required of the TCAs to define the scope of work for rehabilitation tendering (e.g., exact locations requiring rehabilitation, the scope of rehabilitation, materials required, etc.).

Location	Uncertainty/ Project Element	Description/ Resolution
Rayrock Waste Dump	Rehabilitation Scope of Work	Specific details are required of the waste dump to define the scope of work for rehabilitation tendering (e.g., exact locations requiring rehabilitation, the scope of rehabilitation, materials required, etc.).
Rayrock General	Asbestos	The methods of which any ACM management was undertaken during building demolition are unknown. To provide further information respecting this potential, surficial soil sampling in the vicinity of site buildings is required in preparation for site work as a matter of due diligence for worker safety. Residual ACMs are not anticipated since soils in the vicinity of buildings will be removed to bedrock surface.
Power Line (all locations)	Wood Treatment Chemicals on Power Poles	Recently-identified information indicates power poles may have been treated with wood preservatives at the Barge Landing. The presence of wood preserving chemicals on power poles may result in power poles needing to be handled as hazardous waste. Representative power pole locations will be visited in 2020. Samples of the wood and soil in the vicinity of the poles will be collected and analyzed for chemical treatments. If remedial activities are required for either the poles or the soils they will be managed in accordance with this RAP.
Barge Landing	Power Pole Treatment	Recently-identified information indicates power poles may have been treated with wood preservatives at the Barge Landing. The process of wood preserving had the potential to impact soils. Historical data will be reviewed to identify the approximate location of the wood treatment area and the soils at these locations tested for potential contaminants of concern. If impacted soils are identified they will either be placed into either the Mill Lake or Sun Rose CDFs or an appropriately licensed third party disposal facility.
REX	Exploration Workings	The entirety of REX has not been explored to-date. Inspections will be undertaken in 2020 to identify additional debris and/or exploration workings. Additional areas of environmental concern, if identified, will be managed in accordance with the processes outlined in this RAP.
General	Training	This project will require worker training that is not necessarily available or convenient in the Yellowknife area. This could include radiation safety training, asbestos worker training, ATV safety training amongst other items. The need for training should be assessed prior to undertaking work as there may be a requirement to coordinate project specific training in order to properly and safely conduct the works.

The process of developing engineered design drawings and specifications may identify outstanding design issues.

6.11 Remediation Materials Inventory

Table C10, in Appendix C, provides a summary of materials associated with the remediation project including quantities of waste rock, impacted soils to be managed, blast rock, borrow soil and hazardous and non-hazardous wastes. We note that this table is preliminary in nature and additional refinement will be undertaken in 2020.

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Appendix C

Table C1

Rayrock Remediation Project Closure Objectives and Criteria
Kwetı̨ı̨ɂaà (Rayrock) Remediation Project
Public Services and Procurement Canada

Closure Objective	Closure Criteria	Monitoring, Maintenance and Inspection

1. Minimize public and worker health and safety risks	• **1-1** Residual risks are identified, and local residents are, and continue to be, informed of residual hazards (post-remediation) through public communication initiatives as outlined in the Engagement Plan.
	• **1-2** The Prime Contractor develops and adheres to a Site-Specific Health and Safety Plan.
	• **1-3** Access to underground workings from surface openings is restricted for the safety of humans and wildlife.
	• **1-4** Concrete foundations and site debris is removed so it is not, and will not become, a safety hazard.
		Active Remediation Phase:
		• Management Plans:
		  ○ Engagement Plan – documents plans for continued engagement, including public communication strategies and regular project update meetings with the Tłı̨chǫ Government, Kwetı̨ı̨ɂaa Elders Committee (KEC) and community members
		  ○ Site-Specific Health and Safety Plan – describes the remediation activities at the site and provides instruction for the applicable health, safety, and environmental policies and regulations related to the remediation activities, reviewed and accepted by WSCC
		  ○ Waste Management Plan – guides the effective management of waste, communicates waste types and disposal requirements
		  ○ Emergency Management and Fire Protection Plan – communicates emergency response measures and lines of communication, commits to actions that promote fire prevention and fire safety
		• Site Wide Hazard Assessment: provided to Prime Contractor to communicate existing site hazards
		• Design engineering drawings are signed and sealed by a Qualified Professional and the specifications outlined therein are met.
		• As-built engineering drawings for closure of mine openings are signed and sealed by Qualified Professional and submitted to Wek'èezhìi Land and Water Board (WLWB), and closures are inspected by Mines Inspector as per the NWT Mine Health and Safety Act.
		• Satisfactory final inspection by Qualified Professional and Land Use inspector.
		
		Post Closure Phase:
		• Long-term monitoring and reporting requirements are met, includes documenting plans for continued engagement
		• Ongoing Monitoring & Sampling (OMS) activities are undertaken as required
		• Signage / Story Boards at site outlining history of the site including remediation

2. Minimize the human health and environmental impact of the sites	• **2-1** Surface water and sediment quality in Mill Lake are improved to reduce exposure of humans and aquatic and terrestrial receptors to contaminants.
	• **2-2** Approved effluent quality criteria are met during discharge of Mill Lake surface water and water treatment process wastes are disposed of in a controlled manner, so they are not, and will not become, a source of environmental contamination.
	• **2-3** Contaminated materials (i.e., soil, sediment, waste rock and tailings) are remediated or risk managed to reduce exposure of humans and aquatic and terrestrial receptors to contaminants.
	• **2-4** Non-hazardous and hazardous site debris is removed so it is not, and will not become, a source of future environmental contamination.
	• **2-5** Elements are designed to meet regulatory requirements and design specifications are met.
	• **2-6** Remediated areas are designed and constructed to promote positive drainage and resist erosion, including targeted revegetation with native species
	• **2-7** Remediated areas are not, and will not become, a source of future environmental contamination.
	• **2-8** Geochemically suitable borrow sources are used and quarrying regulations/ guidelines are met such that borrow materials/areas are not a source of future environmental contamination and do not pose a safety risk.
	• **2-9** Water quality objectives in Sherman Lake are met, as per the approved Aquatics Effects Monitoring Plan. Is this a repeat of 2-2?
		Active Remediation Phase:
		• Management Plans:
		  ○ Waste Management Plan – guides the effective management of waste, communicates waste types and disposal requirements
		  ○ Water and Wastewater Management Plan – guides the effective management of water and wastewater on site, including monitoring of treated water treatment plant effluent
		  ○ Sediment and Erosion Control Plan – provides guidance for sediment and erosion control measures to be implemented prior to, during and after remediation activities.
		  ○ Quarry Management Plan – identifies borrow areas and describes methods for effective use and closure of these areas
		  ○ Spill Contingency Plan – provides a plan for spill events
		  ○ Aquatic Effects Monitoring Plan – describes monitoring of water, fish and benthos, and sediment quality in Sherman Lake prior to, during and after remediation activities.
		• Human Health and Ecological Risk Assessment: assesses the potential risks to human and ecological health as a result of exposure to radiological contaminants to guide remedial decisions
		• Design engineering drawings are signed and sealed by a Qualified Professional and the specifications outlined therein are met.
		• Confirmatory sampling of soil, sediment and water during construction activities to verify remedial targets are met.
		• Quality assurance inspections during construction activities
		• Satisfactory final inspection by Qualified Professional and Land Use inspector.
		
		Post Closure Phase:
		• Long-term monitoring and reporting requirements are met, including water quality monitoring and geotechnical inspections
		• OMS activities are undertaken as required

Table C1

Rayrock Remediation Project Closure Objectives and Criteria
Kwetı̨ı̨ɂaà (Rayrock) Remediation Project
Public Services and Procurement Canada

Closure Objective	Closure Criteria	Monitoring, Maintenance and Inspection
3. Maximize the potential for future traditional use of the land	• **3-1** Work with the Tłı̨chǫ Government and KEC to reduce the size of the Kwetı̨ı̨ɂaa Avoidance Zone to the extent feasible and restore confidence that the water in the region is safe to drink and the land is safe to use.	*Active Remediation Phase:* • Management Plans o Engagement Plan – documents plans for continued engagement, including regular project update meetings with the Tłı̨chǫ Government, KEC and community members o Aquatic Effects Monitoring Plan – gathering and use of traditional knowledge to design monitoring, implement monitoring and interpret monitoring results o Wildlife Management and Monitoring Plan – gathering and use of traditional knowledge to design monitoring, implement monitoring and interpret monitoring results • Tłı̨chǫ Government and KEC input and involvement in Remedial Action Plan development via Technical Briefings and RAP Workouts *Post Closure Phase:* • Long-term monitoring and reporting requirements are met, includes documenting plans for continued engagement and gathering and use of traditional knowledge to design monitoring, implement monitoring (with select monitoring completed by Tłı̨chǫ Government) and interpret monitoring results
4. Reduce the Government of Canada's environmental liability while protecting Tłı̨chǫ land and water	• **4-1** Elements are designed to meet regulatory requirements and design specifications are met. • **4-2** Residual risks are managed on site via long term monitoring and operation, maintenance and surveillance (OMS) activities until suitable end points are achieved.	*Active Remediation Phase:* • Management Plans: o Site-Specific Health and Safety Plan – describes the remediation activities at the site and provides instruction for the applicable health, safety, and environmental policies and regulations related to the remediation activities, reviewed and accepted by WSCC o Waste Management Plan – guides the effective management of waste, communicates waste types and disposal requirements o Emergency Management and Fire Protection Plan – communicates emergency response measures and lines of communication, commits to actions that promote fire prevention and fire safety • Site Wide Hazard Assessment: provided to Prime Contractor to communicate existing site hazards • Design engineering drawings are signed and sealed by a Qualified Professional and the specifications outlined therein are met. • As-built engineering drawings for closure of mine openings are signed and sealed by Qualified Professional and submitted to WLWB, and closures are inspected by Mines Inspector as per the NWT Mine Health and Safety Act • Manifests for waste disposal are provided for off-site disposal of hazardous materials. • Satisfactory final inspection by Qualified Professional, Land Use inspector and Tłı̨chǫ Government representative. *Post Closure Phase:* • Long-term monitoring and reporting requirements are met • OMS activities are undertaken as required • Inspection and reporting to Canadian Nuclear Safety Commission is completed in accordance with Waste Nuclear Substance License
5. Implement remedial approaches that are cost-effective, satisfy the ALARA principal, and are robust over the long term	• **5-1** Elements are designed to meet regulatory requirements and design specifications are met. Climate change considerations have been included in designs. • **5-2** Minimize long term maintenance requirements by selecting remedial options that are lower in maintenance, lower in long-term costs and have a low probability of failure.	*Active Remediation Phase:* • Remedial options evaluations include constructability, longevity, construction cost and OMS cost considerations. • Design engineering drawings are signed and sealed by a Qualified Professional and the specifications outlined therein are met. • As-built engineering drawings for closure of mine openings are signed and sealed by Qualified Professional and submitted to WLWB, and closures are inspected by Mines Inspector as per the NWT Mine Health and Safety Act. • Satisfactory final inspection by Qualified Professional and Land Use inspector. *Post Closure Phase:* • Long-term monitoring and reporting requirements are met • OMS activities are undertaken as required

Table C1

Rayrock Remediation Project Closure Objectives and Criteria
Kwetįį̨ʔaà (Rayrock) Remediation Project
Public Services and Procurement Canada

Closure Objective	Closure Criteria	Monitoring, Maintenance and Inspection

6. Incorporate traditional and local knowledge, obtained through Elder guidance, into remedial design, implementation and monitoring	• **6-1** Collect and utilize traditional and local knowledge to inform remediation decisions where parties are interested, and information is available
	• **6-2** Support the Tłı̨chǫ Government's work with the KEC to document traditional knowledge about water, land and animals at the site and track changes over time thereby increasing Tłı̨chǫ citizen confidence in the safety of the land and water.
		Active Remediation Phase:
		• Management Plans
		  ○ Engagement Plan – document plans to gather traditional knowledge
		  ○ Aquatic Effects Monitoring Plan – gathering and use of traditional knowledge to design monitoring, implement monitoring and interpret monitoring results
		  ○ Wildlife Management and Monitoring Plan – gathering and use of traditional knowledge to design monitoring, implement monitoring and interpret monitoring results
		• Input and involvement in Archaeological Assessment activities
		• Tłı̨chǫ Government and KEC input and involvement in Remedial Action Plan development via Technical Briefings and RAP Workouts
		
		Post Closure Phase:
		• Long-term monitoring and reporting requirements are met, includes documenting plans for continued engagement and gathering and use of traditional knowledge to design monitoring, implement monitoring and interpret monitoring results

7. Maximize socio-economic benefits to the Tłįcho (as per Chapter 26.3 of Tłįcho Final Agreement)	• **7-1** Structure remediation contracts to maximize opportunities for Indigenous and northern businesses to the extent practicable. • **7-2** Use Government of Canada procurement tools that are designed to offer preference to Indigenous suppliers if available. • **7-3** Use Indigenous Opportunities Considerations (IOCs) in contractor tenders. • **7-4** Communicate socio-economic opportunities and benefits. • **7-5** Increase and maintain participation in community-based monitoring initiatives.	*Active Remediation Phase:* • Management Plans ○ Engagement Plan – documents plans for continued engagement, including regular project update meetings with the Tłı̨chǫ Government, KEC and community members • Complete progressive remediation activities via the Remediation Construction Services for Northern Contaminated Sites (NCS) Supply Arrangement in advance of full-scale remediation • Include IOC commitments in contractor tenders and report on IOC achievements *Post Closure Phase:* • Long-term monitoring and reporting requirements are met, includes documenting plans for continued engagement and exploring options for community-based monitoring

8. Comply with all legal/regulatory obligations and Federal, Territorial, and Departmental policies	• **8-1** Elements are designed to meet regulatory requirements and design specifications are met.
	• **8-2** Adhere to Government of Canada procurement policies, procedures and best practices by using a competitive process that aims to get the best value for Canadians while enhancing access, competition and fairness.
	• **8-3** Comply with the requirements of the Type A Water License issued by the WLWB including adherence to management plans and development and execution of a long term monitoring plan and operation, maintenance and surveillance (OMS) plan.
		Active Remediation Phase:
		• Management Plans
		  ○ Water Management and Monitoring Plan -Water quality monitoring.
		  ○ Waste and Wastewater Management Plan
		  ○ Sediment and Erosion Control (SEC) Plan
		• Design engineering drawings are signed and sealed by a Qualified Professional and the specifications outlined therein are met.
		• Satisfactory final inspection by Qualified Professional and Land Use inspector.
		• Reporting to the WLWB
		
		Post-Closure Phase:
		• Long-term monitoring and reporting requirements are met
		• OMS activities are undertaken as required

9. Remediate the sites in a manner that instills Tłı̨chǫ confidence and increases public awareness of remedial activities in the North	• **9-1** Inform affected parties about the Rayrock Remediation Project and communicate opportunities to participate in the Project. • **9-2** Maintain alignment between the expectations of the Tłı̨chǫ and the Rayrock Remediation Project.	*Active Remediation Phase:* • Management Plans: ○ Engagement Plan – requirements are met and reported to WLWB • Tłı̨chǫ Government and KEC input and involvement in Remedial Action Plan development via Technical Briefings and RAP Workouts • The WLWB Type A Water Licensing Process includes public review of application and participation in Technical Session(s) and Public Hearing(s) • Design engineering drawings are signed and sealed by a Qualified Professional and the specifications outlined therein are met. *Post Closure Phase:* • Long-term monitoring and reporting requirements are met • OMS activities are undertaken as required

Table C2

"90% RAP" Work Out Session Results - Rayrock, Satellite Sites, Barge Landing and Powerline
Kwetı̨ı̨ɂaà (Rayrock) Remediation Project
Public Services and Procurement Canada

Mine Component	Remedial Options Work-out (50% Remedial Action Plan)					Selected Remedial Option		
	Option 1 No Action	Option 2 Technical Option	Option 3 Technical Option	Option 4 Technical Option	Option 5 Technical or Hybrid Option	75% RAP	90% RAP	Details
Concrete – Mill Pad	Leave as-is	Control and Monitor	Soil Cap	Excavate and Dispose On-site	Excavate and Dispose Off-site	Excavate and Dispose On-site	Excavate and Dispose On-site	• Relocate concrete to Mill Lake disposal cell. • No change in selected remedial option since 50% RAP Workout
Concrete – Other Foundations	Leave as-is	Control and Monitor	Excavate and Dispose On-site	Excavate and Dispose Off-site		Excavate and Dispose On-site	Excavate and Dispose On-site	• Relocate concrete to Mill Lake disposal cell. • No change in selected remedial option since 50% RAP Workout
Mine Openings (Vent Raises, Adit)	Leave as-is	Control and Monitor	Foam Covers	Engineered Concrete Covers		Engineered Covers	Vent Raises Engineered Covers Adit: Leave as-is	• Vent Raises – confirm closure status with NWT Chief Inspector of Mines, then if needed construct either foam plugs with rock cover, concrete or steel cap. Contact WSCC to determine if current closure is acceptable (since sealed with concrete during original remediation) • Adit – confirm closure status with NWT Chief Inspector of Mines, Leave as-is and contact WSCC to confirm that current closure is acceptable. • No change in selected remedial option since 50% RAP Workout
Trenches (REX)	Leave as-is	Control (Fence) and Monitor	Granular Fill				>1.5m – Granular Fill <1.5m – Leave as-is	• Requires assessment • If trench is over 1.5m in depth, use granular fill to mitigate physical hazard. Otherwise, leave as-is. • New component added since 50% RAP Workout
Non-Hazardous Waste	Leave as-is	Control and Monitor	Consolidate and Dispose On-site	Consolidate and Dispose Off-site		Consolidate and Dispose Off-site	Consolidate and Dispose Off-site	• Waste to be consolidated and shipped off-site for disposal at an approved facility • Waste to be screened (gamma) prior to transport off-site as per CNSC guidance. • Recent feedback from Elders confirms leaving waste as-is would be unacceptable
Metal Impacted Sediments in Mill Lake	Leave as-is	Control and Monitor	Cover in Place	Excavate and Dispose On-site	Excavate and Dispose Off-site	Containment Cell in Mill Lake, Drainage Swale	Dewater Sediments Using Geosynthetic Bags, Construct Disposal Cell in Mill Lake Basin, Create Free-Draining Lake Bottom	• Impacted sediments to be contained in new CDF • Lake will be drained. • Leave as-is and control/monitor determined to be unacceptable.
Metal Impacted Water in Mill Lake	Leave as-is	Control and Monitor	Pump and Treat			Pump and Treat	Pump and Treat	• Pump/treat water and discharge into Sherman Lake • Leave as-is and control/monitor determined to be unacceptable
Spilled Tailings	Leave as-is	Control and Monitor	Cover in Place	Excavate and Dispose On-site	Excavate and Dispose Off-site	Excavate and Dispose On-site	Leave Well-Vegetated Areas as-is. Otherwise, Excavate and Dispose On-site	• HHERA did not identify unacceptable risk that requires remedial action. • Leave well-vegetated tailings as is. Otherwise, excavate and relocate to Mill Lake disposal cell • No change in selected remedial option since 50% RAP Workout
Metal Impacted Soil	Leave as-is	Control and Monitor	Cover in Place	Excavate and Dispose On-site	Excavate and Dispose Off-site	Excavate and Dispose On-site (in Mill Lake Containment Cell)	Leave Well-Vegetated Areas as-is. Otherwise, Excavate and Dispose On-site	• HHERA did not identify unacceptable risk that requires remedial action. • Leave well-vegetated tailings as is. Otherwise, excavate and relocate to Mill Lake disposal cell • Mill Creek to be left as-is • Note that in some locations, soil and spilled tailings are intermixed • No change in selected remedial option since 50% RAP Workout
Borrow Areas (Airstrip, North Borrow Area)	Leave as-is	Control and Monitor	Regrade			Regrade	Restoration	• Regrade for positive drainage and reclaim/restore, revegetate to the extent practicable • Leave as-is not acceptable due to observed erosional issues.

Table C2

"90% RAP" Work Out Session Results - Rayrock, Satellite Sites, Barge Landing and Powerline
Kwetı̨ı̨ʔaà (Rayrock) Remediation Project
Public Services and Procurement Canada

Mine Component	Remedial Options Work-out (50% Remedial Action Plan)					Selected Remedial Option		
	Option 1 No Action	Option 2 Technical Option	Option 3 Technical Option	Option 4 Technical Option	Option 5 Technical or Hybrid Option	75% RAP	90% RAP	Details
Waste Dump	Leave as-is	Repair Cap				Repair Cap	Repair Cap, Continue to Monitor	• Leave as-is not acceptable due to observed erosional issues. • Maintenance required on an as-needed basis in accordance with LTMP. • Consider leaving stockpiled granular material for future maintenance.
Tailings Cap	Leave as-is	Repair Cap				Repair Cap	Repair Cap, Continue to Monitor	• Leave as-is not acceptable due to observed erosional issues. • Maintenance required on an as-needed basis in accordance with LTMP. • Consider leaving stockpiled granular material for future maintenance.
Hazardous Waste	Leave as-is	Remove Off-site				Remove Off-site	Remove Off-site	• Waste to be shipped off-site for disposal at an approved facility, in accordance with TDG requirements • Waste to be screened (gamma) prior to transport off-site as per CNSC guidance. • No change in selected remedial option since 50% RAP Workout • Consider potential for ACM intermixed with metal impacted soil. Additional PPE required if there is a risk of ACM.
PAH Impacted Soil	Leave as-is	Excavate and Dispose Off-site					Leave as-is or Excavate and Dispose Off-site	• Requires assessment. Uncertain if PAH impacts are present. • PAH impacted soil along the powerline is unlikely (limited soil exists). • If identified, a limited risk assessment may be required to guide remedial decisions. • New component added since 50% RAP Workout
PAH Impacted Power Poles	Leave as-is	Consolidate and Dispose Off-site					Consolidate and Dispose Off-site	• Requires assessment. Uncertain if PAH impacts are present. • Power poles are very weathered. • If only a portion of pole is impacted, only the impacted portion will be disposed off-site. Remaining portion will be treated as non-hazardous waste • New component added since 50% RAP Workout
Waste Rock	Leave as-is	Cover in Place	Excavate and Dispose On-site	Excavate and Dispose Off-site			Leave Well-Vegetated Areas as-is. Otherwise, Excavate and Dispose On-site	• Includes internal access roads and pads on the Rayrock site, and the waste rock pile at the Mill area. • Waste rock has leaching potential • Leave well-vegetated areas as is. Otherwise, excavate & relocate to Mill Lake disposal cell • New component added since 50% RAP Workout

Colour coding is as follows:

- RED Shading: Options regarded to not meet the project objectives.
- YELLOW Shading: Options anticipated to likely meet the project objectives, but not preferred as compared to other option(s)
- GREEN Shading: Preferred remedial options.
- No Shading reflects no option identified

Table C3

“90% RAP” Work Out Session Results – Sun Rose
Kwetı̨ı̨ɂaà (Rayrock) Remediation Project
Public Services and Procurement Canada

Mine Component	Remedial Options Work-out (50% Remedial Action Plan)					Selected Remedial Option		
	Option 1 No Action	Option 2 Technical Option	Option 3 Technical Option	Option 4 Technical Option	Option 5 Technical or Hybrid Option	75% RAP	90% RAP	Details
Mine Openings (Shaft)	Leave as-is	Control and Monitor	Foam Covers	Engineered Covers		TBD, Requires Assessment, Likely Engineered Cover	Engineered Cover	• Construct either plugs with rock cover, concrete or steel cap (closure options to be evaluated during design) to comply with NWT Mine Health and Safety Regulations • Leave as-is and control/monitor not acceptable.
Exploration Workings	Leave as-is	Control and Monitor	Granular Cap	Concrete Cap		TBD, Requires Assessment, Cover or Fence	Cover Exploration Showings with Concrete Cap, Install Signs for Risk Communication	• Formerly referred to as “Blast Pits” – currently referred to as “exploration workings” • Administrative controls alone determined to not be acceptable. • Longevity of granular cap uncertain • Cover exploration workings themselves with concrete cap. Installation of signs is also recommended since naturally elevated gamma in area.
Waste Rock Piles	Leave as-is	Control and Monitor	Consolidate and Cover			TBD, Requires Assessment, Likely Consolidate and Cover with Clay Cap	Consolidate and Cover with Clay Cap	• Concern is related to gamma radiation rather than metals leaching. • Leave as is and control/monitor determined to be unacceptable. • Waste rock piles WR2 and WR3 to be consolidated with WR1, pushed lower into the gully and capped with clay. Grade to promote positive drainage and prevent ponding, revegetate to the extent practicable.
Metal Impacted Soil	Leave as-is					TBD, Requires Assessment, Likely Leave as is	Loose Impacted Soil Near Shaft to be placed into containment area at WR1. Otherwise, Leave as-is.	• HHERA did not identify unacceptable risk.
Access Roads	Leave as-is					TBD, Requires Assessment, Likely leave as is	Leave as-is	• HHERA did not identify unacceptable risk.
Non-Hazardous Waste	Leave as-is	Control and Monitor	Consolidate and Dispose On-site	Consolidate and Dispose Off-site		Consolidate and Dispose Off-site	Consolidate and Dispose Off-site	• Waste to be consolidated at Rayrock and shipped off-site for disposal at an approved facility • Waste to be screened (gamma) prior to transport off-site as per CNSC guidance. • Potential for disposal of non-hazardous waste in the shaft. TG does not have any concerns with this approach but needs to confirm with Elders. This potential remedial action was disclosed to active mineral claim holders and no issues were identified.
Lake/Pond Sediments	Leave as-is					Leave as-is	Leave as-is	• Did not identify unacceptable risk.
Surface Water	Leave as-is					Leave as-is	Leave as-is	• Did not identify unacceptable risk. • Tłı̨chǫ may choose to complete community-based monitoring if there are local concerns related to water quality.

Colour coding is as follows:

- RED Shading: Options regarded to not meet the project objectives.
- YELLOW Shading: Options anticipated to likely meet the project objectives, but not preferred as compared to other option(s)
- GREEN Shading: Preferred remedial options.
- No Shading reflects no option identified

Table C4

Summary of Project-Related Technical Reports
Kwetı̨ı̨ ɂàà (Rayrock) Remediation Project
Public Services and Procurement Canada

Report Date	Author	Title
1984, Jun	M. Kalin	Rayrock Northwest Territories History Uranium Tailing and Environment, Institute for Environmental Studies – University of Toronto
1985, Jul	Hatfield Consultants Limited	An Evaluation of Environmental Conditions Associated with the Abandoned Uranium Mines at Rayrock and Echo Bay
1986, Oct	Soniassy	Monitoring of the Rayrock Abandoned Mine Site, Rayrock, NWT
1995	Enviropac	Radiation Safety Plan
1995	PWGSC	Decommissioning Plan
1995, Nov	Soilcon Laboratories Ltd.	Rayrock Mine, Northwest Territories : 1995 Monitoring Program (DRAFT)
1997	Dogrib Renewable Resources Committee	The Trees All Changed to Wood, Dogrib Treaty 11 Council
1996, Oct	Golder Associates Ltd.	Environmental monitoring program for assessing remediation efforts at the Rayrock uranium mine
1997 (Assumed)	PWGSC	Rayrock Mine N.W.T. Rehabilitate Mine Tailings, Radioactive Waste & Secure Mine Openings, Construction Management Report
1999, Apr	Golder Associates Ltd.	Report on Review of the Short-term Monitoring Program, and Recommendations for Long-term Monitoring at the Rayrock Mine site
1999, Mar	SRK Consulting	Rayrock Mine Rehabilitation Post-reclamation Inspection and Work Plan
1999, Oct	PWGSC	Erosion Repairs at Rayrock Mine Site: Site Supervision Report
2000, Feb	Atomic Energy of Canada, Low-Level Radioactive Waste Management Office	Short-term Environmental Monitoring Program: Rayrock Uranium Mine
2001, Mar	Golder Associates Ltd.	Report: Update on Risk Assessment of Former Rayrock Mine Site to Incorporate Fall 2000 Fish Radionuclide Data
2001, Mar	Golder Associates Ltd.	Results of 2000 Rayrock Long-Term Monitoring Program
2001, Aug	Canadian Nuclear Safety Commission	CNSC Review Comments on Consultant Reports Rayrock Mine Site (PSL 208/2002)
2001, Aug	SRK Consulting	Rayrock Mine Inspection
2001, Oct	Knight Piésold Ltd.	Rayrock Mine Long Term Monitoring Program Fall 2001 Site Inspection Integrity of Mine Openings
2001, Oct	Knight Piésold Ltd.	Rayrock Mine Long Term Monitoring Program Fall 2001 Site Inspection Integrity of the Tailings Areas and Their Covers
2002, Mar	Rescan Environmental Services Ltd.	Revised Rayrock Long-Term Monitoring Program
2002, Apr	Rescan Environmental Services Ltd.	Results of Fall 2001 Rayrock Long-Term Monitoring Program
2003, Feb	Rescan Environmental Services Ltd.	Results of 2002 Rayrock Long-Term Monitoring Program
2004, Feb	Rescan Environmental Services Ltd.	Results of Fall 2003 Rayrock Long-Term Monitoring Program
2005, Jan	Rescan Environmental Services Ltd.	Results of Fall 2004 Rayrock Long-Term Monitoring Program
2006, Feb	Rescan Environmental Services Ltd.	Results of Fall 2005 Rayrock Long-Term Monitoring Program
2006, Feb	Rescan Environmental Services Ltd.	Rayrock Transportation Route Enhanced Phase I Assessment
2006, Nov	Rescan Environmental Services Ltd.	Results of Fall 2006 Rayrock Long-Term Monitoring Program
2007, Jun	Indian and Northern Affairs Canada	2006 Preliminary Asbestos Survey of Mill and Camp Site
2008, Mar	Rescan Environmental Services Ltd.	Results of Fall 2007 Rayrock Long-Term Monitoring Program
2009, Feb	Rescan Environmental Services Ltd.	Results of Fall 2008 Rayrock Long-Term Monitoring Program
2010, Jan	Rescan Environmental Services Ltd.	2009 Rayrock Long-Term Monitoring Program
2010, Mar	SENES Consultants Limited	Rayrock Supplemental Site Assessment and Monitoring Program

Table C4

Summary of Project-Related Technical Reports
Kwetı̨ı̨ɂàà (Rayrock) Remediation Project
Public Services and Procurement Canada

Report Date	Author	Title
2012, Mar	Rescan Environmental Services Ltd.	Rayrock Mine: Gap Analysis of Preliminary Quantitative Ecological Risk Assessment. Prepared for Aboriginal Affairs and Northern Development Canada by Rescan Environmental Services Ltd.: Yellowknife, Northwest Territories
2012, Mar	Rescan Environmental Services Ltd.	Rayrock Mine, Rayrock Comprehensive Remediation Performance Assessment Report
2013, Mar	Franz Environmental and Columbia Environmental Consulting Ltd.	Phase II Environmental Site Assessment Sun-Rose Mine – SM 290 Northwest Territories
2013, Mar	Columbia Environmental Consulting Ltd.	Phase I/II Environmental Site Assessment Horn Plateau – Rex Showing (SM371) Northwest Territories
2014, Mar	SENES Consultants Limited	Gap Filling Program at Former Rayrock Mine Site
2014, Dec	Water and Earth Science Associates Ltd.	FINAL Site Wide Hazard Assessment – Rayrock
2015, Mar	Ecofor Consulting Ltd.	Rayrock Mine Archaeological Impact Assessment - Final Report
2015, Mar	Arcadis SENES Canada	2014 Rayrock Compliance Monitoring Program Former Rayrock Mine, NT
2015, Mar	AMEC Environment & Infrastructure	Human Health Preliminary Quantitative Risk Assessment
2015, Mar	AMEC Environment & Infrastructure	Phase III Environmental Site Assessment SM290 – Sun Rose Claim Northwest Territories
2015, Mar	AMEC Environment & Infrastructure	Remedial Options Analysis Sun Rose Claim - SM290 Northwest Territories
2015, Mar	AMEC Environment & Infrastructure	Screening Level Ecological Risk Assessment SM290 - Sun Rose Claim Northwest Territories
2015	Tłı̨chǫ Research and Training Institute	"Like a Sick Person Sleeping" TK Study for Aboriginal Affairs and Northern Development (AANDC) Risk Assessment of the Kwetı̨ı̨ɂàà Contaminated Mine Site
2016, Jan	Arcadis Canada Inc.	Hydrologic Study of Beta and Gamma Lakes, Rayrock Mine, Northwest Territories
2016, Feb	Arcadis Canada Inc.	2015 Site Stabilization Activities
2016, Feb	Arcadis Canada Inc.	Phase I and II Environmental Site Assessments of Five Satellite Exploration Sites and the Barge Landing
2016, Jan	Fielding Environmental	Rayrock Mine & Marian River Watershed Study - 2015
2016, Feb	Arcadis Canada Inc.	Phase III Environmental Site Assessment, Rayrock Mine, Northwest Territories
2017, Jan	Arcadis Canada Inc.	Delineation of Contamination of Mill Lake and the Associated Drainage Area Former Rayrock Mine, Northwest Territories
2017, Mar	Arcadis Canada Inc.	2016 Site Stabilization Activities
2017, Mar	Arcadis Canada Inc.	Phase I and II Environmental Site Assessments of Sherman Lake Camp and the Barge Landing and Aerial Reconnaissance of the Former Power Line
2017, Mar	Arcadis Canada Inc.	Hydrogeological Study, Rayrock Mine, Northwest Territories
2017, Jun	Indigenous and Northern Affairs Canada	Conceptual Site Model – Rayrock Uranium Mine, Sun Rose Site, Barge Landing and Associated Satellite Sites
2017, Oct	Arcadis Canada Inc.	Rayrock Freshet Observations and Data Collection Program
2017, Sep	Canadian Nuclear Safety Commission	Waste Nuclear Substance Licence Rayrock Idle Mine Site
2017, Sep	Canadian Nuclear Safety Commission	Licence Conditions Handbook Rayrock Idle Mine Site Waste Nuclear Substance Licence (WNSL) WNSL-W5-3208.08/2027
2017, Dec	Arcadis Canada Inc.	Data Collection Program Rayrock Remediation Project
2018, Jan	Arcadis Canada Inc.	Class Cost C Estimate for Remedial Options Analysis, Former Rayrock Mine Site and Ancillary Sites
2018, Jan	Arcadis Canada Inc.	Remedial Options Analysis for the Former Rayrock Mine Site, Satellite Exploration Sites, Sherman Lake Camp, Barge Landing and Former Power Line
2018, Jan	Canada North Environmental Services, Arcadis Canada Inc.	Human Health and Ecological Risk Assessment for Rayrock Mine Site (Final Report)
2018, Mar	Arcadis Canada Inc.	Remedial Options Analysis for the Former Rayrock Mine Site and Satellite Exploration Sites
2018, Nov	Arcadis Canada Inc.	2017 Data Collection Program, Rayrock Remediation Program

Table C4

Summary of Project-Related Technical Reports
Kweṭı̨ ı̨ ʔa̧à (Rayrock) Remediation Project
Public Services and Procurement Canada

Report Date	Author	Title
2018, Dec	AECOM Canada Inc.	Rayrock Remediation Project Remedial Action Plan, 75% Draft (Draft Document)
2018, Dec	Tłı̨chǫ Government Department of Culture & Lands Protection	Summary Report, Kweṭı̨ a̧à Traditional Monitoring Program
2019, Feb	AECOM Canada Inc.	2019 Remedial Action Plan Update – Preliminary Draft, Sun Rose Claim, Northwest Territories
2019, Mar	AECOM Canada Inc.	2018 Field Program Summary, Rayrock Mine Remediation Project
2019, Mar	AECOM Canada Inc.	Sun Rose Claim: 2018 Field Reconnaissance
2019, Mar	AECOM Canada Inc.	Rayrock Remedial Action Plan – Desktop Assessment of Ground Stability
2019, Mar	Fielding Environmental	Rayrock Mine (Kweṭı̨ ʔa̧à) Remediation Project 2018/19: Multiday Elder-led Site Tour and Sampling Exercise at Rayrock Mine and Surrounding Area
2020, Mar	AECOM Canada Ltd.	Sun Rose Advanced Exploration Site – 2019 Gamma Survey Report
2020, May	AECOM Canada Ltd.	Rayrock Remediation Project Remedial Action Plan – Water Treatment Options Report
2020, Mar	AECOM Canada Ltd.	Former Rayrock Mine, 2019 Field Program Summary Report
2020 Mar	AECOM Canada Ltd.	Sun Rose Advanced Exploration Site, 2019 Field Program Summary Report
2020. Mar	AECOM Canada Ltd.	Sun Rose Advanced Exploration Site, 2019 Gamma Survey Report
2020, Mar	AECOM Canada Ltd.	Mill Lake Sediment Hydrogeology Report
2020, Apr	AECOM Canada Ltd.	Sun Rose Advanced Exploration Site, Detailed Radiological Human Health and Ecological Risk Assessment
2020, Mar	AECOM Canada Ltd.	2019 Mill Lake Water and Sediment Depth Measurement Results, Rayrock Remedial Action Planning
2020, May	AECOM Canada Ltd.	Rayrock Remediation Project Remedial Action Plan, Water Treatment Options Report
2020, May	AECOM Canada Ltd.	2020 Mill Lake Sediment Hydrogeology Assessment
2020, Jun	AECOM Canada Ltd.	Mill Lake Sediment Remediation Feasibility Study (DRAFT)

Table C5

Historical Sediment Analytical Results - Metals
Kwetı̨ı̨ɂàà (Rayrock) Remediation Project
Public Services and Procurement Canada

Sample Information									Laboratory Analytical Results (mg/kg)																									
				NAD_1983_UTM_Zone_11N Coordinates					Metals Assessed to CCME Guidelines							Metals Assessed to Thompson Guidelines					Metals without Published CCME or Thompson Sediment Guidelines													
Sample ID	Sample Depth (mbss)	Sample Type	Data Source	Easting	Northing	Sampling Location	Sampling Date	Moisture Content (%)	Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Lead (Pb)	Mercury (Hg)	Zinc (Zn)	Molybdenum (Mo)	Nickel (Ni)	Selenium (Se)	Uranium (U)	Vanadium (V)	Aluminum (Al)	Antimony (Sb)	Barium (Ba)	Beryllium (Be)	Boron (B)	Hex. Chromium (Cr 6+)	Cobalt (Co)	Iron (Fe)	Magnesium (Mg)	Manganese (Mn)	Silver (Ag)	Thallium (Tl)	Tin (Sn)	Soluble Boron (mg/L)
Referenced Guidelines																																		
CCME Sediment Guidelines for the Protection of Aquatic Life: Interim Sediment Quality Objective [a]								-	5.9	0.6	37.3	35.7	35	0.17	123	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG
CCME Sediment Guidelines for the Protection of Aquatic Life: Probable Effects Level [a]								-	17	3.5	90	197	91.3	0.486	315	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG
Thompson Sediment Guidelines: Lowest Effect Level [b] Closest Observation Method								-	~~9.8~~	~~NG~~	~~47.6~~	~~22.2~~	~~36.7~~	~~NG~~	~~NG~~	8.3	21	0.9	32	27.3	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG
Thompson Sediment Guidelines: Severe Effects Level [b] Closest Observation Method								-	~~346.4~~	~~NG~~	~~115.4~~	~~268.8~~	~~412.4~~	~~NG~~	~~NG~~	540	170	4.7	3410	77	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG
Thompson Sediment Guidelines: Lowest Effect Level [b] Weighted Method								-	~~9.8~~	~~NG~~	~~47.6~~	~~22.2~~	~~36.7~~	~~NG~~	~~NG~~	13.8	23.4	1.9	104.4	35.2	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG
Thompson Sediment Guidelines: Severe Effects Level [b] Weighted Method								-	~~346.4~~	~~NG~~	~~115.4~~	~~268.8~~	~~412.4~~	~~NG~~	~~NG~~	1238.5	484	16.1	5874.1	160	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG
Analytical Results: Background Reference Lake Sediments																																		
New Control Lake	0.0 - 0.1	Loose Organic Sediment	Rescan, 2012	-	-	New Control Lake	1996	-	11	<1	24	25	9	0.09	65	<4	18	<.2	24	26	13750	-	120	<1	15	-	-	14050	4100	220	<1	-	-	
New Control Lake	0.0 - 0.05	Loose Organic Sediment	Rescan, 2012	-	-	New Control Lake	2011	-	23.3	0.4	59	41	10	0.13	85	1.4	33	0.7	11	61	33433	0.8	203	1.0	36	-	13	31200	-	373	0.1	-	1.4	-
CL_001_20190806	0.1	Loose Organic Sediment	AECOM, 2019	523500	7037196	Control Lake	6-Aug-19	93	13.6	2.24	19.7	193	13.3	0.078	477	10.8	22.9	2.31	172	43.4	16000	0.52	197	3.40	7.3	<1.1[e]	29.5	40300	3290	5030	0.141	1.15	0.45	-
CL_002_20190806	0.1	Loose Organic Sediment	AECOM, 2019	523350	7037041	Control Lake	6-Aug-19	93	3.23	0.448	24.0	102	6.39	0.10	174	1.73	19.1	1.20	72	21.8	16500	0.34	99.3	1.65	7.2	<1.2[e]	7.04	14200	5020	316	0.104	0.174	0.50	-
NL_001_20190806	0.1	Loose Organic Sediment	AECOM, 2019	524125	7038014	Neghoa Lake	6-Aug-19	97	0.96	0.717	14.3	174	5.48	0.065	172	8.09	21.9	0.79	111	13.3	7220	0.25	57.6	1.05	6.4	<2.7[e]	8.95	7490	2690	111	0.080	0.105	0.34	-
NL_002_20190806	0.1	Loose Organic Sediment	AECOM, 2019	523682	7037399	Neghoa Lake	6-Aug-19	96	1.01	0.798	15.7	173	6.17	0.064	183	8.77	22.9	1.00	144	14.3	7930	0.29	65.0	1.27	7.2	<2.0[e]	8.27	5570	3170	118	0.103	0.118	0.32	-
							Average		8.9	0.9	26	118	8	0.09	192.67	6.2	23	1.2	89	30	15806	0.44	123.65	1.674	13.2	-	13.352	18802	3654	1028	0.1056	0.3868	0.602	-
Analytical Results: Mill Lake																																		
Loose Organic Sediment (0.0 m to 0.1 m)																																		
GSW3 0-2CM	0 - 0.02	Loose Organic Sediment	LLRWMO 2000	522711	7035947	Mill Lake (SW3)	Nov-96	-	7.0	<1	16	730	68	0.24	410	6	15	7.8	3390	16	11300	-	80	<1	40	-	18	15800	4800	350	<1	-	-	-
GSW3 2-5CM	0.02 - 0.05	Loose Organic Sediment	LLRWMO 2000	522711	7035947	Mill Lake (SW3)	Nov-96	-	10	<1	22	740	100	0.25	440	11	19	8.6	5910	32	22000	-	110	<1	29	-	20	23200	8700	470	<1	-	-	-
GSW3 5-15CM	0.05 - 0.15	Loose Organic Sediment	LLRWMO 2000	522711	7035947	Mill Lake (SW3)	Nov-96	-	5.5	<1	13	220	14	0.15	490	<4	17	1.6	884	17	20800	-	91	<1	<10	-	11	12700	5400	210	<1	-	-	-
Mill Lake	0 - 0.05	Loose Organic Sediment	Rescan 2012	522702	7036029	Mill Lake	31-Aug-11	96	9.6	1.3	22	823	82	0.24	530	6.8	19	12	3933	33	26400	0.3	92	3.3	33	-	22	24267	11400	433	0.3	0.5	1.7	-
MILL 1-SED	0.05 - 0.1	Loose Organic Sediment	Arcadis 2016	522739	7036294	Mill Lake	29-Sep-15	90	2.2	0.80	6.70	150	3.9	<0.10	260	1.8	7.1	5.2	1600	7.0	-	<1.0	48	1.20	-	<0.080	4.4	-	-	-	<0.40	<0.20	<2.0	2.5
MILL 2-SED	0.05 - 0.1	Loose Organic Sediment	Arcadis 2016	522794	7036260	Mill Lake	29-Sep-15	95	2.6	0.60	13	110	4.0	<0.10	200	1.6	10	2.9	800	14	-	<1.0	58	1.6	-	<0.080	6.4	-	-	-	<0.40	<0.20	<2.0	1.6
MILL 3-SED	0.05 - 0.1	Loose Organic Sediment	Arcadis 2016	522693	7036003	Mill Lake	29-Sep-15	88	3.4	1.10	9.4	200	4.8	0.11	280	1.7	12	6.1	1200	7.6	-	<1.0	88	2.2	-	<0.080	9.6	-	-	-	<0.40	<0.20	<2.0	1.9
MILL 4-SED	0.05 - 0.1	Loose Organic Sediment	Arcadis 2016	522702	7036034	Mill Lake	29-Sep-15	94	3.1	0.83	13	170	5.1	0.11	260	2.2	15	4.2	1200	10	-	<0.50	69	1.9	-	<0.080	5.7	-	-	-	<0.20	0.12	<1.0	2.3
MILL 5-SED	0.05 - 0.1	Loose Organic Sediment	Arcadis 2016	522665	7036063	Mill Lake	29-Sep-15	94	4.0	0.78	13	180	9.4	0.12	400	2.2	14	3.2	780	17	-	<0.50	63	2.3	-	<0.080	9.3	-	-	-	<0.20	0.16	<1.0	1.7
MILL 6-SED	0.05 - 0.1	Loose Organic Sediment	Arcadis 2016	522659	7036102	Mill Lake	29-Sep-15	95	4.3	1.00	14	320	17	0.13	350	5.3	15	6.0	2200	15	-	0.76	73	2	-	<0.080	9.3	-	-	-	<0.20	0.19	<1.0	2.9
MILL 7-SED	0.05 - 0.1	Loose Organic Sediment	Arcadis 2016	522601	7036093	Mill Lake	29-Sep-15	95	9.6	1.60	12	1200	32	0.16	340	6.6	15	18	6500	18	-	0.96	52	1.7	-	<0.080	12	-	-	-	0.33	0.27	2.3	1.0
MILL 8-SED	0.05 - 0.1	Loose Organic Sediment	Arcadis 2016	522616	7036135	Mill Lake	29-Sep-15	93	4.7	1.10	12	480	13	0.13	330	3.8	16	9.6	2000	10	-	0.6	63	1.6	-	<0.080	11	-	-	-	<0.20	0.20	<1.0	2.5
MILL 9-SED	0.05 - 0.1	Loose Organic Sediment	Arcadis 2016	522650	7036171	Mill Lake	29-Sep-15	96	4.5	0.99	7.7	240	10	0.14	270	10	8.7	5.7	1700	8.7	-	1.1	57	1.8	-	<0.080	6.1	-	-	-	<0.40	<0.20	<2.0	3.4
MILL 10-SED	0.05 - 0.1	Loose Organic Sediment	Arcadis 2016	522663	7036201	Mill Lake	29-Sep-15	96	5.7	1.30	15	380	18	0.19	390	5.7	15	7.1	1600	17	-	<1.0	81.0	2.3	-	<0.080	13	-	-	-	<0.40	0.23	<2.0	2.6
SED-1	0.05 - 0.1	Loose Organic Sediment	Arcadis 2017	522605	7036120	Mill Lake	25-Sep-16	85	6.4	1.6	-	700	40	0.13	330	5.6	16	14	6200	12	-	1.1	59	2.10	-	<0.080	11	-	-	-	0.26	0.24	<1.0	1.1
SED-2	0.05 - 0.1	Loose Organic Sediment	Arcadis 2017	522621	7036118	Mill Lake	25-Sep-16	85	4.4	1.2	-	310	14	0.098	280	1.9	15	7.1	2500	8.8	-	<0.50	77	2.2	-	<0.080	8.5	-	-	-	<0.20	0.15	<1.0	0.98
SED-3	0.05 - 0.1	Loose Organic Sediment	Arcadis 2017	522611	7036131	Mill Lake	25-Sep-16	89	3.2	1.3	-	350	8.2	<0.10	320	2.7	17	11	1300	9.8	-	<1.0	72	1.8	-	<0.080	9.2	-	-	-	<0.40	<0.20	<2.0	2.1
SED-4	0.05 - 0.1	Loose Organic Sediment	Arcadis 2017	522627	7036136	Mill Lake	25-Sep-16	86	4.9	0.91	-	320	22	0.11	320	5.0	16	6.1	3900	11	-	<1.0	76	1.8	-	<0.080	9.1	-	-	-	<0.40	<0.20	<2.0	2.2
SED-5	0.05 - 0.1	Loose Organic Sediment	Arcadis 2017	522619	7036145	Mill Lake	25-Sep-16	90	3.3	1.2	-	350	9.9	<0.10	390	2.8	14	7.2	1800	9	-	<1.0	77	1.9	-	<0.080	8.7	-	-	-	<0.40	<0.20	<2.0	2
SED-6	0.05 - 0.1	Loose Organic Sediment	Arcadis 2017	522692	7035997	Mill Lake	25-Sep-16	95	4.5	1.3	-	350	19	0.16	230	2.0	8.9	11	3300	6.3	-	<1.0	76	1.5	-	<0.080	9.7	-	-	-	<0.40	<0.20	<2.0	2.2
ML17-CORE-01 SA-1	0-0.1	Loose Organic Sediment	Arcadis 2018	522688	7036103	Mill Lake	4-Sep-17	94	4.4	1.1	-	290	26	0.20	420	5.0	18	5.2	1800	20	-	1.1	61	2.60	-	<1.3	14	-	-	-	<0.40	0.24	<2.0	1.2
ML17-CORE-02 SA-1	0-0.1	Loose Organic Sediment	Arcadis 2018	522761	7036196	Mill Lake	5-Sep-17	98	4.9	0.94	-	410	23	0.25	340	8.0	17	6.7	3400	13	-	1.3	68	1.70	-	<4.4	11	-	-	-	<0.40	0.24	<2.0	3.2
ML17-CORE-03 SA-1	0-0.1	Loose Organic Sediment	Arcadis 2018	522622	7036135	Mill Lake	6-Sep-17	96	<2.0	0.95	-	180	4.5	0.11	380	2.3	17	3.2	150	14	-	<1.0	80	2.20	-	<1.8	8.5	-	-	-	<0.40	0.20	<2.0	2.3
ML_GEOTECH_SED	0 - 0.05	Loose Organic Sediment	AECOM, 2019	522675.95	7036143.27	Mill Lake	2-Aug-19	96	3.7	1.1	18	250	13.0	0.15	420	3.0	18	4.2	700	19	13000	<1.0	66	2.9	7.0	<1.8[e]	13	8600	4300	160	<0.40	0.25	<2.0	2.4

Table C5

Historical Sediment Analytical Results - Metals
Kwetı̨ı̨ɂàà (Rayrock) Remediation Project
Public Services and Procurement Canada

Sample Information									Laboratory Analytical Results (mg/kg)																									
				NAD_1983_UTM_Zone_11N Coordinates					Metals Assessed to CCME Guidelines							Metals Assessed to Thompson Guidelines					Metals without Published CCME or Thompson Sediment Guidelines													
Sample ID	Sample Depth (mbss)	Sample Type	Data Source	Easting	Northing	Sampling Location	Sampling Date	Moisture Content (%)	Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Lead (Pb)	Mercury (Hg)	Zinc (Zn)	Molybdenum (Mo)	Nickel (Ni)	Selenium (Se)	Uranium (U)	Vanadium (V)	Aluminum (Al)	Antimony (Sb)	Barium (Ba)	Beryllium (Be)	Boron (B)	Hex. Chromium (Cr 6+)	Cobalt (Co)	Iron (Fe)	Magnesium (Mg)	Manganese (Mn)	Silver (Ag)	Thallium (Tl)	Tin (Sn)	Soluble Boron (mg/L)
Referenced Guidelines																																		
CCME Sediment Guidelines for the Protection of Aquatic Life: Interim Sediment Quality Objective [a]								-	5.9	0.6	37.3	35.7	35	0.17	123	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG
CCME Sediment Guidelines for the Protection of Aquatic Life: Probable Effects Level [a]								-	17	3.5	90	197	91.3	0.486	315	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG
Thompson Sediment Guidelines: Lowest Effect Level [b] Closest Observation Method								-	~~9.8~~	~~NG~~	~~47.6~~	~~22.2~~	~~36.7~~	~~NG~~	~~NG~~	8.3	21	0.9	32	27.3	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG
Thompson Sediment Guidelines: Severe Effects Level [b] Closest Observation Method								-	~~346.4~~	~~NG~~	~~115.4~~	~~268.8~~	~~412.4~~	~~NG~~	~~NG~~	540	170	4.7	3410	77	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG
Thompson Sediment Guidelines: Lowest Effect Level [b] Weighted Method								-	~~9.8~~	~~NG~~	~~47.6~~	~~22.2~~	~~36.7~~	~~NG~~	~~NG~~	13.8	23.4	1.9	104.4	35.2	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG
Thompson Sediment Guidelines: Severe Effects Level [b] Weighted Method								-	~~346.4~~	~~NG~~	~~115.4~~	~~268.8~~	~~412.4~~	~~NG~~	~~NG~~	1238.5	484	16.1	5874.1	160	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG
ML_WT_SED	0 - 0.05	Loose Organic Sediment	AECOM, 2019	522695	7036079	Mill Lake	2-Aug-19	96	3.1	**0.96**	17	**200**	9.3	0.14	**380**	2.4	17	**3.2**	**590**	18	17000	<1.0	63	2.6	8.4	<1.9[e]	11	16000	4400	290	<0.40	0.25	<2.0	1.9
							Average		5.0	**1.0891**	14	**386.12**	22.804	0.16	**350.4**	4.4	15	**7.1**	**2373.5**	15	18417	0.90	72	2.0545	23.5	-	10.86	16761	6500	318.83	0.2967	0.2314	2	2.1
Loose Organic Sediment (0.1 m to 0.2 m)																																		
ML17-CORE-01 SA-2	0.1-0.2	Loose Organic Sediment	Arcadis 2018	522688	7036103	Mill Lake	4-Sep-17	92	<2.0	**0.93**	-	**150**	5.4	0.14	**380**	2.1	13	**2.5**	**190**	17	-	<1.0	53	2.40	-	<0.98	11	-	-	-	<0.40	<0.20	<2.0	1.5
ML17-CORE-02 SA-2	0.1-0.2	Loose Organic Sediment	Arcadis 2018	522761	7036196	Mill Lake	5-Sep-17	95	3.8	**0.94**	-	**310**	16	**0.21**	**360**	4.7	17	**4.5**	**2100**	14	-	<1.0	74	1.90	-	<1.6	9.3	-	-	-	<0.40	0.23	<2.0	3.2
ML17-CORE-03 SA-2	0.1-0.2	Loose Organic Sediment	Arcadis 2018	522622	7036135	Mill Lake	6-Sep-17	92	4.9	**0.96**	-	**350**	30	0.16	**360**	6.3	21	**5.3**	**2600**	19	-	1.3	80	1.90	-	<1.0	13	-	-	-	<0.40	0.25	<2.0	1.6
							Average		4.4	**0.9433**	-	**270**	17	0.17	**366.67**	4.4	17	**4.1**	**1630**	16.667	-	1.3	69	2.07	-	-	11.1	-	-	-	<0.40	0.24	<2.0	2.1
Loose Organic Sediment (0.2 m to 0.3 m)																																		
ML17-CORE-01 SA-3	0.2-0.3	Loose Organic Sediment	Arcadis 2018	522688	7036103	Mill Lake	4-Sep-17	87	2.0	**0.99**	-	**150**	4.9	0.12	**390**	2.4	15	**3.2**	**190**	19	-	<1.0	60	2.70	-	<0.60	11	-	-	-	<0.40	0.20	<2.0	2.3
ML17-CORE-02 SA-3	0.2-0.3	Loose Organic Sediment	Arcadis 2018	522761	7036196	Mill Lake	5-Sep-17	88	2.7	**0.87**	-	**210**	8.3	**0.17**	**370**	2.6	17	**3.1**	**630**	15	-	<1.0	71	2.10	-	<0.68	7.9	-	-	-	<0.40	0.23	<2.0	0.98
ML17-CORE-03 SA-3	0.2-0.3	Loose Organic Sediment	Arcadis 2018	522622	7036135	Mill Lake	6-Sep-17	91	1.9	**0.90**	-	**160**	5.8	0.13	**350**	2.3	15	**2.9**	**340**	13	-	<0.50	68	2.00	-	<0.84	8.2	-	-	-	<0.20	0.18	<1.0	2.0
ML_SED_20200205_VCO1_0.2	0.2	Loose Organic Sediment		522699	7036097	VC01	5-Feb-20	95	2.6	**1.00**	24	**210**	5.4	0.120	**380**	3.00	21	**3.3**	**310**	14	11000	0.77	75	1.90	5.50	<1.7[e]	8.4	9200	3400	140	<0.20	0.21	<1.0	1.4
ML_SED_20200206_VC03_0.2	0.2	Loose Organic Sediment		522663	7036198	VC03	6-Feb-20	92	3.1	**1.2**	15	**190**	7.0	0.11	**440**	3.6	16	**3.7**	**320**	22	18000	<0.50	60	3.2	6.3	<1.1[e]	13	29000	3600	250	0.21	0.24	<1.0	3.0
							Average		2.5	**1.0**	20	**184**	6.3	0.13	**386**	2.8	16.8	**3.2**	**358**	17	14500	0.77	66.8	2.38	5.9	-	9.7	19100	3500	195	0.21	0.212	-	1.9
Loose Organic Sediment (0.3 m to 0.4 m)																																		
ML17-CORE-01 SA-4	0.3-0.4	Loose Organic Sediment	Arcadis 2018	522688	7036103	Mill Lake	4-Sep-17	92	2.1	**1.2**	-	**170**	4.1	0.11	**470**	2.9	15	**3.3**	**140**	21	-	<1.0	59	3.00	-	<0.94	13	-	-	-	<0.40	0.22	<2.0	1.8
ML17-CORE-02 SA-4	0.3-0.4	Loose Organic Sediment	Arcadis 2018	522761	7036196	Mill Lake	5-Sep-17	92	3.5	**0.39**	-	**79**	6.3	0.059	**160**	1.5	**26**	**1.1**	**91**	**35**	-	<0.50	140	1.10	-	<0.99	9.7	-	-	-	<0.20	0.22	<1.0	1.1
ML17-CORE-03 SA-4	0.3-0.4	Loose Organic Sediment	Arcadis 2018	522622	7036135	Mill Lake	6-Sep-17	94	1.7	**0.98**	-	**160**	4.5	0.11	**340**	2.1	14	**2.8**	**150**	12	-	<0.50	66	1.90	-	<1.3	7.7	-	-	-	<0.20	0.17	<1.0	1.5
							Average		2.4	**0.9**	-	**136**	5.0	0.1	**323**	2.2	18	**2.4**	**127**	23	-	<1.0	88.333	2.00	-	<1.3	10.133	-	-	-	<0.40	0.2033	<2.0	1.5
Loose Organic Sediment (0.4 m to 1.2 m)																																		
ML17-CORE-01 SA-5	0.4-0.5	Loose Organic Sediment	Arcadis 2018	522688	7036103	Mill Lake	4-Sep-17	90	<2.0	**0.97**	-	**130**	3.6	<0.10	**340**	2.3	13	**3.1**	**120**	16	-	<1.0	61	2.30	-	<0.82	9.8	-	-	-	<0.40	<0.20	<2.0	1.8
ML17-CORE-02 SA-5	0.4-0.5	Loose Organic Sediment	Arcadis 2018	522761	7036196	Mill Lake	5-Sep-17	92	2.4	**0.81**	-	**200**	7.8	0.16	**350**	2.5	16	**3.0**	**600**	14	-	<1.0	70	2.00	-	<1.0	7.6	-	-	-	<0.40	0.22	<2.0	N/A
ML17-CORE-03 SA-5	0.4-0.5	Loose Organic Sediment	Arcadis 2018	522622	7036135	Mill Lake	6-Sep-17	94	<2.0	**1.1**	-	**180**	5.6	0.12	**390**	2.4	15	**3.2**	**230**	13	-	<1.0	69	2.00	-	<1.3	8.1	-	-	-	<0.40	<0.20	<2.0	1.7
ML_SED_20200206_VC02_0.4	0.4	Loose Organic Sediment		522615	7036132	VC02	6-Feb-20	93	2.4	**0.97**	14	**200**	6.9	0.092	**370**	2.3	15	**3.4**	**370**	14	13000	<0.50	65	2.2	11	<1.1[e]	9.2	10000	3800	150	<0.20	0.17	<1.0	2.7
ML_SED_20200206_VC02_0.4 B	0.4	Loose Organic Sediment		522615	7036132	VC02	43867	93	3.5	**1.1**	17	**250**	9.8	0.11	**430**	2.7	18	**4.7**	**600**	16	-	<0.50	76	2.5	-	<1.1[e]	12	-	-	-	<0.20	0.22	<1.0	-[f]
ML_SED_20200206_VC02_0.4 C	0.4	Loose Organic Sediment		522615	7036132	VC02	6-Feb-20	93	3.4	**1.1**	18	**230**	9.7	0.09	**410**	2.7	18	**4.2**	**570**	16	-	<0.50	73	2.3	-	<1.1[e]	11	-	-	-	<0.20	0.20	<1.0	-[f]
ML_SED_20200207_VC06_0.4	0.4	Loose Organic Sediment		522717	7036142	VC06	7-Feb-20	94	2.4	**0.92**	14	**190**	6.8	0.110	**370**	2.20	15	**2.8**	**300**	16	14000	<0.50	57	2.30	4.20	<1.4[e]	11.0	13000	3600	210	<0.20	0.19	<1.0	2.0
ML_SED_20200206_VC03_0.6	0.6	Loose Organic Sediment		522663	7036198	VC03	6-Feb-20	91	2.9	**1.4**	15	**200**	4.4	0.097	**430**	3.5	16	**4.4**	**190**	22	17000	<0.50	70	3.1	5.4	<0.92[e]	13	24000	2700	270	0.22	0.21	<1.0	2.7

Table C5

Historical Sediment Analytical Results - Metals
Kwetį į ʔaà (Rayrock) Remediation Project
Public Services and Procurement Canada

Sample Information									Laboratory Analytical Results (mg/kg)																									
				NAD_1983_UTM_Zone_11N Coordinates					Metals Assessed to CCME Guidelines							Metals Assessed to Thompson Guidelines					Metals without Published CCME or Thompson Sediment Guidelines													
Sample ID	Sample Depth (mbss)	Sample Type	Data Source	Easting	Northing	Sampling Location	Sampling Date	Moisture Content (%)	Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Lead (Pb)	Mercury (Hg)	Zinc (Zn)	Molybdenum (Mo)	Nickel (Ni)	Selenium (Se)	Uranium (U)	Vanadium (V)	Aluminum (Al)	Antimony (Sb)	Barium (Ba)	Beryllium (Be)	Boron (B)	Hex. Chromium (Cr 6+)	Cobalt (Co)	Iron (Fe)	Magnesium (Mg)	Manganese (Mn)	Silver (Ag)	Thallium (Tl)	Tin (Sn)	Soluble Boron (mg/L)
Referenced Guidelines																																		
CCME Sediment Guidelines for the Protection of Aquatic Life: Interim Sediment Quality Objective [a]								-	5.9	0.6	37.3	35.7	35	0.17	123	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG
CCME Sediment Guidelines for the Protection of Aquatic Life: Probable Effects Level [a]								-	17	3.5	90	197	91.3	0.486	315	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG
Thompson Sediment Guidelines: Lowest Effect Level [b] Closest Observation Method								-	~~9.8~~	~~NG~~	~~47.6~~	~~22.2~~	~~36.7~~	~~NG~~	~~NG~~	8.3	21	0.9	32	27.3	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG
Thompson Sediment Guidelines: Severe Effects Level [b] Closest Observation Method								-	~~346.4~~	~~NG~~	~~115.4~~	~~268.8~~	~~412.4~~	~~NG~~	~~NG~~	540	170	4.7	3410	77	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG
Thompson Sediment Guidelines: Lowest Effect Level [b] Weighted Method								-	~~9.8~~	~~NG~~	~~47.6~~	~~22.2~~	~~36.7~~	~~NG~~	~~NG~~	13.8	23.4	1.9	104.4	35.2	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG
Thompson Sediment Guidelines: Severe Effects Level [b] Weighted Method								-	~~346.4~~	~~NG~~	~~115.4~~	~~268.8~~	~~412.4~~	~~NG~~	~~NG~~	1238.5	484	16.1	5874.1	160	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG
ML_SED_20200206_VC03_0.6 B	0.6	Loose Organic Sediment		522663	7036198	VC03	6-Feb-20	91	3.0	1.4	15	190	5.9	0.10	460	3.5	16	3.9	280	22	18000	<0.50	61	3.4	6.4	<0.92[e]	12	28000	3300	250	0.20	0.21	<1.0	2.9
ML_SED_20200206_VC03_0.6 C	0.6	Loose Organic Sediment		522663	7036198	VC03	6-Feb-20	91	2.8	1.3	15	180	5.8	0.098	440	3.3	16	3.7	260	21	18000	<0.50	60	3.1	6.1	<0.92[e]	12	27000	3200	240	<0.20	0.20	<1.0	2.9
ML_SED_20200207_VC05_0.6	0.6	Loose Organic Sediment		522762	7036198	VC05	7-Feb-20	93	2.8	0.96	15	170	5.3	<0.10[h]	380	2.7	16	2.8	190	17	14000	<1.0	66	2.3	4.8	<1.2[e]	11	10000	3300	150	<0.40	0.20	<2.0	2.5
ML_SED_20200205_VCO1_0.8	0.8	Loose Organic Sediment		522699	7036097	VC01	5-Feb-20	95	2.5	1.10	20	270	3.4	0.082	320	4.0	21	4.7	180	13	7700	0.67	71	1.30	6.20	<1.6[e]	7.5	9500	2300	120	<0.20	0.20	<1.0	2.2
ML_SED_20200207_VC06_0.8	0.8	Loose Organic Sediment		522717	7036142	VC06	7-Feb-20	96	2.8	1.10	15	210	4.3	0.093	380	2.7	17	3.5	160	17	13000	<0.50	70	2.30	4.00	<0.080	14.0	13000	2600	190	0.21	0.23	<1.0	2.1
ML_SED_20200207_VC04_1.0	1.0	Loose Organic Sediment		522772	7036324	VC04	7-Feb-20	88	2.5	0.99	13	170	4.9	0.095	310	2.0	15	3.7	220	13	12000	<0.50	84	2.2	4.5	<0.68[e]	6.7	6000	3500	130	<0.20	0.20	<1.0	1.9
ML_SED_20200206_VC02_1.2	1.2	Loose Organic Sediment		522615	7036132	VC02	6-Feb-20	92	2.5	1.2	13	260	4.5	0.082	390	3.1	16	4.5	200	14	9800	<0.50	65	1.7	4.2	<0.99[e]	9.5	13000	2800	120	<0.20	0.19	<1.0	2.1
							Average		2.8	1.1	15	202	5.9	0.10	384.67	2.8	16	3.7	298	16	13650	0.67	67.867	2.3333	5.68	-	10.293	15350	3110	183	0.21	0.2031	-	2.2917
Compacted Organic Sediment (1.2 m to 3.0 m)																																		
ML_SED_20200206_VC03_1.2	1.2	Compacted Organic Sediment		522663	7036198	VC03	6-Feb-20	94	2.5	1.2	13	240	3.7	0.079	340	3.1	16	4.8	160	16	12000	<0.50	55	2.0	5.3	<1.2[e]	9.9	27000	2400	230	<0.20	0.18	<1.0	3.2
ML_SED_20200207_VC05_1.3	1.3	Compacted Organic Sediment		522762	7036198	VC05	7-Feb-20	95	3.0	1.1	14	300	4.0	<0.10[h]	320	4.5	19	4.9	160	15	7600	<1.0	80	1.3	7.7	<1.5[e]	8.3	16000	2800	170	<0.40	0.21	<2.0	3.8
ML_SED_20200205_VCO1_1.6	1.6	Compacted Organic Sediment		522699	7036097	VC01	5-Feb-20	93	3.5	1.30	29	380	4.7	0.083	370	5.7	26	5.5	200	19	8900	0.84	100	1.20	7.60	<1.2[e]	7.6	15000	3200	160	0.21	0.28	<1.0	1.5
ML_SED_20200206_VC02_1.8	1.8	Compacted Organic Sediment		522615	7036132	VC02	6-Feb-20	94	4.3	1.4	21	390	6.4	0.075	430	3.9	23	5.1	230	22	11000	<0.50	75	1.6	4.9	<1.2[e]	11	26000	4400	170	0.23	0.25	<1.0	2.5
ML_SED_20200206_VC02_1.8 B	1.8	Compacted Organic Sediment		522615	7036132	VC02	6-Feb-20	94	4.0	1.0	19	300	7.4	<0.050	320	3.2	19	4.5	310	20	9300	<0.50	73	1.3	5.3	<1.2[e]	8.9	19000	3900	150	<0.20	0.23	<1.0	1.7[g]
ML_SED_20200206_VC02_1.8 C	1.8	Compacted Organic Sediment		522615	7036132	VC02	6-Feb-20	94	4.3	1.2	25	380	8.1	<0.10	400	3.7	24	5.3	380	23	-	<1.0	90	1.6	-	<1.2[e]	11	-	-	-	<0.40	0.23	<2.0	-[f]
ML_SED_20200206_VC03_1.8	1.8	Compacted Organic Sediment		522663	7036198	VC03	6-Feb-20	89	7.3	1.3	20	350	5.3	0.064	380	5.2	23	5.5	180	22	9900	<0.50	79	1.5	5.2	<0.092[e]	9.8	30000	4000	250	0.21	0.27	<1.0	3.4
ML_SED_20200207_VC05_1.8	1.8	Compacted Organic Sediment		522762	7036198	VC05	7-Feb-20	94	2.8	1.1	14	270	3.8	<0.10[h]	310	3.6	19	4.8	170	13	8900	<1.0	82	1.4	7.4	<1.4[e]	8.3	12000	2600	170	<0.40	<0.20	<2.0	3.0
ML_SED_20200207_VC06_2.1	2.1	Compacted Organic Sediment		522717	7036142	VC06	7-Feb-20	92	11	1.30	31	430	7.7	0.067	450	4.50	34	3.4	140	31	15000	<0.50	110	1.70	5.60	<0.96[e]	11.0	33000	6700	240	0.24	0.32	<1.0	2.5
ML_SED_20200207_VC06_2.1 B	2.1	Compacted Organic Sediment		522717	7036142	VC06	7-Feb-20	92	11	1.30	31	430	7.7	0.065	450	4.30	34	3.6	140	32	15000	<0.50	110	1.70	6.90	<0.96[e]	11.0	34000	7000	250	0.24	0.33	<1.0	2.6
ML_SED_20200207_VC06_2.1 C	2.1	Compacted Organic Sediment		522717	7036142	VC06	7-Feb-20	92	11	1.30	31	420	7.7	0.065	450	4.60	34	3.6	140	31	14000	<0.50	110	1.70	6.40	<0.96[e]	11.0	33000	6500	230	0.24	0.34	<1.0	2.6
ML_SED_20200207_VC04_2.2	2.2	Compacted Organic Sediment		522772	7036324	VC04	7-Feb-20	86	2.0	0.81	9.9	200	3.1	0.057	200	2.7	12	3.5	140	10	7100	<0.50	64	1.2	5	<0.57[e]	4.8	8300	2400	110	<0.20	0.16	<1.0	2.1
ML_SED_20200207_VC05_2.3	2.3	Compacted Organic Sediment		522762	7036198	VC05	7-Feb-20	91	6.9	1.4	34	420	8.7	<0.10[h]	490	5.4	33	4.1	150	33	14000	<1.0	130	1.8	6.1	<0.86[e]	12	32000	6700	240	<0.40	0.38	<2.0	3.9
ML_SED_20200207_VC04_3.0	3.0	Compacted Organic Sediment		522772	7036324	VC04	7-Feb-20	92	3.2	1.1	15	290	4.3	0.062	270	4.8	18	4.0	210	17	8500	<0.50	75	1.3	6.6	<0.94[e]	6.6	18000	3800	150	<0.20	0.24	<1.0	2.8
							Average		5.5	1.2	22	343	5.9	0.1	370	4.2	24	4.5	194	22	10862	0.84	88.071	1.5214	6.1538	-	9.3714	23331	4338.5	193.85	0.2283	0.2631	-	2.825
Clay																																		
ML_SED_20200206_VC03_2.6	2.6	Clay		522663	7036198	VC03	6-Feb-20	38	4.9	0.14	54	36	9.2	<0.050	120	<0.40	34	<0.50	4.3	54	20000	<0.50	190	0.83	4.4	<0.080	13	31000	11000	360	<0.20	0.32	1.6	0.15
ML_SED_20200205_VCO1_3.0	3.0	Clay		522699	7036097	VC01	5-Feb-20	32	3.4	0.10	35	23	6.6	<0.050	110	<0.40	22	<0.50	3.2	39	15000	<0.50	120	0.62	3.10	<0.080	9.3	24000	9700	330	<0.20	0.20	1.1	<0.10
ML_SED_20200207_VC06_3.2	3.2	Clay		522717	7036142	VC06	7-Feb-20	34	5.3	0.13	60	35	12	<0.050	96	0.49	38	<0.50	4.0	61	21000	<0.50	220	0.79	4.30	<0.080	14.0	33000	12000	390	<0.20	0.40	1.6	0.12
ML_SED_20200207_VC05_3.5	3.5	Clay		522762	7036198	VC05	7-Feb-20	33	2.9	0.10	35	23	7.1	<0.050	66	<0.40	24	<0.50	3.0	36	17000	<0.50	120	0.49	4.5	<0.080	9.0	27000	11000	360	<0.20	0.23	<1.0	<0.10
ML_SED_20200207_VC04_4.2	4.2	Clay		522772	7036324	VC04	7-Feb-20	24	2.2	0.091	27	23	4.5	<0.050	150	<0.40	17	<0.50	4.0	28	12000	<0.50	77	0.6	3.6	<0.080	8.4	19000	9900	330	<0.20	0.14	<1.0	<0.10
							Average		3.7	0.1	42	28	7.9	<0.25	108	0.5	27	<0.25	3.7	44	17000	<0.50	145.4	0.666	3.98	<0.080	10.74	26800	10720	354	<0.20	0.258	1.4333	0.135

Table C5

Historical Sediment Analytical Results - Metals
Kwetį į ʔa (Rayrock) Remediation Project
Public Services and Procurement Canada

Sample Information									Laboratory Analytical Results (mg/kg)																									
				NAD_1983_UTM_Zone_11N Coordinates					Metals Assessed to CCME Guidelines							Metals Assessed to Thompson Guidelines					Metals without Published CCME or Thompson Sediment Guidelines													
Sample ID	Sample Depth (mbss)	Sample Type	Data Source	Easting	Northing	Sampling Location	Sampling Date	Moisture Content (%)	Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Lead (Pb)	Mercury (Hg)	Zinc (Zn)	Molybdenum (Mo)	Nickel (Ni)	Selenium (Se)	Uranium (U)	Vanadium (V)	Aluminum (Al)	Antimony (Sb)	Barium (Ba)	Beryllium (Be)	Boron (B)	Hex. Chromium (Cr 6+)	Cobalt (Co)	Iron (Fe)	Magnesium (Mg)	Manganese (Mn)	Silver (Ag)	Thallium (Tl)	Tin (Sn)	Soluble Boron (mg/L)
Referenced Guidelines																																		
CCME Sediment Guidelines for the Protection of Aquatic Life: Interim Sediment Quality Objective [(a)]								-	5.9	0.6	37.3	35.7	35	0.17	123	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG
CCME Sediment Guidelines for the Protection of Aquatic Life: Probable Effects Level [(a)]								-	17	3.5	90	197	91.3	0.486	315	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG
Thompson Sediment Guidelines: Lowest Effect Level [(b)] Closest Observation Method								-	~~9.8~~	~~NG~~	~~47.6~~	~~22.2~~	~~36.7~~	~~NG~~	~~NG~~	8.3	21	0.9	32	27.3	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG
Thompson Sediment Guidelines: Severe Effects Level [(b)] Closest Observation Method								-	~~346.4~~	~~NG~~	~~115.4~~	~~268.8~~	~~412.4~~	~~NG~~	~~NG~~	540	170	4.7	3410	77	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG
Thompson Sediment Guidelines: Lowest Effect Level [(b)] Weighted Method								-	~~9.8~~	~~NG~~	~~47.6~~	~~22.2~~	~~36.7~~	~~NG~~	~~NG~~	13.8	23.4	1.9	104.4	35.2	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG
Thompson Sediment Guidelines: Severe Effects Level [(b)] Weighted Method								-	~~346.4~~	~~NG~~	~~115.4~~	~~268.8~~	~~412.4~~	~~NG~~	~~NG~~	1238.5	484	16.1	5874.1	160	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG
Sand																																		
ML_SED_20200206_VC02_2.2	2.2	Sand		522615	7036132	VC02	6-Feb-20	19	1.8	0.06	9	15	2.7	<0.050	**260**	<0.40	6.9	<0.50	4.5	15	8300	<0.50	15	0.62	<2.0	<0.080	7	15000	7900	410	<0.20	<0.10	<1.0	<0.10

NOTES

[(a)] Canadian Council of Ministers of the Environment (CCME) Guidelines, Sediment Quality Guidelines for the Protection of Aquatic Life, 1999

[(b)] Thompson et al. (2005) - Derivation and Use of Sediment Quality Guidelines for Ecological Risk Assessment of Metals and RadioNuclides Released to the Environment From Uranium Mining and Milling Activities in Canada

[(c)] Sample locations taken off of historical map and are an approximate value only

[(d)] Reportable detection limits for historical data vary and can be found in their respective reports

[(e)] Detection limits raised due to high moisture content, samples contain => 50% moisture.

[(f)] Not enough sample volume to complete analysis for soluble boron

[(g)] Detectiom limits raised based on sample weight used for analysis

[(h)] RDL increased to 0.10

Low-Level Radioactive Waste Management Office (LLRWMO) 2000 - Short-Term Environmental Monitoring Program, Rayrock Uranium Mine, February 2000

Rescan 2012 - Rayrock Comprehensive Remediation Performance Assessment Report, 2011. Prepared for Aboriginal Affairs and Northern Development Canada; Yellowknife, Northwest Territories; March 2012.

Arcadis 2016 - Phase III Environmental Site Assessment, Rayrock Mine, Northwest Territories; February 2016.

Arcadis 2017 - Delineation of Contamination of Mill Lake and the Associated Drainage Area, Former Rayrock Mine, Northwest Territories; January 2017.

Arcadis 2018 - Data Collection Program, Rayrock Remediation Program; November 2018.

BOLD Exceeds CCME Interim Sediment Quality Objectives

BOLD, yellow background, Exceeds CCME Probable Effects Level

BOLD indicates reported concentration greater than Thompson Sediment Guidelines Lowest Effect Level (where no CCME guideline exists only) **-** Closest Observation Method

BOLD, grey background, indicates reported concentration greater than Thompson Sediment Guidelines Severe Effect Level (where no CCME guideline exists only) **-** Closest Observation Method

Italics - Sample RDL greater than CCME/Thompson Sediment Guidelines

NG - no guideline

RDL - Reportable Detection Limit

\- parameter not analyzed

mg/kg - milligrams per kilogram

mbss - meters below sediment surface

Table C6

Historical Sediment Analytical Results - Radionuclides
Kwetı̨ ı̨aà (Rayrock) Remediation Project
Public Services and Procurement Canada

Sample Information								Laboratory Analytical Results (Bq/g)													
Sample ID	Data Source	Sample Depth (mbss)	Sample Type	NAD_1983_UTM_Zone_11 N Coordinates Easting / Northing		Sampling Location	Sampling Date	Gross Alpha	Gross Beta	Lead-210	Polonium-210	Potassium-40	Radium-226	Radium-228	Thorium-228	Thorium-230	Thorium-232	Thorium-234	Uranium-234	Uranium-235	Uranium-238
Thompson Sediment Guidelines: Lowest Effect Level [(a)]								-	-	0.80	0.90	-	0.60	-	-	-	-	-	-	-	-
Thompson Sediment Guidelines: Severe Effects Level [(a)]								-	-	12.10	20.80	-	14.40	-	-	-	-	-	-	-	-
Background																					
New Control Lake	Not Available		Loose Organic Sediment			New Control Lake				0.4	0.5	-	0.1	-	0.05	0.10	0.04	-	0.14	0.010	0.14
CL_001_20190806	AECOM, 2020	0.1	Loose Organic Sediment	523500	7037196	Control Lake	6-Aug-19	-	-	0.64	-	<1.0	0.18	<0.10	<0.10	<0.80	-	2.71	2.20	0.082	1.90
CL_002_20190806	AECOM, 2020	0.1	Loose Organic Sediment	523350	7037041	Control Lake	6-Aug-19	-	-	0.35	-	<1.0	<0.10	<0.10	<0.10	<0.80	-	1.14	1.03	0.038	0.920
NL_001_20190806	AECOM, 2020	0.1	Loose Organic Sediment	524125	7038014	Neghoa Lake	6-Aug-19	-	-	0.23	-	<1.0	<0.10	<0.10	<0.10	<0.80	-	2.03	1.75	0.066	1.53
NL_002_20190806	AECOM, 2020	0.1	Loose Organic Sediment	523682	7037399	Neghoa Lake	6-Aug-19	-	-	0.17	-	<1.0	<0.10	<0.10	<0.10	<0.80	-	2.28	1.94	0.076	1.66
							Average	-	-	0.36	0.53	<1.0	0.14	<0.10	0.05	0.10	0.04	2.04	1.41	0.054	1.23
Mill Lake																					
Loose Organic Sediment (0.0 m to 0.1 m)																					
Mill Lake	Rescan 2012	0 - 0.05	Loose Organic Sediment	522702	7036029	Mill Lake	31-Aug-11	-	-	**15**	**14**	-	**9.3**	-	0.45	11	0.24	-	48.5	2.27	48.5
ML_GEOTECH_SED	AECOM, 2020	0 - 0.05	Loose Organic Sediment	522676	7036143	Mill Lake	2-Aug-19	-	-	0.15	-	<1.0	<0.10	<0.10	<0.10	<0.80	-	0.460	11.5	0.420	9.60
ML_WT_SED	AECOM, 2020	0 - 0.05	Loose Organic Sediment	522695	7036079	Mill Lake	2-Aug-19	-	-	0.15	-	<1.0	<0.10	<0.10	<0.10	<0.80	-	0.440	9.40	0.340	7.70
GSW3 2-5CM	LLRWMO 2000	0.02 - 0.05	Loose Organic Sediment	522711	7035947	Mill Lake (SW3)	Nov-96	-	-	**14**	**15**	-	**16**	-	-	25	-	-	-	-	-
MILL 7-SED	Arcadis 2016	0.05 - 0.1	Loose Organic Sediment	522601	7036093	Mill Lake	29-Sep-15	-	-	**11.20**	-	-	**11.2**	-	-	-	-	-	-	-	-
MILL 8-SED	Arcadis 2016	0.05 - 0.1	Loose Organic Sediment	522616	7036135	Mill Lake	29-Sep-15	-	-	**4.04**	-	-	**4.05**	-	-	-	-	-	-	-	-
MILL 6-SED	Arcadis 2016	0.05 - 0.1	Loose Organic Sediment	522659	7036102	Mill Lake	29-Sep-15	-	-	**4.48**	-	-	**3.90**	-	-	-	-	-	-	-	-
MILL 4-SED	Arcadis 2016	0.05 - 0.1	Loose Organic Sediment	522702	7036034	Mill Lake	29-Sep-15	-	-	0.63	-	-	**3.10**	-	-	-	-	-	-	-	-
MILL 10-SED	Arcadis 2016	0.05 - 0.1	Loose Organic Sediment	522663	7036201	Mill Lake	29-Sep-15	-	-	**2.86**	-	-	**2.5**	-	-	-	-	-	-	-	-
MILL 3-SED	Arcadis 2016	0.05 - 0.1	Loose Organic Sediment	522693	7036003	Mill Lake	29-Sep-15	-	-	**1.40**	-	-	**1.81**	-	-	-	-	-	-	-	-
MILL 1-SED	Arcadis 2016	0.05 - 0.1	Loose Organic Sediment	522739	7036294	Mill Lake	29-Sep-15	-	-	0.71	-	-	**1.63**	-	-	-	-	-	-	-	-
MILL 2-SED	Arcadis 2016	0.05 - 0.1	Loose Organic Sediment	522794	7036260	Mill Lake	29-Sep-15	-	-	**1.55**	-	-	**1.37**	-	-	-	-	-	-	-	-
MILL 5-SED	Arcadis 2016	0.05 - 0.1	Loose Organic Sediment	522665	7036063	Mill Lake	29-Sep-15	-	-	0.34	-	-	**1.09**	-	-	-	-	-	-	-	-
MILL 9-SED	Arcadis 2016	0.05 - 0.1	Loose Organic Sediment	522650	7036171	Mill Lake	29-Sep-15	-	-	**1.41**	-	-	**0.740**	-	-	-	-	-	-	-	-
SED-1	Arcadis 2017	0.05 - 0.1	Loose Organic Sediment	522605	7036120	Mill Lake	25-Sep-16	-	-	**14.1**	-	-	**18.8**	-	-	-	-	-	-	-	-
SED-2	Arcadis 2017	0.05 - 0.1	Loose Organic Sediment	522621	7036118	Mill Lake	25-Sep-16	-	-	**5.60**	-	-	**8.10**	-	-	-	-	-	-	-	-
SED-4	Arcadis 2017	0.05 - 0.1	Loose Organic Sediment	522627	7036136	Mill Lake	25-Sep-16	-	-	**6.20**	-	-	**7.30**	-	-	-	-	-	-	-	-
SED-3	Arcadis 2017	0.05 - 0.1	Loose Organic Sediment	522611	7036131	Mill Lake	25-Sep-16	-	-	**3.06**	-	-	**5.30**	-	-	-	-	-	-	-	-
SED-5	Arcadis 2017	0.05 - 0.1	Loose Organic Sediment	522619	7036145	Mill Lake	25-Sep-16	-	-	**3.68**	-	-	**4.90**	-	-	-	-	-	-	-	-
SED-6	Arcadis 2017	0.05 - 0.1	Loose Organic Sediment	522692	7035997	Mill Lake	25-Sep-16	-	-	**6.00**	-	-	**4.00**	-	-	-	-	-	-	-	-
ML17-CORE-01 SA-1	Arcadis 2018	0-0.1	Loose Organic Sediment	522688	7036103	Mill Lake	4-Sep-17	-	-	**6.30**	**5.00**	-	**3.00**	-	-	4.00	-	-	-	-	-
ML17-CORE-02 SA-1	Arcadis 2018	0-0.1	Loose Organic Sediment	522761	7036196	Mill Lake	5-Sep-17	-	-	**4.40**	**5.90**	-	**1.50**	-	-	1.60	-	-	-	-	-
ML17-CORE-03 SA-1	Arcadis 2018	0-0.1	Loose Organic Sediment	522622	7036135	Mill Lake	6-Sep-17	-	-	**11.4**	**6.30**	-	**2.10**	-	-	4.20	-	-	-	-	-
							Average	-	-	5.16	9.24	<1.0	5.32	<0.10	0.45	9.16	0.24	0.45	23.13	1.010	21.93

Table C6

Historical Sediment Analytical Results - Radionuclides
Kwetį įaà (Rayrock) Remediation Project
Public Services and Procurement Canada

Sample Information								Laboratory Analytical Results (Bq/g)													
Sample ID	Data Source	Sample Depth (mbss)	Sample Type	NAD_1983_UTM_Zone_11 N Coordinates Easting / Northing		Sampling Location	Sampling Date	Gross Alpha	Gross Beta	Lead-210	Polonium-210	Potassium-40	Radium-226	Radium-228	Thorium-228	Thorium-230	Thorium-232	Thorium-234	Uranium-234	Uranium-235	Uranium-238
Loose Organic Sediment (0.1 m to 0.2 m)																					
GSW3 0-2CM	LLRWMO 2000	0 - 0.02	Loose Organic Sediment	522711	7035947	Mill Lake (SW3)	Nov-96	-	-	**12**	**8.0**	-	**9.5**	-	-	0.05	-	-	-	-	-
GSW3 5-15CM	LLRWMO 2000	0.05 - 0.15	Loose Organic Sediment	522711	7035947	Mill Lake (SW3)	Nov-96	-	-	**2.5**	**2.5**	-	**3.5**	-	-	0.75	-	-	-	-	-
ML17-CORE-01 SA-2	Arcadis 2018	0.1-0.2	Loose Organic Sediment	522688	7036103	Mill Lake	4-Sep-17	-	-	0.31	0.190	-	0.48	-	-	0.24	-	-	-	-	-
ML17-CORE-02 SA-2	Arcadis 2018	0.1-0.2	Loose Organic Sediment	522761	7036196	Mill Lake	5-Sep-17	-	-	0.32	0.430	-	0.12	-	-	0.36	-	-	-	-	-
ML17-CORE-03 SA-2	Arcadis 2018	0.1-0.2	Loose Organic Sediment	522622	7036135	Mill Lake	6-Sep-17	-	-	**4.90**	**7.40**	-	**2.60**	-	-	3.30	-	-	-	-	-
							Average	-	-	**4.01**	**3.70**	-	**3.24**	-	-	0.94	-	-	-	-	-
Loose Organic Sediment (0.2 m to 0.3 m)																					
ML17-CORE-01 SA-3	Arcadis 2018	0.2-0.3	Loose Organic Sediment	522688	7036103	Mill Lake	4-Sep-17	-	-	0.19	0.165	-	0.16	-	-	0.23	-	-	-	-	-
ML17-CORE-02 SA-3	Arcadis 2018	0.2-0.3	Loose Organic Sediment	522761	7036196	Mill Lake	5-Sep-17	-	-	0.25	0.330	-	0.15	-	-	<0.80	-	-	-	-	-
ML17-CORE-03 SA-3	Arcadis 2018	0.2-0.3	Loose Organic Sediment	522622	7036135	Mill Lake	6-Sep-17	-	-	0.55	0.860	-	0.36	-	-	0.49	-	-	-	-	-
							Average	-	-	0.33	0.45	-	0.22	-	-	0.36	-	-	-	-	-
Loose Organic Sediment (0.3 m to 0.4 m)																					
ML17-CORE-01 SA-4	Arcadis 2018	0.3-0.4	Loose Organic Sediment	522688	7036103	Mill Lake	4-Sep-17	-	-	0.15	0.168	-	0.10	-	-	0.26	-	-	-	-	-
ML17-CORE-02 SA-4	Arcadis 2018	0.3-0.4	Loose Organic Sediment	522761	7036196	Mill Lake	5-Sep-17	-	-	0.15	0.580	-	0.10	-	-	<0.80	-	-	-	-	-
ML17-CORE-03 SA-4	Arcadis 2018	0.3-0.4	Loose Organic Sediment	522622	7036135	Mill Lake	6-Sep-17	-	-	0.27	0.188	-	0.14	-	-	0.25	-	-	-	-	-
							Average	-	-	0.19	0.31	-	0.11	-	-	0.26	-	-	-	-	-
Loose Organic Sediment (0.4 m to 1.2 m)																					
ML_SED_20200205_VCO1_0.2	AECOM, 2020B	0.2	Loose Organic Sediment	522699	7036097	Mill Lake, VC01	5-Feb-20	6.10	7.00	<0.10	-	<1.0	<0.10	<0.10	<0.10	<0.80	-	0.260	3.5	0.13	3.0
ML_SED_20200206_VC03_0.2	AECOM, 2020B	0.2	Loose Organic Sediment	522663	7036198	Mill Lake, VC03	6-Feb-20	9.2	12.4	<0.10	-	<1.0	<0.10	<0.10	<0.10	<0.80	-	0.430	5.4	0.22	4.5
ML_SED_20200206_VC02_0.4	AECOM, 2020B	0.4	Loose Organic Sediment	522615	7036132	Mill Lake, VC02	6-Feb-20	8.2	9.8	<0.10	-	<1.0	<0.10	<0.10	<0.10	<0.80	-	0.500	5.2	0.24	4.6
ML_SED_20200207_VC06_0.4	AECOM, 2020B	0.4	Loose Organic Sediment	522717	7036142	Mill Lake, VC06	7-Feb-20	7.1	9.7	<0.10	-	<1.0	<0.10	<0.10	<0.10	<0.80	-	0.320	4.9	0.19	4.2
ML17-CORE-01 SA-5	Arcadis 2018	0.4-0.5	Loose Organic Sediment	522688	7036103	Mill Lake	4-Sep-17	-	-	0	0	-	<0.10	-	-	0.23	-	-	-	-	-
ML17-CORE-02 SA-5	Arcadis 2018	0.4-0.5	Loose Organic Sediment	522761	7036196	Mill Lake	5-Sep-17	-	-	0.16	0.162	-	<0.10	-	-	0.26	-	-	-	-	-
ML17-CORE-03 SA-5	Arcadis 2018	0.4-0.5	Loose Organic Sediment	522622	7036135	Mill Lake	6-Sep-17	-	-	<0.10	0.154	-	<0.10	-	-	0.25	-	-	-	-	-
ML_SED_20200206_VC03_0.6	AECOM, 2020B	0.6	Loose Organic Sediment	522663	7036198	Mill Lake, VC03	6-Feb-20	5.0	6.8	<0.10	-	<1.0	<0.10	<0.10	<0.10	<0.80	-	0.280	3.7	0.16	3.2
ML_SED_20200207_VC05_0.6	AECOM, 2020B	0.6	Loose Organic Sediment	522762	7036198	Mill Lake, VC05	7-Feb-20	4.0	4.9	<0.10	-	<1.0	<0.10	<0.10	<0.10	<0.80	-	0.150	2.5	0.094	2.1
ML_SED_20200205_VCO1_0.8	AECOM, 2020B	0.8	Loose Organic Sediment	522699	7036097	Mill Lake, VC01	5-Feb-20	3.3	4.7	<0.10	-	<1.0	<0.10	<0.10	<0.10	<0.80	-	0.100	2.2	0.088	1.9
ML_SED_20200207_VC06_0.8	AECOM, 2020B	0.8	Loose Organic Sediment	522717	7036142	Mill Lake, VC06	7-Feb-20	2.7	4.0	<0.10	-	<1.0	<0.10	<0.10	<0.10	<0.80	-	0.140	1.9	0.094	1.7
ML_SED_20200207_VC04_1.0	AECOM, 2020B	1.0	Loose Organic Sediment	522772	7036324	Mill Lake, VC04	7-Feb-20	5.1	6.9	<0.10	-	<1.0	<0.10	<0.10	<0.10	<0.80	-	0.300	5.8	0.29	5.7
ML_SED_20200206_VC02_1.2	AECOM, 2020B	1.2	Loose Organic Sediment	522615	7036132	Mill Lake, VC02	6-Feb-20	4.7	6.2	<0.10	-	<1.0	<0.10	<0.10	<0.10	<0.80	-	0.190	3.2	0.15	2.9
							Average	5.54	7.24	0.17	0.16	<1.0	<0.10	<0.10	<0.10	<0.80	-	0.27	3.83	0.17	3.4

Table C6

Historical Sediment Analytical Results - Radionuclides
Kwetı̨ ɂaà (Rayrock) Remediation Project
Public Services and Procurement Canada

Sample Information								Laboratory Analytical Results (Bq/g)													
Sample ID	Data Source	Sample Depth (mbss)	Sample Type	NAD_1983_UTM_Zone_11 N Coordinates Easting / Northing		Sampling Location	Sampling Date	Gross Alpha	Gross Beta	Lead-210	Polonium-210	Potassium-40	Radium-226	Radium-228	Thorium-228	Thorium-230	Thorium-232	Thorium-234	Uranium-234	Uranium-235	Uranium-238
Compacted Organic Sediment (1.2 m to 3.0 m)																					
ML_SED_20200206_VC03_1.2	AECOM, 2020B	1.2	Compacted Organic Sediment	522663	7036198	Mill Lake, VC03	6-Feb-20	3.50	4.80	<0.10	-	<1.0	<0.10	<0.10	<0.10	<0.80	-	0.18	2.5	0.088	2.0
ML_SED_20200207_VC05_1.3	AECOM, 2020B	1.3	Compacted Organic Sediment	522762	7036198	Mill Lake, VC05	7-Feb-20	3.80	5.00	<0.10	-	<1.0	<0.10	<0.10	<0.10	<0.80	-	0.150	2.6	0.10	2.2
ML_SED_20200205_VCO1_1.6	AECOM, 2020B	1.6	Compacted Organic Sediment	522699	7036097	Mill Lake, VC01	5-Feb-20	4.10	5.30	<0.10	-	<1.0	<0.10	<0.10	<0.10	<0.80	-	0.180	2.9	0.12	2.4
ML_SED_20200206_VC02_1.8	AECOM, 2020B	1.8	Compacted Organic Sediment	522615	7036132	Mill Lake, VC02	6-Feb-20	6.0	7.8	<0.10	-	<1.0	<0.10	<0.10	<0.10	<0.80	-	0.220	4.1	0.18	3.6
ML_SED_20200206_VC03_1.8	AECOM, 2020B	1.8	Compacted Organic Sediment	522663	7036198	Mill Lake, VC03	6-Feb-20	4.00	4.70	<0.10	-	<1.0	<0.10	<0.10	<0.10	<0.80	-	0.21	2.8	0.10	2.3
ML_SED_20200207_VC05_1.8	AECOM, 2020B	1.8	Compacted Organic Sediment	522762	7036198	Mill Lake, VC05	7-Feb-20	3.40	4.50	<0.10	-	<1.0	<0.10	<0.10	<0.10	<0.80	-	0.150	2.0	0.070	1.7
ML_SED_20200207_VC06_2.1	AECOM, 2020B	2.1	Compacted Organic Sediment	522717	7036142	Mill Lake, VC06	7-Feb-20	3.60	4.60	<0.10	-	<1.0	<0.10	<0.10	<0.10	<0.80	-	0.170	1.9	0.089	1.7
ML_SED_20200207_VC04_2.2	AECOM, 2020B	2.2	Compacted Organic Sediment	522772	7036324	Mill Lake, VC04	7-Feb-20	3.40	4.40	<0.10	-	<1.0	<0.10	<0.10	<0.10	<0.80	-	0.240	2.5	0.10	2.1
ML_SED_20200207_VC05_2.3	AECOM, 2020B	2.3	Compacted Organic Sediment	522762	7036198	Mill Lake, VC05	7-Feb-20	3.50	5.20	<0.10	-	<1.0	<0.10	<0.10	<0.10	<0.80	-	0.150	2.6	0.10	2.1
ML_SED_20200207_VC04_3.0	AECOM, 2020B	3.0	Compacted Organic Sediment	522772	7036324	Mill Lake, VC04	7-Feb-20	6.40	8.30	<0.10	-	<1.0	<0.10	<0.10	<0.10	<0.80	-	0.300	4.5	0.19	3.6
							Average	4.17	5.46	<0.10	-	<1.0	<0.10	<0.10	<0.10	<0.80	-	0.20	2.84	0.114	2.37
Clay																					
ML_SED_20200206_VC03_2.6	AECOM, 2020B	2.6	Clay Sediment	522663	7036198	Mill Lake, VC03	6-Feb-20	1.30	1.64	<0.10	-	<1.0	<0.10	<0.10	<0.10	<0.80	-	<0.050	0.079	<0.010	0.072
ML_SED_20200205_VCO1_3.0	AECOM, 2020B	3.0	Clay Sediment	522699	7036097	Mill Lake, VC01	5-Feb-20	1.10	1.83	<0.10	-	<1.0	<0.10	<0.10	<0.10	<0.80	-	<0.050	0.056	<0.010	0.058
ML_SED_20200207_VC06_3.2	AECOM, 2020B	3.2	Clay Sediment	522717	7036142	Mill Lake, VC06	7-Feb-20	1.10	1.71	<0.10	-	<1.0	<0.10	<0.10	<0.10	<0.80	-	<0.050	0.077	<0.010	0.077
ML_SED_20200207_VC05_3.5	AECOM, 2020B	3.5	Clay Sediment	522762	7036198	Mill Lake, VC05	7-Feb-20	1.20	2.20	<0.10	-	<1.0	<0.10	<0.10	<0.10	<0.80	-	<0.050	0.055	<0.010	0.052
ML_SED_20200207_VC04_4.2	AECOM, 2020B	4.2	Clay Sediment	522772	7036324	Mill Lake, VC04	7-Feb-20	1.00	1.83	<0.10	-	<1.0	<0.10	<0.10	<0.10	<0.80	-	<0.050	0.091	<0.010	0.086
							Average	1.14	1.84	<0.10	-	<1.0	<0.10	<0.10	<0.10	<0.80	-	<0.050	0.07	<0.010	0.07
Sand																					
ML_SED_20200206_VC02_2.2	AECOM, 2020B	2.2	Sand Sediment	522615	7036132	Mill Lake, VC02	6-Feb-20	1.2	2.2	<0.10	-	<1.0	<0.10	<0.10	<0.10	<0.80	-	0.090	0.102	<0.010	0.093

NOTES
BOLD, indicates reported concentration greater than Thompson Sediment Guidelines Lowest Effect Level
BOLD, Gret background, indicates reported concentration greater than Thompson Sediment Guidelines Severe Effect Level
[a] Thompson et al. (2005) - Derivation and Use of Sediment Quality Guidelines for Ecological Risk Assessment of Metals and RadioNuclides Released to the Environment From Uranium Mining and Milling Activities in Canada
[a] Sample locations taken off of historical map and are an approximate value only
[b] Reportable detection limits for historical data vary and can be found in their respective reports
Low-Level Radioactive Waste Management Office (LLRWMO) 2000 - Short-Term Environmental Monitoring Program, Rayrock Uranium Mine, February 2000
Rescan 2012 - Rayrock Comprehensive Remediation Performance Assessment Report, 2011. Prepared for Aboriginal Affairs and Northern Development Canada; Yellowknife, Northwest Territories; March 2012.
Arcadis 2016 - Phase III Environmental Site Assessment, Rayrock Mine, Northwest Territories; February 2016.
Arcadis 2017 - Delineation of Contamination of Mill Lake and the Associated Drainage Area, Former Rayrock Mine, Northwest Territories; January 2017.
Arcadis 2018 - Data Collection Program, Rayrock Remediation Program; November 2018.
Italic, underlined, indicates reported concentration greater than Thompson Sediment Guidelines Lowest Effect Level
Italic, underlined, indicates reported concentration greater than Thompson Sediment Guidelines Lowest Effect Level
NG - no guideline
RDL - Reportable Detection Limit
- parameter not analyzed
mg/kg - milligrams per kilogram
mbss - meters below sediment surface

AECOM

Table C7

Historical Surface Water Analytical Results - Select Metals and Isotopes
Kweṭı̨ı̨ɂàà (Rayrock) Remediation Project
Public Services and Procurement Canada

Lake Group	Sample Location	Sample Date (mm/dd/yyyy)	Sample ID	pH	Hardness (as CaCO3)	Copper Dissolved	Copper Total Guideline	Copper Total	Lead Dissolved	Lead Total	Lead Total	Lead-210 Dissolved	Lead-210 Total	Polonium-210 Dissolved	Polonium-210 Total	Radium-226 Dissolved	Radium-226 Total	Thorium-228 Dissolved	Thorium-228 Total	Thorium-230 Dissolved	Thorium-230 Total	Thorium-232 Dissolved	Thorium-232 Total	Uranium Dissolved	Uranium Total	Uranium-234 Dissolved	Uranium-234 Total	Uranium-235 Dissolved	Uranium-235 Total	Uranium-238 Dissolved	Uranium-238 Total
			Unit	ph units	mg/l	mg/l	mg/L	mg/l	mg/l	mg/L	mg/l	bq/l	bq/l	bq/l	bq/l	bq/l	bq/l	bq/l	bq/l	bq/l	bq/l	bq/l	bq/l	mg/l	mg/l	bq/l	bq/l	bq/l	bq/l	bq/l	bq/l
			CCME Freshwater[1]	9	NG	NG	CCME Guideline varies with Hardness	Varies[2] 0.005	NG	CCME Guideline varies with Hardness	Varies[3] 0.001 to 0.005	NG	NG	NG	NG	NG	1	NG	NG	NG	NG	NG	NG	NG	0.015 0.005 Interim	NG	NG	NG	NG	NG	NG
New Control Lake																															
New Control Lake	Control Lake 85	7/13/1983	RR-0001-052	7.60		0.0152	0.002	0.0015	0.0018	0.001	< 0.0001		0.07				0.04								0.0002						
New Control Lake	Control Lake 85	9/19/1984	RR-0001-019				0.002	0.003		0.001	< 0.001		< 0.02				< 0.005								0.6						
New Control Lake	Control Lake 85	11/20/1996	RR-0001-060			0.002	0.002		< 0.002	0.001		< 0.02		< 0.005		< 0.005				< 0.01				< 0.001							
New Control Lake	Control Lake 85	11/20/1996	RR-0001-061			0.002	0.002		< 0.002	0.001		< 0.02		< 0.005		< 0.005				< 0.01				< 0.001							
New Control Lake	SWNC2 New Control	8/21/1997	RR-0001-096			0.001	0.002		< 0.002	0.001		< 0.02		< 0.005		< 0.005				< 0.01				< 0.001							
New Control Lake	SWNC2 New Control (Duplicate)	8/21/1997	RR-0001-097			0.001	0.002		< 0.002	0.001		< 0.02		< 0.005		< 0.005				< 0.01				< 0.001							
New Control Lake	SWNC2 New Control	8/29/2004	RR-0002-038				0.002	0.0011		0.001	0.00015		< 0.02		< 0.005		0.007		< 0.01		< 0.01		< 0.01		0.00042		< 0.2		0.0007		0.00459
New Control Lake	SWNC2 New Control	8/29/2004	RR-0002-038			0.0011	0.002		0.00008	0.001		< 0.02		< 0.005		0.008		< 0.01		< 0.01		< 0.01		0.00038		0.2		0.004		0.0304	
New Control Lake	SWNC2 New Control	8/29/2004	RR-0002-038	7.74	54.0		0.002			0.001																					
New Control Lake	SWNC2 New Control	8/22/2005	RR-0002-045			0.0007	0.002	0.00146	< 0.00005	0.001	< 0.00005	< 0.02	< 0.02	< 0.005	< 0.005	< 0.005	< 0.005	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.00032	0.00036	< 0.2	< 0.2	0.0002	0.0002	0.0038	0.0038
New Control Lake	SWNC2 New Control	8/22/2005	RR-0002-045	8.00	47.9		0.002			0.001																					
New Control Lake	SWNC2 New Control	8/11/2006	RR-0002-059			0.00076	0.002	0.00109	< 0.00005	0.001	0.000063	< 0.02	< 0.02	< 0.005	< 0.005	< 0.005	< 0.01	< 0.01	< 0.01	0.02	< 0.01	< 0.01	< 0.01	0.000301	0.00036	< 0.2	< 0.2	0.0004	0.0004	0.0035	0.0038
New Control Lake	SWNC2 New Control	8/11/2006	RR-0002-059	7.96	55.5		0.002			0.001																					
New Control Lake	SWNC2 New Control	8/28/2007	RR-0002-069	7.66	50.0	0.00065	0.002	0.00084	< 0.00005	0.001	< 0.00005	< 0.02	< 0.02	< 0.005	< 0.005	< 0.005	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.02	< 0.01	0.000261	0.00032	< 0.2	< 0.2	0.0001	0.0002	0.0038	0.0047
New Control Lake	SWNC2 New Control	8/27/2008	RR-0002-080	7.78	49.7	0.00074	0.002	0.00094	< 0.00005	0.001	< 0.00005	< 0.02	< 0.02	< 0.005	< 0.005	< 0.005	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.000465	0.00049	< 0.2	< 0.2	0.0002	0.0002	0.00401	0.00432
New Control Lake	SWNC2 New Control	8/30/2009	RR-0002-089	7.11	48.1	0.00068	0.002	0.00092	< 0.00005	0.001	< 0.00005	< 0.02	< 0.02	< 0.005	< 0.005	< 0.005	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.000249	0.00029	< 0.2	< 0.2	0.0002	0.0003	0.0028	0.0034
New Control Lake	SWNC2 New Control	8/30/2011	RR-0003-002	7.84	57.5	< 0.0001	0.002	0.00059	< 0.00005	0.001	< 0.00005	< 0.02	< 0.02	< 0.005	< 0.005	< 0.005	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.000365	0.00039	0.007	0.004	0.0003	0.0002	0.007	0.004
New Control Lake	SWNC2 New Control	8/6/2014	RR-0003-008	8.28	67.0	0.0006	0.002	0.0011	< 0	0.0019	< 0		< 0.1		< 0.01		< 0.01		< 0.01		0.019		< 0.01	0.00063	0.00074		0.012		< 0.01		0.022
Maximum Concentration (post 2000, selected parameters)				8.3	67.0			0.0015																	0.00074						
Average Concentration (post 2000, selected parameters)				7.8	53.7			0.0010																	0.00042						
Lowest Concentration (post 2000, selected parameters)				7.1	47.9			0.00059																	0.00029						
Sherman Lake																															
Sherman Lake	Sherman 79-2	6/15/1979	RR-0001-028				0.002			0.001															3.5						
Sherman Lake	Sherman 79-5	6/15/1979	RR-0001-029				0.002			0.001															4.4						
Sherman Lake	Sherman 79-10	6/15/1979	RR-0001-030				0.002			0.001															4.6						
Sherman Lake	Sherman Lake NE	6/15/1979	RR-0001-031				0.002			0.001															3.2						
Sherman Lake	Sherman 79-2	6/15/1979	RR-0001-033		36		0.002	< 0.02		0.001	0.008																				
Sherman Lake	Sherman 79-5	6/15/1979	RR-0001-034		28		0.002	< 0.02		0.001	0.006																				
Sherman Lake	Sherman 79-10	6/15/1979	RR-0001-035		28		0.002	< 0.02		0.001	0.006																				
Sherman Lake	Sherman Lake NE	6/15/1979	RR-0001-036		28		0.002	< 0.02		0.001	0.006																				
Sherman Lake	Sherman 6W1	7/13/1983	RR-0001-045	8.00		0.0025	0.002	0.0025	< 0.0001	0.001	< 0.0001		0.55				0.02								0.00020						
Sherman Lake	Sherman Lake NE	7/13/1983	RR-0001-046	8.50		0.0023	0.002	0.002	< 0.0001	0.001	< 0.0001		0.06				0.001								0.00090						
Sherman Lake	Sherman Lake NE	9/19/1984	RR-0001-020				0.002	0.005		0.001	< 0.001		< 0.02				0.005								0.7						
Sherman Lake	Sherman Lake Main	9/19/1984	RR-0001-021				0.002	0.005		0.001	< 0.001		0.04				0.005								0.8						
Sherman Lake	Sherman Lake SW6	9/19/1984	RR-0001-024				0.002	0.12		0.001	< 0.001		< 0.02				< 0.005								0.6						
Sherman Lake	Sherman S1	7/18/1986	RR-0003-058				0.002	0.0053		0.001	0.0016		< 0.03				0.005								< 0.001						
Sherman Lake	Sherman S3	7/18/1986	RR-0003-061				0.002	0.005		0.001	< 0.001																				
Sherman Lake	Sherman S3	7/18/1986	RR-0003-062				0.002	0.005		0.001	< 0.001																				
Sherman Lake	SW8 Sherman	7/18/1986	RR-0003-063				0.002	0.0046		0.001	< 0.001		< 0.03				0.01								0.00011						
Sherman Lake	SW8 Sherman (Duplicate)	7/18/1986	RR-0003-064				0.002	0.0043		0.001	< 0.001																				
Sherman Lake	SW8 Sherman	7/18/1986	RR-0003-065				0.002	0.0036		0.001	< 0.001																				
Sherman Lake	SW8 Sherman	7/18/1986	RR-0003-066				0.002	0.0054		0.001	< 0.001																				
Sherman Lake	SW8 Sherman	7/18/1986	RR-0003-067				0.002	0.0066		0.001	< 0.001																				
Sherman Lake	SW8 Sherman	7/18/1986	RR-0003-068				0.002	0.0047		0.001	< 0.001																				
Sherman Lake	Sherman Lake Main	7/18/1986	RR-0003-069				0.002	0.0053		0.001	< 0.001																				
Sherman Lake	Sherman Lake Main	7/18/1986	RR-0003-070				0.002	0.0046		0.001	< 0.001																				
Sherman Lake	Sherman S6	7/18/1986	RR-0003-071				0.002	0.0052		0.001	< 0.001																				
Sherman Lake	Sherman S6	7/18/1986	RR-0003-072				0.002	0.0052		0.001	0.0006																				
Sherman Lake	Sherman S6	7/18/1986	RR-0003-073				0.002	0.005		0.001	< 0.001																				
Sherman Lake	Sherman Lake NE	7/18/1986	RR-0003-074				0.002	0.0052		0.001	< 0.001		< 0.03				0.02								0.00120						
Sherman Lake	Sherman Lake NE (Duplicate)	7/18/1986	RR-0003-075				0.002	0.0055		0.001	< 0.001																				
Sherman Lake	Sherman Lake SW6	11/20/1996	RR-0001-065			0.003	0.002		< 0.002	0.001		0.03		0.02		0.005				< 0.01				0.0006							
Sherman Lake	SW7 Sherman	11/20/1996	RR-0001-066			0.003	0.002		< 0.002	0.001		< 0.02		0.005		0.01				< 0.01				0.0007							
Sherman Lake	SW8 Sherman	11/20/1996	RR-0001-067			0.002	0.002		< 0.002	0.001		< 0.02		0.03		0.005				< 0.01				0.0006							
Sherman Lake	SW8 Sherman	11/20/1996	RR-0001-068			0.006	0.002		< 0.002	0.001		< 0.02		0.01		0.005				< 0.01				0.0007							
Sherman Lake	SW8 Sherman (Duplicate)	11/20/1996	RR-0001-069			0.002	0.002		< 0.002	0.001		< 0.02		< 0.005		0.02				< 0.01				0.0006							
Sherman Lake	Sherman Lake SW6	8/21/1997	RR-0002-001			0.004	0.002		< 0.002	0.001		< 0.02		< 0.005		0.07				0.07				0.0028							
Sherman Lake	SW7 Sherman	8/21/1997	RR-0002-002			0.003	0.002		< 0.002	0.001		< 0.02		< 0.005		0.006				< 0.01				0.0007							
Sherman Lake	SW8 Sherman	8/21/1997	RR-0002-003			0.001	0.002		< 0.002	0.001		< 0.02		0.009		0.006				< 0.01				0.0009							
Sherman Lake	Sherman Lake SW6	10/1/2000	RR-0003-083			0.0028	0.002	0.004	0.0012	0.001	0.0003	< 0.061	< 0.061	< 0.007	< 0.015	0.00444	0.00703	0.00333	0.07	0.0481	1.4	0.00592	0.08	0.0013	0.00130	0.00555	0.00444	< 0.011	< 0.011	0.00518	0.42
Sherman Lake	Sherman Lake SW6 (Duplicate)	10/1/2000	RR-0003-085			0.0022	0.002	0.004	0.0007	0.001	0.0005	< 0.061	< 0.061	< 0.007	< 0.007	0.00518	0.00629	0.01406	< 0.016	0.074	0.02146	0.00333	0.00333	0.001	0.00150	0.02442	< 0.052	0.0037	< 0.041	0.01998	< 0.052
Sherman Lake	Sherman Lake	9/20/2001	RR-0001-001			0.0028	0.002	0.0034	< 0.00005	0.001	0.00008	< 0.02	< 0.02	< 0.005	< 0.005	0.009	< 0.005	< 0.01	< 0.01	< 0.01	0.02	< 0.01	< 0.01	0.00074	0.00084	0.2	0.2	0.0004	0.0005	0.00828	0.00904
Sherman Lake	Sherman Lake (Duplicate)	9/20/2001	RR-0001-002			0.0028	0.002	0.0032	< 0.00005	0.001	0.00007	< 0.02	< 0.02	< 0.005	< 0.005	0.009	0.02	< 0.01	< 0.01	< 0.01	0.02	< 0.01	< 0.01	0.0007	0.00080	0.2	0.2	0.0004	0.0004	0.0082	0.00883
Sherman Lake	Sherman Lake	8/12/2002	RR-0001-007			0.0027	0.002	0.0029	< 0.00005	0.001	0.00009	< 0.02	< 0.02	< 0.005	< 0.005	0.007	0.006	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.00066	0.00066	< 0.2	0.2	0.0004	0.0003	0.0107	0.0081
Sherman Lake	Sherman Lake (Duplicate)	8/12/2002	RR-0001-008			0.0028	0.002	0.003	< 0.00005	0.001	0.00008	< 0.02	< 0.02	< 0.005	< 0.005	0.009	0.006	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.00066	0.00067	< 0.2	< 0.2	0.0005	0.0003	0.0095	0.0079
Sherman Lake	Sherman Lake	8/17/2003	RR-0002-030	7.93	44.8		0.002			0.001																					
Sherman Lake	Sherman Lake (Duplicate)	8/17/2003	RR-0002-031	7.93	43.9		0.002			0.001																					
Sherman Lake	Sherman Lake	8/17/2003	RR-0002-030			0.0022	0.002	0.0025	< 0.00005	0.001	< 0.00005	< 0.02	< 0.02	< 0.005	< 0.005	< 0.005	< 0.005	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.00063	0.00065	< 0.2	< 0.2	0.0005	0.0003	0.011	0.007
Sherman Lake	Sherman Lake (Duplicate)	8/17/2003	RR-0002-031			0.0023	0.002	0.0024	< 0.00005	0.001	< 0.00005	< 0.02	< 0.02	< 0.005	< 0.005	< 0.005	< 0.005	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.00062	0.00065	< 0.2	< 0.2	0.0004	0.0003	0.0091	0.0071
Sherman Lake	Sherman Lake	8/29/2004	RR-0002-034				0.002	0.0028		0.001	< 0.00005		< 0.02		< 0.005		0.005		< 0.01		< 0.01		< 0.01		0.00060		< 0.2		0.0011		0.0069
Sherman Lake	Sherman Lake	8/29/2004	RR-0002-034			0.0021	0.002		< 0.00005	0.001		< 0.02		< 0.005		0.007		< 0.01		< 0.01		< 0.01		0.00061		< 0.2		0.0035		0.0267	
Sherman Lake	Sherman Lake	8/29/2004	RR-0002-034	7.75	45.8		0.002			0.001																					
Sherman Lake	Sherman Lake	8/22/2005	RR-0002-041			0.00289	0.002	0.00315	< 0.00005	0.001	< 0.00005	< 0.02	< 0.02	< 0.005	< 0.005	< 0.005	< 0.005	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.000561	0.00069	< 0.2	< 0.2	0.0003	0.0004	0.0068	0.0094
Sherman Lake	Sherman Lake (Duplicate)	8/22/2005	RR-0002-042			0.00236	0.002	0.0028	< 0.00005	0.001	< 0.00005	< 0.02	< 0.02	< 0.005	< 0.005	0.005	< 0.005	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.000537	0.00062	< 0.2	< 0.2	0.0003	0.0003	0.0065	0.0062
Sherman Lake	Sherman Lake	8/22/2005	RR-0002-041	7.46	44.3		0.002			0.001																					
Sherman Lake	Sherman Lake (Duplicate)	8/22/2005	RR-0002-042	7.90	43.6		0.002			0.001																					
Sherman Lake	Sherman Lake (Duplicate)	8/11/2006	RR-0002-055			0.00348	0.002	0.00308	0.000053	0.001	0.000128	< 0.02	< 0.02	< 0.005	< 0.005	< 0.005	0.008	< 0.01	< 0.01	0.02	< 0.01	< 0.01	< 0.01	0.000522	0.00055	< 0.2	< 0.2	0.0002	0.0002	0.0063	0.0065
Sherman Lake	Sherman Lake	8/11/2006	RR-0002-054			0.00225	0.002	0.00291	< 0.00005	0.001	0.000114	< 0.02	< 0.02	0.009	< 0.005	0.16	0.16	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.000512	0.00048	< 0.2	< 0.2	0.0003	0.0003	0.006	0.0068
Sherman Lake	Sherman Lake	8/11/2006	RR-0002-054	7.14	51.5		0.002			0.001																					
Sherman Lake	Sherman Lake (Duplicate)	8/11/2006	RR-0002-055	7.84	50.8		0.002			0.001																					
Sherman Lake	Sherman Lake	8/28/2007	RR-0002-063	7.86	42.5	0.00221	0.002	0.00258	< 0.00005	0.001	< 0.00005	< 0.02	< 0.02	< 0.005	< 0.005	< 0.005	0.009	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.000381	0.00043	< 0.2	< 0.2	0.0002	0.0002	0.0044	0.0054
Sherman Lake	Sherman Lake (Duplicate)	8/28/2007	RR-0002-064	7.75	41.6	0.00222	0.002	0.00247	< 0.00005	0.001	< 0.00005	< 0.02	< 0.02	< 0.005	< 0.005	0.007	0.01	< 0.01	< 0.01	< 0.01	0.01	< 0.01	< 0.01	0.000381	0.00042	< 0.2	< 0.2	0.0002	0.0002	0.0046	0.005
Sherman Lake	Sherman Lake	8/27/2008	RR-0002-075	7.80	40.8	0.00192	0.002	0.00208	< 0.00005	0.001	< 0.00005	< 0.02	< 0.02	< 0.005	< 0.005	< 0.005	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.000733	0.00130	< 0.2	< 0.2	0.0003	0.0003	0.0073	0.00513
Sherman Lake	Sherman Lake	8/30/2009	RR-0002-084	7.41	41.3	0.00189	0.002	0.00225	< 0.00005	0.001	< 0.00005	< 0.02	< 0.02	< 0.005	< 0.005	< 0.005	0.009	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.000361	0.00039	< 0.2	< 0.2	0.0002	0.0007	0.0042	0.0057
Sherman Lake	Sherman Lake	9/1/2011	RR-0002-097	7.87	40.6	0.00173	0.002	0.00178	< 0.00005	0.001	< 0.00005	< 0.02	< 0.02	< 0.005	< 0.005	< 0.005	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.000369	0.00040	0.004	0.006	0.0002	0.0003	0.004	0.006
Sherman Lake	Sherman 2014	8/6/2014	RR-0003-003	7.89	45	0.0015	0.002	0.0018	< 0	0.001	< 0		< 0.1		< 0.01		0.011		< 0.01		0.029		< 0.01	0.00041	0.00047		< 0.01		< 0.01		< 0.01
Sherman Lake	Sherman 17-6	9/11/2017	RR-0003-041				0.002	0.0037		0.001	0.00091		< 0.1				< 0.01								0.00320						
Sherman Lake	Sherman Lake (Duplicate)	9/17/2018	DUP1_20180917	7.76	49	0.0015	0.002	0.0016	< 0.00020	0.001	< 0.00020													0.00058	0.00055						
Sherman Lake	Sherman Lake	9/17/2018	SW001_20180917_20180917	7.80	49	0.0013	0.002	0.002	< 0.00020	0.001	< 0.00020													0.00052	0.00054						
Sherman Lake	Sherman Lake	9/17/2018	SW002_20180917_20180917	7.75	52	0.0014	0.002	0.0017	< 0.00020	0.001	< 0.00020													0.00052	0.00056						
Sherman Lake	Sherman Lake	9/17/2018	SW003_20180917_20180917	7.76	49	0.0015	0.002	0.0018	< 0.00020	0.001	< 0.00020													0.00057	0.00061						
Sherman Lake	Sherman Lake	9/17/2018	SW004_20180917_20180917	7.74	49	0.0012	0.002	0.0017	< 0.00020	0.001	< 0.00020													0.00047	0.00050						
Sherman Lake	Sherman Lake	9/17/2018	SW005_20180917_20180917	7.75	49	0.0012	0.002	0.0015	< 0.00020	0.001	< 0.00020													0.00048	0.00051						
Sherman Lake	Sherman Lake	9/17/2018	SW006_20180917_20180917	7.72	49	0.0012	0.002	0.0016	< 0.00020	0.001	< 0.00020													0.00049	0.00049						
Maximum Concentration (post 2000, selected parameters)				7.9	52.0			0.004																	0.00320						
Average Concentration (post 2000, selected parameters)				7.7	46.1			0.0025																	0.00075						
Lowest Concentration (post 2000, selected parameters)				7.1	40.6			0.0015																	0.00039						

Table C7

Historical Surface Water Analytical Results - Select Metals and Isotopes
Kwetı̨ı̨ɂàà (Rayrock) Remediation Project
Public Services and Procurement Canada

Sample Information				General		Select Metals and Isotopes																									
			Parameter	pH	Hardness (as CaCO3)	Copper			Lead			Lead-210		Polonium-210		Radium-226		Thorium-228		Thorium-230		Thorium-232		Uranium		Uranium-234		Uranium-235		Uranium-238	
			Fraction			Dissolved	Total Guideline	Total	Dissolved	Total	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total
			Unit	ph units	mg/l	mg/l	mg/L	mg/l	mg/l	mg/L	mg/l	bq/l	bq/l	bq/l	bq/l	bq/l	bq/l	bq/l	bq/l	bq/l	bq/l	bq/l	bq/l	mg/l	mg/l	bq/l	bq/l	bq/l	bq/l	bq/l	bq/l
			CCME Freshwater[1]	9	NG	NG	CCME	Varies[3]	NG	CCME	Varies[3]	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	0.015	NG	NG	NG	NG	NG	NG
					NG	NG	Guideline varies with Hardness	0.005	NG	Guideline varies with Hardness	0.001 to 0.005	NG	NG	NG	NG	NG	1	NG	NG	NG	NG	NG	NG	NG	0.005 Interim	NG	NG	NG	NG	NG	NG
Lake Group	Sample Location	Sample Date (mm/dd/yyyy)	Sample ID																												
Alpha Lake																															
Alpha Lake	Alpha 79-1	6/15/1979	RR-0001-027				0.002			0.001															5.6						
Alpha Lake	Alpha 79-1	6/15/1979	RR-0001-032		40		0.002	< 0.02		0.001	0.012																				
Alpha Lake	Alpha 79-1	7/13/1983	RR-0001-043	7.10		0.043	0.002	0.071	< 0.0001	0.001	< 0.0001		0.05				0.4								0.00470						
Alpha Lake	Alpha 79-1	7/13/1983	RR-0001-044	7.00		0.044	0.002	0.057	< 0.0001	0.001	0.0033		0.9				0.7								0.00090						
Alpha Lake	Alpha Lake 85	9/19/1984	RR-0001-023				0.002	3.19		0.001	0.002		1.8				9.5								95						
Alpha Lake	Alpha 05	7/18/1986	RR-0003-079				0.002	0.0389		0.001	< 0.001		0.14				0.55								0.00240						
Alpha Lake	SW5 Alpha	7/18/1986	RR-0003-080				0.002	0.0382		0.001	< 0.001		0.14				0.55								0.00310						
Alpha Lake	Alpha 79-1	7/20/1995	RR-0001-054				0.002	0.01		0.001	< 0.001		0.04				0.19								< 0.001						
Alpha Lake	SW5 Alpha	11/20/1996	RR-0001-064			0.007	0.002		< 0.002	0.001		< 0.02		0.01		0.06				1.8				0.0011							
Alpha Lake	SW5 Alpha	8/21/1997	RR-0001-100			0.02	0.002		0.002	0.001		0.1		0.08		0.39				4.7				0.0084							
Alpha Lake	SW5 Alpha	10/1/2000	RR-0003-081			0.017	0.002	0.0240	0.0009	0.001	0.0024	0.07585		< 0.015		0.10989		0.0111		0.1258		0.0037		0.0321	0.03360	0.3811		0.01184		0.3626	
Alpha Lake	SW5 Alpha (Duplicate)	10/1/2000	RR-0003-082			0.0175	0.002	0.0250	0.0009	0.001	0.0017	< 0.061	0.12617	< 0.015	0.0518	0.09768	0.2738	0.01036	0.02294	0.1221	0.1517	0.00925	0.00703	0.0326	0.03470	0.4218	0.3811	0.01961	0.01739	0.4884	0.3663
Alpha Lake	Lake Alpha	9/20/2001	RR-0001-003			0.0056	0.002	0.0074	< 0.00005	0.001	0.0002	< 0.02	0.04	< 0.005	0.02	0.05	0.09	< 0.01	< 0.01	0.03	0.05	< 0.01	< 0.01	0.00201	0.00220	0.5	0.7	0.0011	0.0011	0.022	0.0241
Alpha Lake	Lake Alpha (Duplicate)	9/20/2001	RR-0001-004			0.0055	0.002	0.0074	< 0.00005	0.001	0.0002	< 0.02	0.05	< 0.005	0.01	0.05	0.09	< 0.01	< 0.01	0.01	0.06	< 0.01	< 0.01	0.00202	0.00218	0.5	0.7	0.0011	0.0011	0.0225	0.0245
Alpha Lake	Lake Alpha	8/12/2002	RR-0001-009			0.0088	0.002	0.0127	0.00008	0.001	0.00052	< 0.02	0.02	< 0.005	0.02	0.04	0.08	< 0.01	< 0.01	0.04	0.07	< 0.01	< 0.01	0.00283	0.00318	0.2	0.2	0.0018	0.0016	0.0389	0.0382
Alpha Lake	Lake Alpha (Duplicate)	8/12/2002	RR-0001-010			0.0086	0.002	0.0118	< 0.00005	0.001	0.00038	< 0.02	< 0.02	0.008	0.04	0.07	0.09	< 0.01	< 0.01	0.04	0.08	< 0.01	< 0.01	0.00284	0.00309	0.2	0.5	0.0021	0.0018	0.0415	0.0379
Alpha Lake	Lake Alpha	8/17/2003	RR-0002-027	8.03	67		0.002			0.001																					
Alpha Lake	Lake Alpha	8/17/2003	RR-0002-027			0.0099	0.002	0.0108	0.00006	0.001	0.00016	< 0.02	0.1	< 0.005	0.04	0.08	0.08	< 0.01	< 0.01	0.02	0.03	< 0.01	< 0.01	0.0141	0.01230	< 0.2	< 0.2	0.0072	0.0072	0.149	0.149
Alpha Lake	Lake Alpha	8/29/2004	RR-0002-035				0.002	0.0152		0.001	0.00109		0.06		0.03		0.11		< 0.01		0.07		< 0.01		0.00304		< 0.2		0.0043		0.0357
Alpha Lake	Lake Alpha	8/29/2004	RR-0002-035			0.0084	0.002		0.00013	0.001		< 0.02		0.008		0.06		< 0.01		0.02		< 0.01		0.00266		< 0.2		0.004		0.0304	
Alpha Lake	Lake Alpha	8/29/2004	RR-0002-035	7.92	45.7		0.002			0.001																					
Alpha Lake	Alpha 05	7/3/2005	RR-0002-049			0.00753	0.002	0.0101	< 0.00005	0.001	0.000206	< 0.02	< 0.02	0.005	0.02	0.03	0.07	< 0.01	< 0.01	0.03	0.07	< 0.01	< 0.01	0.00391	0.00717	< 0.2	< 0.2	0.0032	0.0022	0.0604	0.0423
Alpha Lake	Alpha 05	7/3/2005	RR-0002-049	7.48	47.2		0.002			0.001																					
Alpha Lake	Lake Alpha	8/22/2005	RR-0002-043			0.00838	0.002	0.0140	0.000057	0.001	0.000334	0.02	0.03	0.005	0.03	0.05	0.009	< 0.01	< 0.01	0.02	0.05	< 0.01	< 0.01	0.00206	0.00280	< 0.2	< 0.2	0.0012	0.001	0.0237	0.0229
Alpha Lake	Lake Alpha	8/22/2005	RR-0002-043	7.92	46		0.002			0.001																					
Alpha Lake	Lake Alpha	8/11/2006	RR-0002-062			0.00654	0.002	0.0114	0.000064	0.001	0.000298	< 0.02	0.06	0.01	0.04	0.07	0.09	< 0.01	< 0.01	0.05	0.06	< 0.01	< 0.01	0.00198	0.00214	< 0.2	< 0.2	0.0011	0.0013	0.024	0.028
Alpha Lake	Lake Alpha	8/11/2006	RR-0002-062	7.96	55.1		0.002			0.001																					
Alpha Lake	Lake Alpha	8/28/2007	RR-0002-065	7.79	45.4	0.00595	0.002	0.0069	< 0.00005	0.001	0.000092	< 0.02	< 0.02	< 0.005	0.01	0.04	0.06	< 0.01	< 0.01	0.02	0.05	< 0.01	< 0.01	0.00139	0.00165	< 0.2	< 0.2	0.0008	0.0008	0.0169	0.0202
Alpha Lake	Lake Alpha	8/27/2008	RR-0002-076	7.59	45.8	0.00501	0.002	0.0058	< 0.00005	0.001	0.000116	< 0.02	0.04	< 0.005	0.02	0.06	0.05	< 0.01	< 0.01	0.04	0.11	< 0.01	< 0.01	0.00277	0.00291	< 0.2	< 0.2	0.0016	0.0032	0.0357	0.0653
Alpha Lake	Lake Alpha	8/30/2009	RR-0002-085	8.01	42.3	0.00471	0.002	0.0063	< 0.00005	0.001	0.000122	< 0.02	< 0.02	< 0.005	0.006	0.03	0.04	< 0.01	< 0.01	0.02	0.05	< 0.01	< 0.01	0.00109	0.00131	< 0.2	< 0.2	0.0008	0.0007	0.018	0.016
Alpha Lake	Lake Alpha (Duplicate)	8/30/2009	RR-0002-086	7.96	42.5	0.0047	0.002	0.0063	< 0.00005	0.001	0.000131	< 0.02	< 0.02	0.008	0.009	0.04	0.04	< 0.01	< 0.01	0.02	0.06	< 0.01	< 0.01	0.00103	0.00107	< 0.2	< 0.2	0.0005	0.0007	0.01	0.014
Alpha Lake	Lake Alpha	9/1/2011	RR-0002-098	7.79	45.7	0.00546	0.002	0.0070	< 0.00005	0.001	0.000094	< 0.02	< 0.02	< 0.005	< 0.005	< 0.005	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.00134	0.00160	0.004	0.006	0.0002	0.0003	0.004	0.006
Alpha Lake	Lake Alpha (Duplicate)	9/1/2011	RR-0002-099	7.79	45.7	0.00545	0.002	0.0069	< 0.00005	0.001	0.000096	< 0.02	< 0.02	< 0.005	0.01	0.03	0.05	< 0.01	< 0.01	0.08	0.13	< 0.01	< 0.01	0.00136	0.00153	0.014	0.017	0.0007	0.0008	0.014	0.017
Alpha Lake	Lake Alpha	8/6/2014	RR-0003-005	7.62	49	0.0051	0.002	0.0072	< 0	0.001	< 0		< 0.1		< 0.01		0.06		< 0.011		0.046		< 0.01	0.00087	0.00100		< 0.01		< 0.01		< 0.01
Maximum Concentration (post 2000, selected parameters)				8.0	67.0			0.071										Note: Max Uranium calculation excludes 1984-09-19 data which is assumed to be erroneous							0.03470						
Average Concentration (post 2000, selected parameters)				7.7	48.1			0.018										Note: Average Uranium calculation excludes 1984-09-19 data which is assumed to be erroneous							0.00584						
Lowest Concentration (post 2000, selected parameters)				7.0	42.3			0.0058																	0.00090						
Lake A																															
Lake A	Lake A 7W2	7/13/1983	RR-0001-047	7.70		< 0.001	0.002	< 0.001	< 0.0001	0.001	< 0.0001		0.03				0.04								0.00020						
Lake A	Lake A 7W1	7/13/1983	RR-0001-048	7.80		0.0011	0.002	0.0024	< 0.0001	0.001	0.0013																				
Lake A	Lake A 7W1	7/18/1986	RR-0003-076				0.002	0.0042		0.001	< 0.001		< 0.03				0.005								< 0.001						
Lake A	Lake A 7W2	7/18/1986	RR-0003-077				0.002	0.0059		0.001	0.0006																				
Lake A	Lake A 17-1	7/18/1986	RR-0003-078				0.002	0.0038		0.001	< 0.001		< 0.03				0.005								< 0.001						
Lake A	Lake A W2	7/20/1995	RR-0001-055				0.002	0.0020		0.001	< 0.001		< 0.02				0.005								< 0.001						
Lake A	SW11 Lake A	11/20/1996	RR-0001-073			0.002	0.002		< 0.002	0.001		< 0.02		0.005		0.005				0.01				0.00012							
Lake A	SW11 Lake A	8/21/1997	RR-0002-006			< 0.001	0.002		< 0.002	0.001		< 0.02		< 0.005		< 0.005				< 0.01				< 0.001							
Lake A	Lake A 2014	8/6/2014	RR-0003-009	7.68	48	0.0014	0.002	0.0021	< 0	0.001	< 0		< 0.1		0.011		< 0.01		< 0.01		0.014		< 0.01	0.00033	0.00037		< 0.01		< 0.01		< 0.01
Lake A	Lake A 17-1	9/14/2017	RR-0003-042				0.002	0.0021		0.001	< 0		< 0.1				< 0.01								0.00026						
Maximum Concentration (post 2000, selected parameters)				7.8	48.0			0.0059																	0.00037						
Average Concentration (post 2000, selected parameters)				7.7	48.0			0.0032																	0.00028						
Lowest Concentration (post 2000, selected parameters)				7.7	48.0			0.0020																	0.00020						
Mill Lake																															
Mill Lake	Mill 9W1	7/13/1983	RR-0001-053	8.60		0.0051	0.002	0.0069	< 0.0001	0.001	< 0.0001		0.1				0.45								0.082						
Mill Lake	Mill W5	7/20/1995	RR-0001-057				0.002	0.0060		0.001	< 0.001		< 0.02				0.35								0.185						
Mill Lake	SW3 Mill	11/20/1996	RR-0001-062			0.014	0.002		< 0.002	0.001		0.03		0.02		0.25				0.01				0.057							
Mill Lake	SW3 Mill	8/21/1997	RR-0001-098			0.007	0.002		< 0.002	0.001		0.1		< 0.005		0.25				< 0.01				0.051							
Mill Lake	Mill Lake	8/28/2007	RR-0002-068	7.69	85.1	0.00375	0.0021	0.0044	< 0.00005	0.0026	< 0.00005	< 0.02	< 0.02	< 0.005	0.02	0.22	0.24	0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.104	0.105	1.4	1.6	0.058	0.063	1.3	1.34
Mill Lake	Mill Lake	8/27/2008	RR-0002-073	7.80	84.2	0.00281	0.002	0.0033	< 0.00005	0.0026	< 0.00005	0.04	0.02	< 0.005	0.02	0.19	0.28	< 0.01	< 0.01	0.01	< 0.01	< 0.01	< 0.01	0.0812	0.065	1.3	1.3	0.0539	0.0557	1.11	1.17
Mill Lake	Mill Lake	8/30/2009	RR-0002-082	7.76	80.1	0.00367	0.002	0.0043	< 0.00005	0.0024	0.00005	< 0.02	< 0.02	0.03	0.02	0.19	0.18	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.0865	0.084	1.4	1.2	0.049	0.0528	0.99	1.12
Mill Lake	Mill Lake	8/31/2011	RR-0002-096	7.83	80.5	0.00275	0.002	0.0034	< 0.00005	0.0024	< 0.00005	< 0.02	< 0.02	< 0.005	0.02	0.23	0.22	< 0.01	< 0.01	< 0.01	0.01	< 0.01	< 0.01	0.104	0.104	1.2	1.2	0.056	0.056	1.2	1.2
Mill Lake	Mill Lake	8/6/2014	RR-0003-004	7.82	94	0.0024	0.0022	0.0032	< 0	0.0029	0.0027		< 0.1		0.016		0.27		< 0.01		0.026		0.013	0.14	0.160		2.3		0.1		2
Mill Lake	Mill Lake	5/26/2017	RR-0003-032				0.002	0.0034		0.001	< 0		< 0.1				0.35								0.100						
Mill Lake	Mill Lake (Duplicate)	9/17/2018	DUP2_20180917	7.77	81	0.0030	0.002	0.0034	< 0.00020	0.0024	< 0.00020													0.078	0.080						
Mill Lake	Mill Lake	9/17/2018	SW007_20180917_20180917	7.78	81	0.0032	0.002	0.0037	< 0.00020	0.0024	0.00021													0.077	0.082						
Mill Lake	Mill Lake	9/17/2018	SW008_20180917_20180917	7.47	78	0.0030	0.002	0.0034	< 0.00020	0.0023	< 0.00020													0.081	0.083						
Mill Lake	Mill Lake	9/17/2018	SW009_20180917_20180917	7.73	79	0.0031	0.002	0.0076	< 0.00020	0.0024	0.00046													0.075	0.086						
Mill Lake	Mill Lake	9/17/2018	SW010_20180917_20180917	7.72	80	0.0031	0.002	0.0036	< 0.00020	0.0024	< 0.00020													0.079	0.082						
Mill Lake	Mill Lake	9/17/2018	SW011_20180917_20180917	7.75	81	0.0031	0.002	0.0038	< 0.00020	0.0024	< 0.00020													0.082	0.081						
Mill Lake	Mill Lake	9/17/2018	SW012_20180917_20180917	7.77	81	0.0031	0.002	0.0041	< 0.00020	0.0024	< 0.00020													0.079	0.089						
Mill Lake	Mill Lake	9/17/2018	SW013_20180917_20180917	7.77	81	0.0031	0.002	0.0038	< 0.00020	0.0024	< 0.00020													0.080	0.081						
Mill Lake	Mill Lake	9/17/2018	SW014_20180917_20180917	7.76	81	0.0032	0.002	0.0038	< 0.00020	0.0024	< 0.00020													0.081	0.082						
Mill Lake	Mill Lake	9/17/2018	SW015_20180917_20180917	7.78	81	0.0031	0.002	0.0037	< 0.00020	0.0024	< 0.00020													0.079	0.081						
Mill Lake	Mill Lake	8/3/2019	ML_SW009_1.5_20190803	7.89	78	0.0036	0.002	0.0041	<0.00020	0.0023	< 0.00020		<1.0				<1.0				<5.0			0.075	0.076		1.06		0.043		0.96
Mill Lake	Mill Lake	8/3/2019	ML_SW010_3.0_20190803	7.89	78	0.0036	0.002	0.0041	<0.00020	0.0023	< 0.00020		<1.0				<1.0				<5.0			0.076	0.075		1.07		0.046		0.95
Mill Lake	Mill Lake	2/8/2020	ML_SW_20200208_VC06	6.59	89	.0026	0.0021	0.0033	< 0.00020	0.0026	< 0.00020		<1.0				<0.10		<0.50		<5.0		<0.10	0.083	0.099		<0.50		<0.50		0.86
Maximum Concentration (post 2000, selected parameters)				8.6	94.0			0.0076																	0.185						
Average Concentration (post 2000, selected parameters)				7.7	81.4			0.0042																	0.093						
Lowest Concentration (post 2000, selected parameters)				6.6	78.0			0.0032																	0.065						

Notes:

NG = No Guideline

[1] Canadian Council of Ministers of the Environment, Canadian Environmental Quality Guidelines, Freshwater Aquatic Life On-Line, Accessed 18.10.28

[2] Ontario, Provincial Water Quality Objectives, February, 1999 (data only compared to in absence of CCME guideline)

[3] Guideline concentration varies with hardness

1001 Bold/Red font indicates reported concentration greater than CCME Freshwater Guideline

2001 Bold font indicates reported concentration greater than Ontario PWQO (where no CCME guideline exists only)

<0.01 Grey font indicates circumstance where the laboratory's minimum detection limit is greater than the referenced CCME or MOE guideline

Table C8

Historic Surface Water Analytical Results - General Metals (1 of 3)
Kwetı̨ą̀à (Rayrock) Remediation Project
Public Services and Procurement Canada

Sample Information				Parameter	Hardness (as CaCO3)	Aluminum		Antimony		Arsenic		Barium		Beryllium		Boron		Cadmium		Calcium		Chromium		Cobalt	
				Fraction		Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total
				Unit	mg/l	mg/l		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
				CCME Freshwater[1]	NG	NG	0.100	NG	NG	NG	0.005	NG	NG	NG	NG	NG	1.5	NG	0.0009	NG	NG	NG	NG	NG	NG
		Ontario, Provincial Water Quality Objectives, February, 1999[2]			NG	NG	0.075	NG	0.02 Interim	NG	0.005 Interim	NG	NG	NG	NG	NG	0.2 Interim	NG	0.0001 Interim	NG	NG	NG	NG	NG	0.0009 Interim
Lake Group	Sample Location	Sample Date (mm/dd/yyyy)	Sample ID	Sample Depth (m below surface)																					
New Control Lake																									
New Control Lake	Control Lake 85	7/13/1983	RR-0001-052							0.0025	0.0025							0.00009	0.00007					0.003	0.0025
New Control Lake	Control Lake 85	9/19/1984	RR-0001-019																< 0.001						
New Control Lake	Control Lake 85	11/20/1996	RR-0001-060			0.012						0.005		< 0.001		< 0.001		< 0.001		7		0.001		< 0.001	
New Control Lake	Control Lake 85	11/20/1996	RR-0001-061			0.014						0.007		< 0.001		< 0.001		< 0.001		9.7		0.001		< 0.001	
New Control Lake	SWNC2 New Control	8/21/1997	RR-0001-096			0.015						0.008		< 0.001		0.045		< 0.001		14		0.002		< 0.001	
New Control Lake	SWNC2 New Control (Duplicate)	8/21/1997	RR-0001-097			0.014						0.009		< 0.001		0.022		< 0.001		14		0.001		< 0.001	
New Control Lake	SWNC2 New Control	8/29/2004	RR-0002-038				0.042		0.0002		0.0015		0.00832		< 0.001		0.05		< 0.00005		15.7		< 0.001		< 0.0001
New Control Lake	SWNC2 New Control	8/29/2004	RR-0002-038			0.006		0.0001		0.0012		0.00749		< 0.001		0.05		< 0.00005		15.9		< 0.001		< 0.0001	
New Control Lake	SWNC2 New Control	8/29/2004	RR-0002-038		54.0																				
New Control Lake	SWNC2 New Control	8/22/2005	RR-0002-045			0.0067	0.0577	< 0.0001	< 0.0001	0.00109	0.00121	0.00727	0.00832	< 0.001	< 0.001	0.047	0.051	< 0.00002	< 0.00002	14.5	15.6	< 0.001	< 0.001	< 0.0001	< 0.0001
New Control Lake	SWNC2 New Control	8/22/2005	RR-0002-045		47.9																				
New Control Lake	SWNC2 New Control	8/11/2006	RR-0002-059			0.0064	0.0523	< 0.0001	< 0.0001	0.00143	0.00161	0.00705	0.00808	< 0.001	< 0.001	0.052	0.054	< 0.00002	< 0.00002	16	16.2	< 0.001	< 0.001	< 0.0001	< 0.0001
New Control Lake	SWNC2 New Control	8/11/2006	RR-0002-059		55.5																				
New Control Lake	SWNC2 New Control	8/28/2007	RR-0002-069		50.0	0.0026	0.0278	< 0.0001	< 0.0001	0.00122	0.00141	0.00743	0.00812	< 0.001	< 0.001	0.0493	0.0494	< 0.00002	< 0.00002	14.7	15.3	< 0.001	0.0003	< 0.0001	< 0.0001
New Control Lake	SWNC2 New Control	8/27/2008	RR-0002-080		49.7	0.0075	0.0416	< 0.0001	< 0.0001	0.00117	0.00136	0.00881	0.0101	< 0.001	< 0.001	0.0471	0.0521	< 0.00002	< 0.00002	15.1	17	< 0.001	0.00022	< 0.0001	< 0.0001
New Control Lake	SWNC2 New Control	8/30/2009	RR-0002-089		48.1	0.0033	0.0252	< 0.0001	< 0.0001	0.00103	0.00123	0.00801	0.00866	< 0.001	< 0.001	0.052	0.054	< 0.00002	< 0.00002	14	15.4	< 0.001	< 0.001	< 0.0001	< 0.0001
New Control Lake	SWNC2 New Control	8/30/2011	RR-0003-002		57.5	< 0.001	0.0291	< 0.0001	< 0.0001	0.00118	0.00138	0.00885	0.00939	< 0.001	< 0.001	0.0513	0.0487	< 0.00002	< 0.00002	16.7	16.4	< 0.001	0.00016	< 0.0001	< 0.0001
New Control Lake	SWNC2 New Control	8/6/2014	RR-0003-008		67.0	0.01	0.19	< 0.001	< 0.001	0.0013	0.0018	0.012	0.015	< 0.001	< 0.001	0.053	0.057	< 0.00002	< 0.00002	19	20	< 0.001	< 0.001	< 0	< 0
Sherman Lake																									
Sherman Lake	Sherman 79-2	6/15/1979	RR-0001-028																						
Sherman Lake	Sherman 79-5	6/15/1979	RR-0001-029																						
Sherman Lake	Sherman 79-10	6/15/1979	RR-0001-030																						
Sherman Lake	Sherman Lake NE	6/15/1979	RR-0001-031																						
Sherman Lake	Sherman 79-2	6/15/1979	RR-0001-033		36						< 0.02								< 0.002		11.6		< 0.05		< 0.05
Sherman Lake	Sherman 79-5	6/15/1979	RR-0001-034		28						< 0.02								< 0.002		11.7		< 0.05		< 0.05
Sherman Lake	Sherman 79-10	6/15/1979	RR-0001-035		28						< 0.02								< 0.002		11.3		< 0.05		< 0.05
Sherman Lake	Sherman Lake NE	6/15/1979	RR-0001-036		28						< 0.02								< 0.002		11.3		< 0.05		< 0.05
Sherman Lake	Sherman 6W1	7/13/1983	RR-0001-045							0.0025	0.0025							0.00007	0.00025					0.0019	0.0018
Sherman Lake	Sherman Lake NE	7/13/1983	RR-0001-046							0.0042	0.0042							0.00008	0.00005					0.0019	0.0019
Sherman Lake	Sherman Lake NE	9/19/1984	RR-0001-020																< 0.001						
Sherman Lake	Sherman Lake Main	9/19/1984	RR-0001-021																< 0.001						
Sherman Lake	Sherman Lake SW6	9/19/1984	RR-0001-024																< 0.001						
Sherman Lake	Sherman S1	7/18/1986	RR-0003-058																						
Sherman Lake	Sherman S3	7/18/1986	RR-0003-061																						
Sherman Lake	Sherman S3	7/18/1986	RR-0003-062																						
Sherman Lake	SW8 Sherman	7/18/1986	RR-0003-063																						
Sherman Lake	SW8 Sherman (Duplicate)	7/18/1986	RR-0003-064																						
Sherman Lake	SW8 Sherman	7/18/1986	RR-0003-065																						
Sherman Lake	SW8 Sherman	7/18/1986	RR-0003-066																						
Sherman Lake	SW8 Sherman	7/18/1986	RR-0003-067																						
Sherman Lake	SW8 Sherman	7/18/1986	RR-0003-068																						
Sherman Lake	Sherman Lake Main	7/18/1986	RR-0003-069																						
Sherman Lake	Sherman Lake Main	7/18/1986	RR-0003-070																						
Sherman Lake	Sherman S6	7/18/1986	RR-0003-071																						
Sherman Lake	Sherman S6	7/18/1986	RR-0003-072																						
Sherman Lake	Sherman S6	7/18/1986	RR-0003-073																						
Sherman Lake	Sherman Lake NE	7/18/1986	RR-0003-074																						
Sherman Lake	Sherman Lake NE (Duplicate)	7/18/1986	RR-0003-075																						
Sherman Lake	Sherman Lake SW6	11/20/1996	RR-0001-065			0.025						0.012		< 0.001		< 0.001		< 0.001		12		0.002		< 0.001	
Sherman Lake	SW7 Sherman	11/20/1996	RR-0001-066			0.027						0.013		< 0.001		< 0.001		< 0.001		13		0.001		< 0.001	
Sherman Lake	SW8 Sherman	11/20/1996	RR-0001-067			0.018						0.011		< 0.001		< 0.001		< 0.001		12		< 0.001		< 0.001	
Sherman Lake	SW8 Sherman	11/20/1996	RR-0001-068			0.012						0.011		< 0.001		< 0.001		< 0.001		11		< 0.001		< 0.001	
Sherman Lake	SW8 Sherman (Duplicate)	11/20/1996	RR-0001-069			0.02						0.011		< 0.001		< 0.001		< 0.001		12		0.001		< 0.001	
Sherman Lake	Sherman Lake SW6	8/21/1997	RR-0002-001			< 0.005						0.013		< 0.001		0.011		< 0.001		14		0.002		< 0.001	
Sherman Lake	SW7 Sherman	8/21/1997	RR-0002-002			< 0.005						0.01		< 0.001		0.009		< 0.001		10		0.001		< 0.001	
Sherman Lake	SW8 Sherman	8/21/1997	RR-0002-003			< 0.005						0.009		< 0.001		0.006		< 0.001		10		0.001		< 0.001	
Sherman Lake	Sherman Lake SW6	10/1/2000	RR-0003-083			0.01	0.19	< 0.001	< 0.005	< 0	< 0.001	0.0098	0.0122	< 0.001	< 0.001	0.006	0.004	< 0.0001	< 0	9.92	9.8	0.0005	0.0012	< 0.0001	< 0
Sherman Lake	Sherman Lake SW6 (Duplicate)	10/1/2000	RR-0003-085			0.01	0.57	< 0.001	< 0.005	< 0	< 0.001	0.0096	0.0155	< 0.001	< 0.001	0.008	0.005	< 0.0001	< 0	10	10.1	0.0004	0.0015	< 0.0001	0.0003
Sherman Lake	Sherman Lake	9/20/2001	RR-0001-001			< 0.005	0.132	< 0.0001	< 0.0001	0.0005	0.0005	0.00942	0.0107	< 0.001	< 0.001	< 0.01	< 0.01	< 0.00005	< 0.00005	9.51	9.36	< 0.001	< 0.001	< 0.0001	< 0.0001
Sherman Lake	Sherman Lake (Duplicate)	9/20/2001	RR-0001-002			< 0.005	0.126	< 0.0001	< 0.0001	0.0005	0.0005	0.00901	0.0103	< 0.001	< 0.001	< 0.01	< 0.01	< 0.00005	< 0.00005	9.63	9.55	< 0.001	< 0.001	< 0.0001	< 0.0001
Sherman Lake	Sherman Lake	8/12/2002	RR-0001-007			0.01	0.059	< 0.0001	< 0.0001	0.0005	0.0005	0.00833	0.00885	< 0.001	< 0.001	< 0.01	< 0.01	< 0.00005	< 0.00005	9.03	9.22	< 0.001	< 0.001	< 0.0001	< 0.0001
Sherman Lake	Sherman Lake (Duplicate)	8/12/2002	RR-0001-008			0.008	0.062	< 0.0001	< 0.0001	0.0005	0.0005	0.00833	0.00904	< 0.001	< 0.001	< 0.01	< 0.01	< 0.00005	< 0.00005	9.17	8.99	< 0.001	< 0.001	< 0.0001	< 0.0001
Sherman Lake	Sherman Lake	8/17/2003	RR-0002-030		44.8																				
Sherman Lake	Sherman Lake (Duplicate)	8/17/2003	RR-0002-031		43.9																				
Sherman Lake	Sherman Lake	8/17/2003	RR-0002-030			0.004	0.037	< 0.0001	< 0.0001	0.0006	0.0006	0.00741	0.00773	< 0.001	< 0.001	< 0.01	< 0.01	< 0.00005	< 0.00005	9.2	9.04	< 0.001	< 0.001	< 0.0001	< 0.0001
Sherman Lake	Sherman Lake (Duplicate)	8/17/2003	RR-0002-031			0.004	0.032	< 0.0001	< 0.0001	0.0006	0.0006	0.00748	0.00766	< 0.001	< 0.001	< 0.01	< 0.01	< 0.00005	< 0.00005	9.05	9.25	< 0.001	< 0.001	< 0.0001	< 0.0001
Sherman Lake	Sherman Lake	8/29/2004	RR-0002-034				0.023		< 0.0001		0.0005		0.00781		< 0.001		< 0.01		< 0.00005		9.55		< 0.001		< 0.0001
Sherman Lake	Sherman Lake	8/29/2004	RR-0002-034			0.004		< 0.0001		0.0005		0.00726		< 0.001		0.01		< 0.00005		9.66		< 0.001		< 0.0001	
Sherman Lake	Sherman Lake	8/29/2004	RR-0002-034		45.8																				
Sherman Lake	Sherman Lake	8/22/2005	RR-0002-041			0.0076	0.0321	< 0.0001	< 0.0001	0.00051	0.00059	0.00779	0.00869	< 0.001	< 0.001	0.01	0.01	< 0.00002	< 0.00002	9.74	10.2	< 0.001	< 0.001	< 0.0001	< 0.0001
Sherman Lake	Sherman Lake (Duplicate)	8/22/2005	RR-0002-042			0.0031	0.0301	< 0.0001	< 0.0001	0.00051	0.00057	0.00758	0.00867	< 0.001	< 0.001	< 0.01	0.01	< 0.00002	< 0.00002	9.5	10.1	< 0.001	< 0.001	< 0.0001	< 0.0001
Sherman Lake	Sherman Lake	8/22/2005	RR-0002-041		44.3																				
Sherman Lake	Sherman Lake (Duplicate)	8/22/2005	RR-0002-042		43.6																				
Sherman Lake	Sherman Lake (Duplicate)	8/11/2006	RR-0002-055			0.0057	0.0389	< 0.0001	< 0.0001	0.00057	0.0006	0.00756	0.00817	< 0.001	< 0.001	0.01	0.012	< 0.00002	< 0.00002	10.2	9.72	< 0.001	< 0.001	< 0.0001	< 0.0001
Sherman Lake	Sherman Lake	8/11/2006	RR-0002-054			0.0049	0.0498	< 0.0001	< 0.0001	0.00052	0.00061	0.0075	0.00818	< 0.001	< 0.001	0.011	0.012	< 0.00002	< 0.00002	10.3	10.5	< 0.001	0.00256	< 0.0001	< 0.0001
Sherman Lake	Sherman Lake	8/11/2006	RR-0002-054		51.5																				
Sherman Lake	Sherman Lake (Duplicate)	8/11/2006	RR-0002-055		50.8																				
Sherman Lake	Sherman Lake	8/28/2007	RR-0002-063		42.5	0.0019	0.0276	< 0.0001	< 0.0001	0.000485	0.000518	0.00795	0.00854	< 0.001	< 0.001	0.0098	0.01	< 0.00002	< 0.00002	8.89	9.05	< 0.001	0.00011	< 0.0001	< 0.0001
Sherman Lake	Sherman Lake (Duplicate)	8/28/2007	RR-0002-064		41.6	0.0046	0.0238	< 0.0001	< 0.0001	0.000473	0.000485	0.00788	0.00824	< 0.001	< 0.001	0.0095	0.0095	< 0.00002	< 0.00002	8.65	8.68	0.00014	0.00016	< 0.0001	< 0.0001
Sherman Lake	Sherman Lake	8/27/2008	RR-0002-075		40.8	0.0033	0.0203	< 0.0001	< 0.0001	0.000466	0.000522	0.00814	0.00842	< 0.001	< 0.001	0.0096	0.0095	< 0.00002	< 0.00002	9.4	9.37	< 0.001	0.0001	< 0.0001	< 0.0001
Sherman Lake	Sherman Lake	8/30/2009	RR-0002-084		41.3	0.0035	0.0299	< 0.0001	< 0.0001	0.00047	0.00049	0.00784	0.00858	< 0.001	< 0.001	0.012	0.014	< 0.00002	< 0.00002	8.56	8.66	< 0.001	< 0.001	< 0.0001	< 0.0001
Sherman Lake	Sherman Lake	9/1/2011	RR-0002-097		40.6	0.0039	0.0338	< 0.0001	< 0.0001	0.000447	0.000458	0.00673	0.00703	< 0.001	< 0.001	0.0119	0.0128	< 0.00002	< 0.00002	8.37	8.39	< 0.001	0.00016	< 0.0001	< 0.0001
Sherman Lake	Sherman 2014	8/6/2014	RR-0003-003		45	0.0093	0.024	< 0.001	< 0.001	0.00059	0.00052	< 0.01	< 0.01	< 0.001	< 0.001	< 0.02	0.021	< 0.00002	< 0.00002	9.5	9.4	< 0.001	< 0.001	< 0	< 0
Sherman Lake	Sherman 17-6	9/11/2017	RR-0003-041				2.6		< 0.001		0.0012		0.042		< 0.001		< 0.02		0.000043		13		0.0059		0.0013
Sherman Lake	Sherman Lake (Duplicate)	9/17/2018	DUP1_20180917		49	0.0037	0.024	< 0.00060	< 0.00060	0.00055	0.00055	< 0.010	< 0.010	< 0.0010	< 0.0010	< 0.020	< 0.020	< 0.020	< 0.020	10	10	< 0.0010	< 0.0010	< 0.00030	< 0.00030
Sherman Lake	Sherman Lake	9/17/2018	SW001_20180917_20180917		49	0.0056	0.022	< 0.00060	< 0.00060	0.00049	0.00054	< 0.010	< 0.010	< 0.0010	< 0.0010	< 0.020	< 0.020	< 0.020	< 0.020	10	10	< 0.0010	< 0.0010	< 0.00030	< 0.00030
Sherman Lake	Sherman Lake	9/17/2018	SW002_20180917_20180917		52	0.0084	0.024	< 0.00060	< 0.00060	0.00047	0.00050	< 0.010	< 0.010	< 0.0010	< 0.0010	< 0.020	< 0.020	< 0.020	< 0.020	11	10	< 0.0010	< 0.0010	< 0.00030	< 0.00030
Sherman Lake	Sherman Lake	9/17/2018	SW003_20180917_20180917		49	0.0063	0.023	< 0.00060	< 0.00060	0.00051	0.00052	< 0.010	< 0.010	< 0.0010	< 0.0010	< 0.020	< 0.020	< 0.020	< 0.020	10	10	< 0.0010	< 0.0010	< 0.00030	< 0.00030
Sherman Lake	Sherman Lake	9/17/2018	SW004_20180917_20180917		49	0.0047	0.022	< 0.00060	< 0.00060	0.00048	0.00059	< 0.010	< 0.010	< 0.0010	< 0.0010	< 0.020	< 0.020	< 0.020	< 0.020	10	10	< 0.0010	< 0.0010	< 0.00030	< 0.00030
Sherman Lake	Sherman Lake	9/17/2018	SW005_20180917_20180917		49	0.0042	0.025	< 0.00060	< 0.00060	0.00048	0.00060	< 0.010	< 0.010	< 0.0010	< 0.0010	< 0.020	< 0.020	< 0.020	< 0.020	10	10	< 0.0010	< 0.0010	< 0.00030	< 0.00030
Sherman Lake	Sherman Lake	9/17/2018	SW006_20180917_20180917		49	0.0041	0.020	< 0.00060	< 0.00060	0.00044	0.00050	< 0.010	< 0.010	< 0.0010	< 0.0010	< 0.020	< 0.020	< 0.020	< 0.020	10	9.9	< 0.0010	< 0.0010	< 0.00030	< 0.00030

Table C8

Historic Surface Water Analytical Results - General Metals (1 of 3)
Kwetı̨ı̨ɂàà (Rayrock) Remediation Project
Public Services and Procurement Canada

Sample Information					Hardness	Metals																			
				Parameter	(as CaCO3)	Aluminum		Antimony		Arsenic		Barium		Beryllium		Boron		Cadmium		Calcium		Chromium		Cobalt	
				Fraction		Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total
				Unit	mg/l	mg/l		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
				CCME Freshwater[1]	NG	NG	0.100	NG	NG	NG	0.005	NG	NG	NG	NG	NG	1.5	NG	0.0009	NG	NG	NG	NG	NG	NG
		Ontario, Provincial Water Quality Objectives, February, 1999[2]			NG	NG	0.075	NG	0.02 Interim	NG	0.005 Interim	NG	NG	NG	NG	NG	0.2 Interim	NG	0.0001 Interim	NG	NG	NG	NG	NG	0.0009 Interim
Lake Group	Sample Location	Sample Date (mm/dd/yyyy)	Sample ID	Sample Depth (m below surface)																					
Alpha Lake																									
Alpha Lake	Alpha 79-1	6/15/1979	RR-0001-027																						
Alpha Lake	Alpha 79-1	6/15/1979	RR-0001-032		40						< 0.02								< 0.002		11.5		< 0.05		< 0.05
Alpha Lake	Alpha 79-1	7/13/1983	RR-0001-043							< 0.001	0.001							< 0.00005	< 0.00005					0.002	0.002
Alpha Lake	Alpha 79-1	7/13/1983	RR-0001-044							0.0027	0.004							0.00011	0.00039					0.002	0.0022
Alpha Lake	Alpha Lake 85	9/19/1984	RR-0001-023																< 0.001						
Alpha Lake	Alpha 05	7/18/1986	RR-0003-079																						
Alpha Lake	SW5 Alpha	7/18/1986	RR-0003-080																						
Alpha Lake	Alpha 79-1	7/20/1995	RR-0001-054										0.011				< 0.05		< 0.001				0.002		< 0.001
Alpha Lake	SW5 Alpha	11/20/1996	RR-0001-064			0.076						0.015		< 0.001		0.003		< 0.001		14		0.002		< 0.001	
Alpha Lake	SW5 Alpha	8/21/1997	RR-0001-100			0.091						0.013		< 0.001		0.014		< 0.001		18		0.003		< 0.001	
Alpha Lake	SW5 Alpha	10/1/2000	RR-0003-081			0.04	**1.05**	< 0.001	< 0.005	< 0	< 0.001	0.0112	0.0237	< 0.001	< 0.001	0.003	0.014	< 0.0001	< 0	13.2	16	0.0006	0.0042	< 0.0001	0.0004
Alpha Lake	SW5 Alpha (Duplicate)	10/1/2000	RR-0003-082			0.05	**1.19**	< 0.001	< 0.005	< 0	< 0.001	0.0112	0.023	< 0.001	< 0.001	0.003	0.005	< 0.0001	< 0	13.1	14.4	0.0006	0.002	< 0.0001	0.0004
Alpha Lake	Lake Alpha	9/20/2001	RR-0001-003			0.011	**0.186**	< 0.0001	< 0.0001	0.0005	0.0006	0.0109	0.0126	< 0.001	< 0.001	< 0.01	< 0.01	< 0.00005	< 0.00005	9.75	9.61	< 0.001	0.0006	< 0.0001	< 0.0001
Alpha Lake	Lake Alpha (Duplicate)	9/20/2001	RR-0001-004			0.032	**0.178**	< 0.0001	< 0.0001	0.0005	0.0005	0.0109	0.0124	< 0.001	< 0.001	< 0.01	< 0.01	< 0.00005	< 0.00005	9.56	9.54	< 0.001	< 0.001	< 0.0001	< 0.0001
Alpha Lake	Lake Alpha	8/12/2002	RR-0001-009			0.04	**0.19**	< 0.0001	< 0.0001	0.0006	0.0006	0.00941	0.0112	< 0.001	< 0.001	< 0.01	0.08	< 0.00005	< 0.00005	9.44	9.26	< 0.001	< 0.001	< 0.0001	0.0001
Alpha Lake	Lake Alpha (Duplicate)	8/12/2002	RR-0001-010			0.04	**0.161**	< 0.0001	< 0.0001	0.0006	0.0006	0.00928	0.0109	< 0.001	< 0.001	< 0.01	< 0.01	< 0.00005	< 0.00005	9.66	9.74	< 0.001	< 0.001	< 0.0001	< 0.0001
Alpha Lake	Lake Alpha	8/17/2003	RR-0002-027		67																				
Alpha Lake	Lake Alpha	8/17/2003	RR-0002-027			0.006	0.081	< 0.0001	< 0.0001	0.0006	0.0006	0.0113	0.0113	< 0.001	< 0.001	< 0.01	< 0.01	< 0.00005	< 0.00005	14.4	13.4	< 0.001	< 0.001	< 0.0001	< 0.0001
Alpha Lake	Lake Alpha	8/29/2004	RR-0002-035				**0.243**		< 0.0001		0.0007		0.0139		< 0.001		< 0.01		< 0.00005		9.26		0.0006		0.0002
Alpha Lake	Lake Alpha	8/29/2004	RR-0002-035			0.031		< 0.0001		0.0007		0.0106		< 0.001		< 0.01		< 0.00005		9.38		< 0.001		< 0.0001	
Alpha Lake	Lake Alpha	8/29/2004	RR-0002-035		45.7																				
Alpha Lake	Alpha 05	7/3/2005	RR-0002-049			0.0257	**0.101**	< 0.0001	< 0.0001	0.00054	0.00056	0.00915	0.0102	< 0.001	< 0.001	< 0.01	< 0.01	< 0.00002	< 0.00002	9.97	10.9	< 0.001	< 0.001	< 0.0001	< 0.0001
Alpha Lake	Alpha 05	7/3/2005	RR-0002-049		47.2																				
Alpha Lake	Lake Alpha	8/22/2005	RR-0002-043			0.0136	**0.103**	< 0.0001	< 0.0001	0.00055	0.00078	0.00892	0.0128	< 0.001	< 0.001	< 0.01	0.013	< 0.00002	< 0.00002	9.89	13.1	< 0.001	< 0.001	< 0.0001	0.00011
Alpha Lake	Lake Alpha	8/22/2005	RR-0002-043		46																				
Alpha Lake	Lake Alpha	8/11/2006	RR-0002-062			0.0081	0.0536	< 0.0001	< 0.0001	0.00069	0.00076	0.00866	0.00921	< 0.001	< 0.001	0.01	0.011	< 0.00002	< 0.00002	11	11.7	< 0.001	< 0.001	< 0.0001	< 0.0001
Alpha Lake	Lake Alpha	8/11/2006	RR-0002-062		55.1																				
Alpha Lake	Lake Alpha	8/28/2007	RR-0002-065		45.4	0.0031	0.0334	< 0.0001	< 0.0001	0.000527	0.000573	0.00896	0.00944	< 0.001	< 0.001	0.0076	0.0078	< 0.00002	< 0.00002	9.29	9.1	0.00018	0.00018	< 0.0001	< 0.0001
Alpha Lake	Lake Alpha	8/27/2008	RR-0002-076		45.8	0.0077	0.0523	< 0.0001	< 0.0001	0.000542	0.000604	0.0109	0.0115	< 0.001	< 0.001	0.0086	0.0082	< 0.00002	< 0.00002	10.5	10.1	0.00017	0.00025	< 0.0001	< 0.0001
Alpha Lake	Lake Alpha	8/30/2009	RR-0002-085		42.3	0.0085	0.0463	< 0.0001	< 0.0001	0.00052	0.00061	0.00791	0.00879	< 0.001	< 0.001	0.01	0.014	< 0.00002	< 0.00002	8.71	9.61	< 0.001	< 0.001	< 0.0001	< 0.0001
Alpha Lake	Lake Alpha (Duplicate)	8/30/2009	RR-0002-086		42.5	0.0077	0.0742	< 0.0001	< 0.0001	0.00051	0.00056	0.00805	0.00917	< 0.001	< 0.001	0.011	0.014	< 0.00002	< 0.00002	8.7	9.3	< 0.001	< 0.001	< 0.0001	< 0.0001
Alpha Lake	Lake Alpha	9/1/2011	RR-0002-098		45.7	0.0217	**0.121**	< 0.0001	< 0.0001	0.00052	0.000551	0.00963	0.0111	< 0.001	< 0.001	0.0123	0.0136	< 0.00002	< 0.00002	9.6	10	0.00019	0.00035	< 0.0001	< 0.0001
Alpha Lake	Lake Alpha (Duplicate)	9/1/2011	RR-0002-099		45.7	0.022	**0.125**	< 0.0001	< 0.0001	0.000475	0.000546	0.00951	0.0109	< 0.001	< 0.001	0.0122	0.0137	< 0.00002	< 0.00002	9.57	9.77	0.00019	0.00033	< 0.0001	< 0.0001
Alpha Lake	Lake Alpha	8/6/2014	RR-0003-005		49	0.0098	0.025	< 0.001	< 0.001	0.00054	0.00071	0.01	0.011	< 0.001	< 0.001	< 0.02	< 0.02	< 0.00002	< 0.00002	11	9.9	< 0.001	< 0.001	< 0	< 0
Lake A																									
Lake A	Lake A 7W2	7/13/1983	RR-0001-047							0.003	0.003							0.00007	0.00009					0.0019	0.0018
Lake A	Lake A 7W1	7/13/1983	RR-0001-048							0.002	0.002							0.00005	0.00008					0.0019	0.0025
Lake A	Lake A 7W1	7/18/1986	RR-0003-076																						
Lake A	Lake A 7W2	7/18/1986	RR-0003-077																						
Lake A	Lake A 17-1	7/18/1986	RR-0003-078																						
Lake A	Lake A W2	7/20/1995	RR-0001-055										0.012				< 0.05		< 0.001				0.003		< 0.001
Lake A	SW11 Lake A	11/20/1996	RR-0001-073			0.028						0.015		< 0.001		0.005		< 0.001		11		< 0.001		< 0.001	
Lake A	SW11 Lake A	8/21/1997	RR-0002-006			0.021						0.011		< 0.001		< 0.002		< 0.001		10		0.001		< 0.001	
Lake A	Lake A 2014	8/6/2014	RR-0003-009		48	0.014	0.068	< 0.001	< 0.001	0.00058	0.00068	0.011	0.013	< 0.001	< 0.001	< 0.02	< 0.02	< 0.00002	< 0.00002	10	9.8	< 0.001	< 0.001	< 0	< 0
Lake A	Lake A 17-1	9/14/2017	RR-0003-042				**0.12**		< 0.001		0.00067		0.015		< 0.001		< 0.02		< 0.00002		9.5		< 0.001		< 0
Mill Lake																									
Mill Lake	Mill 9W1	7/13/1983	RR-0001-053							0.002	0.002							< 0.00005	0.0001					0.0025	0.0025
Mill Lake	Mill W5	7/20/1995	RR-0001-057										0.014				< 0.05		< 0.001				0.005		< 0.001
Mill Lake	SW3 Mill	11/20/1996	RR-0001-062			0.044						0.013		< 0.001		< 0.001		< 0.001		23		0.001		< 0.001	
Mill Lake	SW3 Mill	8/21/1997	RR-0001-098			0.04						0.013		< 0.001		0.004		< 0.001		22		0.002		< 0.001	
Mill Lake	Mill Lake	8/28/2007	RR-0002-068		85.1	0.0156	0.0192	< 0.0001	< 0.0001	0.000325	0.000328	0.0126	0.0128	< 0.001	< 0.001	0.0125	0.0128	< 0.00002	< 0.00002	25.4	25.5	0.00017	0.00013	< 0.0001	< 0.0001
Mill Lake	Mill Lake	8/27/2008	RR-0002-073		84.2	0.0154	0.0192	< 0.0001	< 0.0001	0.00038	0.000303	0.0128	0.0125	< 0.001	< 0.001	0.0139	0.0121	< 0.00002	< 0.00002	25.7	24.7	0.00017	< 0.001	< 0.0001	< 0.0001
Mill Lake	Mill Lake	8/30/2009	RR-0002-082		80.1	0.0202	0.0222	0.00022	0.00051	0.00035	0.00041	0.0124	0.0124	< 0.001	< 0.001	0.014	0.014	< 0.00002	< 0.00002	24	23.4	< 0.001	< 0.001	< 0.0001	< 0.0001
Mill Lake	Mill Lake	8/31/2011	RR-0002-096		80.5	0.013	0.0206	0.00006	0.000057	0.000315	0.0003	0.0138	0.0135	< 0.001	< 0.001	0.0148	0.0154	< 0.00002	< 0.00002	24.2	24	< 0.001	< 0.001	< 0.0001	< 0.0001
Mill Lake	Mill Lake	8/6/2014	RR-0003-004		94	0.031	0.032	< 0.001	< 0.001	0.00041	0.00038	0.02	0.02	< 0.001	< 0.001	0.021	< 0.02	< 0.00002	< 0.00002	28	28	< 0.001	< 0.001	< 0	< 0
Mill Lake	Mill Lake	5/26/2017	RR-0003-032				0.055		< 0.001		0.00035		0.014		< 0.001		< 0.02		< 0.00002		24		< 0.001		< 0
Mill Lake	Mill Lake (Duplicate)	9/17/2018	DUP2_20180917		81	0.023	0.025	< 0.00060	< 0.00060	0.00030	0.00029	0.012	0.012	< 0.0010	< 0.0010	< 0.020	< 0.020	< 0.020	< 0.020	24	24	< 0.0010	< 0.0010	< 0.00030	< 0.00030
Mill Lake	Mill Lake	9/17/2018	SW007_20180917_20180917		81	0.021	0.025	< 0.00060	< 0.00060	0.00030	0.00035	0.012	0.012	< 0.0010	< 0.0010	< 0.020	< 0.020	< 0.020	< 0.020	24	24	< 0.0010	< 0.0010	< 0.00030	< 0.00030
Mill Lake	Mill Lake	9/17/2018	SW008_20180917_20180917		78	0.021	0.026	< 0.00060	< 0.00060	0.00029	0.00033	0.011	0.012	< 0.0010	< 0.0010	< 0.020	< 0.020	< 0.020	< 0.020	24	24	< 0.0010	< 0.0010	< 0.00030	< 0.00030
Mill Lake	Mill Lake	9/17/2018	SW009_20180917_20180917		79	0.022	0.068	< 0.00060	< 0.00060	0.00028	0.00042	0.012	0.014	< 0.0010	< 0.0010	< 0.020	< 0.020	< 0.020	< 0.020	24	24	< 0.0010	< 0.0010	< 0.00030	< 0.00030
Mill Lake	Mill Lake	9/17/2018	SW010_20180917_20180917		80	0.022	0.024	< 0.00060	< 0.00060	0.00030	0.00036	0.012	0.012	< 0.0010	< 0.0010	< 0.020	< 0.020	< 0.020	< 0.020	24	24	< 0.0010	< 0.0010	< 0.00030	< 0.00030
Mill Lake	Mill Lake	9/17/2018	SW011_20180917_20180917		81	0.021	0.025	< 0.00060	< 0.00060	0.00028	0.00030	0.012	0.012	< 0.0010	< 0.0010	< 0.020	< 0.020	< 0.020	< 0.020	24	24	< 0.0010	< 0.0010	< 0.00030	< 0.00030
Mill Lake	Mill Lake	9/17/2018	SW012_20180917_20180917		81	0.024	0.025	< 0.00060	< 0.00060	0.00037	0.00033	0.012	0.012	< 0.0010	< 0.0010	< 0.020	< 0.020	< 0.020	< 0.020	24	24	< 0.0010	< 0.0010	< 0.00030	< 0.00030
Mill Lake	Mill Lake	9/17/2018	SW013_20180917_20180917		81	0.027	0.026	< 0.00060	< 0.00060	0.00036	0.00039	0.011	0.012	< 0.0010	< 0.0010	< 0.020	< 0.020	< 0.020	< 0.020	24	24	< 0.0010	< 0.0010	< 0.00030	< 0.00030
Mill Lake	Mill Lake	9/17/2018	SW014_20180917_20180917		81	0.021	0.025	< 0.00060	< 0.00060	0.00031	0.00034	0.012	0.012	< 0.0010	< 0.0010	< 0.020	< 0.020	< 0.020	< 0.020	24	24	< 0.0010	< 0.0010	< 0.00030	< 0.00030
Mill Lake	Mill Lake	9/17/2018	SW015_20180917_20180917		81	0.022	0.026	< 0.00060	< 0.00060	0.00030	0.00031	0.011	0.012	< 0.0010	< 0.0010	< 0.020	< 0.020	< 0.020	< 0.020	24	24	< 0.0010	< 0.0010	< 0.00030	< 0.00030
Mill Lake	Mill Lake	8/3/2019	ML_SW009_1.5_20190803	1.5 m	78	0.035	0.043	<0.00060	< 0.00060	0.00026	0.00036	0.014	0.013	<0.0010	< 0.0010	<0.020	< 0.020	<0.020	< 0.020	23	23	<0.0010	< 0.0010	<0.00030	< 0.00030
Mill Lake	Mill Lake	8/3/2019	ML_SW010_3.0_20190803	3.0 m	78	0.034	0.042	<0.00060	< 0.00060	0.00033	0.0004	0.013	0.013	<0.0010	< 0.0010	<0.020	< 0.020	<0.020	<0.020	23	23	<0.0010	< 0.0010	<0.00030	< 0.00030
Mill Lake	Mill Lake	2/8/2020	ML_SW_20200208_VC06		89	0.014	0.019	<0.00060	<0.00060	0.00028	0.0004	0.015	0.016	<0.0010	<0.0010	<0.020	<0.020	<0.00002	<0.000020	27	27	<0.0010	<0.0010	<0.00030	<0.00030

Notes:

NG = No Guideline
[1] Canadian Council of Ministers of the Environment, Canadian Environmental Quality Guidelines, Freshwater Aquatic Life On-Line, Accessed 18.10.28
[2] Ontario, Provincial Water Quality Objectives, February, 1999 (data only compared to in absence of CCME guideline)
[3] Guideline concentration varies with hardness
1001 Bold/Red font indicates reported concentration greater than CCME Freshwater Guideline
2001 Bold font indicates reported concentration greater than Ontario PWQO (where no CCME guideline exists only)
<0.01 Grey font indicates circumstance where the laboratory's minimum detection limit is greater than the referenced CCME or MOE guideline

Table C8

Historic Surface Water Analytical Results - General Metals (2 of 3)
Kwetı̨ı̨ɂà (Rayrock) Remediation Project
Public Services and Procurement Canada

Sample Information					Hardness	Metals																			
Parameter					(as CaCO3)	Iron		Lithium		Magnesium		Manganese		Mercury		Molybdenum		Nickel			Phosphorus	Phosphorus	Phosphorus, Total	Potassium	
Fraction						Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Total	Dissolved	Total	N	Dissolved	Total
Unit					mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/L	Varies[3]	mg/l	mg/l	mg/l	mg/l	mg/l
CCME Freshwater[1]					NG	NG	0.3	NG	NG	NG	NG	NG	NG	NG	0.000026	NG	0.073	NG	CCME	0.005	NG	NG	NG	NG	NG
		Ontario, Provincial Water Quality Objectives, February, 1999[2]			NG	NG	0.3	NG	NG	NG	NG	NG	NG	NG	0.0002	NG	NG	NG	Guideline varies with Hardness	0.025	NG	<10 Aesthetic		NG	NG
Lake Group	Sample Location	Sample Date (mm/dd/yyyy)	Sample ID	Sample Depth (m below surface)																					
New Control Lake																									
New Control Lake	Control Lake 85	7/13/1983	RR-0001-052			0.093	0.11											< 0.001	0.025	< 0.001					
New Control Lake	Control Lake 85	9/19/1984	RR-0001-019				< 0.03													< 0.001					
New Control Lake	Control Lake 85	11/20/1996	RR-0001-060			0.008				1.9		0.003		< 0.00005		< 0.001		< 0.001	0.025		< 0.05			0.8	
New Control Lake	Control Lake 85	11/20/1996	RR-0001-061			0.008				2.7		0.004		< 0.00005		< 0.001		< 0.001	0.025		< 0.05			1.2	
New Control Lake	SWNC2 New Control	8/21/1997	RR-0001-096			0.043				3.3		0.001		< 0.00005		< 0.001		< 0.001	0.025		< 0.05			0.7	
New Control Lake	SWNC2 New Control (Duplicate)	8/21/1997	RR-0001-097			0.052				4.3		< 0.001		< 0.00005		< 0.001		< 0.001	0.025		< 0.05			1	
New Control Lake	SWNC2 New Control	8/29/2004	RR-0002-038				0.17		< 0.005		3.5		0.0261		< 0.00001		0.00018		0.025	< 0.001		< 0.3			< 2
New Control Lake	SWNC2 New Control	8/29/2004	RR-0002-038			< 0.03		< 0.005		3.5		0.00059		< 0.00001		0.00018		< 0.001	0.025		< 0.3			< 2	
New Control Lake	SWNC2 New Control	8/29/2004	RR-0002-038		54.0														0.025						
New Control Lake	SWNC2 New Control	8/22/2005	RR-0002-045			< 0.03	0.068	< 0.005	< 0.005	2.85	3.09	0.000125	0.00628	< 0.00001	< 0.00001	0.000164	0.000208	< 0.001	0.025	< 0.001	< 0.3	< 0.3		0.727	0.802
New Control Lake	SWNC2 New Control	8/22/2005	RR-0002-045		47.9														0.025				0.0047		
New Control Lake	SWNC2 New Control	8/11/2006	RR-0002-059			< 0.03	0.119	< 0.005	< 0.005	3.77	3.77	< 0.00005	0.0183	< 0.00001	< 0.00001	0.00019	0.000197	< 0.001	0.025	< 0.001	< 0.3	< 0.3		< 0.05	< 0.05
New Control Lake	SWNC2 New Control	8/11/2006	RR-0002-059		55.5														0.025				0.023		
New Control Lake	SWNC2 New Control	8/28/2007	RR-0002-069		50.0	< 0.03	0.13			3.24	3.34	0.00012	0.0187	< 0.00001	< 0.00001	0.000169	0.000201	0.00026	0.025	0.00043			0.0225	0.765	0.796
New Control Lake	SWNC2 New Control	8/27/2008	RR-0002-080		49.7	0.01	0.13	< 0.005	< 0.005	2.92	3.34	0.000669	0.0194	< 0.00001	< 0.00001	0.000202	0.000208	0.00045	0.025	0.00036	< 0.3	< 0.3	0.0366	0.858	0.952
New Control Lake	SWNC2 New Control	8/30/2009	RR-0002-089		48.1	< 0.03	0.13	< 0.005	< 0.005	3.19	3.47	0.00022	0.0272	0.000015	< 0.00001	0.000157	0.000176	0.00098	0.025	0.00054	< 0.3	< 0.3	0.0232	0.97	1.06
New Control Lake	SWNC2 New Control	8/30/2011	RR-0003-002		57.5	< 0.03	0.169	< 0.005	< 0.005	3.82	3.78	0.000105	0.0282	< 0.00001	< 0.00001	0.000183	0.000177	0.00024	0.025	0.0003	< 0.3	< 0.3	0.0345	1.18	1.18
New Control Lake	SWNC2 New Control	8/6/2014	RR-0003-008		67.0	< 0.06	0.3	< 0.02	< 0.02	4.5	4.5	< 0.004	0.026	< 0.005	< 0.005	0.00023	0.00031	< 0.001	0.071	0.00059	< 0.1	< 0.1		1.2	1.3
Sherman Lake																									
Sherman Lake	Sherman 79-2	6/15/1979	RR-0001-028																0.025						
Sherman Lake	Sherman 79-5	6/15/1979	RR-0001-029																0.025						
Sherman Lake	Sherman 79-10	6/15/1979	RR-0001-030																0.025						
Sherman Lake	Sherman Lake NE	6/15/1979	RR-0001-031																0.025						
Sherman Lake	Sherman 79-2	6/15/1979	RR-0001-033		36		0.04				6.21				< 0				0.025	< 0.03		0.03			1.94
Sherman Lake	Sherman 79-5	6/15/1979	RR-0001-034		28		< 0.03				6.25				< 0				0.025	< 0.03		0.02			1.97
Sherman Lake	Sherman 79-10	6/15/1979	RR-0001-035		28		< 0.03				6.17				< 0				0.025	< 0.03		0.01			1.93
Sherman Lake	Sherman Lake NE	6/15/1979	RR-0001-036		28		< 0.03				6.17				< 0				0.025	< 0.03		0.01			1.93
Sherman Lake	Sherman 6W1	7/13/1983	RR-0001-045			< 0.005	0.033											< 0.001	0.025	< 0.001					
Sherman Lake	Sherman Lake NE	7/13/1983	RR-0001-046			< 0.005	< 0.005											< 0.001	0.025	< 0.001					
Sherman Lake	Sherman Lake NE	9/19/1984	RR-0001-020				< 0.03												0.025	< 0.001					
Sherman Lake	Sherman Lake Main	9/19/1984	RR-0001-021				0.03												0.025	0.001					
Sherman Lake	Sherman Lake SW6	9/19/1984	RR-0001-024				0.1												0.025	0.003					
Sherman Lake	Sherman S1	7/18/1986	RR-0003-058																0.025	< 0.005					
Sherman Lake	Sherman S3	7/18/1986	RR-0003-061																0.025	< 0.005					
Sherman Lake	Sherman S3	7/18/1986	RR-0003-062																0.025	< 0.005					
Sherman Lake	SW8 Sherman	7/18/1986	RR-0003-063																0.025	< 0.005					
Sherman Lake	SW8 Sherman (Duplicate)	7/18/1986	RR-0003-064																0.025	< 0.005					
Sherman Lake	SW8 Sherman	7/18/1986	RR-0003-065																0.025	< 0.005					
Sherman Lake	SW8 Sherman	7/18/1986	RR-0003-066																0.025	< 0.005					
Sherman Lake	SW8 Sherman	7/18/1986	RR-0003-067																0.025	< 0.005					
Sherman Lake	SW8 Sherman	7/18/1986	RR-0003-068																0.025	< 0.005					
Sherman Lake	Sherman Lake Main	7/18/1986	RR-0003-069																0.025	< 0.005					
Sherman Lake	Sherman Lake Main	7/18/1986	RR-0003-070																0.025	< 0.005					
Sherman Lake	Sherman S6	7/18/1986	RR-0003-071																0.025	< 0.005					
Sherman Lake	Sherman S6	7/18/1986	RR-0003-072																0.025	< 0.005					
Sherman Lake	Sherman S6	7/18/1986	RR-0003-073																0.025	< 0.005					
Sherman Lake	Sherman Lake NE	7/18/1986	RR-0003-074																0.025	< 0.005					
Sherman Lake	Sherman Lake NE (Duplicate)	7/18/1986	RR-0003-075																0.025	< 0.005					
Sherman Lake	Sherman Lake SW6	11/20/1996	RR-0001-065			0.037				7		< 0.001		< 0.00005		< 0.001		< 0.001	0.025		< 0.05			2.5	
Sherman Lake	SW7 Sherman	11/20/1996	RR-0001-066			0.041				7.5		0.001		< 0.00005		< 0.001		< 0.001	0.025		< 0.05			2.8	
Sherman Lake	SW8 Sherman	11/20/1996	RR-0001-067			0.031				6.7		< 0.001		< 0.00005		< 0.001		< 0.001	0.025		< 0.05			2.3	
Sherman Lake	SW8 Sherman	11/20/1996	RR-0001-068			0.03				6.6		< 0.001		< 0.00005		< 0.001		< 0.001	0.025		< 0.05			2.2	
Sherman Lake	SW8 Sherman (Duplicate)	11/20/1996	RR-0001-069			0.032				6.8		< 0.001		< 0.00005		< 0.001		< 0.001	0.025		< 0.05			2.4	
Sherman Lake	Sherman Lake SW6	8/21/1997	RR-0002-001			0.041				6.7		0.002		< 0.00005		< 0.001		< 0.001	0.025		< 0.05			1.7	
Sherman Lake	SW7 Sherman	8/21/1997	RR-0002-002			0.009				6.1		< 0.001		< 0.00005		< 0.001		< 0.001	0.025		< 0.05			1.7	
Sherman Lake	SW8 Sherman	8/21/1997	RR-0002-003			0.007				6.1		0.003		< 0.00005		< 0.001		< 0.001	0.025		< 0.05			1.7	
Sherman Lake	Sherman Lake SW6	10/1/2000	RR-0003-083			0.09	0.27			5.19	5.15	0.0025	0.0244			0.0013	0.0003	0.0008	0.025	0.0013	0.01	0.06		1.92	1.97
Sherman Lake	Sherman Lake SW6 (Duplicate)	10/1/2000	RR-0003-085			0.04	0.61			5.26	5.33	0.0036	0.0373			0.0012	0.0003	0.0008	0.025	0.0016	0.01	0.07		1.9	2.04
Sherman Lake	Sherman Lake	9/20/2001	RR-0001-001			< 0.03	0.13	< 0.005	< 0.005	5.3	5.3	0.00022	0.013	< 0.00001	< 0.00001	0.00019	0.00019	0.0006	0.025	0.0006	< 0.3	< 0.3		< 2	< 2
Sherman Lake	Sherman Lake (Duplicate)	9/20/2001	RR-0001-002			< 0.03	0.13	< 0.005	< 0.005	5.4	5.4	0.00017	0.0125	< 0.00001	< 0.00001	0.00018	0.00018	0.0006	0.025	0.0005	< 0.3	< 0.3		< 2	< 2
Sherman Lake	Sherman Lake	8/12/2002	RR-0001-007			< 0.03	0.05	< 0.005	< 0.005	5.3	5.4	0.00015	0.00685	< 0.00001	< 0.00001	0.00018	0.00017	< 0.001	0.025	< 0.001	< 0.3	< 0.3		< 2	< 2
Sherman Lake	Sherman Lake (Duplicate)	8/12/2002	RR-0001-008			< 0.03	0.05	< 0.005	< 0.005	5.3	5.2	0.00018	0.00698	< 0.00001	< 0.00001	0.00017	0.00017	< 0.001	0.025	< 0.001	< 0.3	< 0.3		< 2	< 2
Sherman Lake	Sherman Lake	8/17/2003	RR-0002-030		44.8														0.025						
Sherman Lake	Sherman Lake (Duplicate)	8/17/2003	RR-0002-031		43.9														0.025						
Sherman Lake	Sherman Lake	8/17/2003	RR-0002-030			< 0.03	0.05	< 0.005	< 0.005	5.3	5.3	0.00013	0.00963	< 0.00001	< 0.00001	0.00018	0.00018	< 0.001	0.025	< 0.001	< 0.3	< 0.3		< 2	< 2
Sherman Lake	Sherman Lake (Duplicate)	8/17/2003	RR-0002-031			< 0.03	0.05	< 0.005	< 0.005	5.2	5.3	0.00019	0.00959	< 0.00001	< 0.00001	0.00019	0.00018	0.0005	0.025	< 0.001	< 0.3	< 0.3		< 2	< 2
Sherman Lake	Sherman Lake	8/29/2004	RR-0002-034				0.04		< 0.005		5.2		0.0134		< 0.00001		0.00015		0.025	< 0.001		< 0.3			< 2
Sherman Lake	Sherman Lake	8/29/2004	RR-0002-034			< 0.03		< 0.005		5.3		0.00018		< 0.00001		0.00016		< 0.001	0.025		< 0.3			< 2	
Sherman Lake	Sherman Lake	8/29/2004	RR-0002-034		45.8														0.025						
Sherman Lake	Sherman Lake	8/22/2005	RR-0002-041			< 0.03	0.068	< 0.005	< 0.005	4.84	5.14	0.000447	0.0199	< 0.00001	< 0.00001	0.000191	0.000197	0.00065	0.025	0.00064	< 0.3	< 0.3		1.66	1.68
Sherman Lake	Sherman Lake (Duplicate)	8/22/2005	RR-0002-042			< 0.03	0.057	< 0.005	< 0.005	4.82	5.13	0.000225	0.0188	< 0.00001	< 0.00001	0.000176	0.000198	0.00056	0.025	0.00058	< 0.3	< 0.3		1.53	1.62
Sherman Lake	Sherman Lake	8/22/2005	RR-0002-041		44.3														0.025				0.006		
Sherman Lake	Sherman Lake (Duplicate)	8/22/2005	RR-0002-042		43.6														0.025				0.0043		
Sherman Lake	Sherman Lake (Duplicate)	8/11/2006	RR-0002-055			< 0.03	0.057	< 0.005	< 0.005	6.16	5.85	0.000065	0.0113	< 0.00001	< 0.00001	0.000193	0.000194	0.00067	0.025	0.00061	< 0.3	< 0.3		< 0.05	< 0.05
Sherman Lake	Sherman Lake	8/11/2006	RR-0002-054			< 0.03	0.078	< 0.005	< 0.005	6.25	6.35	< 0.00005	0.0114	< 0.00001	< 0.00001	0.000172	0.000212	< 0.001	0.025	0.00109	< 0.3	< 0.3		< 0.05	< 0.05
Sherman Lake	Sherman Lake	8/11/2006	RR-0002-054		51.5														0.025				0.0149		
Sherman Lake	Sherman Lake (Duplicate)	8/11/2006	RR-0002-055		50.8														0.025				0.0166		
Sherman Lake	Sherman Lake	8/28/2007	RR-0002-063		42.5	< 0.03	0.042			4.92	4.97	< 0.00005	0.00752	< 0.00001	< 0.00001	0.000179	0.00019	0.00043	0.025	0.00048			0.0125	1.43	1.48
Sherman Lake	Sherman Lake (Duplicate)	8/28/2007	RR-0002-064		41.6	< 0.03	0.037			4.85	4.91	0.00124	0.00711	< 0.00001	< 0.00001	0.000167	0.000171	0.00044	0.025	0.00053			0.0128	1.41	1.41
Sherman Lake	Sherman Lake	8/27/2008	RR-0002-075		40.8	< 0.03	0.05	< 0.005	< 0.005	4.21	4.15	0.000206	0.0144	< 0.00001	< 0.00001	0.000176	0.000165	0.0004	0.025	0.00035	< 0.3	< 0.3	0.0161	1.54	1.52
Sherman Lake	Sherman Lake	8/30/2009	RR-0002-084		41.3	< 0.03	0.071	< 0.005	< 0.005	4.85	4.99	0.000202	0.019	< 0.00001	< 0.00001	0.000174	0.00018	< 0.001	0.025	0.00055	< 0.3	< 0.3	0.021	1.44	1.5
Sherman Lake	Sherman Lake	9/1/2011	RR-0002-097		40.6	< 0.03	0.05	< 0.005	< 0.005	4.79	4.75	0.000102	0.009	< 0.00001	< 0.00001	0.00016	0.000167	0.00042	0.025	0.00046	< 0.3	< 0.3	0.0126	1.43	1.42
Sherman Lake	Sherman 2014	8/6/2014	RR-0003-003		45	< 0.06	0.065	< 0.02	< 0.02	5.2	5.2	< 0.004	0.012	0.01	< 0.005	0.00021	0.0002	< 0.001	0.025	0.00053	< 0.1	< 0.1		1.4	1.5
Sherman Lake	Sherman 17-6	9/11/2017	RR-0003-041				2.9		< 0.02		5.4		0.14		< 0.000002		0.0012		0.025	0.0045		< 0.1			1.6
Sherman Lake	Sherman Lake (Duplicate)	9/17/2018	DUP1_20180917		49	< 0.060	0.094	< 0.020	< 0.020	5.6	5.6	< 0.0040	0.045			< 0.00020	< 0.00020	< 0.00050	0.025	0.00056	< 0.10	< 0.10		1.6	1.6
Sherman Lake	Sherman Lake	9/17/2018	SW001_20180917_20180917		49	< 0.060	0.090	< 0.020	< 0.020	5.6	5.4	< 0.0040	0.045			0.00021	0.00021	< 0.00050	0.025	0.00067	< 0.10	< 0.10		1.6	1.6
Sherman Lake	Sherman Lake	9/17/2018	SW002_20180917_20180917		52	< 0.060	0.084	< 0.020	< 0.020	5.7	5.4	< 0.0040	0.042			0.00030	0.00022	< 0.00050	0.025	0.00051	< 0.10	< 0.10		1.6	1.6
Sherman Lake	Sherman Lake	9/17/2018	SW003_20180917_20180917		49	< 0.060	0.077	< 0.020	< 0.020	5.7	5.5	0.0059	0.037			0.00021	< 0.00020	< 0.00050	0.025	0.00051	< 0.10	< 0.10		1.6	1.6
Sherman Lake	Sherman Lake	9/17/2018	SW004_20180917_20180917		49	< 0.060	0.11	< 0.020	< 0.020	5.7	5.4	< 0.0040	0.053			0.00021	< 0.00020	< 0.00050	0.025	0.00057	< 0.10	< 0.10		1.6	1.6
Sherman Lake	Sherman Lake	9/17/2018	SW005_20180917_20180917		49	< 0.060	0.11	< 0.020	< 0.020	5.7	5.4	< 0.0040	0.055			0.00020	0.00021	< 0.00050	0.025	< 0.00050	< 0.10	< 0.10		1.6	1.6
Sherman Lake	Sherman Lake	9/17/2018	SW006_20180917_20180917		49	< 0.060	0.11	< 0.020	< 0.020	5.6	5.4	< 0.0040	0.054			< 0.00020	< 0.00020	< 0.00050	0.025	< 0.00050	< 0.10	< 0.10		1.6	1.6

Table C8

Historic Surface Water Analytical Results - General Metals (2 of 3)
Kwetı̨ı̨ɂà (Rayrock) Remediation Project
Public Services and Procurement Canada

Sample Information					Hardness	Metals																			
				Parameter	(as CaCO3)	Iron		Lithium		Magnesium		Manganese		Mercury		Molybdenum		Nickel			Phosphorus	Phosphorus	Phosphorus, Total	Potassium	
				Fraction		Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Total	Dissolved	Total	N	Dissolved	Total
				Unit	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/L	Varies[3]	mg/l	mg/l	mg/l	mg/l	mg/l
				CCME Freshwater[1]	NG	NG	0.3	NG	NG	NG	NG	NG	NG	NG	0.000026	NG	0.073	NG	CCME	0.005	NG	NG	NG	NG	NG
		Ontario, Provincial Water Quality Objectives, February, 1999[2]			NG	NG	0.3	NG	NG	NG	NG	NG	NG	NG	0.0002	NG	NG	NG	Guideline varies with Hardness	0.025	NG	<10 Aesthetic		NG	NG
Lake Group	Sample Location	Sample Date (mm/dd/yyyy)	Sample ID	Sample Depth (m below surface)																					
Alpha Lake																									
Alpha Lake	Alpha 79-1	6/15/1979	RR-0001-027																0.025						
Alpha Lake	Alpha 79-1	6/15/1979	RR-0001-032		40		< 0.03				6.17				< 0				0.025	< 0.03		0.03			1.96
Alpha Lake	Alpha 79-1	7/13/1983	RR-0001-043			0.26	0.4											< 0.001	0.025	< 0.001					
Alpha Lake	Alpha 79-1	7/13/1983	RR-0001-044			0.26	0.71											< 0.001	0.025	< 0.001					
Alpha Lake	Alpha Lake 85	9/19/1984	RR-0001-023				1.57												0.025	0.016					
Alpha Lake	Alpha 05	7/18/1986	RR-0003-079																0.025	< 0.005					
Alpha Lake	SW5 Alpha	7/18/1986	RR-0003-080																0.025	< 0.005					
Alpha Lake	Alpha 79-1	7/20/1995	RR-0001-054												< 0.00001		< 0.00005		0.025	0.005					
Alpha Lake	SW5 Alpha	11/20/1996	RR-0001-064			0.098				8.1		0.002		< 0.00005		< 0.001		0.001	0.025		< 0.05			3	
Alpha Lake	SW5 Alpha	8/21/1997	RR-0001-100			1.2				8.2		0.13		< 0.00005		< 0.001		0.002	0.025		< 0.05			2.3	
Alpha Lake	SW5 Alpha	10/1/2000	RR-0003-081			0.08	0.84			5.59	6.52	0.0045	0.0242			0.0017	0.0007	0.0009	0.025	0.0054	0.01	0.07		1.5	1.93
Alpha Lake	SW5 Alpha (Duplicate)	10/1/2000	RR-0003-082			0.09	0.83			5.57	6.04	0.0046	0.017			0.0018	0.0006	0.0009	0.025	0.0028	0.01	0.06		1.51	1.93
Alpha Lake	Lake Alpha	9/20/2001	RR-0001-003			< 0.03	0.15	< 0.005	< 0.005	5.4	5.4	0.0003	0.00697	< 0.00001	< 0.00001	0.00023	0.00023	0.0007	0.025	0.0007	< 0.3	< 0.3		< 2	< 2
Alpha Lake	Lake Alpha (Duplicate)	9/20/2001	RR-0001-004			< 0.03	0.15	< 0.005	< 0.005	5.3	5.4	0.00043	0.00686	< 0.00001	< 0.00001	0.00023	0.00023	0.0017	0.025	0.0007	< 0.3	< 0.3		< 2	< 2
Alpha Lake	Lake Alpha	8/12/2002	RR-0001-009			0.03	0.2	< 0.005	< 0.005	5.4	5.3	0.00027	0.00865	< 0.00001	< 0.00001	0.00024	0.00029	0.0006	0.025	0.0017	< 0.3	< 0.3		< 2	< 2
Alpha Lake	Lake Alpha (Duplicate)	8/12/2002	RR-0001-010			0.03	0.2	< 0.005	< 0.005	5.5	5.6	0.00024	0.00855	< 0.00001	< 0.00001	0.00023	0.00024	0.0006	0.025	0.0007	< 0.3	< 0.3		< 2	< 2
Alpha Lake	Lake Alpha	8/17/2003	RR-0002-027		67														0.071						
Alpha Lake	Lake Alpha	8/17/2003	RR-0002-027			< 0.03	0.18	< 0.005	< 0.005	7.6	7.2	0.00013	0.00783	< 0.00001	< 0.00001	0.00038	0.00035	0.0007	0.025	0.0007	< 0.3	< 0.3		< 2	< 2
Alpha Lake	Lake Alpha	8/29/2004	RR-0002-035				0.37		< 0.005		5.4		0.0164		< 0.00001		0.0003		0.025	0.0011		< 0.3			2
Alpha Lake	Lake Alpha	8/29/2004	RR-0002-035			< 0.03		< 0.005		5.4		0.00045		< 0.00001		0.0003		0.0008	0.025		< 0.3			< 2	
Alpha Lake	Lake Alpha	8/29/2004	RR-0002-035		45.7														0.025						
Alpha Lake	Alpha 05	7/3/2005	RR-0002-049			0.046	0.173	< 0.005	< 0.005	5.41	5.79	0.000326	0.0142	< 0.00001	< 0.00001	0.000214	0.000271	0.00061	0.025	0.00066	< 0.3	< 0.3		< 0.05	< 0.05
Alpha Lake	Alpha 05	7/3/2005	RR-0002-049		47.2														0.025						
Alpha Lake	Lake Alpha	8/22/2005	RR-0002-043			0.037	0.222	< 0.005	< 0.005	5.18	6.82	0.000442	0.0135	< 0.00001	< 0.00001	0.000245	0.000354	0.00062	0.025	0.00209	< 0.3	< 0.3		1.39	1.86
Alpha Lake	Lake Alpha	8/22/2005	RR-0002-043		46														0.025				0.0094		
Alpha Lake	Lake Alpha	8/11/2006	RR-0002-062			0.147	0.509	< 0.005	< 0.005	6.74	7.17	0.000613	0.0363	< 0.00001	< 0.00001	0.000253	0.00024	0.00059	0.025	0.00176	< 0.3	< 0.3		< 0.05	< 0.05
Alpha Lake	Lake Alpha	8/11/2006	RR-0002-062		55.1														0.025				0.0231		
Alpha Lake	Lake Alpha	8/28/2007	RR-0002-065		45.4	0.016	0.158			5.38	5.33	0.000073	0.00644	< 0.00001	< 0.00001	0.000219	0.000209	0.00053	0.025	0.00056			0.0159	1.28	1.26
Alpha Lake	Lake Alpha	8/27/2008	RR-0002-076		45.8	0.069	0.273	< 0.005	< 0.005	4.8	4.6	0.000625	0.0185	< 0.00001	< 0.00001	0.000224	0.000205	0.00059	0.025	0.00058	< 0.3	< 0.3	0.0203	1.46	1.42
Alpha Lake	Lake Alpha	8/30/2009	RR-0002-085		42.3	0.048	0.185	< 0.005	< 0.005	4.99	5.38	0.00029	0.00912	< 0.00001	< 0.00001	0.000207	0.000227	0.00059	0.025	0.00068	< 0.3	< 0.3	0.0128	1.37	1.5
Alpha Lake	Lake Alpha (Duplicate)	8/30/2009	RR-0002-086		42.5	0.05	0.215	< 0.005	< 0.005	5.05	5.28	0.0003	0.00879	< 0.00001	< 0.00001	0.00019	0.000214	0.00055	0.025	0.00091	< 0.3	< 0.3	0.0126	1.4	1.5
Alpha Lake	Lake Alpha	9/1/2011	RR-0002-098		45.7	0.044	0.199	< 0.005	< 0.005	5.28	5.56	0.000215	0.00721	< 0.00001	< 0.00001	0.000238	0.000267	0.00064	0.025	0.00072	< 0.3	< 0.3	0.0179	1.4	1.5
Alpha Lake	Lake Alpha (Duplicate)	9/1/2011	RR-0002-099		45.7	0.046	0.201	< 0.005	< 0.005	5.29	5.46	0.000229	0.00719	< 0.00001	< 0.00001	0.000243	0.000257	0.00063	0.025	0.0007	< 0.3	< 0.3	0.0173	1.4	1.47
Alpha Lake	Lake Alpha	8/6/2014	RR-0003-005		49	< 0.06	0.28	< 0.02	< 0.02	5.4	5.5	< 0.004	0.0098	< 0.005	< 0.005	< 0	0.00029	0.00059	0.025	0.00077	< 0.1	< 0.1		1.3	1.3
Lake A																									
Lake A	Lake A 7W2	7/13/1983	RR-0001-047			0.082	0.13											< 0.001	0.025	< 0.001					
Lake A	Lake A 7W1	7/13/1983	RR-0001-048			0.052	0.15											< 0.001	0.025	< 0.001					
Lake A	Lake A 7W1	7/18/1986	RR-0003-076																0.025	< 0.005					
Lake A	Lake A 7W2	7/18/1986	RR-0003-077																0.025	< 0.005					
Lake A	Lake A 17-1	7/18/1986	RR-0003-078																0.025	< 0.005					
Lake A	Lake A W2	7/20/1995	RR-0001-055												< 0.00001		< 0.00005		0.025	< 0.001					
Lake A	SW11 Lake A	11/20/1996	RR-0001-073			0.059				7.1		0.002		< 0.00005		< 0.001		< 0.001	0.025		< 0.05			2.5	
Lake A	SW11 Lake A	8/21/1997	RR-0002-006			0.072				6.1		0.023		< 0.00005		< 0.001		< 0.001	0.025		< 0.05			1.7	
Lake A	Lake A 2014	8/6/2014	RR-0003-009		48	< 0.06	0.21	< 0.02	< 0.02	5.7	5.7	< 0.004	0.023	< 0.005	< 0.005	0.00021	0.00022	< 0.001	0.025	0.00072	< 0.1	< 0.1		1.6	1.7
Lake A	Lake A 17-1	9/14/2017	RR-0003-042				0.15		< 0.02		5.9		0.013		< 0.000002		0.00028		0.025	0.00069		< 0.1			1.8
Mill Lake																									
Mill Lake	Mill 9W1	7/13/1983	RR-0001-053			0.083	0.1											0.0043	0.025	0.0043					
Mill Lake	Mill W5	7/20/1995	RR-0001-057												< 0.00001		< 0.00005		0.025	< 0.001					
Mill Lake	SW3 Mill	11/20/1996	RR-0001-062			0.041				5.2		0.009		< 0.00005		< 0.001		< 0.001	0.025		< 0.05			1.4	
Mill Lake	SW3 Mill	8/21/1997	RR-0001-098			0.008				4.7		< 0.001		< 0.00005		< 0.001		< 0.001	0.025		< 0.05			1	
Mill Lake	Mill Lake	8/28/2007	RR-0002-068		85.1	< 0.03	0.018			5.28	5.28	0.00008	0.0133	< 0.00001	< 0.00001	0.000258	0.000266	< 0.001	0.085	< 0.001			0.0065	1.03	1.03
Mill Lake	Mill Lake	8/27/2008	RR-0002-073		84.2	< 0.03	0.027	< 0.005	< 0.005	4.84	3.86	0.00015	0.0189	< 0.00001	< 0.00001	0.000232	0.000211	0.00015	0.084	< 0.001	< 0.3	< 0.3	0.0074	1.03	1
Mill Lake	Mill Lake	8/30/2009	RR-0002-082		80.1	0.034	< 0.03	< 0.005	< 0.005	4.9	4.82	0.00037	0.0123	< 0.00001	< 0.00001	0.000247	0.000258	< 0.001	0.081	0.00054	< 0.3	< 0.3	0.0034	1	0.985
Mill Lake	Mill Lake	8/31/2011	RR-0002-096		80.5	< 0.03	0.028	< 0.005	< 0.005	4.84	4.81	0.000307	0.0178	< 0.00001	< 0.00001	0.000252	0.000253	< 0.001	0.081	< 0.001	< 0.3	< 0.3	0.0088	0.985	0.987
Mill Lake	Mill Lake	8/6/2014	RR-0003-004		94	< 0.06	< 0.06	< 0.02	< 0.02	5.6	5.6	0.016	0.033	< 0.005	< 0.005	0.00034	0.00047	< 0.001	0.092	< 0.001	< 0.1	< 0.1		1.1	1.1
Mill Lake	Mill Lake	5/26/2017	RR-0003-032				0.091		< 0.02		4.5		0.11				0.00023		0.025	< 0.001		< 0.1			1
Mill Lake	Mill Lake (Duplicate)	9/17/2018	DUP2_20180917		81	< 0.060	< 0.060	< 0.020	< 0.020	4.9	4.8	< 0.0040	0.0090			< 0.00020	0.00021	< 0.00050	0.081	< 0.00050	< 0.10	< 0.10		1.0	1.0
Mill Lake	Mill Lake	9/17/2018	SW007_20180917_20180917		81	< 0.060	< 0.060	< 0.020	< 0.020	4.9	4.8	< 0.0040	0.0091			0.00023	0.00024	< 0.00050	0.081	< 0.00050	< 0.10	< 0.10		1.0	1.0
Mill Lake	Mill Lake	9/17/2018	SW008_20180917_20180917		78	< 0.060	< 0.060	< 0.020	< 0.020	4.7	4.8	< 0.0040	0.0093			0.00022	0.00022	< 0.00050	0.079	< 0.00050	< 0.10	< 0.10		0.99	1.0
Mill Lake	Mill Lake	9/17/2018	SW009_20180917_20180917		79	< 0.060	0.19	< 0.020	< 0.020	4.7	4.8	< 0.0040	0.052			0.00025	0.00021	< 0.00050	0.080	0.00072	< 0.10	< 0.10		1.0	1.1
Mill Lake	Mill Lake	9/17/2018	SW010_20180917_20180917		80	< 0.060	< 0.060	< 0.020	< 0.020	4.8	4.7	< 0.0040	0.0091			0.00026	0.00020	< 0.00050	0.081	< 0.00050	< 0.10	< 0.10		1.0	1.1
Mill Lake	Mill Lake	9/17/2018	SW011_20180917_20180917		81	< 0.060	< 0.060	< 0.020	< 0.020	4.9	4.8	< 0.0040	0.0090			0.00025	0.00023	< 0.00050	0.081	< 0.00050	< 0.10	< 0.10		1.0	1.0
Mill Lake	Mill Lake	9/17/2018	SW012_20180917_20180917		81	< 0.060	< 0.060	< 0.020	< 0.020	4.9	4.9	< 0.0040	0.0091			0.00024	0.00023	< 0.00050	0.081	< 0.00050	< 0.10	< 0.10		1.0	1.0
Mill Lake	Mill Lake	9/17/2018	SW013_20180917_20180917		81	< 0.060	< 0.060	< 0.020	< 0.020	4.9	4.8	< 0.0040	0.0089			0.00021	0.00021	< 0.00050	0.081	< 0.00050	< 0.10	< 0.10		1.0	1.0
Mill Lake	Mill Lake	9/17/2018	SW014_20180917_20180917		81	< 0.060	< 0.060	< 0.020	< 0.020	4.9	4.8	< 0.0040	0.0087			0.00023	0.00021	< 0.00050	0.081	0.00078	< 0.10	< 0.10		1.0	1.0
Mill Lake	Mill Lake	9/17/2018	SW015_20180917_20180917		81	< 0.060	< 0.060	< 0.020	< 0.020	4.9	4.9	< 0.0040	0.0092			0.00023	0.00021	< 0.00050	0.081	< 0.00050	< 0.10	< 0.10		1.0	1.1
Mill Lake	Mill Lake	8/3/2019	ML_SW009_1.5_20190803	1.5 m	78	<0.060	0.073	<0.020	< 0.020	4.9	4.7	<0.0040	0.024	0.0033	-	0.00044	0.00026	<0.00050	0.081	< 0.00050	<0.10	< 0.10		1.1	1.0
Mill Lake	Mill Lake	8/3/2019	ML_SW010_3.0_20190803	3.0 m	78	<0.060	0.072	<0.020	< 0.020	4.9	4.6	<0.0040	0.023	0.0034	-	0.00049	0.00032	<0.00050	0.081	< 0.00050	<0.10	< 0.10		1.0	1.0
Mill Lake	Mill Lake	2/8/2020	ML_SW_20200208_VC06		89	<0.060	<0.060	<0.020	<0.020	5.4	5.4	0.052	0.053	<0.0000019	<0.0000019	0.00031	0.00025	<0.00050	.081	<0.00050	<0.10	<0.10		1.1	1.1

Notes:

NG = No Guideline

[1] Canadian Council of Ministers of the Environment, Canadian Environmental Quality Guidelines, Freshwater Aquatic Life On-Line, Accessed 18.10.28

[2] Ontario, Provincial Water Quality Objectives, February, 1999 (data only compared to in absence of CCME guideline)

[3] Guideline concentration varies with hardness

1001 Bold/Red font indicates reported concentration greater than CCME Freshwater Guideline

2001 Bold font indicates reported concentration greater than Ontario PWQO (where no CCME guideline exists only)

<0.01 Grey font indicates circumstance where the laboratory's minimum detection limit is greater than the referenced CCME or MOE guideline

Table C8

Historic Surface Water Analytical Results - General Metals (3 of 3)
Kwetı̨ı̨ɂàà (Rayrock) Remediation Project
Public Services and Procurement Canada

Sample Information					Hardness	Metals																			
				Parameter	(as CaCO3)	Silicon		Silver		Sodium		Strontium		Sulfur, elemental		Thallium		Tin		Titanium		Vanadium		Zinc	
				Fraction		Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total
				Unit	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
				CCME Freshwater[1]	NG	NG	NG	NG	0.00025	NG	NG	NG	NG	NG	NG	NG	0.0008	NG	NG	NG	NG	NG	NG	NG	0.007
		Ontario, Provincial Water Quality Objectives, February, 1999[2]			NG	NG	NG	NG	0.0001	NG	NG	NG	NG	NG	NG	NG	0.0003 Interim	NG	NG	NG	NG	NG	0.006 Interim	NG	0.02 Interim
Lake Group	Sample Location	Sample Date (mm/dd/yyyy)	Sample ID	Sample Depth (m below surface)																					
New Control Lake																									
New Control Lake	Control Lake 85	7/13/1983	RR-0001-052																					0.027	0.027
New Control Lake	Control Lake 85	9/19/1984	RR-0001-019																						< 0.005
New Control Lake	Control Lake 85	11/20/1996	RR-0001-060			0.15		< 0.001		3.2		0.026								< 0.001		< 0.001		< 0.005	
New Control Lake	Control Lake 85	11/20/1996	RR-0001-061			0.017		< 0.001		4.6		0.036								< 0.001		< 0.001		< 0.005	
New Control Lake	SWNC2 New Control	8/21/1997	RR-0001-096			1.9		< 0.001		2		0.028								< 0.001		< 0.001		< 0.005	
New Control Lake	SWNC2 New Control (Duplicate)	8/21/1997	RR-0001-097			1.1		< 0.001		2.5		0.036								< 0.001		< 0.001		< 0.005	
New Control Lake	SWNC2 New Control	8/29/2004	RR-0002-038				0.96		< 0.00001		3		0.0301				< 0.0001		< 0.0001		< 0.01		< 0.001		0.004
New Control Lake	SWNC2 New Control	8/29/2004	RR-0002-038			0.83		< 0.00001		3		0.0293				< 0.0001		< 0.0001		< 0.01		< 0.001		0.003	
New Control Lake	SWNC2 New Control	8/29/2004	RR-0002-038		54.0																				
New Control Lake	SWNC2 New Control	8/22/2005	RR-0002-045			0.822	0.863	< 0.00001	< 0.00001	2.5	2.4	0.0285	0.0307			< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.01	< 0.01	< 0.001	< 0.001	< 0.001	< 0.001
New Control Lake	SWNC2 New Control	8/22/2005	RR-0002-045		47.9																				
New Control Lake	SWNC2 New Control	8/11/2006	RR-0002-059			1.34	1.43	< 0.00001	< 0.00001	2.8	2.8	0.0276	0.0292			< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.01	< 0.01	< 0.001	< 0.001	< 0.001	< 0.001
New Control Lake	SWNC2 New Control	8/11/2006	RR-0002-059		55.5																				
New Control Lake	SWNC2 New Control	8/28/2007	RR-0002-069		50.0	1.26	1.32	< 0.00001	< 0.00001	2.87	2.97	0.0292	0.0303									0.000154	0.000312	< 0.001	< 0.001
New Control Lake	SWNC2 New Control	8/27/2008	RR-0002-080		49.7	0.992	1.09	< 0.00001	< 0.00001	3.41	3.86	0.0303	0.0313			< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.01	< 0.01	0.00016	0.00028	< 0.001	< 0.001
New Control Lake	SWNC2 New Control	8/30/2009	RR-0002-089		48.1	1.3	1.35	< 0.00001	< 0.00001	2.9	2.9	0.0292	0.0307			< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.01	< 0.01	< 0.001	< 0.001	< 0.001	0.0022
New Control Lake	SWNC2 New Control	8/30/2011	RR-0003-002		57.5	1.98	2.03	< 0.00001	< 0.00001	3.54	3.47	0.0357	0.0349			< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.01	< 0.01	0.000118	0.000237	< 0.001	< 0.001
New Control Lake	SWNC2 New Control	8/6/2014	RR-0003-008		67.0	1.4	1.8	< 0.0001	< 0.0001	4.4	4.3	0.043	0.043	1.3	1.3	< 0	< 0	< 0.001	< 0.001	< 0.001	0.0099	< 0.001	< 0.001	< 0.003	0.0036
Sherman Lake																									
Sherman Lake	Sherman 79-2	6/15/1979	RR-0001-028																						
Sherman Lake	Sherman 79-5	6/15/1979	RR-0001-029																						
Sherman Lake	Sherman 79-10	6/15/1979	RR-0001-030																						
Sherman Lake	Sherman Lake NE	6/15/1979	RR-0001-031																						
Sherman Lake	Sherman 79-2	6/15/1979	RR-0001-033		36						7.31														< 0.01
Sherman Lake	Sherman 79-5	6/15/1979	RR-0001-034		28						7.4														< 0.01
Sherman Lake	Sherman 79-10	6/15/1979	RR-0001-035		28						7.14														< 0.01
Sherman Lake	Sherman Lake NE	6/15/1979	RR-0001-036		28						7.14														< 0.01
Sherman Lake	Sherman 6W1	7/13/1983	RR-0001-045																					< 0.005	0.006
Sherman Lake	Sherman Lake NE	7/13/1983	RR-0001-046																					< 0.005	< 0.005
Sherman Lake	Sherman Lake NE	9/19/1984	RR-0001-020																						0.008
Sherman Lake	Sherman Lake Main	9/19/1984	RR-0001-021																						< 0.005
Sherman Lake	Sherman Lake SW6	9/19/1984	RR-0001-024																						0.013
Sherman Lake	Sherman S1	7/18/1986	RR-0003-058																						< 0.015
Sherman Lake	Sherman S3	7/18/1986	RR-0003-061																						< 0.015
Sherman Lake	Sherman S3	7/18/1986	RR-0003-062																						0.023
Sherman Lake	SW8 Sherman	7/18/1986	RR-0003-063																						< 0.015
Sherman Lake	SW8 Sherman (Duplicate)	7/18/1986	RR-0003-064																						< 0.015
Sherman Lake	SW8 Sherman	7/18/1986	RR-0003-065																						0.022
Sherman Lake	SW8 Sherman	7/18/1986	RR-0003-066																						0.034
Sherman Lake	SW8 Sherman	7/18/1986	RR-0003-067																						0.02
Sherman Lake	SW8 Sherman	7/18/1986	RR-0003-068																						< 0.015
Sherman Lake	Sherman Lake Main	7/18/1986	RR-0003-069																						0.039
Sherman Lake	Sherman Lake Main	7/18/1986	RR-0003-070																						0.031
Sherman Lake	Sherman S6	7/18/1986	RR-0003-071																						< 0.015
Sherman Lake	Sherman S6	7/18/1986	RR-0003-072																						< 0.015
Sherman Lake	Sherman S6	7/18/1986	RR-0003-073																						< 0.015
Sherman Lake	Sherman Lake NE	7/18/1986	RR-0003-074																						< 0.015
Sherman Lake	Sherman Lake NE (Duplicate)	7/18/1986	RR-0003-075																						0.026
Sherman Lake	Sherman Lake SW6	11/20/1996	RR-0001-065			0.78		< 0.001		17		0.06								< 0.001		< 0.001		0.008	
Sherman Lake	SW7 Sherman	11/20/1996	RR-0001-066			0.84		< 0.001		18		0.064								< 0.001		< 0.001		< 0.005	
Sherman Lake	SW8 Sherman	11/20/1996	RR-0001-067			0.9		< 0.001		17		0.058								< 0.001		< 0.001		< 0.005	
Sherman Lake	SW8 Sherman	11/20/1996	RR-0001-068			0.77		< 0.001		16		0.056								< 0.001		< 0.001		< 0.005	
Sherman Lake	SW8 Sherman (Duplicate)	11/20/1996	RR-0001-069			0.78		< 0.001		17		0.058								< 0.001		< 0.001		< 0.005	
Sherman Lake	Sherman Lake SW6	8/21/1997	RR-0002-001			0.68		< 0.001		5.8		0.058								< 0.001		< 0.001		< 0.005	
Sherman Lake	SW7 Sherman	8/21/1997	RR-0002-002			0.62		< 0.001		5.2		0.051								< 0.001		< 0.001		< 0.005	
Sherman Lake	SW8 Sherman	8/21/1997	RR-0002-003			0.6		< 0.001		5.2		0.051								< 0.001		< 0.001		< 0.005	
Sherman Lake	Sherman Lake SW6	10/1/2000	RR-0003-083					< 0	< 0	4.9	4.7	0.0479	0.0472			< 0.00005	< 0.0001	< 0	< 0	0.0004		< 0.0001	0.0005	0.01	0.025
Sherman Lake	Sherman Lake SW6 (Duplicate)	10/1/2000	RR-0003-085					< 0	< 0	4.9	4.8	0.0485	0.0495			< 0.00005	< 0.0001	< 0	< 0	0.0003		< 0.0001	0.001	0.015	0.031
Sherman Lake	Sherman Lake	9/20/2001	RR-0001-001			0.5	0.71	< 0.00001	< 0.00001	5	5	0.046	0.0461			< 0.0001	< 0.0001	0.0002	0.0002	< 0.01	< 0.01	< 0.001	< 0.001	< 0.001	< 0.001
Sherman Lake	Sherman Lake (Duplicate)	9/20/2001	RR-0001-002			0.49	0.72	< 0.00001	< 0.00001	5	5	0.0443	0.0444			< 0.0001	< 0.0001	0.0006	0.0002	< 0.01	< 0.01	< 0.001	< 0.001	< 0.001	< 0.001
Sherman Lake	Sherman Lake	8/12/2002	RR-0001-007			0.38	0.5	< 0.00001	< 0.00001	4	4	0.0439	0.0435			< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.01	< 0.01	< 0.001	< 0.001	0.004	0.005
Sherman Lake	Sherman Lake (Duplicate)	8/12/2002	RR-0001-008			0.38	0.5	< 0.00001	< 0.00001	4	4	0.0438	0.0434			< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.01	< 0.01	< 0.001	< 0.001	0.004	0.005
Sherman Lake	Sherman Lake	8/17/2003	RR-0002-030		44.8																				
Sherman Lake	Sherman Lake (Duplicate)	8/17/2003	RR-0002-031		43.9																				
Sherman Lake	Sherman Lake	8/17/2003	RR-0002-030			0.3	0.4	< 0.00001	< 0.00001	4	4	0.0427	0.0427			< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.01	< 0.01	< 0.001	< 0.001	< 0.001	< 0.001
Sherman Lake	Sherman Lake (Duplicate)	8/17/2003	RR-0002-031			0.3	0.39	< 0.00001	< 0.00001	4	4	0.0431	0.0426			< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.01	< 0.01	< 0.001	< 0.001	< 0.001	< 0.001
Sherman Lake	Sherman Lake	8/29/2004	RR-0002-034				0.47		< 0.00001		4		0.0423				< 0.0001		< 0.0001		< 0.01		< 0.001		< 0.001
Sherman Lake	Sherman Lake	8/29/2004	RR-0002-034			0.42		< 0.00001		4		0.0431				< 0.0001		< 0.0001		< 0.01		< 0.001		< 0.001	
Sherman Lake	Sherman Lake	8/29/2004	RR-0002-034		45.8																				
Sherman Lake	Sherman Lake	8/22/2005	RR-0002-041			0.294	0.358	< 0.00001	< 0.00001	4	4	0.0454	0.0482			< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.01	< 0.01	< 0.001	< 0.001	0.0028	< 0.001
Sherman Lake	Sherman Lake (Duplicate)	8/22/2005	RR-0002-042			0.309	0.354	< 0.00001	0.000017	3.9	4	0.0445	0.0477			< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.01	< 0.01	< 0.001	< 0.001	< 0.001	< 0.001
Sherman Lake	Sherman Lake	8/22/2005	RR-0002-041		44.3																				
Sherman Lake	Sherman Lake (Duplicate)	8/22/2005	RR-0002-042		43.6																				
Sherman Lake	Sherman Lake (Duplicate)	8/11/2006	RR-0002-055			0.361	0.387	< 0.00001	< 0.00001	4.9	4.3	0.0428	0.044			< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.01	< 0.01	< 0.001	< 0.001	0.0024	< 0.001
Sherman Lake	Sherman Lake	8/11/2006	RR-0002-054			0.365	0.49	< 0.00001	< 0.00001	4.8	4.8	0.0426	0.0431			< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.01	< 0.01	< 0.001	< 0.001	< 0.001	0.0021
Sherman Lake	Sherman Lake	8/11/2006	RR-0002-054		51.5																				
Sherman Lake	Sherman Lake (Duplicate)	8/11/2006	RR-0002-055		50.8																				
Sherman Lake	Sherman Lake	8/28/2007	RR-0002-063		42.5	0.188	0.25	< 0.00001	< 0.00001	4.1	4.13	0.042	0.0434									0.000126	0.000201	< 0.001	< 0.001
Sherman Lake	Sherman Lake (Duplicate)	8/28/2007	RR-0002-064		41.6	0.201	0.238	< 0.00001	< 0.00001	4.08	4.12	0.041	0.0415									0.000098	0.000156	< 0.001	< 0.001
Sherman Lake	Sherman Lake	8/27/2008	RR-0002-075		40.8	0.324	0.394	< 0.00001	< 0.00001	4.57	4.45	0.039	0.0389			< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.01	< 0.01	0.000064	0.000105	< 0.001	< 0.001
Sherman Lake	Sherman Lake	8/30/2009	RR-0002-084		41.3	0.44	0.489	< 0.00001	< 0.00001	4	3.9	0.0403	0.0421			< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.01	< 0.01	< 0.001	< 0.001	< 0.001	< 0.001
Sherman Lake	Sherman Lake	9/1/2011	RR-0002-097		40.6	0.306	0.367	< 0.00001	< 0.00001	4.08	4.04	0.041	0.0409			< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.01	< 0.01	0.000073	0.000122	< 0.001	< 0.001
Sherman Lake	Sherman 2014	8/6/2014	RR-0003-003		45	0.28	0.32	< 0.0001	< 0.0001	4.2	4.2	0.046	0.046	0.89	1	< 0	< 0	< 0.001	< 0.001	< 0.001	0.0011	< 0.001	< 0.001	< 0.003	0.0032
Sherman Lake	Sherman 17-6	9/11/2017	RR-0003-041				8		< 0.0001		3.4		0.061		2.9		< 0		< 0.001		0.11		0.0056		0.011
Sherman Lake	Sherman Lake (Duplicate)	9/17/2018	DUP1_20180917		49	0.47	0.54	< 0.00010	< 0.00010	4.4	4.4	0.043	0.051	0.84	1.0	< 0.00020	< 0.00020	0.0014	< 0.0010	< 0.0010	0.0015	< 0.0010	< 0.0010	< 0.0030	< 0.0030
Sherman Lake	Sherman Lake	9/17/2018	SW001_20180917_20180917		49	0.48	0.54	< 0.00010	< 0.00010	4.4	4.3	0.043	0.049	0.85	0.89	< 0.00020	< 0.00020	0.0015	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0030	< 0.0030
Sherman Lake	Sherman Lake	9/17/2018	SW002_20180917_20180917		52	0.47	0.53	< 0.00010	< 0.00010	4.4	4.4	0.043	0.049	0.86	0.87	< 0.00020	< 0.00020	0.0028	0.0030	< 0.0010	0.0014	< 0.0010	< 0.0010	< 0.0030	< 0.0030
Sherman Lake	Sherman Lake	9/17/2018	SW003_20180917_20180917		49	0.48	0.54	< 0.00010	< 0.00010	4.4	4.3	0.044	0.050	0.85	0.85	< 0.00020	< 0.00020	0.0049	0.0044	< 0.0010	0.0011	< 0.0010	< 0.0010	< 0.0030	< 0.0030
Sherman Lake	Sherman Lake	9/17/2018	SW004_20180917_20180917		49	0.50	0.55	< 0.00010	< 0.00010	4.3	4.3	0.043	0.049	0.85	0.87	< 0.00020	< 0.00020	0.0068	0.0039	< 0.0010	0.0012	< 0.0010	< 0.0010	< 0.0030	< 0.0030
Sherman Lake	Sherman Lake	9/17/2018	SW005_20180917_20180917		49	0.49	0.55	< 0.00010	< 0.00010	4.4	4.2	0.043	0.049	0.83	0.88	< 0.00020	< 0.00020	0.0048	0.0047	< 0.0010	0.0011	< 0.0010	< 0.0010	< 0.0030	< 0.0030
Sherman Lake	Sherman Lake	9/17/2018	SW006_20180917_20180917		49	0.50	0.56	< 0.00010	< 0.00010	4.4	4.3	0.043	0.049	0.88	0.81	< 0.00020	< 0.00020	0.0048	0.0046	< 0.0010	0.0012	< 0.0010	< 0.0010	< 0.0030	< 0.0030

Table C8

Historic Surface Water Analytical Results - General Metals (3 of 3)
Kwetı̨ı̨ɂà (Rayrock) Remediation Project
Public Services and Procurement Canada

Lake Group	Sample Location	Sample Date (mm/dd/yyyy)	Sample ID	Sample Depth (m below surface)	Hardness	Silicon		Silver		Sodium		Strontium		Sulfur, elemental		Thallium		Tin		Titanium		Vanadium		Zinc	
Sample Information				Parameter	(as CaCO3)	Metals																			
				Fraction		Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total
				Unit	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
				CCME Freshwater[1]	NG	NG	NG	NG	0.00025	NG	NG	NG	NG	NG	NG	NG	0.0008	NG	NG	NG	NG	NG	NG	NG	0.007
				Ontario, Provincial Water Quality Objectives, February, 1999[2]	NG	NG	NG	NG	0.0001	NG	NG	NG	NG	NG	NG	NG	0.0003 Interim	NG	NG	NG	NG	NG	0.006 Interim	NG	0.02 Interim
Alpha Lake																									
Alpha Lake	Alpha 79-1	6/15/1979	RR-0001-027																						
Alpha Lake	Alpha 79-1	6/15/1979	RR-0001-032		40						7.43														0.02
Alpha Lake	Alpha 79-1	7/13/1983	RR-0001-043																					< 0.005	< 0.005
Alpha Lake	Alpha 79-1	7/13/1983	RR-0001-044																					0.024	0.012
Alpha Lake	Alpha Lake 85	9/19/1984	RR-0001-023																						0.091
Alpha Lake	Alpha 05	7/18/1986	RR-0003-079																						< 0.015
Alpha Lake	SW5 Alpha	7/18/1986	RR-0003-080																						< 0.015
Alpha Lake	Alpha 79-1	7/20/1995	RR-0001-054						< 0.00001														< 0.001		**0.009**
Alpha Lake	SW5 Alpha	11/20/1996	RR-0001-064			1.1		< 0.001		19		0.07								0.001		< 0.001		< 0.005	
Alpha Lake	SW5 Alpha	8/21/1997	RR-0001-100			5.8		< 0.001		5.6		0.07								0.004		< 0.001		< 0.005	
Alpha Lake	SW5 Alpha	10/1/2000	RR-0003-081					< 0	< 0	4.2	5.8	0.0529	0.0644			< 0.00005	< 0.0001	0.0003	0.0026	0.0011		0.0002	0.0017	0.011	**0.108**
Alpha Lake	SW5 Alpha (Duplicate)	10/1/2000	RR-0003-082					< 0	< 0	4.1	4.4	0.0526	0.0552			< 0.00005	< 0.0001	< 0	< 0	0.0012		0.0002	0.0019	0.012	**0.11**
Alpha Lake	Lake Alpha	9/20/2001	RR-0001-003			0.3	0.63	< 0.00001	< 0.00001	5	5	0.0463	0.0469			< 0.0001	< 0.0001	0.0004	0.0002	< 0.01	< 0.01	< 0.001	< 0.001	< 0.001	0.002
Alpha Lake	Lake Alpha (Duplicate)	9/20/2001	RR-0001-004			0.31	0.65	< 0.00001	< 0.00001	5	5	0.0462	0.0457			< 0.0001	< 0.0001	0.0006	0.0009	< 0.01	< 0.01	< 0.001	< 0.001	< 0.001	< 0.001
Alpha Lake	Lake Alpha	8/12/2002	RR-0001-009			0.38	0.71	< 0.00001	0.00001	4	4	0.0451	0.0462			< 0.0001	< 0.0001	< 0.0001	0.0003	< 0.01	< 0.01	< 0.001	< 0.001	< 0.001	0.003
Alpha Lake	Lake Alpha (Duplicate)	8/12/2002	RR-0001-010			0.39	0.65	< 0.00001	< 0.00001	4	4	0.0446	0.0456			< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.01	< 0.01	< 0.001	< 0.001	< 0.001	0.001
Alpha Lake	Lake Alpha	8/17/2003	RR-0002-027		67																				
Alpha Lake	Lake Alpha	8/17/2003	RR-0002-027			0.44	0.64	< 0.00001	< 0.00001	5	5	0.0575	0.0535			< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.01	< 0.01	< 0.001	< 0.001	< 0.001	< 0.001
Alpha Lake	Lake Alpha	8/29/2004	RR-0002-035				0.81		< 0.00001		5		0.0468				< 0.0001		< 0.0001		0.01		< 0.001		0.006
Alpha Lake	Lake Alpha	8/29/2004	RR-0002-035			0.19		< 0.00001		5		0.0463				< 0.0001		< 0.0001		< 0.01		< 0.001		0.002	
Alpha Lake	Lake Alpha	8/29/2004	RR-0002-035		45.7																				
Alpha Lake	Alpha 05	7/3/2005	RR-0002-049			0.516	0.85	< 0.00001	< 0.00001	4.8	5	0.0441	0.0456			< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.01	< 0.01	< 0.001	< 0.001	< 0.001	0.0022
Alpha Lake	Alpha 05	7/3/2005	RR-0002-049		47.2																				
Alpha Lake	Lake Alpha	8/22/2005	RR-0002-043			0.123	0.266	< 0.00001	0.000013	4.2	5	0.047	0.0575			< 0.0001	< 0.0001	< 0.0001	0.00014	< 0.01	< 0.01	< 0.001	< 0.001	< 0.001	< 0.001
Alpha Lake	Lake Alpha	8/22/2005	RR-0002-043		46																				
Alpha Lake	Lake Alpha	8/11/2006	RR-0002-062			0.296	0.43	< 0.00001	< 0.00001	4.9	5.2	0.0473	0.0452			< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.01	< 0.01	< 0.001	< 0.001	< 0.001	0.002
Alpha Lake	Lake Alpha	8/11/2006	RR-0002-062		55.1																				
Alpha Lake	Lake Alpha	8/28/2007	RR-0002-065		45.4	0.103	0.197	< 0.00001	< 0.00001	4.53	4.44	0.0454	0.0446									0.000104	0.000191	< 0.001	< 0.001
Alpha Lake	Lake Alpha	8/27/2008	RR-0002-076		45.8	0.326	0.527	< 0.00001	< 0.00001	5.03	4.82	0.0445	0.0442			< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.01	< 0.01	0.000102	0.000192	< 0.001	< 0.001
Alpha Lake	Lake Alpha	8/30/2009	RR-0002-085		42.3	0.336	0.388	< 0.00001	< 0.00001	4.1	4.2	0.0425	0.0469			< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.01	< 0.01	< 0.001	< 0.001	< 0.001	< 0.001
Alpha Lake	Lake Alpha (Duplicate)	8/30/2009	RR-0002-086		42.5	0.322	0.457	< 0.00001	< 0.00001	4.1	4.1	0.0434	0.0459			< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.01	< 0.01	< 0.001	< 0.001	< 0.001	0.0012
Alpha Lake	Lake Alpha	9/1/2011	RR-0002-098		45.7	0.603	0.845	< 0.00001	< 0.00001	4.49	4.74	0.0487	0.0502			< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.01	< 0.01	0.000104	0.00023	< 0.001	< 0.001
Alpha Lake	Lake Alpha (Duplicate)	9/1/2011	RR-0002-099		45.7	0.619	0.854	< 0.00001	< 0.00001	4.49	4.72	0.0479	0.0496			< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.01	< 0.01	0.000101	0.000208	< 0.001	< 0.001
Alpha Lake	Lake Alpha	8/6/2014	RR-0003-005		49	0.23	0.21	< 0.0001	< 0.0001	4.4	4.4	0.048	0.05	1.1	1.1	< 0	< 0	< 0.001	< 0.001	< 0.001	0.0013	< 0.001	< 0.001	< 0.003	0.0059
Lake A																									
Lake A	Lake A 7W2	7/13/1983	RR-0001-047																					0.012	0.012
Lake A	Lake A 7W1	7/13/1983	RR-0001-048																					0.012	0.015
Lake A	Lake A 7W1	7/18/1986	RR-0003-076																						< 0.015
Lake A	Lake A 7W2	7/18/1986	RR-0003-077																						< 0.015
Lake A	Lake A 17-1	7/18/1986	RR-0003-078																						< 0.015
Lake A	Lake A W2	7/20/1995	RR-0001-055						< 0.00001														< 0.001		< 0.005
Lake A	SW11 Lake A	11/20/1996	RR-0001-073			0.85		< 0.001		18		0.058								< 0.001		< 0.001		< 0.005	
Lake A	SW11 Lake A	8/21/1997	RR-0002-006			0.77		< 0.001		5.2		0.051								< 0.001		< 0.001		< 0.005	
Lake A	Lake A 2014	8/6/2014	RR-0003-009		48	0.54	0.67	< 0.0001	< 0.0001	4.5	4.6	0.05	0.05	1	1.1	< 0	< 0	< 0.001	< 0.001	< 0.001	0.0032	< 0.001	< 0.001	< 0.003	< 0.003
Lake A	Lake A 17-1	9/14/2017	RR-0003-042				1.1		< 0.0001		5		0.05		1		< 0		< 0.001		0.0032		0.0012		< 0.003
Mill Lake																									
Mill Lake	Mill 9W1	7/13/1983	RR-0001-053																					0.019	**0.028**
Mill Lake	Mill W5	7/20/1995	RR-0001-057						< 0.00001														< 0.001		< 0.005
Mill Lake	SW3 Mill	11/20/1996	RR-0001-062			0.68		< 0.001		7.7		0.11								< 0.001		< 0.001		0.005	
Mill Lake	SW3 Mill	8/21/1997	RR-0001-098			0.22		< 0.001		2.5		0.1								< 0.001		< 0.001		< 0.005	
Mill Lake	Mill Lake	8/28/2007	RR-0002-068		85.1	0.187	0.193	< 0.00001	< 0.00001	2.33	2.29	0.107	0.107									0.000073	0.000087	< 0.001	< 0.001
Mill Lake	Mill Lake	8/27/2008	RR-0002-073		84.2	0.266	0.291	< 0.00001	< 0.00001	2.19	2.4	0.0993	0.0871			< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.01	< 0.01	0.000149	0.000072	0.0017	0.0036
Mill Lake	Mill Lake	8/30/2009	RR-0002-082		80.1	0.183	0.171	< 0.00001	< 0.00001	2.3	2.1	0.105	0.105			< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.01	< 0.01	< 0.001	< 0.001	< 0.001	< 0.001
Mill Lake	Mill Lake	8/31/2011	RR-0002-096		80.5	0.368	0.38	< 0.00001	< 0.00001	2.09	2.08	0.105	0.103			< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.01	< 0.01	< 0.001	0.000068	< 0.001	0.0039
Mill Lake	Mill Lake	8/6/2014	RR-0003-004		94	0.14	0.15	< 0.0001	< 0.0001	2.4	2.3	0.12	0.12	14	15	< 0	< 0	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.003	< 0.003
Mill Lake	Mill Lake	5/26/2017	RR-0003-032				0.53		< 0.0001		2.1		0.092		11		< 0		< 0.001		< 0.001		< 0.001		< 0.003
Mill Lake	Mill Lake (Duplicate)	9/17/2018	DUP2 20180917		81	0.21	0.24	< 0.00010	< 0.00010	2.1	2.1	0.083	0.098	12	12	< 0.00020	< 0.00020	0.0048	0.0016	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0030	< 0.0030
Mill Lake	Mill Lake	9/17/2018	SW007 20180917 20180917		81	0.21	0.25	< 0.00010	< 0.00010	2.1	2.0	0.084	0.098	12	12	< 0.00020	< 0.00020	0.0065	0.0038	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0030	< 0.0030
Mill Lake	Mill Lake	9/17/2018	SW008 20180917 20180917		78	0.22	0.26	< 0.00010	< 0.00010	2.0	2.0	0.091	0.098	12	11	< 0.00020	< 0.00020	0.0025	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0030	< 0.0030
Mill Lake	Mill Lake	9/17/2018	SW009 20180917 20180917		79	0.23	0.30	< 0.00010	< 0.00010	2.0	2.0	0.092	0.099	12	12	< 0.00020	< 0.00020	0.016	0.0090	< 0.0010	0.0013	< 0.0010	< 0.0010	< 0.0030	0.0045
Mill Lake	Mill Lake	9/17/2018	SW010 20180917 20180917		80	0.23	0.24	< 0.00010	< 0.00010	2.0	2.0	0.093	0.097	12	11	< 0.00020	< 0.00020	0.0047	0.0016	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0030	< 0.0030
Mill Lake	Mill Lake	9/17/2018	SW011 20180917 20180917		81	0.21	0.24	< 0.00010	< 0.00010	2.1	2.1	0.084	0.099	12	12	< 0.00020	< 0.00020	0.0052	0.0049	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0030	< 0.0030
Mill Lake	Mill Lake	9/17/2018	SW012 20180917 20180917		81	0.21	0.25	< 0.00010	< 0.00010	2.0	2.1	0.084	0.10	12	12	< 0.00020	< 0.00020	< 0.0010	0.012	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0030	< 0.0030
Mill Lake	Mill Lake	9/17/2018	SW013 20180917 20180917		81	0.21	0.24	< 0.00010	< 0.00010	2.1	2.1	0.084	0.099	12	11	< 0.00020	< 0.00020	0.0075	0.0056	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0030	< 0.0030
Mill Lake	Mill Lake	9/17/2018	SW014 20180917 20180917		81	0.21	0.23	< 0.00010	< 0.00010	2.0	2.1	0.084	0.099	12	12	< 0.00020	< 0.00020	0.0093	0.0081	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0030	< 0.0030
Mill Lake	Mill Lake	9/17/2018	SW015 20180917 20180917		81	0.20	0.23	< 0.00010	< 0.00010	2.0	2.1	0.084	0.10	12	12	< 0.00020	< 0.00020	0.0046	0.0020	< 0.0010	0.0012	< 0.0010	< 0.0010	< 0.0030	< 0.0030
Mill Lake	Mill Lake	8/3/2019	ML SW009 1.5 20190803																						
Mill Lake	Mill Lake	8/3/2019	ML SW010 3.0 20190803																						
Mill Lake	Mill Lake	2/8/2020	ML SW 20200208 VC06		89	0.3	0.38	<0.00010	<0.00010	2.3	2.4	0.1	0.095	13	13	<0.00020	<0.00020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0030	0.0038

Notes:

NG = No Guideline
[1] Canadian Council of Ministers of the Environment, Canadian Environmental Quality Guidelines, Freshwater Aquatic Life On-Line, Accessed 18.10.28
[2] Ontario, Provincial Water Quality Objectives, February, 1999 (data only compared to in absence of CCME guideline)
[3] Guideline concentration varies with hardness
1001 Bold/Red font indicates reported concentration greater than CCME Freshwater Guideline
2001 Bold font indicates reported concentration greater than Ontario PWQO (where no CCME guideline exists only)
<0.01 Grey font indicates circumstance where the laboratory's minimum detection limit is greater than the referenced CCME or MOE guideline

Table C9

Historical Laboratory Analytical Results - Physical Anions
Kwetı̨ı̨ɂà (Rayrock) Remediation Project
Public Services and Procurement Canada

Sample Information			Parameter	Color	Total Suspended Solids	Total Dissolved Solids	Specific Conductivity	Turbidity	Total Organic Carbon	Alkalinity, Total (As CaCO3)	Alkalinity (PP as CACO3)	Bicarbonate (as CaCO3)	Carbonate (as CaCO3)	Dissolved Chloride	Dissolved Sulphate	Fluoride	Ammonia (as N) Total	Nitrate (as N)	Nitrite (as N)	Nitrate (Dissolved)	Dissolved Nitrite (NO2)	Nitrate + Nitrite (as N)	Hydroxide (OH)
			Unit	tcu	mg/l	mg/l	us/cm	ntu	%	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
			CCME Freshwater[1]	NG	5	NG	NG	2	NG	NG	NG	NG	NG	120	NG	0.12	NG	13	0.06	3	NG	NG	NG
Lake Group	Sample Location	Sample Date (mm/dd/yyyy)	Sample ID																				
New Control Lake																							
New Control Lake	Control Lake 85	7/13/1983	RR-0001-052				60																
New Control Lake	Control Lake 85	11/20/1996	RR-0001-060					0.11									0.05					0.06	
New Control Lake	Control Lake 85	11/20/1996	RR-0001-061					0.12									0.09					0.01	
New Control Lake	Control Lake 85	1/30/1997	RR-0001-081		2																		
New Control Lake	SWNC2 New Control	8/21/1997	RR-0001-096														0.08					< 0.01	
New Control Lake	SWNC2 New Control (Duplicate)	8/21/1997	RR-0001-097														0.07					< 0.01	
New Control Lake	SWNC2 New Control	8/29/2004	RR-0002-038		10		111																
New Control Lake	SWNC2 New Control	8/22/2005	RR-0002-045														0.0413						
New Control Lake	SWNC2 New Control	8/22/2005	RR-0002-045	26.4	< 3	75	103	2.16		58.7				1.16	2.46	0.089		< 0.005	< 0.001				
New Control Lake	SWNC2 New Control	8/11/2006	RR-0002-059														0.029						
New Control Lake	SWNC2 New Control	8/11/2006	RR-0002-059	24.8	3	75	97.1	3.35		46.2				1.05	2.41	0.074		< 0.005	< 0.001				
New Control Lake	SWNC2 New Control	8/28/2007	RR-0002-069	18.2	3.5	67	104			54.6				1.11	2.27	0.083	0.045	< 0.005	< 0.001				
New Control Lake	SWNC2 New Control	8/27/2008	RR-0002-080	18.5	4.3	80	115			57.8				1.14	2.31	0.088	0.0307	< 0.005	< 0.001				
New Control Lake	SWNC2 New Control	8/30/2009	RR-0002-089	15.1	< 3	87	111			49.8		49.8	< 1	1.07	3.9	0.085	0.0359	< 0.005	< 0.001				< 1
New Control Lake	SWNC2 New Control	8/30/2011	RR-0003-002		4.7	89	122			61.8		61.8	< 1	1.32	3.63	0.093	0.0166	< 0.005	< 0.001				< 1
New Control Lake	SWNC2 New Control	8/6/2014	RR-0003-008		10	76	140			69	< 0.5	85	< 0.5	2	2.8			0.016	< 0.033			0.016	< 0.5
		Average (Post 2000 - Select Parameters)				78	113			57					2.8								
Sherman Lake																							
Sherman Lake	Sherman 79-2	6/15/1979	RR-0001-033						0.0013	49				7.2	8			< 0.01	< 0.01				
Sherman Lake	Sherman 79-5	6/15/1979	RR-0001-034						0.0011	49				7.2	9			< 0.01	< 0.01				
Sherman Lake	Sherman 79-10	6/15/1979	RR-0001-035						0.0012	51				7.1	8			< 0.01	< 0.01				
Sherman Lake	Sherman Lake NE	6/15/1979	RR-0001-036						0.0012	51				7.1	8			< 0.01	< 0.01				
Sherman Lake	Sherman 6W1	7/13/1983	RR-0001-045				110																
Sherman Lake	Sherman Lake NE	7/13/1983	RR-0001-046				110																
Sherman Lake	Sherman Lake SW6	11/20/1996	RR-0001-065					0.32									0.06					< 0.01	
Sherman Lake	SW7 Sherman	11/20/1996	RR-0001-066					0.32									0.08					0.02	
Sherman Lake	SW8 Sherman	11/20/1996	RR-0001-067					0.34									0.12					0.04	
Sherman Lake	SW8 Sherman	11/20/1996	RR-0001-068					0.35									0.02					< 0.01	
Sherman Lake	SW8 Sherman (Duplicate)	11/20/1996	RR-0001-069					0.27									0.04					0.01	
Sherman Lake	Sherman Lake SW6	1/30/1997	RR-0001-085		< 1																		
Sherman Lake	SW7 Sherman	1/30/1997	RR-0001-086		< 1																		
Sherman Lake	SW8 Sherman	1/30/1997	RR-0001-087		< 1																		
Sherman Lake	SW8 Sherman	1/30/1997	RR-0001-088		< 1																		
Sherman Lake	SW8 Sherman (Duplicate)	1/30/1997	RR-0001-089		< 1																		
Sherman Lake	Sherman Lake SW6	8/21/1997	RR-0002-001														0.09					< 0.01	
Sherman Lake	SW7 Sherman	8/21/1997	RR-0002-002														0.1					< 0.01	
Sherman Lake	SW8 Sherman	8/21/1997	RR-0002-003														0.12					< 0.01	
Sherman Lake	Sherman Lake	8/17/2003	RR-0002-030		6		105																
Sherman Lake	Sherman Lake (Duplicate)	8/17/2003	RR-0002-031		< 3		105																
Sherman Lake	Sherman Lake	8/29/2004	RR-0002-034		< 3		107																
Sherman Lake	Sherman Lake	8/22/2005	RR-0002-041														0.052						
Sherman Lake	Sherman Lake	8/22/2005	RR-0002-041	13.7	4.3	65	102	1.62		48.6				2.76	3.26	0.176		< 0.005	< 0.001				
Sherman Lake	Sherman Lake (Duplicate)	8/22/2005	RR-0002-042														0.053						
Sherman Lake	Sherman Lake (Duplicate)	8/22/2005	RR-0002-042	13	< 3	67	104	1.51		51.4				2.76	3.22	0.175		< 0.005	< 0.001				
Sherman Lake	Sherman Lake	8/11/2006	RR-0002-054														0.075						
Sherman Lake	Sherman Lake	8/11/2006	RR-0002-054	13.1	< 3	69	96.5	2.62		44.4				2.59	2.91	0.163		< 0.005	< 0.001				
Sherman Lake	Sherman Lake (Duplicate)	8/11/2006	RR-0002-055														0.179						
Sherman Lake	Sherman Lake (Duplicate)	8/11/2006	RR-0002-055	13.3	3.5	65	101	2.63		43.3				2.81	2.9	0.111		< 0.005	< 0.001				
Sherman Lake	Sherman Lake	8/28/2007	RR-0002-063	9.1	< 3	63	103			44				2.38	3.01	0.157	< 0.005	< 0.005	< 0.001				
Sherman Lake	Sherman Lake (Duplicate)	8/28/2007	RR-0002-064	9.6	3	65	101			45.3				2.46	3.13	0.163	0.024	< 0.005	< 0.001				
Sherman Lake	Sherman Lake	8/27/2008	RR-0002-075	11.6	3.3	66	105			45.7				2.3	2.91	0.153	0.027	< 0.005	< 0.001				
Sherman Lake	Sherman Lake	8/30/2009	RR-0002-084	9	< 3	64	100			43.5		43.5	< 1	2.14	3.07	0.158	0.0247	< 0.005	< 0.001				< 1
Sherman Lake	Sherman Lake	9/1/2011	RR-0002-097		< 3	63	96.5			44.9		44.9	< 1	2.01	2.74	0.161	0.0121	< 0.005	< 0.001				< 1
Sherman Lake	Sherman 2014	8/6/2014	RR-0003-003		1.3	54	100			49	< 0.5	60	< 0.5	1.9	1.9			< 0.044	< 0.033			< 0.01	< 0.5
Sherman Lake	Sherman 17-6	9/11/2017	RR-0003-041		9.3																		
Sherman Lake	Sherman Lake (Duplicate)	9/17/2018	DUP1_20180917		3.3	56	110	1.5		52	< 1.0	63	< 1.0	2.0	1.1			< 0.010	< 0.010	< 0.044	< 0.033	< 0.014	< 1.0
Sherman Lake	Sherman Lake	9/17/2018	SW001_20180917_20180917		2	56	110	1.4		52	< 1.0	63	< 1.0	2.1	1.3			< 0.010	< 0.010	< 0.044	< 0.033	< 0.014	< 1.0
Sherman Lake	Sherman Lake	9/17/2018	SW002_20180917_20180917		2	58	110	1.3		52	< 1.0	63	< 1.0	2.1	1.4			< 0.010	< 0.010	< 0.044	< 0.033	< 0.014	< 1.0
Sherman Lake	Sherman Lake	9/17/2018	SW003_20180917_20180917		2.7	57	110	1.4		53	< 1.0	65	< 1.0	2.1	1.2			< 0.010	< 0.010	< 0.044	< 0.033	< 0.014	< 1.0
Sherman Lake	Sherman Lake	9/17/2018	SW004_20180917_20180917		2.7	56	110	1.5		52	< 1.0	64	< 1.0	2.1	1.1			< 0.010	< 0.010	< 0.044	< 0.033	< 0.014	< 1.0
Sherman Lake	Sherman Lake	9/17/2018	SW005_20180917_20180917		2.7	56	110	1.5		52	< 1.0	64	< 1.0	2.0	1.1			< 0.010	< 0.010	< 0.044	< 0.033	< 0.014	< 1.0
Sherman Lake	Sherman Lake	9/17/2018	SW006_20180917_20180917		2.7	56	110	1.2		51	< 1.0	63	< 1.0	1.7	1.2			< 0.010	< 0.010	< 0.044	< 0.033	< 0.014	< 1.0
		Average (Post 2000 - Select Parameters)				61	105			48					2.2								

Table C9

Historical Laboratory Analytical Results - Physical Anions
Kwetı̨ı̨ɂà (Rayrock) Remediation Project
Public Services and Procurement Canada

Sample Information			Parameter	Color	Total Suspended Solids	Total Dissolved Solids	Specific Conductivity	Turbidity	Total Organic Carbon	Alkalinity, Total (As CaCO3)	Alkalinity (PP as CACO3)	Bicarbonate (as CaCO3)	Carbonate (as CaCO3)	Dissolved Chloride	Dissolved Sulphate	Fluoride	Ammonia (as N) Total	Nitrate (as N)	Nitrite (as N)	Nitrate (Dissolved)	Dissolved Nitrite (NO2)	Nitrate + Nitrite (as N)	Hydroxide (OH)
			Unit	tcu	mg/l	mg/l	us/cm	ntu	%	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
			CCME Freshwater[1]	NG	5	NG	NG	2	NG	NG	NG	NG	NG	120	NG	0.12	NG	13	0.06	3	NG	NG	NG
Lake Group	Sample Location	Sample Date (mm/dd/yyyy)	Sample ID																				
Alpha Lake																							
Alpha Lake	Alpha 79-1	6/15/1979	RR-0001-032						0.0012	49				7.2	9			< 0.01	< 0.01				
Alpha Lake	Alpha 79-1	7/13/1983	RR-0001-043				120																
Alpha Lake	Alpha 79-1	7/13/1983	RR-0001-044				140																
Alpha Lake	SW5 Alpha	11/20/1996	RR-0001-064					0.76									0.05					< 0.01	
Alpha Lake	SW5 Alpha	1/30/1997	RR-0001-084		2																		
Alpha Lake	SW5 Alpha	8/21/1997	RR-0001-100														0.16					< 0.01	
Alpha Lake	Lake Alpha	8/17/2003	RR-0002-027		< 3		152																
Alpha Lake	Lake Alpha	8/29/2004	RR-0002-035		39		109																
Alpha Lake	Alpha 05	7/3/2005	RR-0002-049		< 3		111																
Alpha Lake	Lake Alpha	8/22/2005	RR-0002-043														0.084						
Alpha Lake	Lake Alpha	8/22/2005	RR-0002-043	17.5	< 3	67	108	2.14		49.4				2.69	3.88	0.181		< 0.005	< 0.001				
Alpha Lake	Lake Alpha	8/11/2006	RR-0002-062														0.017						
Alpha Lake	Lake Alpha	8/11/2006	RR-0002-062	22.9	4.5	69	104	2.76		45.5				2.45	3.1	0.17		< 0.005	< 0.001				
Alpha Lake	Lake Alpha	8/28/2007	RR-0002-065	14.3	< 3	68	104			46.2				2.44	3.49	0.168	0.036	< 0.005	< 0.001				
Alpha Lake	Lake Alpha	8/27/2008	RR-0002-076	19.5	< 3	80	119			57				2.28	3.26	0.156	0.0546	< 0.005	< 0.001				
Alpha Lake	Lake Alpha	8/30/2009	RR-0002-085	12.3	< 3	67	103			43.9		43.9	< 1	2.07	3.23	0.161	0.0273	< 0.005	< 0.001				< 1
Alpha Lake	Lake Alpha (Duplicate)	8/30/2009	RR-0002-086	11.6	< 3	65	102			43.2		43.2	< 1	2.09	3.27	0.163	0.0278	< 0.005	< 0.001				< 1
Alpha Lake	Lake Alpha	9/1/2011	RR-0002-098		< 3	76	108			49.4		49.4	< 1	2.18	3.83	0.168	0.0285	< 0.005	< 0.001				< 1
Alpha Lake	Lake Alpha (Duplicate)	9/1/2011	RR-0002-099		< 3	74	108			48.6		48.6	< 1	2.23	3.94	0.169	0.0287	< 0.005	< 0.001				< 1
Alpha Lake	Lake Alpha	8/6/2014	RR-0003-005		< 1	56	110			51	< 0.5	62	< 0.5	2.1	1.8			< 0.044	< 0.033			< 0.01	< 0.5
		Average (Post 2000 - Select Parameters)				69	112			48					3.3								
Lake A																							
Lake A	Lake A 7W2	7/13/1983	RR-0001-047				140																
Lake A	Lake A 7W1	7/13/1983	RR-0001-048				140																
Lake A	SW11 Lake A	11/20/1996	RR-0001-073					0.53									0.11					0.01	
Lake A	SW11 Lake A	8/21/1997	RR-0002-006														0.15					< 0.01	
Lake A	Lake A 2014	8/6/2014	RR-0003-009		5.3	56	110			50	< 0.5	61	< 0.5	2.5	1.9			< 0.044	< 0.033			< 0.01	< 0.5
Lake A	Lake A 17-1	9/14/2017	RR-0003-042		6																		
		Average (Post 2000 - Select Parameters)				56	110			50					1.9								
Mill Lake																							
Mill Lake	Mill 9W1	7/13/1983	RR-0001-053				180																
Mill Lake	SW3 Mill	11/20/1996	RR-0001-062					0.25									0.09					0.02	
Mill Lake	SW3 Mill	1/30/1997	RR-0001-082		1																		
Mill Lake	SW3 Mill	8/21/1997	RR-0001-098														0.07					< 0.01	
Mill Lake	Mill Lake	8/28/2007	RR-0002-068	6.3	< 3	107	189			46.4				< 0.5	43.8	0.098	0.03	< 0.005	< 0.001				
Mill Lake	Mill Lake	8/27/2008	RR-0002-073	10.1	< 3	118	189			47				< 0.5	43.1	0.087	0.0211	< 0.005	< 0.001				
Mill Lake	Mill Lake	8/30/2009	RR-0002-082	6.7	< 3	111	171			42.2		42.2	< 1	< 0.5	37	0.089	0.0117	< 0.005	< 0.001				< 1
Mill Lake	Mill Lake	8/31/2011	RR-0002-096		< 3	123	179			47.6		47.6	< 1	< 0.5	40	0.086	0.014	< 0.005	< 0.001				< 1
Mill Lake	Mill Lake	8/6/2014	RR-0003-004		1.3	110	200			51	< 0.5	63	< 0.5	< 1	44			< 0.044	< 0.033			< 0.01	< 0.5
Mill Lake	Mill Lake	5/26/2017	RR-0003-032		2																		
Mill Lake	Mill Lake (Duplicate)	9/17/2018	DUP2_20180917		1.3	98	170	0.62		48	< 1.0	59	< 1.0	< 1.0	36			< 0.010	< 0.010	< 0.044	< 0.033	< 0.014	< 1.0
Mill Lake	Mill Lake	9/17/2018	SW007_20180917_20180917		2.7	99	170	0.51		49	< 1.0	60	< 1.0	< 1.0	37			< 0.010	< 0.010	< 0.044	< 0.033	< 0.014	< 1.0
Mill Lake	Mill Lake	9/17/2018	SW008_20180917_20180917		2.7	95	170	0.45		45	< 1.0	55	< 1.0	< 1.0	36			< 0.010	< 0.010	< 0.044	< 0.033	< 0.014	< 1.0
Mill Lake	Mill Lake	9/17/2018	SW009_20180917_20180917		15	96	170	0.54		47	< 1.0	57	< 1.0	< 1.0	36			< 0.010	< 0.010	< 0.044	< 0.033	< 0.014	< 1.0
Mill Lake	Mill Lake	9/17/2018	SW010_20180917_20180917		1.3	98	170	0.61		49	< 1.0	60	< 1.0	< 1.0	37			< 0.010	< 0.010	< 0.044	< 0.033	< 0.014	< 1.0
Mill Lake	Mill Lake	9/17/2018	SW011_20180917_20180917		1.3	98	170	0.53		50	< 1.0	61	< 1.0	< 1.0	36			< 0.010	< 0.010	< 0.044	< 0.033	< 0.014	< 1.0
Mill Lake	Mill Lake	9/17/2018	SW012_20180917_20180917		2.7	96	170	0.53		46	< 1.0	56	< 1.0	< 1.0	36			< 0.010	< 0.010	< 0.044	< 0.033	< 0.014	< 1.0
Mill Lake	Mill Lake	9/17/2018	SW013_20180917_20180917		2	98	170	0.63		49	< 1.0	60	< 1.0	< 1.0	36			< 0.010	< 0.010	< 0.044	< 0.033	< 0.014	< 1.0
Mill Lake	Mill Lake	9/17/2018	SW014_20180917_20180917		2	97	170	0.73		47	< 1.0	57	< 1.0	< 1.0	36			< 0.010	< 0.010	< 0.044	< 0.033	< 0.014	< 1.0
Mill Lake	Mill Lake	9/17/2018	SW015_20180917_20180917		1.3	98	170	0.52		49	< 1.0	60	< 1.0	< 1.0	36			< 0.010	< 0.010	< 0.044	< 0.033	< 0.014	< 1.0
Mill Lake	Mill Lake	8/3/2019	ML_SW009_1.5_20190803		6	110	170	1.1	7.7	48	< 1.0	58	< 1.0	< 1.0	38			< 0.010	< 0.010	< 0.044	< 0.033	< 0.014	< 1.0
Mill Lake	Mill Lake	8/3/2019	ML_SW010_3.0_20190803		2	110	170	1.0	7.0	46	< 1.0	56	< 1.0	< 1.0	37			0.015	< 0.010	0.067	< 0.033	.015	< 1.0
Mill Lake	Mill Lake	2/8/2020	ML_SW_20200208_VC06		2.2	110	200	-	-	64	< 1.0	78	< 1.0	< 1.0	49			0.011	< 0.010	0.050	< 0.033	< 0.014	< 1.0
		Average (Post 2000 - Select Parameters)				104	175			48					38.0								

Notes:

NG = No Guideline
[1] Canadian Council of Ministers of the Environment, Canadian Environmental Quality Guidelines, Freshwater Aquatic Life On-Line, Accessed 18.10.28
1001 Bold/Red font indicates reported concentration greater than CCME Freshwater Guideline
2001 Bold font indicates reported concentration greater than Ontario PWQO (where no CCME guideline exists only)
<0.01 Grey font indicates circumstance where the laboratory's minimum detection limit is greater than the referenced CCME or MOE guideline

Table C10

Materials Summary

Kwetı̨ı̨aà (Rayrock) Remediation Project
Public Services and Procurement Canada

Feature	Description	Contaminants of Concern	Quantity (m3 unless shown otherwise) Soil/Rock	Metal (Non Haz)	Debris (Non-Haz)	Metal (Haz (LBP))	Debris (Haz (ACM) or Other)	Borrow Soil	Material Destination On-Site	Off-Site	Data Source/ Basis for Estimate	Data Confidence Very Low +/- 500%	Low +/-100%	Med +/-50%	Med-High +/-20%	High +/-10%	Actions Needed for Data Refinement
Rayrock																	
Mill Lake	Organic Sediment (Dewatered)	Uranium	29160						X		Assume lake surface area of 36,000 m2 Assume organic sediment thickness of 2.7 m Assume 30% Solids		X	X			Repeat AECOM 2018 survey to provide an additional data set to verify quantity and reduce uncertainty Conduct lake bottom sub profiling survey
Mill Lake	Water in Lake (static)	Uranium, copper, TSS	122760							X	Assume lake surface area of 36,000 m2 Assume organic sediment thickness of 2.7 m Assume 70% Water, average water depth 2.6 m			X			Geotechnical/filter and consolidation testing in the detailed design.
Mill Lake	Blast Rock (New Blast)	None	5700						X		Preliminary engineering calculations (CAD)			X			Number will be refined during engineering design
Mill Pad + Near Adit	Waste Rock	Uranium, other metals	2,000 - 68,000						X		Different quantities provided in different reports. 68,000 assumed to be much too high, likely closer to 2,000 - 4,000 m3 Survey required	X					Conduct detailed site assessment with professional survey crew accompanied by environment lead
Mill Pad + Roadways	Spilled Tailings/Waste Rock Mix	Metals	7500						X		Preliminary calculations as shown on Figure 11 of RAP (9,000 m3) less 1,500 m3 allocated to waste rock			X			Conduct detailed site assessment with professional survey crew accompanied by environment lead Assume 100% use of readily available material and will be placed in cell
Near Mill Pad	Impacted Soil (PHCs)	PHCs	X						X		Soil quantity contained in data summarized on Figure 11			X			Conduct detailed site assessment with professional survey crew accompanied by environment lead Assume 100% use of readily available material and will be placed in cell
Near Mill Pad	Impacted Soil (ACM)	ACM	X						X		Soil quantity contained in data summarized on Figure 11; no differentiation in soil currently made.						Conduct detailed site assessment with professional survey crew accompanied by environment lead Assume 100% use of readily available material and will be placed in cell
Waste Storage Area	Stockpiled Material	None known		50 m3					X		Gross approximation based on photographs. Material can be surveyed on site.	X					Conduct detailed site assessment with professional survey crew accompanied by environment lead Assume 100% use of readily available material and will be placed in cell
Waste Storage Area	Material in Crates (16 ACM, 4 LBP)	ACM, LBP				4000 kg	8000 kg			X	Arcadis reports document materials placed into crates - 16 crates for ACM with content assumed to be 500 kg/crate and 4 crates for metals assumed to be 1,000 kg/crate			X			Crates will be inventoried in 2020. Weights will not likely be determined with accuracy.
Sherman Lake Camp	Waste at the 12 camp sites located on the peninsula in Sherman Lake included drums, pails, cans, stoves, tar paper, wash basins, ammunition box, metal toys, milk pitcher, water jugs, pots, white enamel dishes, shingles, rolled roofing material, remnants of old shacks and miscellaneous metal debris; Waste at the three drum locations included 205 L drums (24 in total), cans and a pail; Waste at the location of Borehole #6 Bedrock included cans, pots and empty ammunition box, wash basin and tin sheeting; and additional wastes at a camp site on the north side of Sherman Lake, west of Mill Creek included stoves, pots, cans, pails, tins, a screen, tar paper, bed springs, wash basin and approximately 20 m of cable. Hazardous waste – small quantity of potential asbestos shingles	ACM					25 kg			X	Visual inspection - Arcadis site walk through		X				No further action may be required other than written description
Vent Raises	Miscellaneous non hazardous debris noted during 2019 inspections; fencing may be disposed of subsequent to capping	None		24	1					X	Assume 1 m3/side of chain link fence x six raises; <1 m3 of other debris						
Adit	The mine adit is closed																
General Site	Concrete Foundations	None	650						X		Concrete has been measured in place.						Variations will not be significant with respect to scope of project
Clay Borrow	Sediment Containment Unit/ Containment Cell	None						24960			<u>Preliminary Quantity</u> 8,000 m x 0.5 m Clay Base 36 m2 wall x 90m/wall x 4 walls 8,0000 m2 x 1 m (avg) cap			X			Engineering Design

Table C10

Materials Summary

Kwetı̨ ı̨aà (Rayrock) Remediation Project
Public Services and Procurement Canada

Feature	Description	Contaminants of Concern	Quantity (m3 unless shown otherwise) Soil/Rock	Metal (Non Haz)	Debris (Non-Haz)	Metal (Haz (LBP))	Debris (Haz (ACM) or Other)	Borrow Soil	Material Destination On-Site	Off-Site	Data Source/ Basis for Estimate	Data Confidence Very Low +/- 500%	Low +/-100%	Med +/-50%	Med-High +/-20%	High +/-10%	Actions Needed for Data Refinement
Clay Borrow	Site Grading - Mill Lake	None						5000			Ballpark estimate			X			Engineering Design
Satellite Sites																	
TED Site	One empty, intact 205 L drum; Two smaller rusted fuel containers (20 L volume); Several stoves and pieces of stove pipe and other general metal; Small quantity of potential ACM shingles (0.5 kg or less); Sparse metal cans (100 or less); Small quantities of plastic refuse and general trash (3 to 4 garbage bags); and Approximately 200 rusty nails where the structure used to stand.				3		1			X	Arcadis Remedial Options Report, AECOM site visit						Variations will not be significant with respect to scope of project
MK Site	Two empty, intact 205 L drums; Hosing and one piece of sheet metal; Sparse metal cans (100 or less); and Small quantities of plastic refuse and general trash (1 to 2 garbage bags).				2					X	Arcadis Remedial Options Report, AECOM site visit						Variations will not be significant with respect to scope of project
CA Site	Heavily decomposed railway ties; a few metal drill rods and scrap metal; and sparse metal cans (50 or less).Large number of "Esso" fuel cans in the camp area (15-30 cans); Several sheets of steel metal and one metal jerry can (approximately 15 L); Sparse metal cans (100 or less); and A drill rod and other metal objects.				3					X	Arcadis Remedial Options Report, AECOM site visit						Variations will not be significant with respect to scope of project
GS Site	Six wooden structures along with small volume of potential ACM shingles (3-5 kg); Multiple metal drill rods, old stove and sheet metal; Large volume of metal cans (300-400); and Small, 5 L cans of "Esso" fuel in drilling areas. Metal-Impacted soil – two areas (1 and 2 m3) impacted with antimony and/or cadmium				3					X	Arcadis Remedial Options Report, AECOM site visit						Variations will not be significant with respect to scope of project
REX	Small quantities of debris (primarily metal) found on site at various locations				2					X	Columbia Environmental Consulting Ltd., AECOM site visit						Variations will not be significant with respect to scope of project
Sun Main/ Sun East																	
Shaft	Metal chain link fence and material covering shaft will require disposal			6						X	Assume 1 m3/side of chain link fence x six raises; <2 m3 of other debris						
Waste Rock Pile WR1			1200						X		Survey				X		Quantity has some variability due to location along hillside; further survey not
Waste Rock Pile WR2			100						X		Survey				X		Quantity has some variability due to location along hillside; further survey not
Waste Rock Pile WR3			100						X		Survey				X		Quantity has some variability due to location along hillside; further survey not
Exploration Working BP1			2						X		Hand measurements				X		Quantity has some variability due to location along hillside; further survey not
Exploration Working BP2			1						X		Hand measurements				X		Quantity has some variability due to location along hillside; further survey not
Exploration Working BP3			2						X		Hand measurements				X		Quantity has some variability due to location along hillside; further survey not
Exploration Working BP4			16						X		Hand measurements				X		Quantity has some variability due to location along hillside; further survey not
General Site	Loose and disturbed soil near mine shaft, powerhouse and former oil tank	PHC, PAH and metals impact	20						X		Quantity unclear in existing reports	X					Site reconnaissance in 2020 to estimate quantity of soil
General Site	Minor amounts of debris present at site.									X	Quantities unknow - expected to be low	X					Site investigations will assist in 2020 to inventory
Borrow Soil								1500			Gross calculation with a cover area of 1500 m2 x 1 m thick						Engineering calculations required
Other																	
Power Line	Wooden Poles						40 Poles			X	Approximate count from 2018 AECOM field report.			X			Site investigations in 2020 will include a recount
Power Line	Waste observed during the aerial survey included a stove, loose wire on the ground and wire reels.										Unknown quantity						Site investigations in 2020 may assist in approximating/

Table C10

Materials Summary

Kwetį į aà (Rayrock) Remediation Project
Public Services and Procurement Canada

Feature	Description	Contaminants of Concern	Quantity (m3 unless shown otherwise)						Material Destination		Data Source/ Basis for Estimate	Data Confidence					Actions Needed for Data Refinement
			Soil/Rock	Metal (Non Haz)	Debris (Non-Haz)	Metal (Haz (LBP))	Debris (Haz (ACM) or Other)	Borrow Soil	On-Site	Off-Site		Very Low +/- 500%	Low +/-100%	Med +/-50%	Med-High +/-20%	High +/-10%	
Barge Landing	Waste at the Wharf Area included a car battery, discarded drums, metal frame, cans, dock anchors, wharf timbers, rock cribbing, stoves and miscellaneous metal debris; Waste on the south side of the Landing included approximately 100 cans and one 205 L empty drum; Waste at the trailer area on the north side of the road included four empty 205 L drums; Waste along the lake shore area included cans, steel rollers, pails, empty 205 L drums, wood skids/skis with metal binders, a very small piece of gasket material and miscellaneous metal debris; and Waste at the Tank Area included one 205 L drum, cans, pails, and miscellaneous metal debris.				5		5 kg				Arcadis site report						Variations will not be significant with respect to scope of project
Barge Landing	Impacted Soil										Soil testing required in 2020 to determine presence or absence	X					Site investigations will assist in 2020 to identify

Waste wood not shown since it is expected to be reused during reclamation (unless shown otherwise)
Debris quantities may contain metal

Imagine it.
Delivered.

Appendix D

RAYROCK (Kwetıı̨ɂaà) REMEDIATION PROJECT

REMEDIAL ACTION PLAN (RAP) – 90% WORKOUT

June 29-30th, 2020 (GoTo Virtual Meeting)

Agenda

Participants:

CIRNAC
- Siobhan Sutherland; Project Analyst and Project Technical Office Representative, CIRNAC-NCSP
- Ron Breadmore; Project Manager, CIRNAC-CARD
- Andrew Richardson; Project Officer, CIRNAC-CARD
- George Lafferty; Community Consultation Officer, CIRNAC-CARD
- Jaqueline Mo; Communications Officer

PSPC – Rebecca Studer-Halbach

AECOM – Joel Nolin, Rob McCullough, Denise Raidich, Mike Sanborn

DXB Consulting – Dave Bynski

Tłıchǫ Government
- Violet Camsell-Blondin
- Longinus Ekwe

Firelight Consulting – Ginger Gibson, Janelle Kuntz, Kalene Gould, Gabe Mahamad

Fielding Environmental – Regan Fielding

CNSC – Dana Pandolfi

Day 1

Opening Prayer

George Lafferty - Tłıchǫ people love their land and we hope we have good meetings and that land and water will be discussed in detail

Opening Comments

- great Technical Session on June 25th
- upcoming MAA process by the Tłıchǫ
- RAP finalization in July…
- these are busy times but we are making amazing progress, despite challenges
- we need to get a strong understanding of technology and options
- this is not a typical or a formal KEC engagement, but we'll move ahead
- agenda overview

1. RAP Overview -AECOM Presentation:

. 75% Recap
. 90% RAP Overview
. Technical Session Recap and Inputs

Questions and Answers:

Q1. Volume of sediment in Mill Lake; how much is there and what is ratio of sediments vs other materials to be managed? This will impact the size of the CDF

A1. The in-situ sediments = 97,000 m3. Waste rock volumes still being confirmed; materials balance still needs to be refined; following final survey this year, sediments should prove out at about 30-35%

Q2. What is the availability of borrow material at Sun Rose?

A2. Borrow is hard to come by and it will be important to keep the footprint small to minimize borrow requirements; quality is similar to what we see at Rayrock

Q3. How deep are the trenches at Sun Rose?

A3. They're really just shattered areas

Q4. Trenches are typically, 3-5 deep. Are there deeper trenches at Rex?

A4. At REX, yes; exploration workings at Sun Rose can be described as shallow scars in the bedrock; exploration working #1 has a total surface area of 3 m2 and is 0.7m deep.

Discussion on borrow sites and material

- important to scope in all these borrow locations now (primary + contingencies, on site at Rayrock and Sun Rose off-site on Tlicho lands); volumes and setbacks are critical for LUP application; all areas have to be well defined for Supplemental Archy Assessment
- for a number of our projects, we have had issues with borrow volumes, quality, sedimentation
- Lessons Learned from other projects will need to go into our application; e.g. Tundra borrows were larger than remediation footprint

Q5. Should GPR + test pitting be considered to confirm borrow quantities, etc.?

A5. Test pitting may be sufficient in areas of shallow overburden; the areas have to be walked; it is possible to tie in some geophysics; GPR in clay has limitations; a lot of the signal can get absorbed; experience at Tundra; almost as big as remediation footprint

Q6. Do current borrow volume estimates show that there is enough borrow material available to meet the larger volumes of borrow material required for construction outside the Mill Lake Basin?

A6. Our estimates indicate there is enough borrow/fill material

Q7. The clean sediments (clay) in Mill Lake; could we use any of that material for cover?

A7. We had same question but it has not yet been evaluated thoroughly; We plan to complete some sub-bottom profiling in Mill Lake which will help refine volumes; if we were to use clean sediments for the cover, we would still need to drain the lake in order to do so?
Discussion on use of clean sediments:

- sub-bottom profile (acoustic method) being proposed may not be able to get down to bedrock; we do not know how thick that clay layer is yet; the technology is a bit of an unknown
- wet clays would not be easy to use; would likely need to be dried
- sediments would likely be best for use within the lake itself
- we might be able to use top meter; we would still need to drain, especially if digging holes

Discussion on Pros and Cons of Mill Lake options:

- a “Pro” for draining the lake is reduced monitoring cost; you’ll need to monitor site in perpetuity to ensure lake remains free-draining … this could be difficult
- other alternatives allow for complete de-watering
- letting the lake re-fill may be a positive (Pro), not a Con; maybe dry wastes could go into the Containment Disposal Facility (CDF) or be managed in another facility; a dry and wet disposal facility could be created
- dry disposal will help compress the wet (geotubes)
- another facility means more monitoring
- CDF size will be based on sediment volume; waste rock doesn’t really add volume it fills voids and makes CDF higher
- Waste rock volumes currently estimated at 68,000 m3 (high end) with approximately 30-40,000 m3 co-mingled tailings/waste rock

Q8. Does the proposed CDF location create possible adit drainage issue? If so, could flow be routed around cell?

A8. There has been no adit draining to date; drainage swales could be designed in; it is a valid concern; there will be some drainage; detailed design will need to evaluate potential for drainage issue

Supplemental question

Q. Will waste rock and tailings need to go into the CDF or if they can be disposed of in a separate facility?

A. Two cells would require significantly more borrow material than one. The footprint of the CDF is based on the sediment volume only. Depending on volume, the waste rock/tailings may make the CDF higher but are unlikely to increase the area we require
Discussion on CDF location and drainage:

- They are typically free draining; they can drain or freeze year by year
- settling pond could be used at toe for catchment
- there is potential for waste rock leaching
- we need to eliminate erosion
- seasonal drainage not yet noted, but over long-term, if ice plug melts out, we could look at other controls such as thermosyphons
- depends on flow volume and depth; flow might be too shallow for thermosyphons to be effective; might need a hybrid and maybe additional cover; would need power for a hybrid
- this has come up at Gordon Lake Group Remediation, where we had a ground collapse due to drainage

Q9. From the 75% RAP workout, we understood that the KEC elders were not concerned with draining of Mill Lake; did the elders express concern over losing lake in 2019? Was it raised in 2019 TK Report?

A9. We're just trying to see both sides of discussions

Discussion on Mill Lake location for CDF:

- this could form part of discussions on Thursday (values)
- Mill Lake basin for CDF has advantages in that it gives secondary containment during and post-remediation; allows us to respond to issues if they should arise; if Long Term monitoring were to show an issue in water quality outside of Mill Lake in future, you've have to try to sort out source
- Mill Lake drainage is well understood; we are trying to protect Sherman; we need to keep outflow within those known flow paths
- risk of re-mobilization of contaminants if lake re-filled; would be reduced if sediments were removed (scraped) under winter program
- there's a risk of release during the movement of sediments
- especially at airstrip location; risk of line break is high and clean up could be complicated

Discussion on Power Line

- power line history is new as of this winter; 2020 field assessment will give us better idea of the scale of the impacts; there is potential for PAH-impacted soils at the Barge Landing; we haven't yet discussed remedial options but assuming excavation and removal off-site; lower risk along corridor than barge landing; risk is likely to be related to creosote
- for creosote impacted poles on DEW line sites, we wrapped and landfilled; they were not classified as hazardous materials; old railroad bridges heavily built with creosote
- they might be used as a levelling base for the filled geo-tubes
  the entire pole may not be impacted; might just be the base (6')

LUNCH

Discussion on elder's position on Mill Lake:

- The Tłı̨chǫ has been talking with Joe Rabesca lately; we might ask him to call in tomorrow; he will be part of MAA discussions on July 2nd

Q10. There are hot spots from spills from old transportation route; it was raised as concern in the first TK Study ("Trees Turned to Wood"); have those hot spots been looked at?

A10. The Mapping Exercise with elders in 2012 looked at this issue (hot spots); a gamma survey had been planned in 2010 but could not be carried out (sections under water)

Q11. Would a gamma survey work under snow (winter program)?

A11. Winter survey wouldn't be effective; snow provides a barrier; might only see highest readings
Q12. Transportation Route and hotspots was flagged in Dene Nation work; maybe the Elders who commented in old TK study could be asked to recall that input; maybe we could have elders interviewed and we could ask if route could be surveyed?

A12. CIRNAC would certainly support the work; you need qualified person to operate meter

Discussion on Tłı̨chǫ capacity and training:

- Radiation safety training is required to operate meter
- Radiation Safety Institute of Canada does offer some on-line training, but it is limited; mostly for lab workers and Radiation Safety Officer
- CNSC does have some informative videos; we recommend that the Licensee have put together a training plan in place, especially as you get closer to remediation
- This was an issue in past with improper meter use; need to understand how meter works; Rayrock doesn't have same levels as the Saskatchewan sites (Cluff, Gunnar)
- BEAHR students may be interested
- CIRNAC will provide examples from Gunnar or Cluff for community-based training if possible to share; some are proprietary and cannot be shared; a lot of information sits with NRCan

2. Multiple Accounts Analysis - AECOM Presentation

Q13. – There were lost economics for the Tłı̨chǫ on original remediation; because of fears over radiation, the Dogrib Rae Band didn't submit a bid on the work and it went to Hay River; we heard that the workers had to wear special gear (moon suits); with new technology and our understanding of risks, the Tłı̨chǫ wants the bulk of the final remediation work; can we have special priority?; this was raised recently by Tłı̨chǫ Investment Corporation and the Hwy 3 upgrade, Frank Channel bridge … how does Canada recognize Economic Measures under Chapter 26 of Tlicho Final Agreement?

A13. Government of Canada's Procurement Policy requires that this be a public tender; GOC has taken steps to increase Indigenous opportunities and recognizes the Tłı̨chǫ Final Agreement as highlighted in recent discussions with Tłı̨chǫ leadership over past 2 years

Discussions on procurement strategy:

- Low complexity work can be directed to TEES
- Bigger work would be public tender with Indigenous Opportunities component
- Canada will be talking more as we move through design process
- Canada will upload copy of the February PowerPoint to BIM
- Tłıchǫ labour force must be used; we required specialized training; we are seeking this through CIRNAC
- CARD will provide links from CNSC and Radiation Safety Institute of Canada; the HAZWOPER training has a radiation safety component; education and training is big part of capacity building
- AECOM did a 1/2 day safety discussion with significant portion spent discussing the radiation safety aspects for the winter work; this was very well received by the Tłıchǫ wildlife monitors

Q14. – On your bullet "acceptance of new mines"; is that for Sun Rose or others?

A14. – This is a general statement for all NWT mines; if Canada-Tłıchǫ can't come up with a final remediation plan for Rayrock, it might be a sore spot for the industry

Discussion on NWT Mining Industry:

- Uranium project was proposed along north shore of GSL (Lutselk'e) a few years ago but due to concerns from Baker Lake, the project was turned down; maybe there was not enough knowledge and education in community
- Under Environment and Sustainability criteria, some of this discussion will come out in the Tłıchǫ's MAA, but there's a lot of water quality data out there
- CIRNAC contributed to WLWB's Jessica Pacayuen research paper last year (meta data status in region); we will follow up with her and report back to group
- Design needs to consider climate change; Recent release of Rae sewage lagoon due to ice plug melting out; DPW and MACA coming into repair the area; a new road has to be built; you see the dips in highway where permafrost has melted away; DOT presented on this at Geoscience a couple of years ago

3. Remedial Options – AECOM Presentation:

Option 1 - In situ Stabilization and On-Site Disposal

- This option didn't score through

Option 2 – Surcharge Sediments in Place and Cover in Place (2a Summer / 2b Winter)

- The Tłıchǫ attended a project management workshop last year on ARD at Wrigley
- There's no mine there, how can there be ARD?
- Due to climate change; the ARD is melting out of the glacier and permafrost
- Alt 2a and 2b were scored through in the MAA. This option didn't score through

Option 3 – Chemical/Physical Sediment Treatment and On-site Disposal

- we wanted to see if we could we work with sediments while they were frozen
- similar situation at Ekati Mine with waste rock piles; had to find a unique cover for those piles

- this is why we considered bringing in polymer

Option 4a – Hydraulic Sediment Pumping + Solidification + On-Site Disposal

- no discussion

Option 4b - Frozen Sediment Excavation + Solidification + On-site Disposal

- we can work year round
- MAA gave us a good score

Option 4c - Frozen Sediment Excavation (top 0.5m) + Solidification + On-site Disposal

- there are constructability challenges
- would need GPR unit to try to keep 0.5m depth during the dig; there's increased chance of error
- upper layer is so light, how will we know if we haven't pulled some of that down into lower layers? What if water samples come back with increases? How can we explain that the increases are ok?
- this option wasn't carried through the MAA

Discussion on sediments:

- we need everyone to understand that the sediments have a very low solids content
- once water is removed, we might have 50-80cm overall sediment depth
- there's no technology that can slice off the upper 10cm of that…

Q15. - This is the option that IPRP gave direction on to go after; what are your thoughts?

A15. - Technically, we can't see how this will work; we can't get separation in solution; the solution sat for 2 months without separation; only with the polymer were able to get separation; trying to excavate the upper few centimeters would just make a mess

Q16. - So we've pushed as far as we can go? Do we put an X through this option now?

A17. – We're going to sample further to confirm this summer; we understand the approach that IPRP is suggesting; on a similar project in Halifax, where we had to do a 15cm scrape off PCB-impacted sediments; we went to 20cm and were able to get clean boundaries; in Mill Lake, we don't know where the high Uranium concentrations sit in the upper layer of sediments; it might be mid-point or at bottom; we just don't know

Q18. – Is it possible the IPRP didn't have a chance to process all the new information in the feasibility study?

A18. – Possibly. CIRNAC will follow up and confirm prior to their review

Q19. Is Mill Lake Uranium risk "high, medium or low"?

A19. There are different Uranium complexes with different minerals; this can change its bioavailability

Q20. - What was the name of the polymer that tested well? When you increase salinity, can it give colloidal results?

A20. – For the anionic polymer, there was no impact on solution; we tried another with anionic polymer and a cationic polymer with a filter press; we will follow up on name of product

Q21. - Are there other international Uranium projects where they are looking at same issues?

A21. – We have excavated frozen sediments; we have experience with different contaminants; Mill Lake is nothing new; we just need to pull the options together into a Rayrock context; Uranium is not the issue; it's the organic content

Discussion on sediments:

- the Slave Geologic Province is unique; very old, some rocks are in Smithsonian; our elders speak of these rocks; back in the day of the Prophet EhtsÀe
- this is why this discussion is so important

Option 5 – Hydraulic Sediment Pumping + Geo-tube Dewatering + Solidification + On-site Disposal

- this is a hybrid option now
- we can pump down the lake
- we can float Toyo pumps onto lake and pump sediment into geo-tubes
- the geo-tubes let the water out and keep sediments back

Q22. – Is base preparation required for the geo-tubes?

A22. – We're putting an aqua-dam at mouth of sidewall and the island; we'll pump all sediment out and then look at lake bottom; we could lay waste rock and geo-synthetic/grid down as base

Q23. - What kind of tolerance do we have on the geo-tube material? Is it puncture proof? What if there were ½ m rock points jutting out of lake bed?

A23. – We'd have to prepare the base and create a mostly flat surface angled for drainage; the geo-tubes are tough (they typically have an inner and outer tube) but if bedrock was rough, we would just lay down some geogrid or waste rock

Q24. – What about temperature sensitivity? Any concerns with geo-tubes and winter application?

A24. – We can use under Rayrockconditions; the sub-bottom survey in 2020 will help us confirm placement

Option 6 – Hydraulic Sediment Pumping + Mechanical Dewatering + Solidification + On-site Disposal

- this option made it through MAA but it didn't score high

Option 7 – Monitored Natural Attenuation (do nothing)

- included only for comparison

Remedial Options Summary Discussions**:**

- AECOM has been invited to join the Tłıchǫ this Thursday

- Firelight has been flagging the alternatives to present to the TG and their elders
- this level of detail is good for the TG's Technical Team; we need to get down to a few options for the updates to the elders; we'll need to spend some for preparation of deck for Thursday
- our MAA will have different criteria and weighting
- you seem convinced in bags standing up to freeze/thaw and northern climate

Q25. - What is shelf life on the geo-tubes?

A25. - We have them in local mines in the NWT, including Tundra (above tree line); they have not been used in High Arctic; we used them at Willow Creek (Ft Simpson); they are tough and we do have containment in Mill Lake; the geo-tubes are sacrificial since they will be placed in the disposal cell (they could even be cut open)

Discussion on geo-tubes:

- at Tundra they were used to filter out sludge from water treatment process; they are not containment; they are like big "coffee filters"
- once they're drained, you can stack them, side-side; they are very versatile

Q26. - For optimization of the CDF placement, to the N/NE of mill pad, there's a bedrock knob that goes out to point, there's a bit of a bench there; would you have enough room to pull water down and work there?

A26. - We know that area and we did measure it; it's not big enough for the geo-tubes and water treatment, but we can look at it again

4. Summary of Remedial Options – Pros and Cons

Option 1 - In situ Stabilization and On-Site Disposal

PROS	CONS
	sediments have very high water content
	even built up with 30% Portland, sediments still wouldn't hold weight
	would need 2000+ truckloads of Portland

- OUT

Option 2 – Surcharge Sediments in Place and Cover in Place (2a Summer / 2b Winter)

2a Summer

PROS	CONS
similar approach used at Sydney Tar Ponds	sediments are soft; we would need to dewater the whole time we surcharge
low constructability risk	summer program would be messy; run off and sediment control

2b Winter

PROS	CONS
easy to construct in winter	unsure on how it will behave in future summers
can be done (and is being done), i.e., transporting materials to site on a winter road	

- IN

Option 3 – Chemical/Physical Sediment Treatment and On-site Disposal

PROS	CONS
	lots of material required; 750+ trucks
	winter road window and truck availability

- OUT

Option 4a – Hydraulic Sediment Pumping + Solidification + On-Site Disposal

PROS	CONS
	high risk pumping and constructability
	needs many truckloads

- OUT

Option 4b - Frozen Sediment Excavation + Solidification + On-site Disposal

PROS	CONS
moderate constructability risk	

- IN

Option 5 – Hydraulic Sediment Pumping + Geo-tube Dewatering + Solidification + On-site Disposal

PROS	CONS
proven technology	
can get down to 20-30% solids with 1 freeze cycle (we will bench scale test summer)	
Toyo pumps are proven in this application	
low tech	

- IN

Option 6 – Hydraulic Sediment Pumping + Mechanical Dewatering + Solidification + On-site Disposal

PROS	CONS
	Involves hydraulic pumping and dredging
	Would need to put mudcat on sediments
	High constructability risk (high tech, mechanical, skilled operators)

Q27. - For Options 5 and 6, is the dredging the same in each?

A27. – Option 5 pumps and Option 6 dredges

- Toyo can pump up to 10% solids
- Taking a dredge to Rayrock is a big risk (high tech) - we need low tech

Option 7 – Monitored Natural Attenuation (do nothing)

PROS	CONS
Low effort	Keeps us monitoring forever
	Admin Controls post closure are not popular with the Tłı̨chǫ
	Doesn't align well with Remedial Objectives)

- a good basis to compare to other options
- we kept in for scoring
- we asked ourselves "Is this still worth carrying through as it won't meet our remedial objectives"?
- we did keep it in ultimately
- the Conceptual Site Model allows for leaving sediments in place
- we would likely have same levels of Uranium in lake as it decants; not sure if we have full limnological understanding of Mill Lake; we don't know if it turns over; the sediment concentrations could remain there forever

5.Multiple Accounts Analysis

Discussion

- Options 3, 4B, 5 and 6 were the top 4
- Socio-EC and Technical have higher weighing and we considered this going in

Q28. - For last slide; cost is given 20% weighting; Ian H recommended doing both cost and non-cost analysis; taking costs out might tip an option to a higher value

A28. – Even if cost was removed, we expect that 4B and 5 would still give is us higher technical score; and will be doing a hybrid of the two; these options also gave the highest scores on Socio Ec and Technology

Q29. - Explain the weighting on different categories (0-2)

A29. - The weighting reflects the relative level of importance of each criterion; for example, adding in community-based research opportunity as suggested by CIRNAC is nice to have (given a 0.5) but not as important as other criterion such as constructability and worker safety (given a 2); we need the option to be constructible with priority on worker safety

- We're looking at options through quantitative and qualitative lens
- Bottom line will be community acceptance
- The Tłıchǫ won't compromise water, land and lives
- If we don't have community support, we don't have anything
- The Environmental Sustainability is our footprint
- Socio-Economic opportunities come from the Remediation and monitoring

Q30. - Why did Option 5 get a lower score (2)

A30. This is a typo; we want it to be protective and it IS (ref. Radar Plot slide)

Discussion

- The Radar Plot shows a skew towards Options 4B and 5
- 4B and 5 score high on each of the categories; a negative value might be helpful
- With respect to effectiveness vs cost effectiveness, you can see how 4B and 5 hit on each of those
- For Tłıchǫ MAA exercise, let's present only the top 3 options only (+ Alt 7?) and the radar plot
- You won't find any Indigenous people who will compromise environment; mining companies develop a site and build their cash flows; we need to do a good job on the remediation; GNWT needs to accept the finished site as well; CIRNAC will need to develop a cash flow to manage project; at Devolution, the GNWT didn't want to accept liability on these sites
- The tailings will remain a federal responsibility; rest of site will get handed over eventually
- The Tłıchǫ are considering just 3 options for our MAA; your Socio-Ec is your judgement; community judgement may be different
- We are drawing on past project experience, including engagement, and we're looking for something we can build in the north; constructability is a big factor
- Some of the constructability is specialized and would rule out the use of local labour
- For the Tłıchǫ MAA, you may want to consider leaving in Option 7 as a means as comparison in addition to the 3 options you're considering

6. Summary Discussions

- From discussions today, there seems to general alignment on MAA and options
- We need to focus effort on Mill Lake
- We'll set placeholders for the options, using options matrix from 50% matrix
- If required, Technical Teams can re-convene after the Tłı̨chǫ MAA exercise
- It's been a good day; the Tłı̨chǫ feels comfortable and getting the "2 Joes" (Cowboy Joe Mantla and Joe Rabesca) involved will help our discussions; Joe Rabesca's experience goes back to Colomac days

Day 2 – June 30, 2020

Housekeeping – Firelight

Opening Prayer – Violet Camsell Blondin

Opening Comments

- Great discussion yesterday on options and how we landed there thru the MAAprocess
- Today, we wanted to pick up on those discussions, recap the current and upcoming MAA approaches and possible areas for alignment
- There are no presentations; we have decks from AECOM and TG ready for reference as needed

- We then want to look at the revised Remedial Options Matrix and:
  -> validate 50% RAP options
  -> populate Mill Lake Options
  -> populate Power line Options

1. Summary of key points from Day 1

- Adit drainage for discussion during Tłı̨chǫ MAA (not a MAA input; a design consideration)
- Inclusion of Option 7 for comparison during Tłı̨chǫ MAA
- The Tłı̨chǫ are developing a set of criterion based on AECOM, but will incorporate TG values; working on ideas now for debriefing the KEC
- The issue of removing Uranium-impacted sediments came up yesterday; our understanding is that they need to be managed on site
- CNSC's WNSL for Rayrock allows CIRNAC to possess, manage, and monitor on site; there is no allowance for removal off-site; a special transport permit would be required; it would be difficult to approve

Discussion on Remediation Approaches:

- The site must be safe, post remediation
- The CDF needs to be distinct so as to prevent future use/disturbance
- TG wants to get direction from the Elders regarding what the landform should looks like and that it is important to be able to use Tlicho oral history for risk communication
- Surface water will need to be diverted around facility
- CIRNAC does have a Closure Process and once a site is remediated, a File Notation is placed with our Lands Department for future development
- Closure Process not always effective and the Tłı̨chǫ may want to bring that to their MAA
- We may need to look at Admin Controls and how they fit with our remedial options

2. Remedial Options Selection

- 50% RAP options are reviewed and validated in the revised matrix
- 75% and 90% status pre-populated by Rebecca with additional columns to right for new entries

Mine Openings

- Rayrock mine openings are more than just vent raises; they include the adit as well and we will need WSCCclearance for the existing backfill

Q31. - Sun Rose shaft option; have these caps been used on other projects; can there be leakage?

A31. - Nothing currently in place for monitoring; we should monitor for 1 season and set as our baseline; this will give us something to measure future cap performance against; CNSC recommends 3 months at least; there could be worker safety issues while working in/close to shaft; long term data would be good and there is no radon or geotechnical data at Sun Rose

Power Line

- PAH soils and PAH poles now added; assessment planned for summer 2020
- remediation may include excavation and removal
- might have to monitor areas where access not possible
- very little soil in these areas, unlikely that we will find impacted soil near poles.

Non-Hazardous Wastes

Q32. Sun Rose non-hazardous waste down shaft; is the Tłı̨chǫ OK with this formof disposal?

A32. Sounds ok but concerned about barge landing

Q33- Are there still docks at Barge Landing?

A33. - Some cribbing, a few rails; no docking

Q34. - Are there shoreline impacts at barge landing?

A34. - Soil sampling has been completed and there are no impacts, small exceedances; no staining; PAH question still not known and will be assessed this summer

Q35. – In early work at Rayrock, George Mackenzie's grandfather was concerned about site runoff and downstream impacts; have there been SNP stations downstream of Rayrock and Sun Rose?

A35. – There are numerous monitoring stations historically and the current plan is to use previously sampled locations.

Q36. - Chief Football is concerned about cancer in communities and some KEC members concerned about their health currently and want to pull out of KEC; we are understanding WQ and flow off-site now; how about air quality?

A36. – Sun Rose monitoring in Chico and lakes below dome were favourable; no exceedances and HHERA raised no issues

Discussions around surface hydrology:

- assessment confirms that Mill Lake is hydraulically isolated from local groundwater
- CIRNAC has created a water quality map for all sites in Google Maps
- maps are helpful for the elders and the Boards
- Arcadis 2018 map traces flow from Gamma Lk to Lake B

Q37. - With regards to the Sun main road, 2 out 3 three samples collected were determined to be potentially acid generating, but with variable leaching potential of metals, and a low leaching potential for uranium specifically. Is the road a risk?

A37. – Overall, the waste rock has a high neutralizing potential and is not deemed a risk

Discussion on “blast pits”

Terminology being revised to more accurately describe the areas. “Exploration showings” is expected to be a translation challenge, so we settled on “exploration workings”

3. Summary Discussions and Next Steps

- Finalize Remedial Options Matrix
- Get status on the Tłıchǫ MAA in Thursday and meet again (both Technical Teams) if need be
- On the 90% RAP review, CNSC is good with a 2 weeks turn around; ESD needs to be informed

Closing Prayer – George Lafferty

- CIRNAC has duty to consult and must satisfy the Tłıchǫ Agreement
- Water/land/animals importance to the Tłıchǫ and KEC members
- Some KEC members have worked at site; Phillip Huskey, Louis Zoe, Joe Black, Noel Drybones, all worked there and would like to see mine remediated; even Jimmy B said he would like to use the land again
- some elders tasted fish with us at Rayrock and were not concerned
- John B Zoe was part of 2014 meetings and he was concerned about past consultations and shares concern over land and waters
- The Tłıchǫ now has good consultants with Firelight and Fielding, who are working well with the team; looking forward to working together

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