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

Government of Northwest Territories | Gouvernement des Territoires du Nord-Ouest

GIANT MINE REMEDIATION PROJECT

Water Management and Monitoring Plan

Version 1.0

January 2019

306-Water Mgmt Plan-53-RPT-0001-Rev2_20181214 (Water Mgmt Plan)

PLAIN LANGUAGE SUMMARY

The Giant Mine (Site) is located within the City of Yellowknife boundary, approximately 1.5 kilometres (km) from the community of Ndilǫ and 9 km from the community of Dettah (Figure 1.1-1). The Site is situated on Commissioner's Land administered by the Government of the Northwest Territories (GNWT). A Reserve (R622T) has been established to allow for the implementation of the remediation of the Site. Subsurface mineral rights are under federal jurisdiction and were withdrawn by Order in Council SI/2005-55 on 15 June 2005.

The Site produced gold from 1948 until 1999 and ore for off-Site processing from 2000 until 2004. In 1999, the owner of the Site went into receivership; care, custody, and control of the Site was transferred to Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) and the GNWT. Ongoing care, maintenance and remediation of the Site is known as the Giant Mine Remediation Project (GMRP). For a more detailed history of the Giant Mine and water management activities during that time, please refer to Section 3 of the Closure and Reclamation Plan (CRP) (CIRNAC and GNWT 2019a).

This Water Management and Monitoring Plan (Water MMP) identifies and describes the water management systems at the Site in support of the Water Licence Application MV2007L8-0031, as a complement to the CRP, and to meet the requirements of Schedule 4 of the Post-Environmental Assessment information package request (MVLWB 2014).This Water MMP encompasses water management at the Site as it moves from the existing conditions into the active remediation/adaptive management phase and post-closure phase. This Water MMP also includes applicable monitoring programs, contingency planning, and reporting requirements.

The sequence of remediation activities presented herein is subject to change as a result of procurement and contractor timelines. Updates to the Water MMP will be ongoing through the life of the GMRP as outlined herein to provide more details on future water management, as remediation moves forward.

REVISION HISTORY

Version	Date Issued	Revision No.	Description of Revision	Page No.	Reviewed By
1.0	January 2019	0	Initial draft of plan		

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List of Acronyms and Abbreviations

Acronym/Abbreviation	Definition
AANDC	Aboriginal Affairs and Northern Development Canada
AECOM	AECOM Canada Ltd.
AEMP	Aquatic Effects Monitoring Program
bgs	below ground surface
CCME	Canadian Council of Ministers of the Environment
CIRNAC	Crown-Indigenous Relations and Northern Affairs Canada
CRP	Closure and Reclamation Plan
DAR	Developer's Assessment Report
DFO	Fisheries and Oceans Canada
e.g.	for example (Latin: exempli gratia)
EA	Environmental Assessment
ECCC	Environment and Climate Change Canada
EEM	Environmental Effects Monitoring
ENR	Environment and Natural Resources (GNWT)
EQC	Effluent Quality Criteria
ETP	Effluent Treatment Plant (existing)
GMRP	Giant Mine Remediation Project
GNWT	Government of the Northwest Territories
Golder	Golder Associates Ltd.
HDPE	High-Density Polyethylene
INAC	Indigenous and Northern Affairs Canada
L	level within the underground mine
masl	metres above sea level
MCM	Main Construction Manager
MDMER	Metal and Diamond Mining Effluent Regulations
MVLWB	Mackenzie Valley Land and Water Board
MVEIRB	Mackenzie Valley Environmental Impact Review Board
n/a	not applicable
NT	Northwest Territories
NWT	Northwest Territories
OMP	Operational Monitoring Program
OMS Manual	Operation, Maintenance and Surveillance Manual
PMP	Probable Maximum Precipitation
PMSA	Probable Maximum Snow Accumulation
POPC	parameter of potential concern
PSPC	Public Services and Procurement Canada
Report of EA	Report of Environmental Assessment and Reasons for Decision
RISS	Regulatory Information Submission System
SDE	Surface Design Engagement
SNP	Surveillance Network Program
SOP	Standard Operation Procedures
SRK	SRK Consulting Inc.
TBD	to be determined
TCA	Tailings Containment Area
TSS	total suspended solids
Water MMP	Water Management and Monitoring Plan
WSC	Water Survey of Canada
WTP	Water Treatment Plant (future)

List of Units and Symbols

Unit/Symbol	Definition
%	percent
<	less than
°	degree (angle)
°C	degrees Celsius
#	number
%	percent
µg/L	micrograms per litre
Bq/L	bequerel per litre
cm	centimetre
g	gram
hp	horsepower
km^2	square kilometre
km	kilometre
L	litre
L/s	litres per second
m^3	cubic metre
m^3/s	cubic metres per second
m^3/mon	cubic metres per month
m	metre
masl	metres above sea level
mg/L	milligrams per litre
mg-N/L	milligrams nitrogen per litre
mg	milligram
mL	millilitre
ML	megalitre
mm	millimetre
s	second
YK	Yellowknife
yr	year

Underground Mine Elevation Conversion Chart

Mine Level and Other Relevant Areas	Elevation at C Shaft (above mean sea level (amsl)
C Shaft collar	173
A2 rim spill point	162
Great Slave Lake	156-157
100 Level	137
250 Level	83
425 Level	33
575 Level	-13
750 Level	-67
Current managed minewater elevation	-77
Bottom of C Shaft	-474

Note: The elevation of tracked mine levels is provided in the table is measured at C-shaft; there is variation in elevation in the tracked underground development openings (e.g. levels) as they grade towards from C-shaft for drainage purposes.

1 INTRODUCTION

1.1 Background

The Giant Mine (Site) is located within the City of Yellowknife boundary, approximately 1.5 kilometres (km) from the community of Ndilǫ and 9 km from the community of Dettah (Figure 1.1-1). The Site is situated on Commissioner's Land administered by the Government of the Northwest Territories (GNWT). A Reserve (R622T) has been established to allow for the implementation of the remediation of the Site. Subsurface mineral rights are under federal jurisdiction and were withdrawn by Order in Council SI/2005-55 on 15 June 2005.

The Site produced gold from 1948 until 1999 and ore for off-Site processing from 2000 until 2004. In 1999, the owner of the Site went into receivership; care, custody, and control of the Site was transferred to Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) and the GNWT. Ongoing care, maintenance and remediation of the Site is known as the Giant Mine Remediation Project (GMRP). For a more detailed history of the Giant Mine and water management activities during that time, please refer to Section 3 of the Closure and Reclamation Plan (CRP) (CIRNAC and GNWT 2019a).

Minewater is sourced from the underground mine, which is pumped year-round, as required, to the surface into the Northwest Pond to maintain the water level in the underground mine at an elevation well below the arsenic storage chambers. This mitigates the potential for flooding of the chambers, which could potentially result in the release of arsenic-laden groundwater to the environment. This mitigation will change as part of the remediation of the Site and water management in the future will pump minewater from the underground mine directly to the future Water Treatment Plant (WTP).

This Water Management and Monitoring Plan (Water MMP) focuses on water management from the commencement of Site remediation until the completion of reclamation activities.

The Water MMP is organized as follows:

- Section 1 presents the purpose, scope, objectives and strategies of this Water MMP
- Section 2 provides relevant background on the GMRP
- Section 3 describes the regulatory background to the Project
- Section 4 describes the existing water management infrastructure, including its purpose and operational management
- Section 5 describes planned water management activities and infrastructure, including its purpose and operational management, during remediation
- Section 6 describes the remaining water management activities and infrastructure post-closure
- Section 7 presents the derived Site-wide water balance
- Section 8 presents a summary of monitoring programs
- Section 9 presents a summary of contingencies
- Section 10 describes reporting requirements
- Section 11 presents the review and evaluation mechanism of this Water MMP

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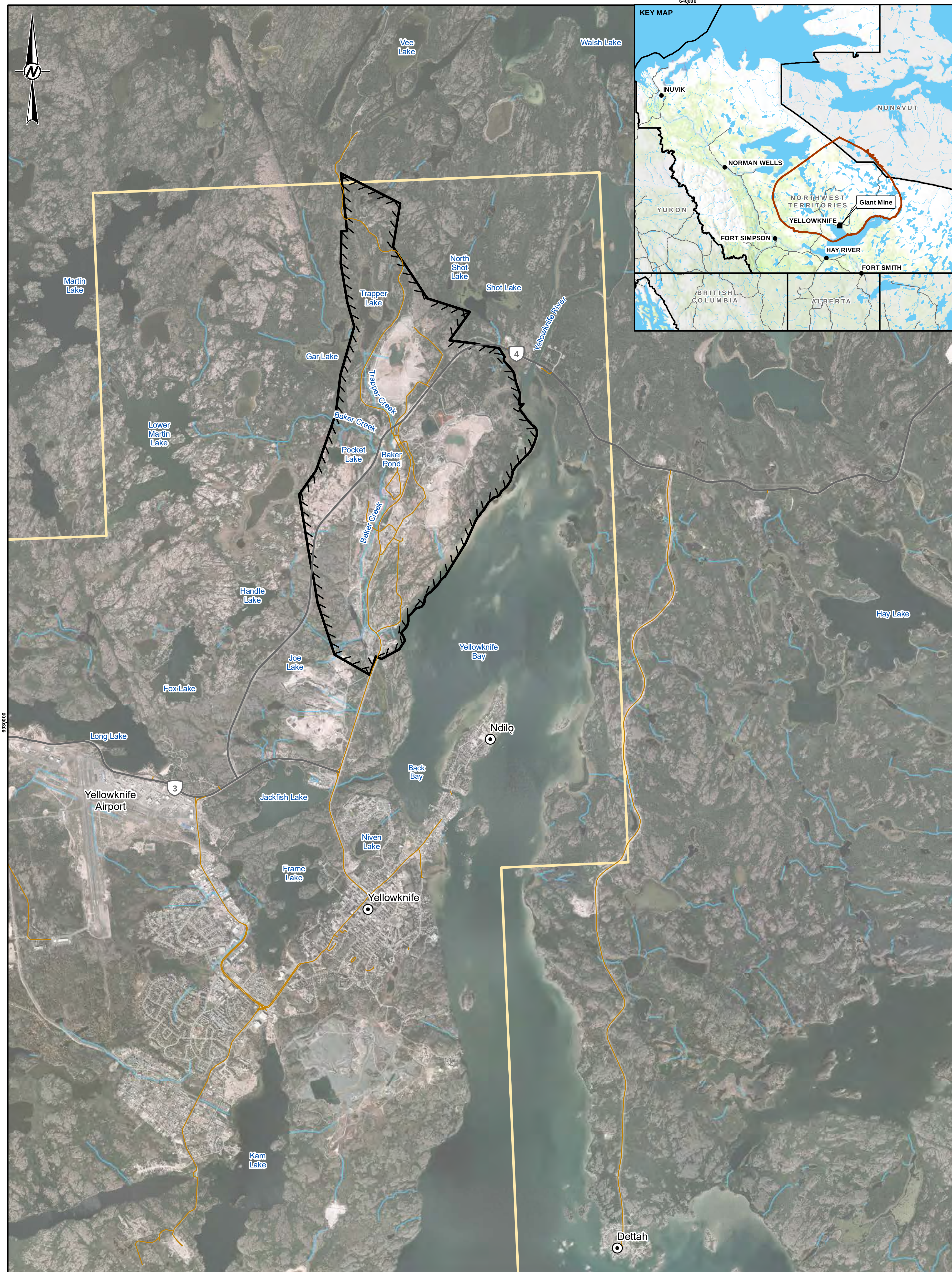

LEGEND

- COMMUNITY
- GIANT MINE PROJECT BOUNDARY
- HIGHWAY
- ROAD
- WATERCOURSE
- MǪWHÌ GOGHA DÈ NĮĮ̀ŁÈÈ BOUNDARY (SETTLED LANDS OF THE TŁĮCHǪ)
- YELLOWKNIFE MUNICIPAL BOUNDARY

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REFERENCE(S)

COMMUNITY, HYDROLOGY AND TRANSPORTATION DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. MUNICIPAL BOUNDARY CONTAINS PUBLIC SECTOR DATASETS MADE AVAILABLE UNDER THE CITY OF YELLOWKNIFE'S OPEN DATA LICENSE V.1.
DATUM: NAD 83 PROJECTION: UTM ZONE 11

PROPONENT

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

Government of Northwest Territories / Gouvernement des Territoires du Nord-Ouest

PROJECT

Giant Mine Remediation Project

YYYY-MM-DD	2018-12-13
DESIGNED	HM
PREPARED	AA
REVIEWED	HM
APPROVED	BW

TITLE

REGIONAL LOCATION OF GIANT MINE

PROJECT NO.	CONTROL	REV.	FIGURE
13-1377-0015	30000	0	1.1-1

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1.2 Purpose and Scope

This document presents the draft Water MMP for the Site as part of the GMRP.

This Water MMP has been developed to satisfy applicable water licence conditions set forth in Water Licence MV2007L8-0031, as well as address any previously made commitments from the Environmental Assessment process (Section 3, Appendix A, and Updated Project Description (CIRNAC and GNWT, 2019b)). This Water MMP encompasses water management at the Site as the GMRP moves from the existing condition of care and maintenance into the active remediation/adaptive management phase and post-closure phase. This Water MMP also includes applicable monitoring programs, contingency planning, and reporting requirements.

Updates to the Water MMP will be ongoing through the life of the GMRP to provide more details on future water management, as remediation moves forward.

The Water MMP focuses on management and monitoring of water quantity and water quality entering and leaving the Site from the following sources:

- surface water
- minewater
- groundwater

Monitoring of the aquatic receiving environment is discussed in the Aquatic Effects Monitoring Program (AEMP).

1.3 Objectives and Strategies

1.3.1 Objectives

The objectives of the Water MMP are to:

- outline water management practices at the Site to minimize the potential for impacts to the public, workers and the receiving environment
- outline water management practices at the Site that meet regulatory requirements and water-related closure objectives and criteria (CIRNAC and GNWT 2019)
- outline water monitoring programs required to meet regulatory requirements and to verify water-related closure objectives and criteria (CIRNAC and GNWT 2019a) are met

1.3.2 Strategies

Strategies to achieve objectives of the Water MMP are to:

- follow regulatory requirements, guidelines, and GMRP-specific criteria
- manage contact water (i.e., water in contact with Developed Areas as defined in the CRP) and non-contact water (i.e., water not in contact with Developed Areas and runoff from remediated areas) separately to the extent practical
- manage and treat contact water on Site
- re-establish natural drainage patterns to the extent possible in consideration of other strategies listed herein

- minimize the number of point discharge locations to Baker Creek
- monitor water quality and quantity

1.4 Linkages to Other Management and Monitoring Plans

The Water MMP will be implemented in conjunction with other Site management and monitoring plans to support the overall GMRP goals and closure objectives. Other GMRP management and monitoring plans that are relevant to this Water MMP are:

- Dust Management and Monitoring Plan
- Borrow Materials and Explosives Management and Monitoring Plan
- Operational Monitoring Plan
- Tailings Management and Monitoring Plan
- Erosion and Sediment Control Plan
- AEMP (Baker Creek)
- AEMP (Yellowknife Bay)
- Surveillance Network Program (SNP)
- Spill Response Plan

There are also a number of water-related plans that directly link to this Water MMP. These plans are discussed in Section 8.

1.5 Required Review and Updates

The current and future water management of the Site is presented in the CRP, which has been provided to affected parties as a part of pre-engagement. In addition, Section 5.12 in the CRP provides a high-level outline of all management and monitoring planned for each phase of the GMRP (CIRNAC and GNWT, 2019a). This Water Management and Monitoring Plan has been submitted as a requirement to the GMRP Post-EA Information Package. The GMRP is requesting that Phase 1 of this plan be approved conditionally upon licence issuance; an updated version will be submitted within 90 days of Water Licence issuance if updates are needed based on the outcomes of the proceedings. Ninety days prior to commencement of Phase 2, the GMRP will submit an updated Water Management and Monitoring Plan for review and approval prior to commencement of remediation activities.

Once the water licence is issued, standard conditions require annual reviews of all management plans; should updates be necessary, an updated plan is to be submitted to the MVLWB for public review and approval. For the GMRP specifically, it is anticipated that management and monitoring plans will require update on a regular basis, in response to updated information provided in Design and Construction Plans.

The schedules for content of Design and Construction Plans, proposed in the draft Water Licence require the monitoring and contingency information in Table 1.5-1 to be provided for all closure activities or constructed components implemented on site (part of Schedule 3, Conditions 1-3):

Table 1.5-1: Monitoring and contingency information required in monitoring and management plans

Design and Construction Plan Components related to Management and Monitoring Plans	
Activity-specific monitoring and mitigation details for the Construction period and the post-Construction/adaptive management and monitoring period.	• monitored components; • sampling locations, parameters measured, and sampling frequency; • reference to any associated monitoring program, including where and how results will be analyzed and reported; • an explanation of how proposed monitoring will assess the risks identified in Schedule 3, Condition 1(g); • linkages to applicable closure objectives and criteria; • linkages to existing management and monitoring plans and programs; and • any other monitoring details required to monitor and mitigate impacts to the Receiving Environment.
A description of contingency activities that will be undertaken if monitoring results show that Engineered Components are not meeting closure criteria or are not satisfying performance criteria.	• Identified risks related to achievement of the closure or performance criteria; • A threshold or action level which defines the point at which monitoring indicates a response is necessary; and • The proposed response to be implemented if threshold exceeded.

In addition, final closure criteria are to be proposed, if needed; operational requirements and any anticipated maintenance, is to be outlined, design details, construction considerations including a QA/QC, and any applicable background information must be included. For a full review of schedule details refer to Part E of the proposed Water Licence.

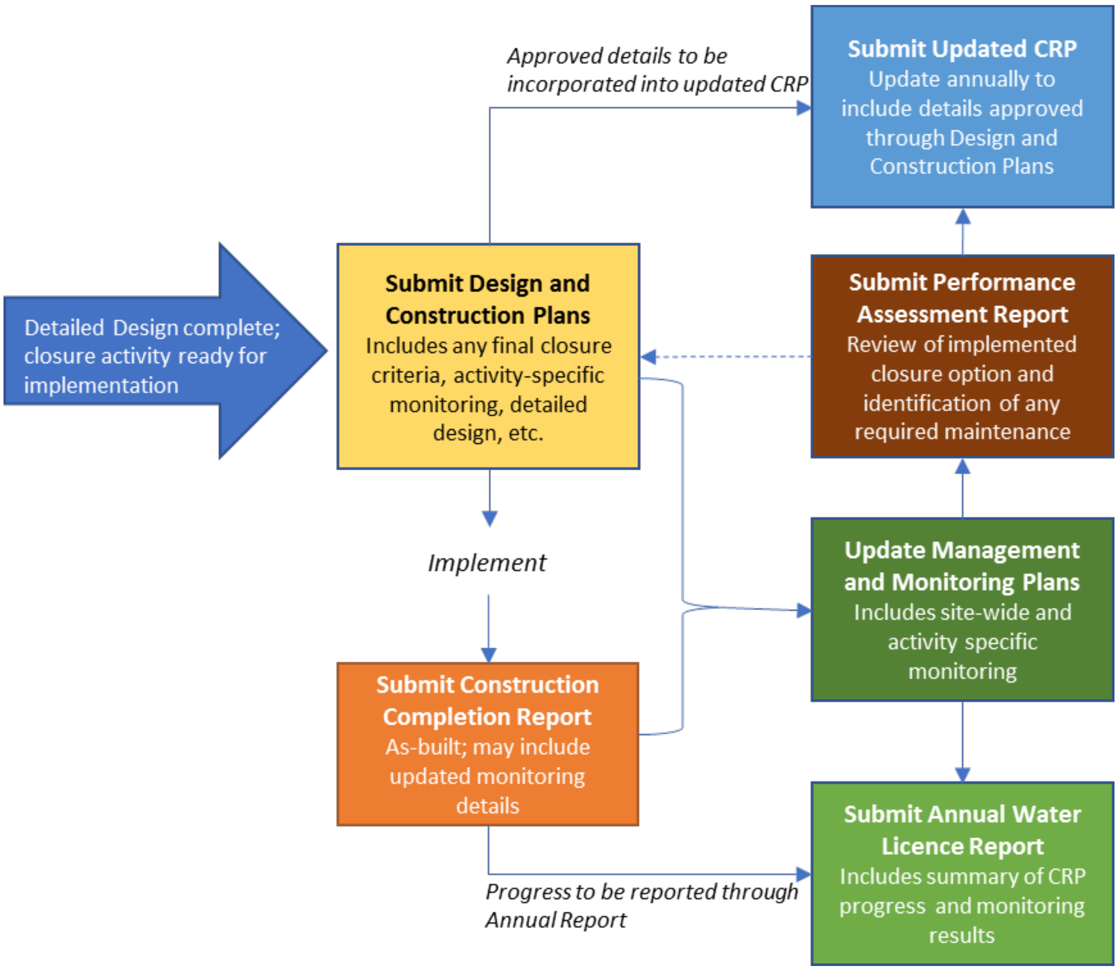
Once construction is completed, Construction Completion Reports and Performance Assessment Reports must be submitted, developed in accordance with the Reclamation Completion Report requirements in the MVLWB (2013) Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the Northwest Territories and outlined in Part E of the Proposed Water Licence. In addition to Guideline requirements, these two reports have been developed to allow the GMRP to propose updates to monitoring, contingencies, and maintenance requirements, if needed. Any updates require Board approval prior to implementation.

Figure 1.5-1 depicts the connection between these three construction-related plans and management and monitoring plans. In consideration of the information to be provided in Design and Construction Plans and Construction Completion Reports, several sections of this management plan may be updated as the GMRP progresses through remediation including:

- Managed water volumes
- Details regarding runoff from active remediation areas
- Monitoring details
- Contingencies

Once updated, plans will be submitted to the Board. Any management and monitoring details not approved by the Board in the Design and Construction, Construction Completion reports, or Performance Assessment Report, requires Board approval. A conformity table which outlines all updates will be included in each new version being submitted to assist with review and approval.

Figure 1.5-1: Linkages between CRP, Construction-related Plans, and Management and Monitoring Plans



2 OVERVIEW OF THE GIANT MINE REMEDIATION PROJECT

2.1 Project Team

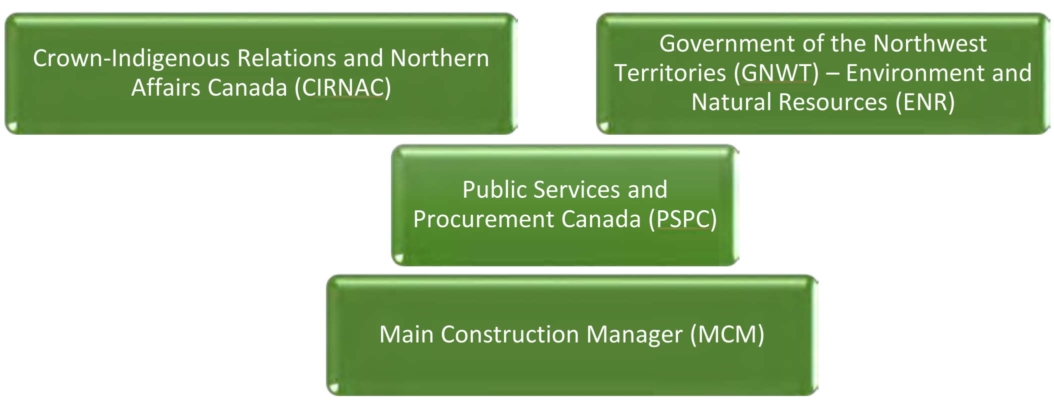
The GMRP is jointly managed through a Cooperation Agreement, with the Government of Canada and the Government of the Northwest Territories (GNWT). The GMRP Team consists of Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) and the Government of the Northwest Territories – Environment and Natural Resources (GNWT-ENR) acting as co-proponents with respect to the Environmental Assessment and other regulatory considerations (Figure 2.1-1). Public Services and Procurement Canada (PSPC) provides contracting services, contract management, and technical support services to CIRNAC. PSPC has awarded the Main Construction Manager (MCM) contract to Parsons Incorporated. This contract will be used to complete implementation activities for the GMRP.

The MCM is responsible for overall site management including emerging risks on site and supporting planning efforts for closure and reclamation during the GMRP. The MCM is responsible for letting and managing various sub-contracts, with the goal of providing employment and maximizing training opportunities for Indigenous peoples and Northerners. Once remediation begins, the MCM will oversee the implementation of the CRP and associated activities.

The GMRP Team is working towards permanent closure and reclamation of the Giant Mine Site. While CIRNAC will ultimately be responsible for compliance with the Type A Water Licence and Land Use Permit issued for the GMRP, the presented water management operations are conducted by private sector contractors procured through the MCM, who is managed by PSPC.

The MCM will be responsible for ensuring required water management controls are in place and working properly. Procured contractors will be required to adhere to water management and monitoring details, once Design and Construction Plans are approved. Refer to Appendix B for an updated list of all contact information for staff responsible for water management for the GMRP.

Figure 2.1-1: Giant Mine Remediation Project Team



2.2 GMRP – Environment, Health and Safety and Community Policy

Within the GMRP, the health and safety of employees and protection of the environment are an over-riding priority. Management is committed to doing everything possible to prevent injuries and to maintain a healthy environment. To this end the GMRP is committed to:

- Protecting the environment and the health and safety of its employees; contractors and the general public;
- Engaging meaningfully with stakeholders;
- Delivering local social and economic benefits; and
- Being a recognized leader in Environment, Health and Safety, and Community (EHSC) management among public environmental remediation projects.

To this end, GMRP will act in a manner that minimizes its negative impacts, maximizes its positive benefits, and continually seek ways to improve its performance.

2.2.1 Overall Commitments

- In order to achieve these objectives, the GMRP is committed to the following:
- The GMRP will plan and execute in a manner that respects and cares for people and the environment.
- The GMRP will comply with all applicable environmental, health and safety, and community (socio-economic and engagement) regulatory, policy and other requirements.
- The GMRP will apply best management practices including best available technology and processes for environmental protection and public safety.
- The GMRP will promote a project-wide culture committed to continual improvement in environmental, health and safety, and community guided by the EHCS Management System.

See Appendix C for the entirety of the GMRP EHSC Policy.

2.3 Giant Mine Site Existing Environment

The Site consists of eight abandoned open pits; an underground mine with arsenic trioxide storage areas; two TCAs with associated rock fill dams; mine waste rock that buttresses Dams 11, 21B and 21D; a tailings re-treatment plant (out of service since 1990); an Effluent Treatment Plant (ETP); a Mill Complex; several warehouses; and a townsite. Baker Creek flows through the Site seasonally with one ponded area. The Site features are outlined in Figure 2.3-1.

Select components of the existing environment related to water management at the Site, sourced from the CRP, are summarized in Appendix D. Additional information on the Project environment can be found in Chapter 2 of the CRP (CIRNAC and GNWT 2019a).

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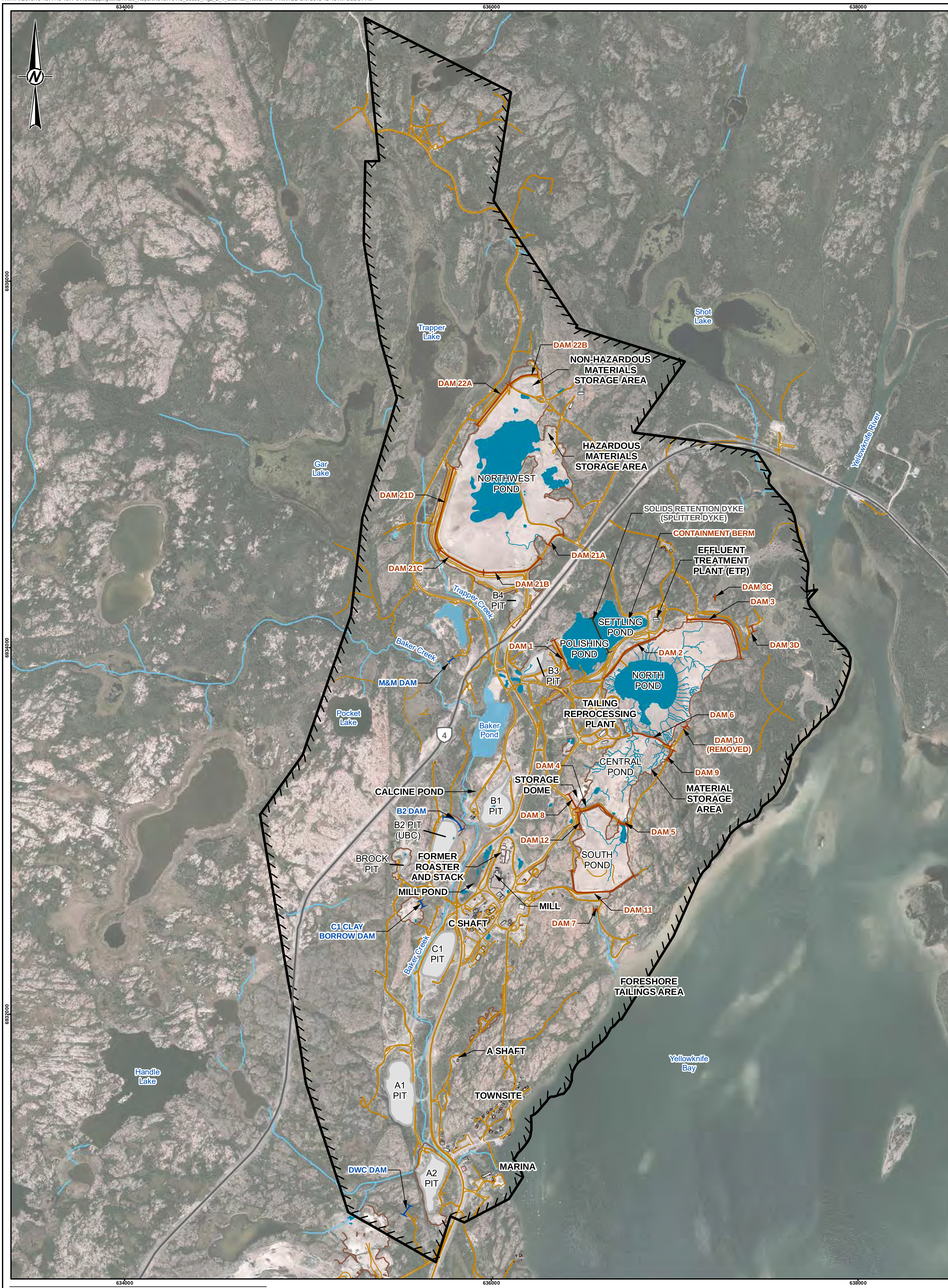

LEGEND

- BUILDING
- GIANT MINE PROJECT BOUNDARY
- HIGHWAY
- INDUSTRIAL WATERCOURSE
- INFRASTRUCTURE
- ROAD
- SPLITTER DYKE
- SURFACE WATER MANAGEMENT DAM/DYKE
- TAILINGS OR SLUDGE RETENTION DAM
- WATERCOURSE
- INDUSTRIAL WATERBODY
- PIT BOUNDARY
- WATERBODY

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REFERENCE(S)

HYDROLOGY AND TRANSPORTATION DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA.
DATUM: NAD 83 PROJECTION: UTM ZONE 11

PROPONENT

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

Government of Northwest Territories
Gouvernement des Territoires du Nord-Ouest

PROJECT

Giant Mine Remediation Project

YYYY-MM-DD	2018-12-13
DESIGNED	DP
PREPARED	AA
REVIEWED	TH
APPROVED	HM

TITLE

GIANT MINE SITE LAYOUT

PROJECT NO.	CONTROL	REV.	FIGURE
13-1377-0015	30000	0	2.3-1

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2.4 Closure and Remediation of the Giant Mine Site

2.4.1 Project Goals

The goals for the GMRP are to:

- minimize public and worker health and safety risks
- minimize the release of contaminants from the Site to the surrounding environment
- remediate the Site in a manner that instills public confidence
- implement an approach that is cost-effective and robust over the long term

2.4.2 Project Closure Objectives

There are six closure objectives related to the management of water on Site:

- BC3. Surface natural drainage patterns are re-established to the extent practicable and to provide conveyance of Site runoff, while managing flood risk to closure infrastructure
- BC4. Water quality and sediment quality in Baker Creek are improved to reduce exposure of aquatic and terrestrial organisms to contaminants
- T1. Arsenic loading from the Tailings Containment Areas (TCAs) to the environment is reduced
- WTP1. Treated minewater to Yellowknife Bay is discharged at a designated near-shore outfall. The outfall location is selected such that Site-specific water quality objectives are met in the receiving environment
- WTP2. WTP discharge meets approved effluent quality criteria (EQC), derived such that Site-specific water quality objectives are met in the receiving environment
- WTP3. WTP waste is disposed of in a controlled manner so it is not, and will not become, a source of contamination to the environment

These objectives align with the Mackenzie Valley Land and Water Board (MVLWB) management policies. Full closure objectives are outlined in the CRP (CIRNAC and GNWT 2019a).

2.4.3 Project Activities

The closure activities for the Site were chosen to meet the closure objectives outlined in Section 2.4.2 and in the CRP (CIRNAC and GNWT 2019a). A brief summary of the closure and reclamation activities relevant to this Water MMP is provided below along with an overview of the three reclamation-focused stages defined for the GMRP associated with CRP development, implementation, and monitoring.

Main closure activities include:

- covering TCAs, backfilling the open pits, freezing the arsenic chambers in the underground mine, stabilizing the underground mine, and use of on-Site borrow/quarry sources,
- re-aligning sections of Baker Creek to prevent flooding of the underground mine, demolishing old buildings, and development of a non-hazardous landfill

- removing highly contaminated soils, removing contaminated sediments from Baker Creek and Baker Pond and dredging or covering select areas of sediment in Yellowknife Bay near the Townsite and Foreshore Tailings Area
- constructing and operating a new WTP that will pump water from the mine pool and treat arsenic to 10 µg/L and meet the remaining proposed EQC
- maintaining the minewater elevation such that it forms a groundwater sink to prevent contamination of lateral groundwater and flooding of the arsenic chambers

These activities will alter the quality of surface water on Site and the quantity of water carried along various flow paths through the Site. More detail on Site water management is provided in Section 4 (existing conditions), Section 5 (Active remediation and adaptive management conditions) and Section 6 (Post-closure conditions). More information on the existing and future Site water balances is provided in Section 7.

2.4.4 Project Phases

The GMRP is defined by three reclamation-focused phases:

Phase 1: Existing Condition - Project Definition; from licence issuance until the first remediation activity commences

Phase 2: Active Remediation and Adaptive Management - implementation of the approved closure activities, which has three corresponding sub-phases, applied on a component-by-component basis:

- Detailed Design
- Active Remediation/Construction (implementation of specific closure activity)
- Adaptive Management (confirmation of component performance)

Phase 3: Post-closure Monitoring and Maintenance[1] – long-term monitoring and maintenance after all site remediation is complete; commences after remediation of components of the CRP are complete and monitoring during Phase 2 adaptive management indicates they are performing as anticipated.

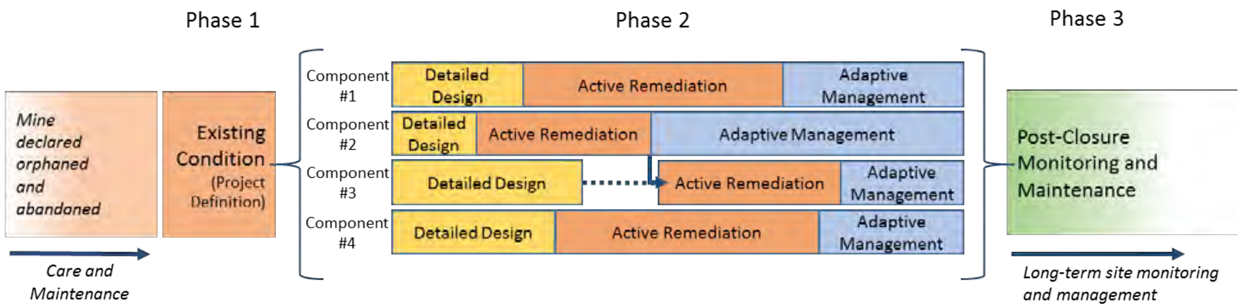
Site-wide water management strategies are anticipated to be the same in all three phases, though activities will change as remediation of Developed Areas progresses, pits and TCAs are capped and covered, a new Water Treatment Plant goes into operation and the Existing Effluent Treatment Plant is decommissioned.

Details on the project phases in relation to GMRP implementation is provided in Section 5.0 of the GMRP Closure and Reclamation Plan (CRP; CIRNAC and GNWT 2019a).

Phases of the CRP and key closure activities are shown on a high-level timeline in Figure 2.4-1. This Water MMP focuses on water management from the commencement of Site remediation until the completion of remediation activities.

[1] Post-closure maintenance of this site includes ongoing operation of the water treatment plant.

Figure 2.4-1: Conceptual Diagram of Giant Mine Remediation Project



2.5 Closure Planning and Engagement

The GMRP has completed substantial engagement, as outlined in the CRP (CIRNAC and GNWT 2019a), the GMRP Engagement Log (CIRNAC and GNWT 2019j) and the Updated Project Description (CIRNAC and GNWT 2019b), which has helped shape the closure activities for the Site. During the EA process (INAC and GNWT 2010), parties reinforced the need for long-term environmental monitoring at the Site.

Specific engagement related to Baker Creek and TCA cover design, including the addition of spillways, was conducted in 2015 and 2016 during Surface Design Engagement (Slater 2016; SRK 2016). With the input from stakeholders, CIRNAC and GNWT decided to eliminate storage of surface water above ground post-remediation, remove contaminated sediments in the creek and relocate the treated effluent discharge to Yellowknife Bay once a new WTP and outfall is commissioned. Stakeholders also provided input on the type and specific location of WTP outfall in Yellowknife Bay during engagement conducted in 2016 and 2017. Specific consultation and evaluation of the alignment options for Baker Creek was conducted in 2017 (AECOM 2017).

3 REGULATORY FRAMEWORK

This Water MMP was developed in consideration of regulatory requirements including legislation, guidance documents, proposed water licence requirements, GMRP commitments and conditions, and GMRP-specific criteria. A full list of legal requirements is found in Appendix A and the CRP and the UPD (CIRNAC and GWNT 2019a and 2019b).

3.1 Legislation

Relevant federal and territorial legislation and permits/licences that apply to the Site include:

- *Canadian Environmental Protection Act* and the Toxic Substances Lists (Government of Canada 1999)
- Fisheries Act and the Metals and Diamond Mining Effluent Regulations (Government of Canada 2002)
- Mackenzie Valley Resource Management Act (Government of Canada 1998)
- Northwest Territories Water Act (Government of Canada 1992) and the Northwest Territories Federal Areas Water Regulations (Government of Canada 2018)

3.1.1 Metal and Diamond Mining Effluent Regulations

The Metal and Diamond Mining Effluent Regulations (MDMER, formerly Metal Mining Effluent Regulations; Government of Canada 2002) apply to all operating metal and diamond mines in Canada. While operations at the Site ceased in 2004, the Site was operating in 2002 when the now MDMER came into force. The Site has not been officially designated as having "closed mine status" under the MDMER because the volume of discharge and water quality do not allow it; therefore, the requirements outlined by the MDMER remain applicable to the Site. These regulations currently impose limits on releases of deleterious substances, which include pH, un-ionized ammonia, arsenic, copper, lead, nickel, zinc, radium-226, cyanide, and total suspended solids (TSS), as well as prohibit the discharge of effluent that is acutely lethal to fish. MDMER limits (Government of Canada 2002) came into effect on 1 June 2018 with full compliance required by 2021; this will result in lower MDMER discharge limits for cyanide, arsenic, and lead.

3.1.2 Proposed Type A Water Licence

Proposed Conditions of the Type A Water Licence are summarized in Appendix A, Table A-1 along with sections of the Water MMP where each condition is addressed. The content of Appendix A will be updated to reflect the final water licence conditions.

3.2 Conditions, Measures and Commitments

There are a number of conditions, Environmental Assessment Measures and Commitments, and information requirements that apply to the GMRP. The following presents the genesis of the conditions, measures and commitments and where concordance with those conditions, measures and commitments can be located in the Project's documentation.

3.2.1 Environment Assessment Commitments

Schedule 4 from the Post EA information request (MVLWB 2014) outlines the information requirements for the Water MMP. These are provided in Appendix A, Table A-2.

Measures and Suggestions from the Report of EA (MVEIRB 2013) as well as any amended Measures from the Final Decision Letter (AANDC 2014) that pertain directly to the Water MMP are summarized in the Updated Project Description (CIRANC and GNWT 2019b), and Appendix A, Tables A-3 and A-4, respectively.

3.2.2 Developer Assessment Report Commitments

Commitments of the Developer Assessment Report (DAR) (INAC and GNWT 2010) are summarized in Appendix A, Table A-5 along with sections of the Water MMP where each condition is addressed.

3.3 Guidance

The following guidance/policy documents were used to support the Water MMP:

- Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the Northwest Territories prepared by the Mackenzie Valley Land and Water Board (November 2013)
- Water and Effluent Quality Management Policy prepared by the Mackenzie Valley Land and Water Board (March 2011)
- DFO Freshwater Intake End of Pipe Fish Screen Guideline (1995)

3.4 Giant Mine Remediation Project Criteria

A number of criteria have been developed to assess the performance of water management practices on Site. These criteria include EQC for the discharge of treated water from the existing ETP and new WTP; Runoff Quality Criteria for the release of runoff from engineered structures; and, design criteria for the construction of water management infrastructure.

3.4.1 Effluent Quality Criteria

The existing ETP will operate for approximately 6 years following the commencement of Phase 2. Minor improvements, if necessary, may be made to the ETP; however, major changes to the existing ETP are not possible. Therefore, a new WTP will be constructed and is expected to be commissioned by 2026. It is anticipated that the existing ETP will remain on stand-by for one year following the commissioning of the new WTP to allow determination that the new WTP is fully functional and able to meet the new EQC. During WTP testing, treated effluent will be directed underground until EQC are reliably achieved.

GMRP-specific EQC are presented in Table 3.4-1 for the existing ETP and proposed WTP addressed in this document. The development of these EQC is discussed in the Effluent Quality Criteria Report for Giant Mine (CIRNAC and GNWT 2019c).

Table 3.4-1: Proposed Effluent Quality Criteria for the Existing Effluent Treatment Plant and the New Water Treatment Plant

Parameter	Units	Existing ETP		WTP	
		Maximum Average Concentration	Maximum Grab Concentration	Maximum Average Concentration	Maximum Grab Concentration
pH		6.5 to 9.0		6.5 to 8.0	
TSS	mg/L	15	30	15	30
Un-ionized ammonia	mg/L	0.5	1.0	0.5	1.0
Total antimony	mg/L	n/a	n/a	0.2	0.3
Total arsenic	mg/L	0.3	0.6	0.01	0.02
Total copper	mg/L	0.03	0.06	0.024	0.033
Total lead	mg/L	0.003	0.006	0.003	0.008
Total nickel	mg/L	0.10	0.20	0.10	0.15
Total zinc	mg/L	0.10	0.20	0.08	0.16
Radium-226	Bq/L	0.37	1.11	0.37	1.11
Cyanide	mg/L	0.03	0.06	0.5	1
Total petroleum hydrocarbons	mg/L	3	5	3	5

TSS = total suspended solids; mg-N/L = milligrams nitrogen per litre; Bq/L = becquerels per litre; ETP = effluent treatment plant; WTP = water treatment plant; MDMER = Metal and Diamond Mining Effluent Regulations

3.4.2 Surface Runoff Quality Criteria

Surface Runoff Quality Criteria will apply to runoff from engineered structures (these include TCAs, remediated pits and the landfill). During closure, surface water from pits, TCAs and engineered covers, will be collected, conveyed to the underground mine pool, and treated until concentrations are confirmed to meet the surface runoff quality criteria presented in Table 3.4-2. Flow to the receiving environment will be established once concentrations are confirmed to be at or below the surface runoff quality criteria. The criteria were set equal to the MDMER limits, in accordance with requirements for water meeting the definition of "*effluent*" (b), under Part 1 of the MDMER (Government of Canada 2002). A limit for total petroleum hydrocarbons was also added due additional traffic at Site through closure.

Surface runoff monitoring stations at discharge points from engineered structures (such as TCA and pit covers and the landfill) will be added to the Surveillance Network Program (SNP) to measure water quality of runoff off engineered structures. Grab samples will be collected weekly from runoff stations during freshet when flow exists (May/June), and analyzed for the GMRP Parameter List (i.e., field parameters, routine parameters and major ions, nutrients, total and dissolved metals and metalloids, and total petroleum hydrocarbons). An annual average will be calculated based on the weekly or monthly samples. Water will be considered acceptable for release to the receiving environment when:

- The annual average from one year of sampling is below the surface runoff criteria in Table 3.4-2.
- Upon return in year 2; runoff water quality from the first month of sampling is below the surface runoff criteria.

Table 3.4-2: Surface Runoff Quality Criteria

Parameter	Units	Surface Runoff Quality Criteria
pH		6.5 to 9.5
TSS	mg/L	15
Un-ionized ammonia	mg-N/L	0.5
Total arsenic	mg/L	0.3
Total copper	mg/L	0.3
Total lead	mg/L	0.1
Total nickel	mg/L	0.5
Total zinc	mg/L	0.5
Radium-226	Bq/L	0.37
Cyanide	mg/L	0.5
Total petroleum hydrocarbons	mg/L	3

Surface runoff criteria were set equal to the MDMER limits, with the addition of total petroleum hydrocarbons.
TSS = total suspended solids; mg-N/L = milligrams nitrogen per litre; Bq/L = becquerels per litre

3.4.3 Water Management Infrastructure Design Criteria

Preliminary water management infrastructure design criteria were adapted from the GMRP's Surface Water, Baker Creek and Tailings Pond Remediation Preliminary Design Reports (Golder 2012a, b and c) in consideration of commitments from the DAR (Appendix A Table A-5). These preliminary criteria will be confirmed or refined during detailed design stages, and updated in future versions of the Water MMP as required. Preliminary design criteria are provided below:

- water management infrastructure shall be designed using the three design storms events as defined in Table 3.4-3
- minor storm events shall be considered for the design of culvert crossings at minor service roads that are not required to access critical facilities
- interim storm events shall be considered for the design of temporary contact water storage and conveyance water management infrastructure that does not directly drain to the receiving environment (thereby potentially releasing contact water to the receiving environment in the event of failure)
- closure storm events shall be considered for the design of i) temporary contact water management infrastructure that has the potential to drain directly to the receiving environment (thereby potentially releasing contact water to the receiving environment in the event of failure); and ii) permanent water management infrastructure
- probable maximum precipitation (PMP) or Probable Maximum Snow Accumulation (PMSA) events shall be considered for the design of spillways and conveyance infrastructure in remediated tailings area
- a minimum freeboard of 0.3 m shall be considered for the design of ditches and storage ponds
- sedimentation ponds shall be designed to settle sand-sized particles for events up to the 10-year 24-hour event

- side slopes of ditches, spillways and sedimentation ponds shall be designed to 2 Horizontal to 1 Vertical (2H:1V) or as recommended by geotechnical studies
- ditch lining shall consist of riprap if deemed required by the designer depending on the competency of the bed material

Criteria above are summarized in Table 3.4-4 for each type of expected water management infrastructure of the GMRP. Natural drainage paths, or those with no potential to cause environmental harm by exposure of tailings or contaminated sediments, may be left in their existing state or designed to a lower standard.

Table 3.4-3: Design Storm Descriptions

Design Storm	Component	Applies To
Minor	50-year, 24-hour rainfall	Culvert crossings at minor service roads that are not required to access critical facilities such as the water treatment plant and freeze control room.
Interim	100-year, 24-hour rainfall + the average melt of the 100-year snow pack over 14 days	Contact water storage and conveyance infrastructure that will exist only in the near term (<10 years).
Closure	500-year, 24-hour rainfall + the average melt of the 100-year snow pack over 14 days	Closure drainage infrastructure where failure has the potential to cause environmental harm by exposure of tailings or contaminated sediments.
PMP or PMSA[1]	PMP + 100-year snow accumulation or PMSA + 100-year rainfall event, whichever is more conservative	Spillways and conveyance infrastructure in remediated tailings area.

Note: 1 – Golder (2017).

Table 3.4-4: Proposed Surface Water Drainage Design Criteria

Water Type	Design Element	Design Component	Design Criteria	Comments
Contact Water	Collection Ditch	Discharge Capacity	Interim Design Storm	-
		Minimum Freeboard	0.3 m	-
	Sump or Collection Pond	Location	Existing pond/sump locations or remediated areas (excavated and partially backfilled)	-
		Storage	Store the Interim Design Storm runoff without any discharge to the environment	Pumping to take place during the runoff event Minimum storage requirements, without pump capacity, to be determined during the design stage
		Minimum Freeboard	0.3 m	-
		Pump Capacity	Prevent spill during the Interim Design Storm and empty the sump/collection pond in a period of 24 hours	-
	Sedimentation Pond (if/as required)	Location	Before discharging to Baker Creek	-
		Settling Capacity	Settle sand-sized particles fraction for 1:10 year, 24 hour event	-
		Flocculation	May be required to settle finer particles, to be determined during the design stage	

Table 3.4-4: Proposed Surface Water Drainage Design Criteria

Water Type	Design Element	Design Component	Design Criteria	Comments
Non-Contact Water	Collection Ditch	Discharge Capacity	Closure Design Storm	-
		Minimum Freeboard	0.3 m	-
	Highway and Culverts	Discharge Capacity	Minor Design Storm for non-essential traffic areas; Closure Design Storm for essential traffic areas (e.g., control building)	Assume overtopping of roadways during extreme events is acceptable
	Reclaimed Tailings Pond Spillways	Discharge Capacity	Closure Design Storm	-

Note: - = no comments.

4 PHASE 1: EXISTING WATER MANAGEMENT SYSTEMS

This section describes the existing water management at the Site, applicable until the initiation of Phase 2: Active Remediation and Adaptive Management (Section 5) and is organized as follows:

- existing surface water infrastructure, inclusive of TCAs and collection and conveyance infrastructure
- existing minewater infrastructure, inclusive of the underground water management system
- existing effluent treatment plant, inclusive of the effluent management system
- existing water use

4.1 Existing Surface Water Infrastructure and Management

4.1.1 General Description

Under existing conditions, surface runoff in contact with the developed areas is collected in sumps, temporarily stored in Mill Pond and TCAs (i.e., South Pond, Central Pond, North Pond and Northwest TCA upstream of the existing ETP, and the Settling Pond and Polishing Pond downstream of the existing ETP), and is discharged to Baker Creek following treatment. Water from the underground workings, comprising groundwater inflows and seepage from the surface, is conveyed to the Northwest Pond. The configuration of the Site's surface water management infrastructure is shown in Figure 4.1-1 (overall extent), Figure 4.1-2 (northern extent), Figure 4.1-3 (central extent), and Figure 4.1-4 (south extent); each relevant flow path is numbered for ease of reference.

The existing condition non-contact water management system includes ditches and pipelines to divert non-contact water away from the Site and into natural receiving waterbodies.

The existing condition contact water management system and its operations are summarized generally as follows:

- Water at A1 Pit, A2 Pit, B3 Pit, and B4 Pit infiltrates entirely to the underground workings.
- Water at B2 Pit is captured by sump and conveyed by pump and pipeline to the underground workings.
- Water from B1 Pit and C1 Pit partially infiltrates to the underground workings, and the remainder is captured by sumps and conveyed by pumps and pipelines to the Mill Pond.
- The Mill Pond has little to no storage capacity and its water is transferred to the Central Pond by pump and pipeline.
- The South Pond has little to no storage capacity and its water is conveyed to the Central Pond by gravity.
- The Central Pond has little to no storage capacity and its water is conveyed to the North Pond by gravity.
- Water from the North Pond is transferred to the Northwest Pond by pump and pipeline once the North Pond is near capacity.
- Mine pool water is conveyed year round from the underground workings at the Akaitcho area by pumps and pipelines to the Northwest Pond to maintain water levels in the mine pool. Minewater is also conveyed, when necessary, from the Supercrest Pumping Station direct to the Northwest Pond. Minewater from the pumping systems in the Akaitcho area combine with the surface runoff water at the Northwest Pond.

- Water in the Northwest Pond accumulates over the winter, and during the open water season is conveyed by pump and pipeline to the existing ETP for treatment.
- Treated water from the existing ETP is discharged to the Settling Pond for settling.
- Water from the Settling Pond is conveyed to the Polishing Pond by a combination of pumps and pipelines and by gravity through the permeable rock-filled Splitter Dyke, for additional settling.
- Water from the Polishing Pond is discharged to Baker Creek by pump and pipeline when discharge criteria are met, or recirculated to the North Pond if discharge criteria are not met, during open water conditions (typically between July and September).
- The North Pond and the Northwest Pond are pumped down by the end of the open water season to maximize available storage capacity in these ponds prior to the following open water season.

General surface water losses to the receiving environment at the Site include:

- evaporation, sublimation, evapotranspiration
- lateral seepage from the Mill Pond to Baker Creek
- lateral seepage from the South Pond, Central Pond, and North Pond towards Yellowknife Bay
- lateral seepage from the Northwest Pond to Trapper Creek

General surface water losses requiring additional water management at the Site include:

- infiltration to the underground workings
- water uses including paste backfill water supply sourced from the North Pond and dust suppression water supply sourced from the Polishing Pond

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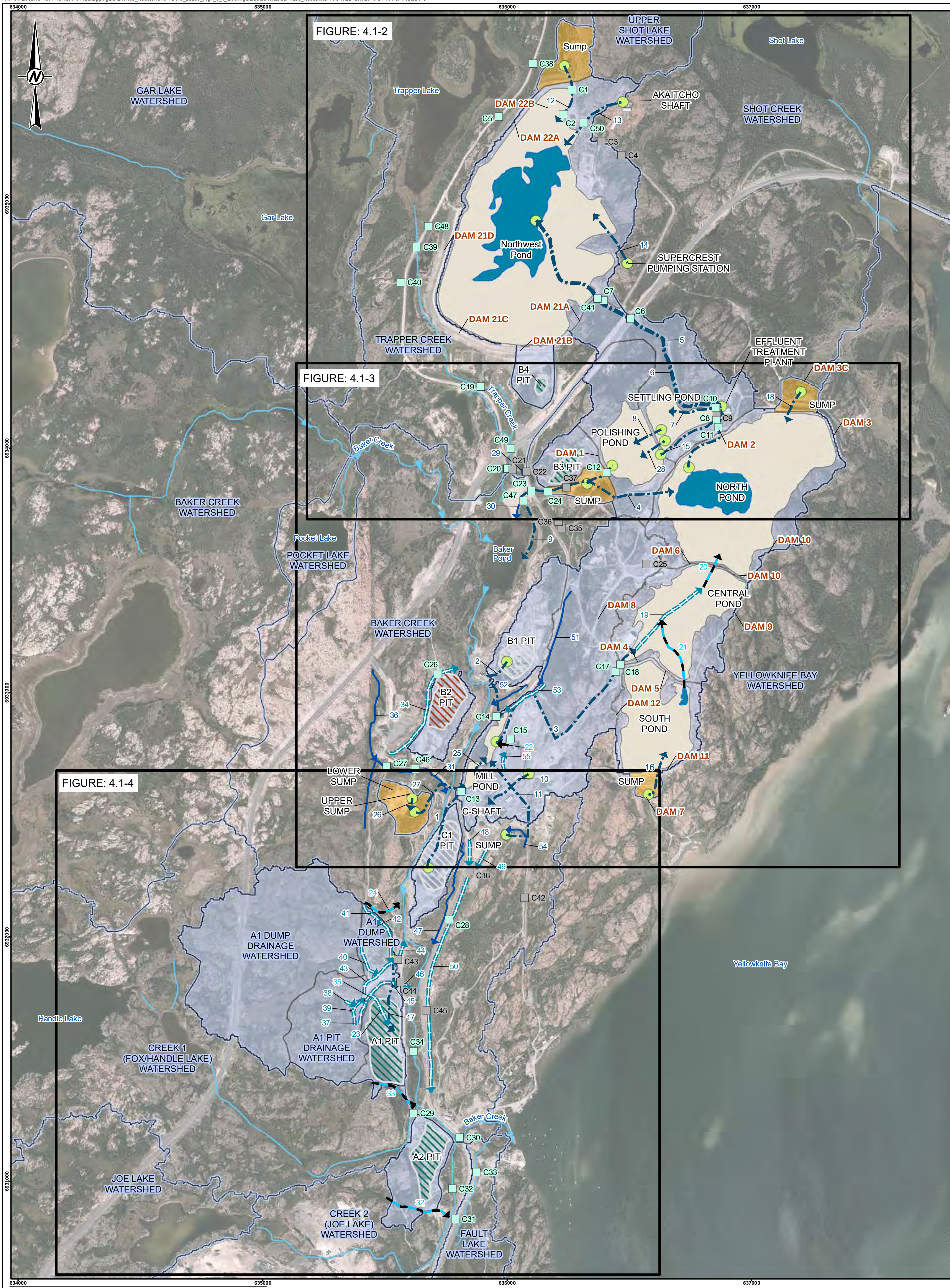

LEGEND

- PUMP STATION

CULVERT

- ACTIVE
- NOT ACTIVE

FLOW PATHS

- DITCH
- NATURAL DRAINAGE
- PIPE (GRAVITY)
- PIPE (PUMPED)
- WATERCOURSE

GIANT MINE WORKS

- PIT (ACTIVE PUMPING TO UNDERGROUND)
- PIT (RUNOFF INFILTRATION TO UNDERGROUND, NO PUMPING)
- PIT (ACTIVE PUMPING TO SURFACE TCA PONDS)
- TCA/MILL POND (FOOTPRINT)
- TCA POND (TYPICAL WETTED AREA)

SURFACE WATER WATERSHED TYPE

- MANAGED WATERSHED AREA
- UNMANAGED WATERSHED AREA
- SITE SUMP CATCHMENT

0 250 500

1:15,000 METRES

REFERENCE(S)

HYDROLOGY AND TRANSPORTATION DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA.
DATUM: NAD 83 PROJECTION: UTM ZONE 11

PROPONENT

Crown-Indigenous Relations and Northern Affairs Canada

Relations Couronne-Autochtones et Affaires du Nord Canada

Government of Northwest Territories / Gouvernement des Territoires du Nord-Ouest

YYYY-MM-DD	2019-01-16
DESIGNED	JL
PREPARED	AA
REVIEWED	JL
APPROVED	NS

PROJECT

Giant Mine Remediation Project

TITLE

EXISTING WATER MANAGEMENT SYSTEMS

PROJECT NO.	CONTROL	REV.	FIGURE
13-1377-0115	30000	0	4.1-1

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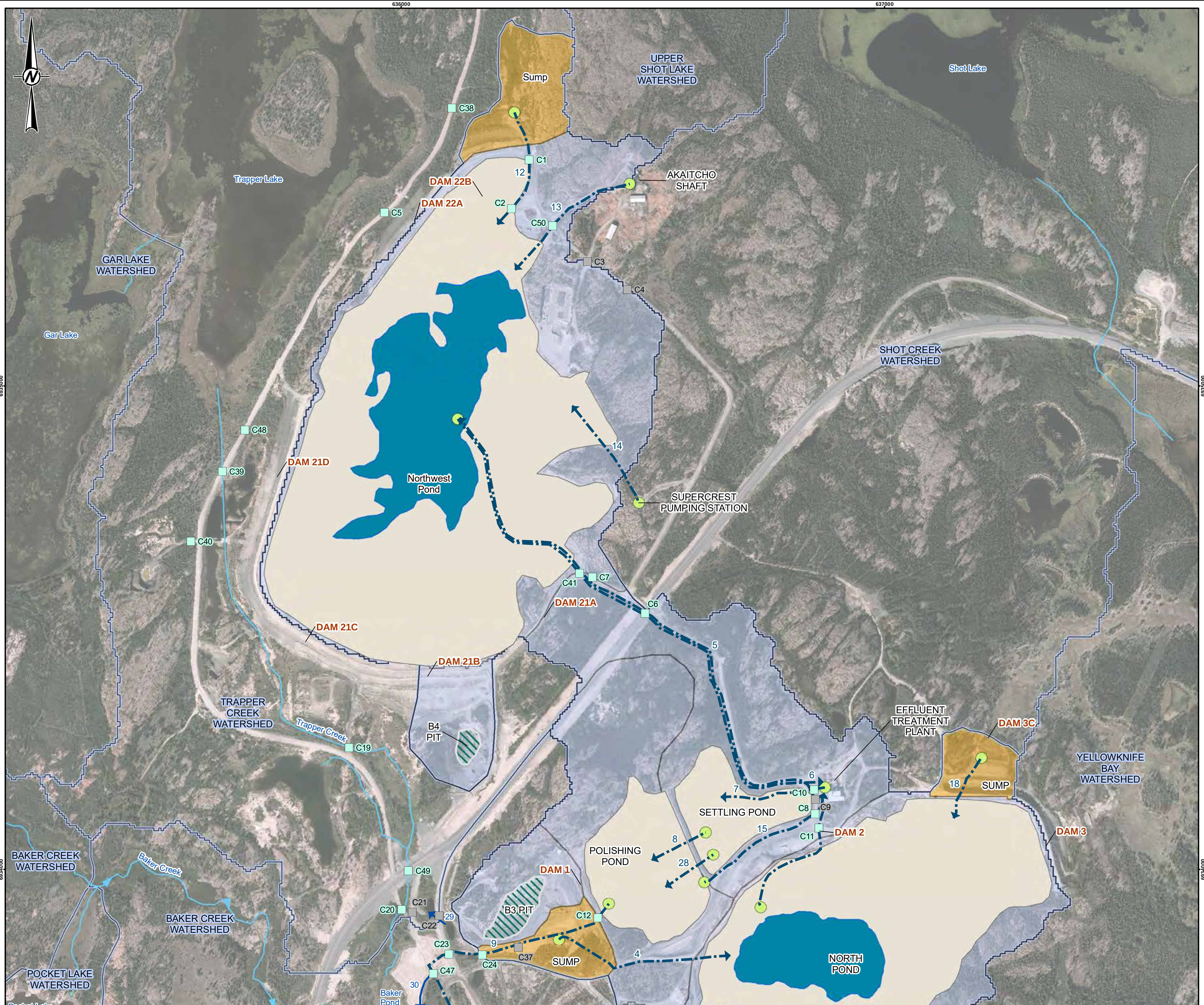

LEGEND

- PUMP STATION

CULVERT

- ACTIVE
- NOT ACTIVE

FLOW PATHS

- NATURAL DRAINAGE
- PIPE (PUMPED)
- WATERCOURSE

GIANT MINE WORKS

- PIT (RUNOFF INFILTRATION TO UNDERGROUND, NO PUMPING)
- TCA/MILL POND (FOOTPRINT)
- TCA POND (TYPICAL WETTED AREA)

SURFACE WATER WATERSHED TYPE

- MANAGED WATERSHED AREA
- UNMANAGED WATERSHED AREA
- SITE SUMP CATCHMENT

0 250 500

1:8,000 METRES

REFERENCE(S)
HYDROLOGY AND TRANSPORTATION DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA.
DATUM: NAD 83 PROJECTION: UTM ZONE 11

PROJECT
Giant Mine Remediation Project

TITLE
EXISTING WATER MANAGEMENT SYSTEMS (NORTHERN EXTENT)

PROPONENT
Crown-Indigenous Relations and Northern Affairs Canada
Relations Couronne-Autochtones et Affaires du Nord Canada
Government of Northwest Territories / Gouvernement des Territoires du Nord-Ouest

YYYY-MM-DD	2019-01-16
DESIGNED	JL
PREPARED	AA
REVIEWED	JL
APPROVED	NS

PROJECT NO.	CONTROL	REV.	FIGURE
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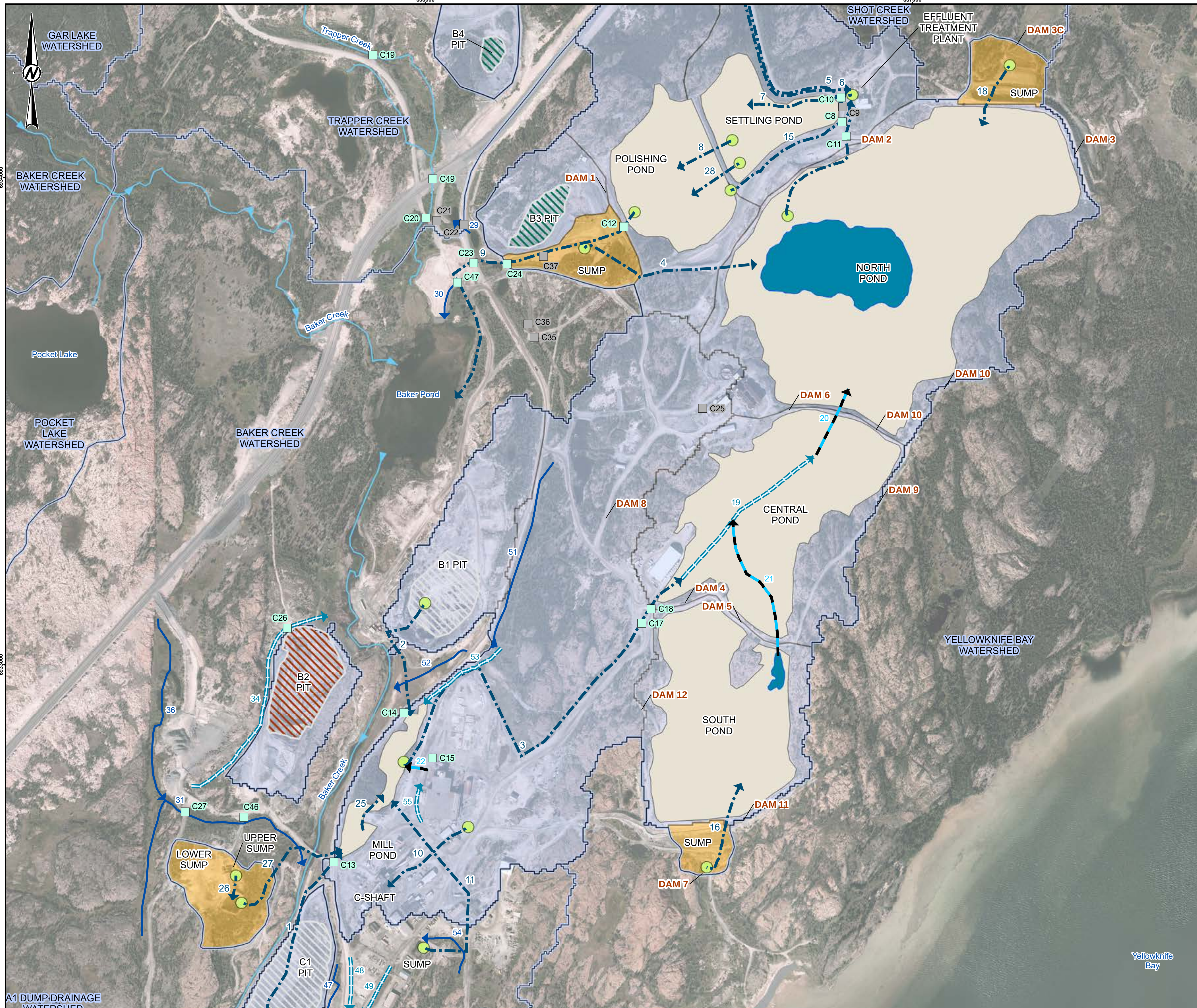

LEGEND

PUMP STATION

CULVERT

- ACTIVE
- NOT ACTIVE

FLOW PATHS

- DITCH
- NATURAL DRAINAGE
- PIPE (GRAVITY)
- PIPE (PUMPED)
- WATERCOURSE

GIANT MINE WORKS

- PIT (ACTIVE PUMPING TO UNDERGROUND)
- PIT (RUNOFF INFILTRATION TO UNDERGROUND, NO PUMPING)
- PIT (ACTIVE PUMPING TO SURFACE TCA PONDS)
- TCA/MILL POND (FOOTPRINT)
- TCA POND (TYPICAL WETTED AREA)

SURFACE WATER WATERSHED TYPE

- MANAGED WATERSHED AREA
- UNMANAGED WATERSHED AREA
- SITE SUMP CATCHMENT

0 250 500

1:8,000 METRES

REFERENCE(S)

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DATUM: NAD 83 PROJECTION: UTM ZONE 11

PROJECT

Giant Mine Remediation Project

TITLE

EXISTING WATER MANAGEMENT SYSTEMS (CENTRAL EXTENT)

PROPONENT

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

Government of Northwest Territories / Gouvernement des Territoires du Nord-Ouest

YYYY-MM-DD	2018-12-05
DESIGNED	JL
PREPARED	AA
REVIEWED	JL
APPROVED	NS

PROJECT NO.	CONTROL	REV.	FIGURE
13-1377-0115	30000	0	4.1-3

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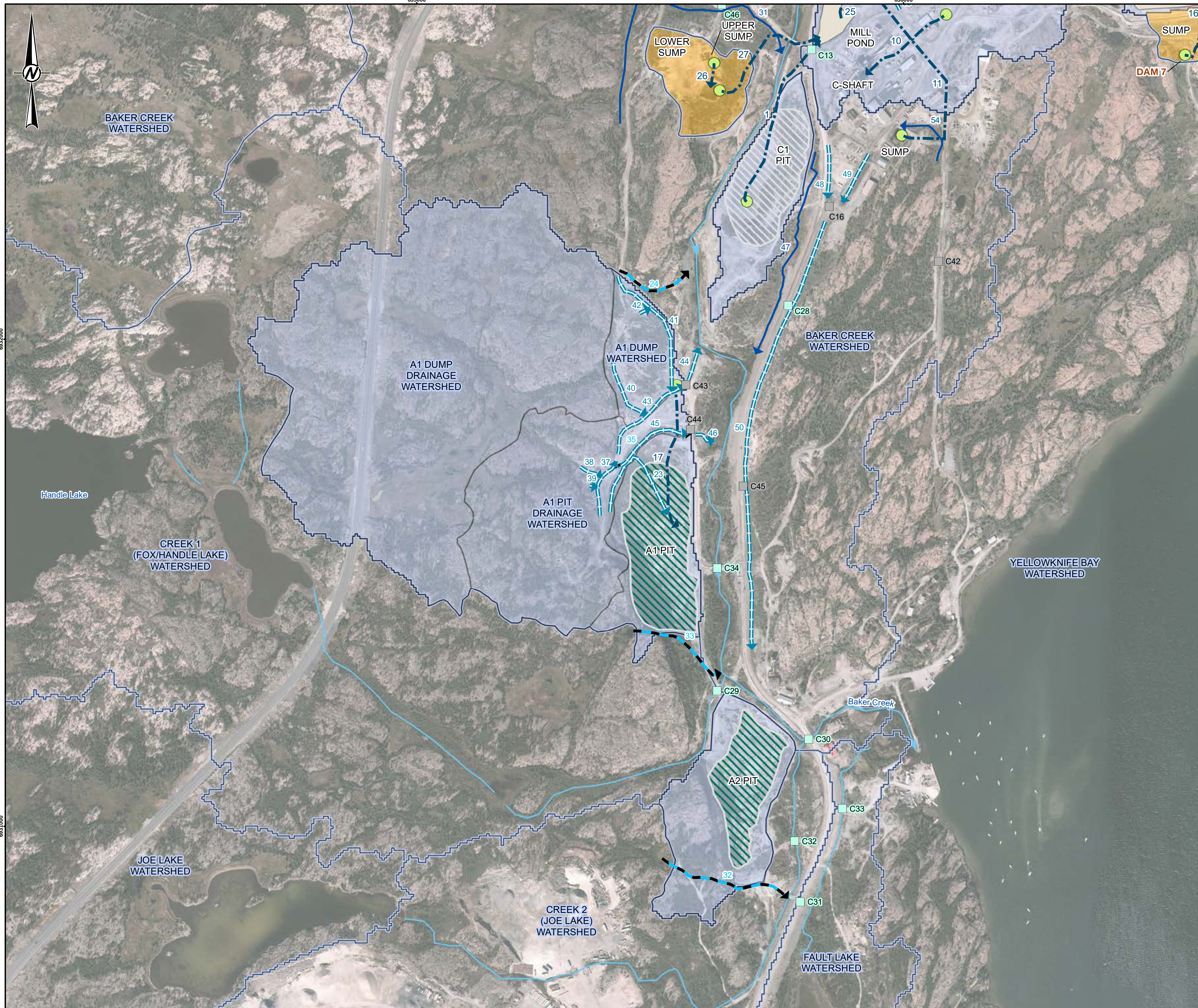


LEGEND

- PUMP STATION

CULVERT

- ACTIVE
- NOT ACTIVE

FLOW PATHS

- DITCH
- NATURAL DRAINAGE
- PIPE (GRAVITY)
- PIPE (PUMPED)
- WATERCOURSE

GIANT MINE WORKS

- PIT (RUNOFF INFILTRATION TO UNDERGROUND, NO PUMPING)
- PIT (ACTIVE PUMPING TO SURFACE TCA PONDS)
- TCA/MILL POND (FOOTPRINT)

SURFACE WATER WATERSHED TYPE

- MANAGED WATERSHED AREA
- UNMANAGED WATERSHED AREA
- SITE SUMP CATCHMENT

0 250 500

1:8,000 METRES

REFERENCE(S)
HYDROLOGY AND TRANSPORTATION DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA.
DATUM: NAD 83 PROJECTION: UTM ZONE 11

PROJECT
Giant Mine Remediation Project

TITLE
EXISTING WATER MANAGEMENT SYSTEMS (SOUTHERN EXTENT)

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

Government of Northwest Territories | Gouvernement des Territoires du Nord-Ouest

YYYY-MM-DD	2018-12-05
DESIGNED	JL
PREPARED	AA
REVIEWED	JL
APPROVED	NS

PROJECT NO.	CONTROL	REV.	FIGURE
13-1377-0115	30000	0	4.1-4

4.1.2 Tailing Containment Areas

Contact water at the Site is stored temporarily in TCAs, including the South Pond, Central Pond, North Pond and Northwest Pond, prior to treatment in the existing ETP, the Settling Pond and the Polishing Pond. Water management characteristics of the TCAs are summarized in Table 4.1-1. Flow pathways and infrastructure locations are also shown in Figure 4.1-1.

Table 4.1-1: Tailings Containment Area Water Management Infrastructure and Flow Pathways

Tailing Containment Area	Contributing Watersheds	Boundary Dams	Water Storage Capacity	Topography	Inflows (Figure 4.1-1)	Outflows (Figure 4.1-1)	Operational Information
South Pond	• Local watershed	• Dam 11 to the south • Dam 12 to the west • Dam 4 and Dam 5 to the north (shared with Central Pond)	• Limited	• Natural (i.e., pre-development) topography drains towards Yellowknife Bay • Existing topography drains northeast towards a standpipe located south of Dam 5 which conveys water into a ditch in the Central Pond by gravity	• Flow Pathway 16: seepage recirculation system from the South Pond via the Dam 11 Sump (located between Dam 7 and Dam 11) and pump	• Flow Pathway 21: gravity water conveyance system to a ditch in the Central Pond by stand pipe • Lateral seepage towards Yellowknife Bay	• Not applicable
Central Pond	• Local watershed • Mill Pond • South Pond	• Dam 4 and Dam 5 to the south (shared with South Pond) • Dam 8 to the west • Dam 6 and Dam 10 to the north (shared with North Pond) • Dam 9 to the east	• Limited	• Natural (i.e., pre-development) topography drains towards Baker Creek • Existing topography drains towards the North Pond by ditch	• Flow Pathway 3 – surface water is pumped from Mill Pond to the Central Pond ditch • Flow Pathway 21 – standpipe conveys runoff from South Pond by gravity.	• Flow Pathway 19: water conveyance ditch to an unnamed sump located south of Dam 6 • Flow Pathway 20: gravity water conveyance system from the unnamed sump (south of Dam 6) to the North Pond by stand pipe • Lateral seepage towards Yellowknife Bay	• Not applicable
North Pond	• Local watershed • Central Pond • Dam 1 Sump	• Dam 6 and Dam 10 to the south (shared with Central Pond) • Dam 2 to the north • Dam 3 and Dam 10 to the east	• See Figure 4.1-5	• Natural (i.e., pre-development) topography mostly drains towards Baker Creek. The northeast extent of the footprint drains to Yellowknife Bay. • Existing topography drains towards a local depression (i.e., the North Pond)	• Flow Pathway 18: seepage recirculation system from the North Pond via the Dam 3 Sump (located between Dam 3 and Dam 3C) and pump • Flow Pathway 4: pumped water from the Dam 1 Sump (located west of Dam 1) • Flow Pathway 20: gravity drainage from the Central Pond via stand pipe	• Flow Pathway 5: pumping system to the Northwest Pond bypassing the existing ETP. This systems is operated during the open water season only • Lateral seepage towards Yellowknife Bay	• Minimum freeboard of 180.3 m (Parsons 2019 forthcoming) • Water levels are managed as a function of water levels in the Polishing Pond to maintain the stability of Dam 2 (Parsons 2019 forthcoming) • Water levels were managed between 173.4 m to 175.5 m from 2010 to 2017

Table 4.1-1: Tailings Containment Area Water Management Infrastructure and Flow Pathways

Tailing Containment Area	Contributing Watersheds	Boundary Dams	Water Storage Capacity	Topography	Inflows (Figure 4.1-1)	Outflows (Figure 4.1-1)	Operational Information
Northwest Pond	• Local watershed • North Pond • Underground mine workings	• Dam 21A, Dam 21B, and Dam 21C to the south • Dam 21D and Dam 22A to the west • Dam 22B to the north	• See Figure 4.1-6	• Natural (i.e., pre-development) topography drains to Trapper Creek • Existing topography drains towards a local depression (i.e., the Northwest Pond)	• Flow Pathway 5: pumping system from the North Pond • Flow Pathway 12: seepage recirculation system from the Northwest Pond via the Dam 22B Sump (located north of Dam 22B) and pump • Flow Pathway 13: Pumping system from the underground mine workings through the Akaitcho Shaft • Flow Pathway 14 – Pumping system from the underground mine workings via the Supercrest borehole	• Flow Pathway 6: pumping system to the existing ETP for treatment	• Only one pipeline connects the Northwest Pond and the existing ETP. Water from the Northwest Pond can only be transferred to the existing ETP (Flow Pathway 6) when there are no water transfers from the North Pond to the Northwest Pond via the existing ETP (Flow Pathways 5). • Treatment in existing ETP occurs during open water season only • Water levels are managed following prescribed action levels (Parsons 2019 forthcoming) • Minimum freeboard of 193.4 m (Parsons 2019 forthcoming) • Water levels were managed between 189.6 m to 192.9 m from 2010 to 2017

Figure 4.1-5: Elevation-Storage Characteristics for the North Pond

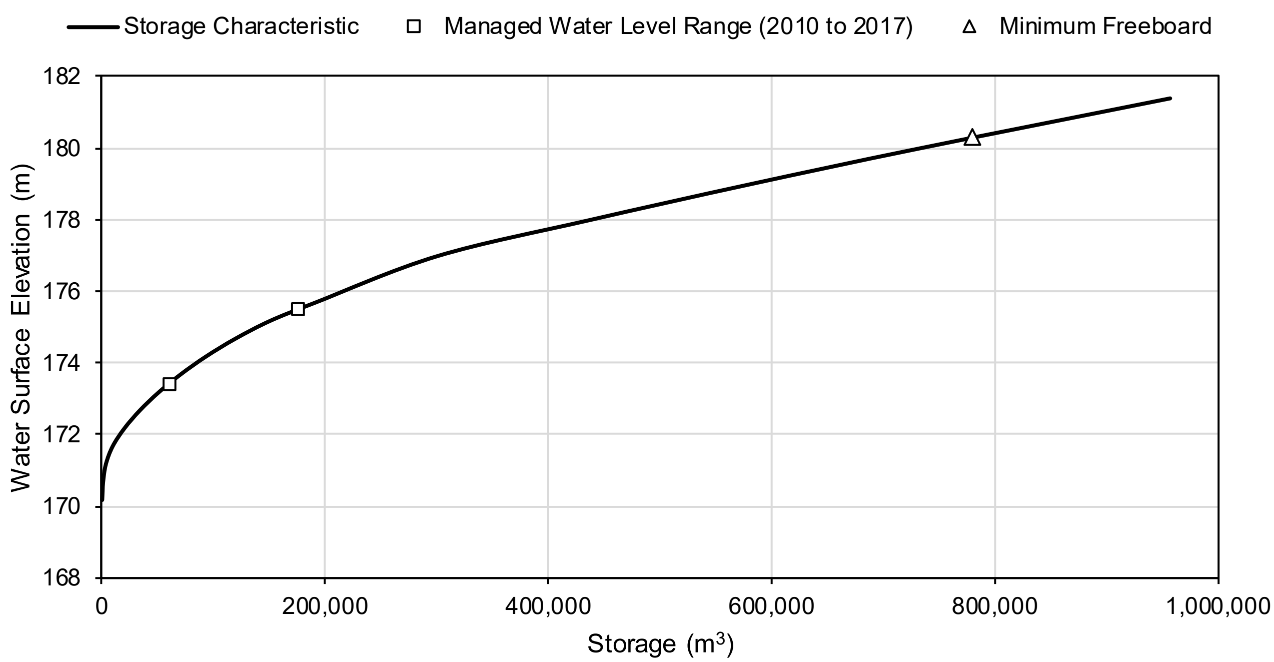
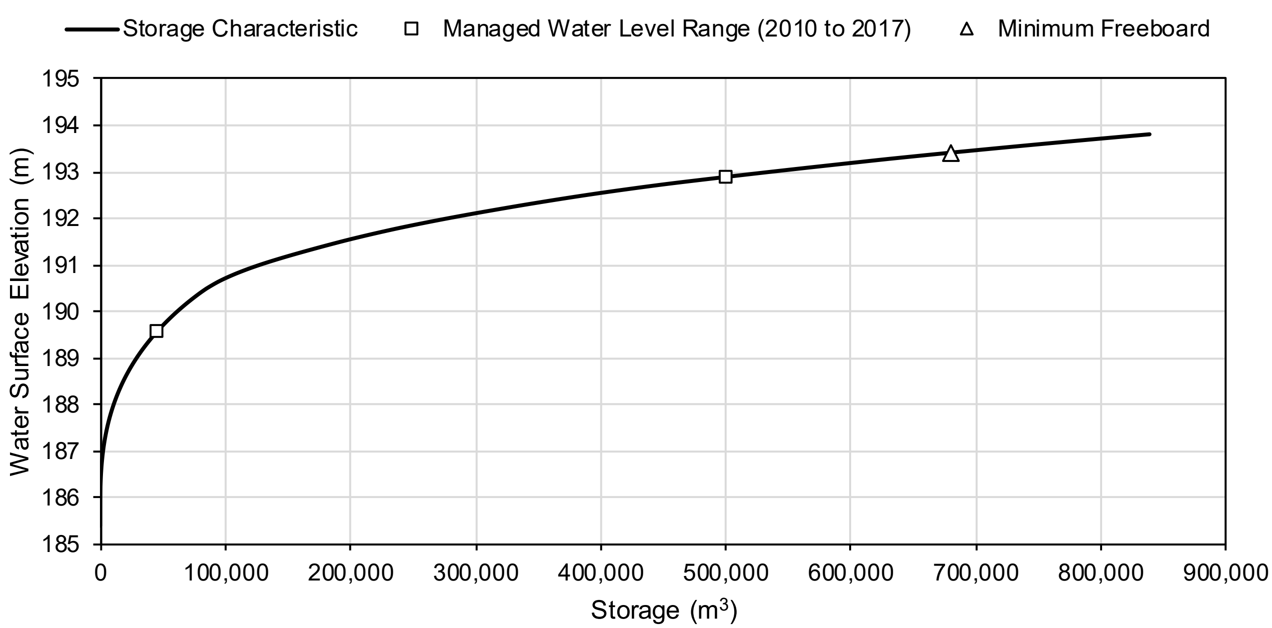


Figure 4.1-6: Elevation-Storage Characteristics for the Northwest Pond



4.1.3 Collection and Conveyance Infrastructure

There are numerous ditches, sumps, pipelines, and culverts at the Site. This infrastructure is intended to divert non-contact water away from contaminated sources and to the receiving environment where possible, to prevent flooding the underground mine, and to convey contact water to treatment.

Key collection and conveyance infrastructure is described in Table 4.1-2 by watershed, from south to north, and shown in Figure 4.1-1. A comprehensive inventory of the Site's infrastructure, including ditches, pipeline, and culverts, is provided in Appendix E.

Table 4.1-2: Collection and Conveyance Infrastructure and Flow Pathways

Watershed	Contributing Watersheds	Topography	Infrastructure and Flow Pathway
A2 Pit	• Local watershed	• Local watershed runoff flows to A2 Pit by gravity and infiltrates to the underground workings	• Runoff upstream (east) of the A2 Pit watershed which would otherwise flow to A2 Pit by gravity is collected and conveyed by pipeline to Creek 2 (Flow Pathway 32), bypassing the A2 Pit watershed. Creek 2 is diverted to Fault Creek by a ditch block located along Creek 2, that forces Creek 2 through Culvert C31 • Creek 1 (Fox/Handle Lake watershed) originates off Site and is diverted north along the A2 Pit watershed boundary to bypass the A2 Pit watershed and drain to Baker Creek
A1 Pit	• Local watershed	• Local watershed runoff flows to A1 Pit by gravity and infiltrates to the underground workings	• The very southern portion of the A1 Pit watershed is non-contact water and is diverted by pipeline to Baker Creek (Flow Pathway 33), bypassing A1 Pit • Runoff west of A1 Pit is conveyed by a series of ditches (Flow Pathways 23, 35, 37, 38, and 39) to A1 Pit. Some of the runoff accumulates behind Culvert C44 which is blocked to prevent the runoff from reaching Baker Creek, and backs up along Flow Pathway 45. Backed up runoff eventually reaches Flow Pathway 23 and flows into A1 Pit. • Runoff from A1 Dump sub-watershed drains through three ditches (Flow Pathways 40, 41 and 43) to Culvert C43, which is blocked and prevents the runoff from reaching Baker Creek. Runoff accumulates upstream of Culvert C43 and is conveyed to A1 Pit by pump and pipeline (Flow Pathway 17) • Runoff north of A1 Pit which would otherwise naturally drain towards A1 Dump is captured prior to becoming contact water by a small catch basin and diverted by pipeline (sometimes referred to as the Glacier pipeline and Ditch Block 3) to Baker Creek (Flow Pathway 24)
C1 Pit	• Local watershed	• Local watershed runoff flows to C1 Pit	• Local watershed runoff flows to C1 Pit by gravity, and is captured by a sump, and conveyed by pump and pipeline to the Mill Pond (Flow Pathway 1)
Upper and Lower Sump (located in the Clay Borrow Pit)	• Local watershed	• Local watershed runoff from the Lower Sump is conveyed to the Upper Sump by pump and pipeline (Flow Pathway 26)	• Runoff from the Upper Sump is conveyed to the Mill Pond by gravity and pipeline (Flow Pathway 27)
Mill Pond	• Local watershed • B1 Pit • C1 Pit • Upper and Lower Sump	• Local watershed runoff flows to the Mill Pond	• Water from the Mill Pond is conveyed by pump and pipeline to the Central Pond (Flow Pathway 3)
B2 Pit	• Local watershed	• Local watershed runoff flows to B2 Pit by gravity and is conveyed to the underground workings by pump and pipeline	• Runoff west of B2 Pit is diverted around the B2 Pit watershed to Baker Creek (Flow Pathway 34)
B1 Pit	• Local watershed	• Local watershed runoff flows to B1 Pit	• Local watershed runoff flows to B1 Pit by gravity, and is captured by a sump, and conveyed by pump and pipeline to the Mill Pond (Flow Pathway 2)
B3 Pit	• Local watershed	• Local watershed runoff flows to B3 Pit	• Local watershed runoff flows to B3 Pit by gravity and infiltrates to the underground workings
B4 Pit	• Local watershed	• Local watershed runoff flows to B4 Pit	• Local watershed runoff flows to B4 Pit by gravity and infiltrates to the underground workings

4.2 Existing Minewater Infrastructure and Management

The underground workings form a network of connected voids, including horizontal drifts, inclined raises, vertical shafts, ramps, chutes and ore stopes to a maximum depth of 610 m below the surface (Figure 4.2-1). In addition, many thousands of exploration drill holes intersect the workings, creating an extensive drainage system for surface water infiltration into the underground mine. Minewater consists of all water that flows into the underground workings through these openings. It also includes water infiltrating into the underground mine from Baker Creek, infiltration from the surface and from pits as described in Section 4.1, and from the shallow and deep groundwater aquifers surrounding the mine workings. Infiltration and direct inflow to the underground workings across the Site increase significantly during the freshet and when the water level in Baker Creek is high.

Throughout active remediation it will be necessary to continue to pump and treat contaminated minewater at the Site. The existing ETP will operate in the interim, until the construction and commissioning of a new WTP during the active remediation phase. The ETP and WTP systems will be used to maintain mine pool levels and treat contaminated site water. Treatment is required as the mine pool includes contaminants, such as arsenic and antimony, which make it unacceptable for direct discharge to the environment.

4.2.1 History

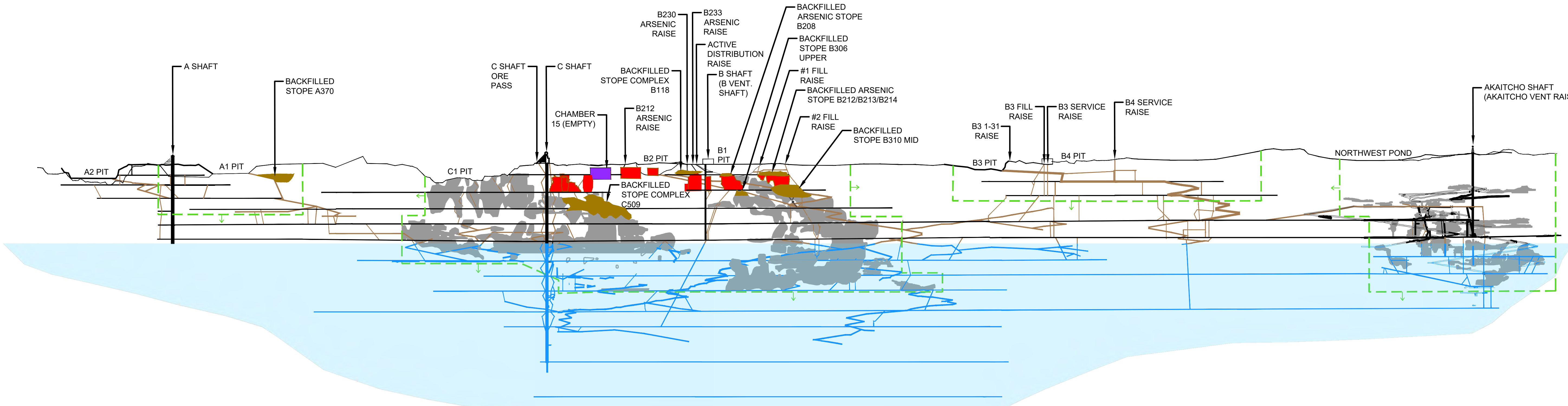
Flooding of the lower levels of the mine was initiated in July 2005, when the pumps on the 2000 Level (-435.2 metres above sea level [masl]) at the bottom of the mine were shut down and removed. In 2007, the pumps on the 1300 Level (approximately -220 masl) were also shut down and removed. Before flooding of the lower mine levels commenced, the dewatering rate required to keep the mine dry was typically about 2,000 m^3 per day in winter, increasing to 4,000 m^3 or more during the freshet period. The underground minewater level is currently held approximately 12 m below the 750 Level.

Hydrogeological investigations conducted at the Site were used to develop a numerical model to evaluate groundwater flow conditions near the Site (SRK 2005b). This model supported the interpretation that the underground mine presently acts as a hydraulic sink, containing the movement of arsenic-affected water in the underground mine workings. This model is presently being updated based on data collected from the monitoring network since the completion of the DAR.

4.2.2 Underground Pumping Systems

Minewater from the underground workings is pumped year-round, as required, from the Akaitcho area to surface storage in the Northwest Pond.

The Akaitcho System is used to maintain the minewater level approximately 12 m below the 750 Level (as measured at C Shaft) and the minewater elevation typically fluctuates by 0.75 m between normal pump start and pump stop levels with slightly higher fluctuations during freshet. This level is below the local groundwater table, and well below the arsenic storage chambers. Therefore, surrounding groundwater flows will continue to be drawn towards the pump area.



LEGEND

FLOODED DEVELOPMENT (DRIFTS, RAISES, ORE-PASSES AND SHAFTS)

DEVELOPMENT (RAMPS, DRIFTS, RAISES, ORE PASSES, AND SHAFTS)

MORE STOPES PRESENT BEYOND DASHED LINE

NON-ARSENIC STOPES

ARSENIC STOPES AND CHAMBERS

EMPTY CHAMBER

BACKFILLED STOPES

NOTES

1. C-TROUGH UNDERGROUND MODEL NOT SHOWN.
2. NOT ALL WORKINGS AND STOPES SHOWN.

REFERENCES

1. INDIAN AND NORTHERN AFFAIRS CANADA - GIANT MINE REMEDIATION PROJECT. DATE: OCTOBER 7, 2008. FILE: S:\5620-GMRP...\UNDERGR...\GIANTLONG2008MASTER.dwg
2. MIRAMAR GIANT MINE LTD. - VENTILATION PROJECT. FILE: VLONG2002.dwg

SOURCE:
GOLDER FIGURE 5.1-2 "VERTICAL PROJECTION SHOWING UNDERGROUND FEATURES" - PROJECT No. 13-1426-0010 - DATED 2018-05-25.

PROJECT
Giant Mine Remediation Project

TITLE
VERTICAL PROJECTION SHOWING UNDERGROUND FEATURES

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

Government of Northwest Territories
Gouvernement des Territoires du Nord-Ouest

YYYY-MM-DD	2018-12-14
DESIGNED	S. Marsanich
PREPARED	C. Eros
REVIEWED	B. Boon
APPROVED	R. Schmidtke

PROJECT NO.	CONTROL	REV.	FIGURE
60581230		B	4.2-1

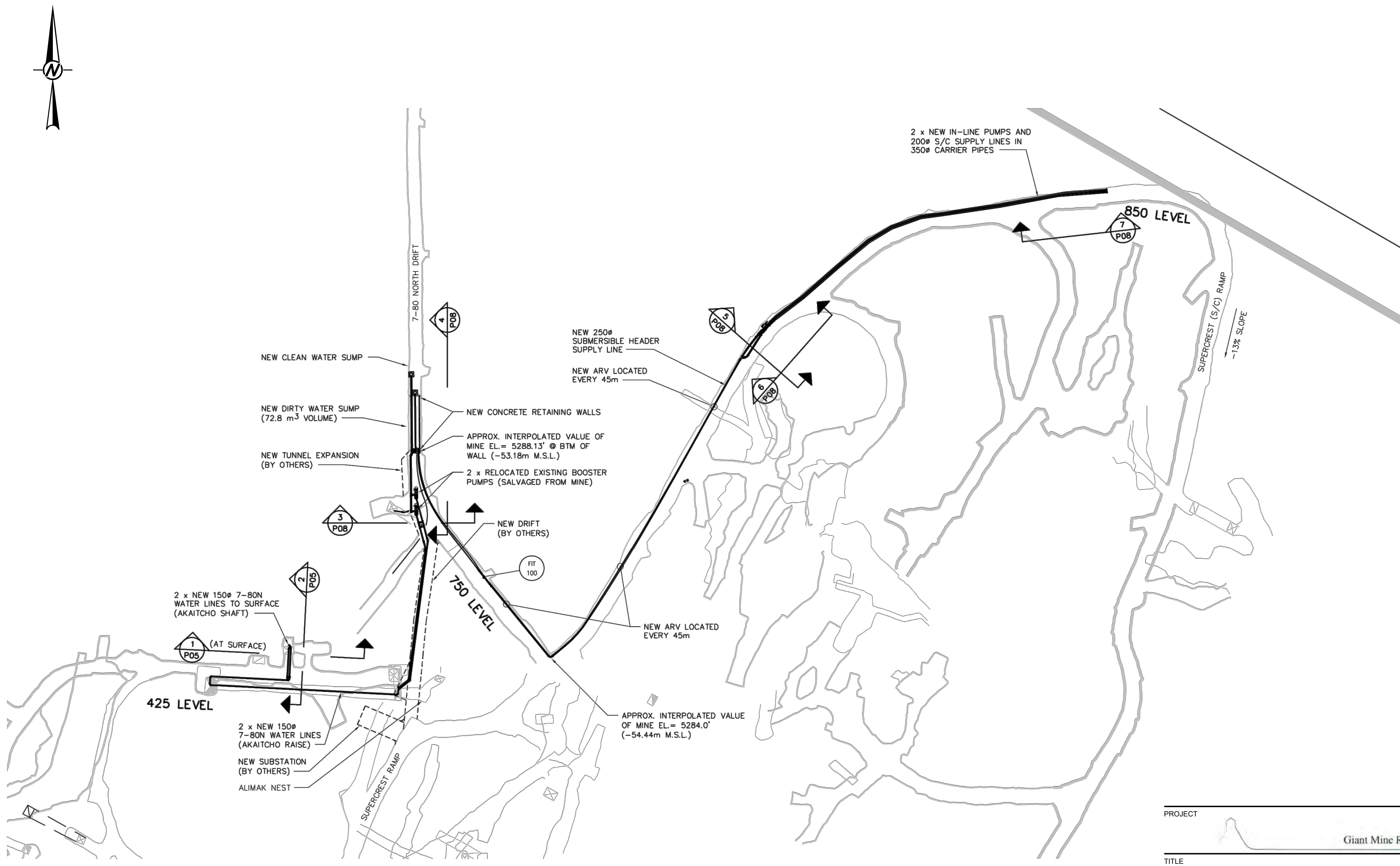
4.2.2.1 Existing Akaitcho Pumping System

Currently, the pumping and management of underground minewater consists of two major systems: the Akaitcho pump system and the High Test System. Minewater from the underground workings is pumped year-round, as required, from below the Akaitcho headframe, to surface storage in the Northwest Pond and is treated at the ETP and discharged to Baker Creek during the open water season.

Two low level in-line pumps, installed into the mine pool below the 850 Level on the Supercrest Ramp, pump minewater into the Akaitcho sump on the 750 Level. In the Akaitcho sump, the mine pool water from the low level pumps mixes with the high test water (refer to Section 4.2.2.2). Two fixed pumps on the 750 Level at the Akaitcho pumping station convey the water from the sump to surface storage in the Northwest Pond.

Figure 4.2-2 shows a plan of the Akaitcho Pumping System, including the Supercrest Ramp which is the current access pathway to the underground pumps. Figure 4.2-3 shows the piping and instrumentation diagram for the Existing Akaitcho Pumping System.

This system must be maintained using an underground travel way. This pumping system became increasingly costly to maintain due to deterioration of ground support; this support was installed in the access ramp that connects the surface to the underground pumping station during production mining in the 1970s. In 2017, CIRNAC applied for amendments to the Giant Mine Site Stabilization Program for Water Licence MV2010L8-0010 and Land Use Permit MV2016S0016 to change the type of pumps used for water management on site. This amendment request was approved, and the Akaitcho Pumping System will be replaced in 2019 with the new system installed/commissioned as described in Section 4.2.2.3.



UNDERGROUND PLAN
N.T.S.

SOURCE:
EARTHTECH PROJECT "GIANT MINE AKAITCHO DEWATERING" - PROJECT No. 91537 - DRAWING No. P04, DATED 07-17-2006.

P:\60581230\900-CAD_GIS\910-CAD\30-FIGURES\G\00\60581230-FIG-00-0000-G-0422.dwg

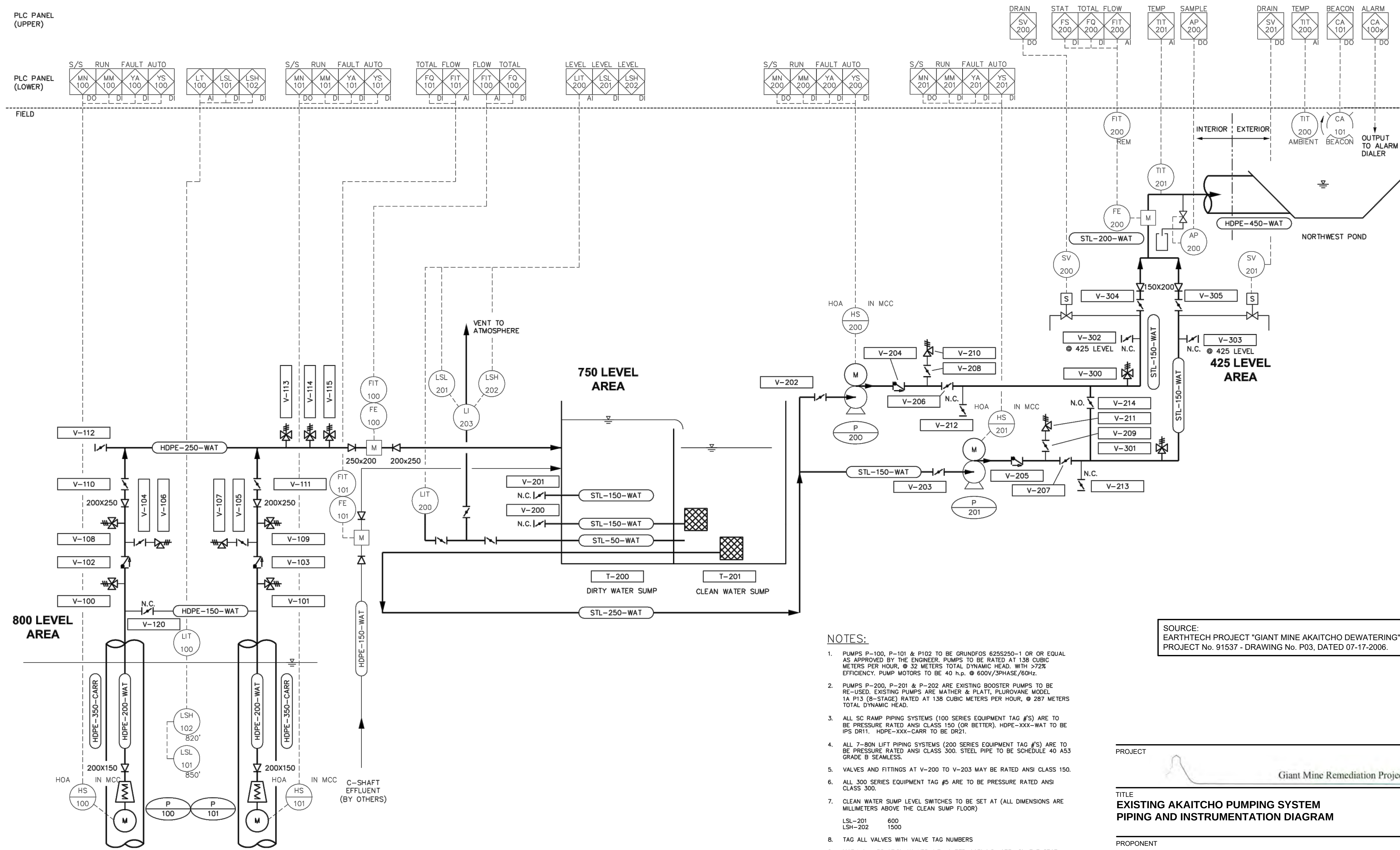
PROJECT
Giant Mine Remediation Project

TITLE
EXISTING AKAITCHO PUMPING SYSTEM
UNDERGROUND PROCESS PIPING PLAN

PROPONENT
Crown-Indigenous Relations and Northern Affairs Canada
Relations Couronne-Autochtones et Affaires du Nord Canada
Government of Northwest Territories / Gouvernement des Territoires du Nord-Ouest

YYYY-MM-DD	2018-12-14
DESIGNED	S. Marsanich
PREPARED	C. Eros
REVIEWED	B. Boon
APPROVED	R. Schmidtke

PROJECT NO.	CONTROL	REV.	FIGURE
60581230		B	4.2-2



NOTES:

1. PUMPS P-100, P-101 & P102 TO BE GRUNDFOS 625S250-1 OR OR EQUAL AS APPROVED BY THE ENGINEER. PUMPS TO BE RATED AT 138 CUBIC METERS PER HOUR, @ 32 METERS TOTAL DYNAMIC HEAD. WITH >72% EFFICIENCY. PUMP MOTORS TO BE 40 h.p. @ 600V/3PHASE/60Hz.
2. PUMPS P-200, P-201 & P-202 ARE EXISTING BOOSTER PUMPS TO BE RE-USED. EXISTING PUMPS ARE MATHER & PLATT, PLUROVANE MODEL 1A P13 (8-STAGE) RATED AT 138 CUBIC METERS PER HOUR, @ 287 METERS TOTAL DYNAMIC HEAD.
3. ALL SC RAMP PIPING SYSTEMS (100 SERIES EQUIPMENT TAG #'S) ARE TO BE PRESSURE RATED ANSI CLASS 150 (OR BETTER). HDPE-XXX-WAT TO BE IPS DR11. HDPE-XXX-CARR TO BE DR21.
4. ALL 7-80N LIFT PIPING SYSTEMS (200 SERIES EQUIPMENT TAG #'S) ARE TO BE PRESSURE RATED ANSI CLASS 300. STEEL PIPE TO BE SCHEDULE 40 A53 GRADE B SEAMLESS.
5. VALVES AND FITTINGS AT V-200 TO V-203 MAY BE RATED ANSI CLASS 150.
6. ALL 300 SERIES EQUIPMENT TAG #5 ARE TO BE PRESSURE RATED ANSI CLASS 300.
7. CLEAN WATER SUMP LEVEL SWITCHES TO BE SET AT (ALL DIMENSIONS ARE MILLIMETERS ABOVE THE CLEAN SUMP FLOOR)

   LSL-201 600
   LSH-202 1500
8. TAG ALL VALVES WITH VALVE TAG NUMBERS
9. MARK ALL ISOLATION VALVES WITH A RED WARNING LABEL ON THE GEAR OPERATOR. "DO NOT OPERATE WHILE PUMP IS ON".

SOURCE:
EARTHTECH PROJECT "GIANT MINE AKAITCHO DEWATERING" - PROJECT No. 91537 - DRAWING No. P03, DATED 07-17-2006.

	SC RAMP PUMP A	SC RAMP PUMP B	SC RAMP PUMP C (SHELF SPARE)	7-80N LIFT PUMP A	7-80N LIFT PUMP B	7-80N LIFT PUMP C (SHELF SPARE)
EQUIP. NO.:	P-100	P-101	P-102	P-200	P-201	P-202
SPEC:	NOTE 1	NOTE 1	NOTE 1	NOTE 2	NOTE 2	NOTE 2
TYPE:	SUBMERSIBLE	SUBMERSIBLE	SUBMERSIBLE	CENTRIFUGAL	CENTRIFUGAL	CENTRIFUGAL
CAPACITY:	138 CU.M/HR	138 CU.M/HR	138 CU.M/HR	138 CU.M/HR	138 CU.M/HR	138 CU.M/HR
HEAD:	32 m	32 m	32 m	287 m	287 m	287 m
POWER:	25 h.p.	25 h.p.	25 h.p.	250 h.p.	250 h.p.	250 h.p.

PROJECT
Giant Mine Remediation Project

TITLE
EXISTING AKAITCHO PUMPING SYSTEM PIPING AND INSTRUMENTATION DIAGRAM

PROPONENT
Crown-Indigenous Relations and Northern Affairs Canada
Relations Couronne-Autochtones et Affaires du Nord Canada
Government of Northwest Territories
Gouvernement des Territoires du Nord-Ouest

YYYY-MM-DD	2018-12-14
DESIGNED	S. Marsanich
PREPARED	C. Eros
REVIEWED	B. Boon
APPROVED	R. Schmidtke

PROJECT NO.	CONTROL	REV.	FIGURE
60581230		B	4.2-3

P:\60581230\900-CAD_GIS\910-CAD\30-FIGURES\G\00\60581230-FIG-00-0000-G-0423.dwg

4.2.2.2 The High Test System

The High Test System is a piped collection system that accepts seepage from areas in the underground mine, including from the arsenic chambers and sewage / greywater from the C-Dry building. This seepage generally has a high arsenic concentration relative to most other areas of the mine and the minepool. Water is collected either directly by gravity or by pumps from collection sumps. The purpose of the High Test System is to collect contaminated water, prior to it entering the mine pool, and to convey it to a sump from which it can be pumped to surface for water treatment.

The High Test System is maintained along C Shaft and a portion of the 750 Level track drive near the B-ramp system and the 7-20 scoop shop. The high test pipes exit to the sump at the 750 Level Akaitcho pumping system (refer to Section 4.2.2.1). Within the Akaitcho sump, high test water is mixed with mine pool water from the Akaitcho low lift pumps, and pumped to surface by the two Akaitcho high lift pumps for storage in the Northwest Pond. Sampling and monitoring in 2014/2015 indicated that 37% of water being moved to the surface came from the High Test System.

The older Supercrest pumping station, located near the Akaitcho pumping system, is still operational. If required, during high inflow periods, the High Test System can be diverted away from the Akaitcho pumping system and into the Supercrest pumping station. The Supercrest pumping station pumps water to the Northwest Pond through a vertical borehole and pipe. For a brief period during freshet in 2012, 2017 and 2018, the high test flow was directed to the Supercrest pumping station to allow the Akaitcho pumping system to concentrate on conveying mine pool water to surface.

The High Test System is shown in Figure 4.2-4 (plan view), Figure 4.2-5 (cross-section), and Figure 4.2-6 (schematic).

Following successful operational trials of the Akaitcho Interim deep well pumping station in 2019 (refer to Section 4.2.2.3) the High Test System will be re-routed, via a short length of piping, to the mine pool near the new pump wells. The fate of the high test line at permanent closure is to be determined through future design work.

Blackwater is currently pumped into the high test line, however it is anticipated that this practice will end during the remediation phase, with blackwater being collected and trucked off Site for treatment in the municipal system. Municipal treatment is the preferred treatment option for blackwater, but the suitability of this option is dependent on approvals for off-site disposal as well as water quality assessments.

P:\60581230\900-CAD_GIS\910-CAD\30-FIGURES\G\00\60581230-FIG-00-0000-G-0424.dwg

PROPONENT

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

Government of Northwest Territories | Gouvernement des Territoires du Nord-Ouest

YYYY-MM-DD	2018-12-14
DESIGNED	S. Marsanich
PREPARED	C. Eros
REVIEWED	B. Boon
APPROVED	R. Schmidtke

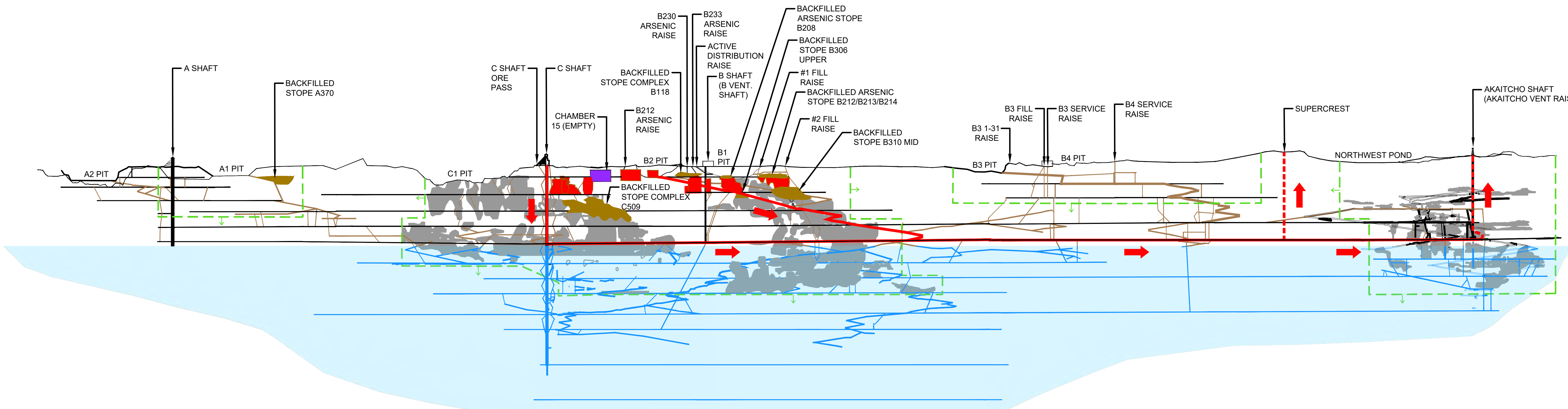
PROJECT

Giant Mine Remediation Project

TITLE

PLAN VIEW OF THE HIGH TEST SYSTEM

PROJECT NO.	CONTROL	REV.	FIGURE
60581230		B	4.2-4



LEGEND

FLOODED DEVELOPMENT (DRIFTS, RAISES, ORE-PASSES AND SHAFTS)

DEVELOPMENT (RAMPS, DRIFTS, RAISES, ORE PASSES, AND SHAFTS)

MORE STOPES PRESENT BEYOND DASHED LINE

NON-ARSENIC STOPES

ARSENIC STOPES AND CHAMBERS

EMPTY CHAMBER

BACKFILLED STOPES

HIGH TEST SYSTEM LINE

NOTES

1. C-TROUGH UNDERGROUND MODEL NOT SHOWN.
2. NOT ALL WORKINGS AND STOPES SHOWN.

REFERENCES

1. INDIAN AND NORTHERN AFFAIRS CANADA - GIANT MINE REMEDIATION PROJECT. DATE: OCTOBER 7, 2008. FILE: S:\5620-GMRP...\UNDERGR...\GIANTLONG2008MASTER.dwg
2. MIRAMAR GIANT MINE LTD. - VENTILATION PROJECT. FILE: VLONG2002.dwg

SOURCE:
GOLDER FIGURE 5.1-2 "VERTICAL PROJECTION SHOWING UNDERGROUND FEATURES" - PROJECT No. 13-1426-0010 - DATED 2018-05-25.

PROJECT
Giant Mine Remediation Project

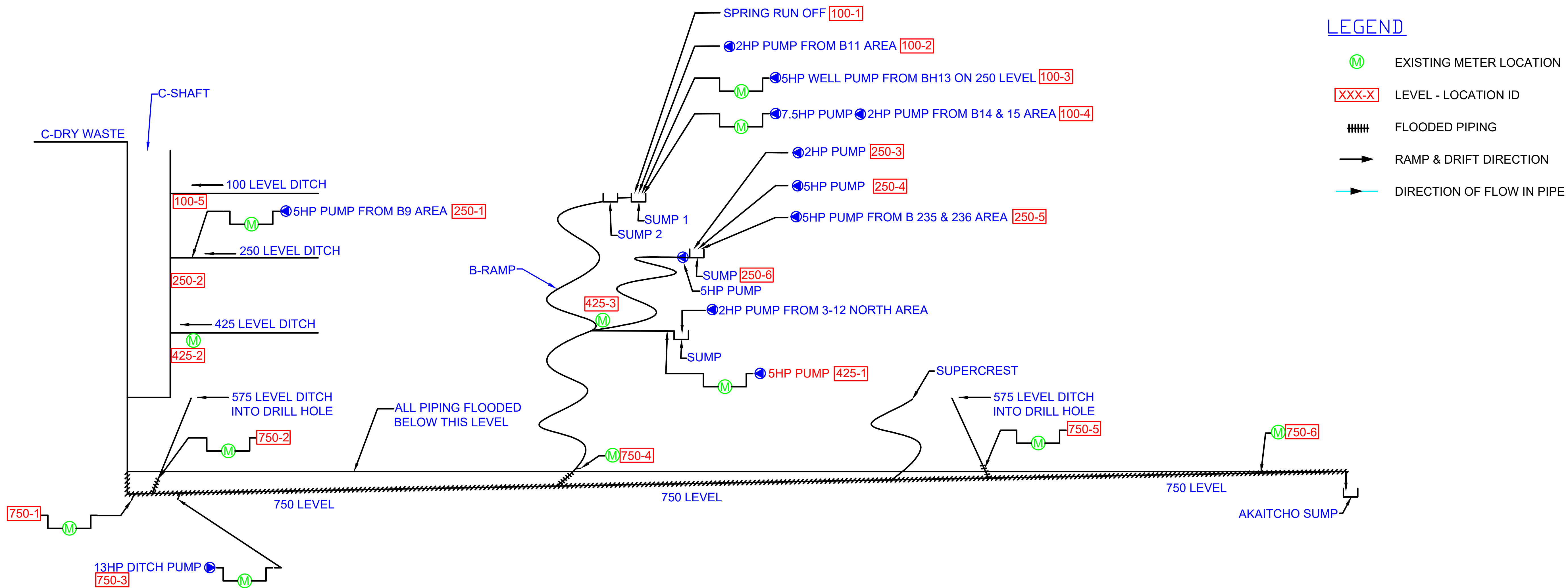
TITLE
VERTICAL PROJECTION SHOWING UNDERGROUND FEATURES INCLUDING HIGH TEST SYSTEM

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

Government of Northwest Territories / Gouvernement des Territoires du Nord-Ouest

YYYY-MM-DD	2018-12-14
DESIGNED	S. Marsanich
PREPARED	C. Eros
REVIEWED	B. Boon
APPROVED	R. Schmidtke

PROJECT NO.	CONTROL	REV.	FIGURE
60581230		B	4.2-5



SOURCE:
AECOM PROJECT "GIANT MINE - MINE WATER CHARACTERIZATION" - PROJECT No. 60310320 - SHEET No. C102, DATED 01-29-2014.

PROJECT
Giant Mine Remediation Project

TITLE
HIGH TEST SYSTEM PUMPING SCHEMATIC

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

Government of Northwest Territories
Gouvernement des Territoires du Nord-Ouest

YYYY-MM-DD	2018-12-14
DESIGNED	S. Marsanich
PREPARED	C. Eros
REVIEWED	B. Boon
APPROVED	R. Schmidtke

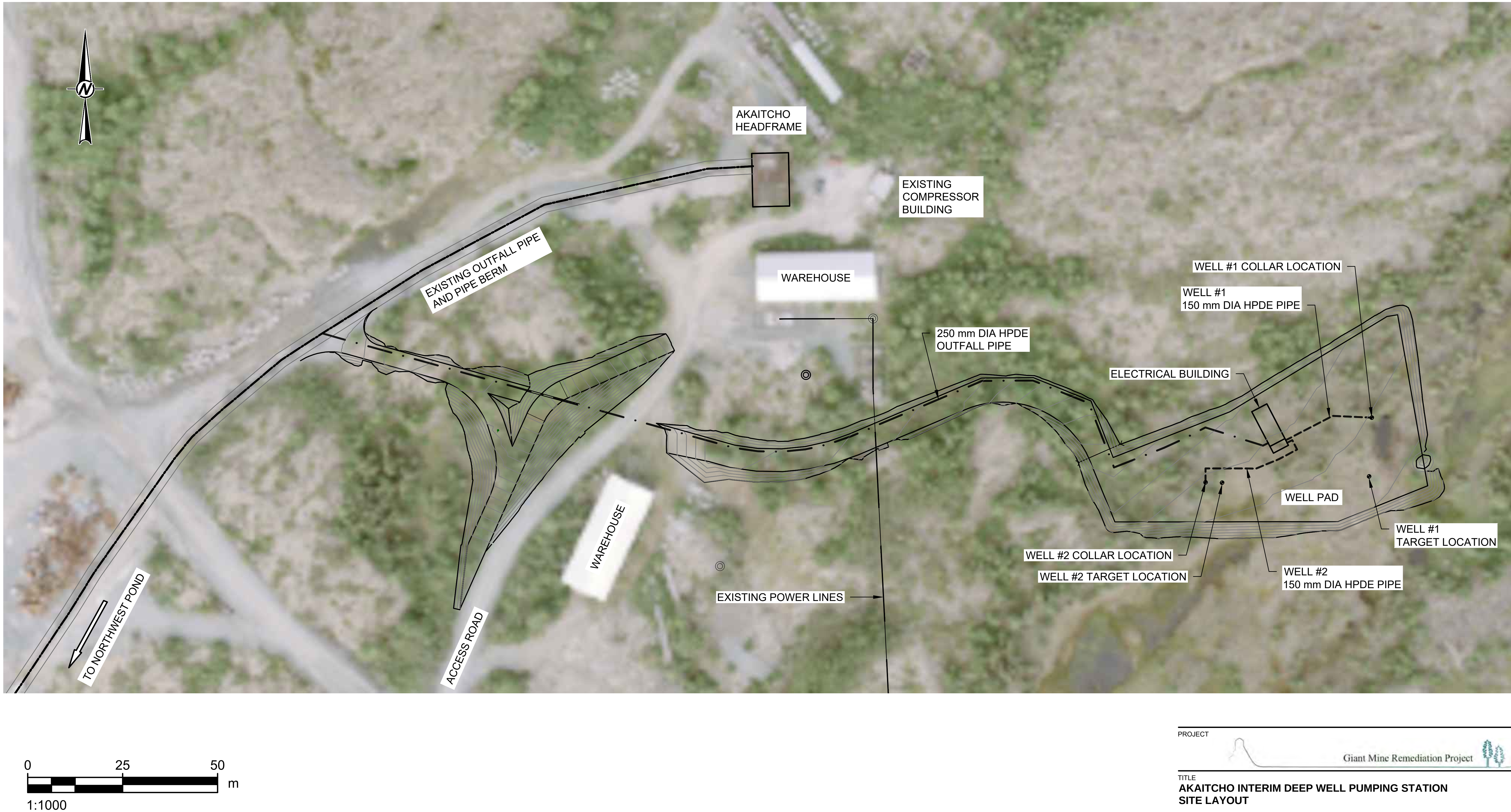
PROJECT NO.	CONTROL	REV.	FIGURE
60581230		B	4.2-6

P:\60581230\900-CAD_GIS\910-CAD\30-FIGURES\G\00\60581230-FIG-00-0000-G-0426.dwg

4.2.2.3 Akaitcho Interim Deep Well Pumping Station

A new system consisting of submersible pumps installed in two deep wells drilled from surface to intersect the flooded underground mine workings in the Akaitcho area below the 750 Level is being installed over 2018/2019 (Figures 4.2-7 and 4.2-8). The location of the pump station near Akaitcho was chosen to enable efficient transfer of minewater to the Northwest Pond and the existing ETP. The system remains the same with minewater from the underground workings pumped year-round to the Northwest Pond, and the combined pump capacity is similar but greater than the combined capacity of the previous underground pumping system. The pumps are assumed to be operational for approximately 8-10 years (to 2026-2028) before pumping moves to the C Shaft. The key advantage of these pumps is that they are installed and maintained from surface, eliminating the requirement for staff to go underground in the Akaitcho area for maintenance of the pumps.

Following successful operational trials of the new pumping system in 2019 during maximum flow conditions (freshet), the existing system, as described in Sections 4.2.2.1 and 4.2.2.2 will be decommissioned.



P:\60581230\900-CAD_GIS\910-CAD\30-FIGURES\G\00\60581230-FIG-00-0000-G-0427.dwg

PROJECT

Giant Mine Remediation Project

TITLE

AKAITCHO INTERIM DEEP WELL PUMPING STATION SITE LAYOUT

PROPONENT

Crown-Indigenous Relations and Northern Affairs Canada

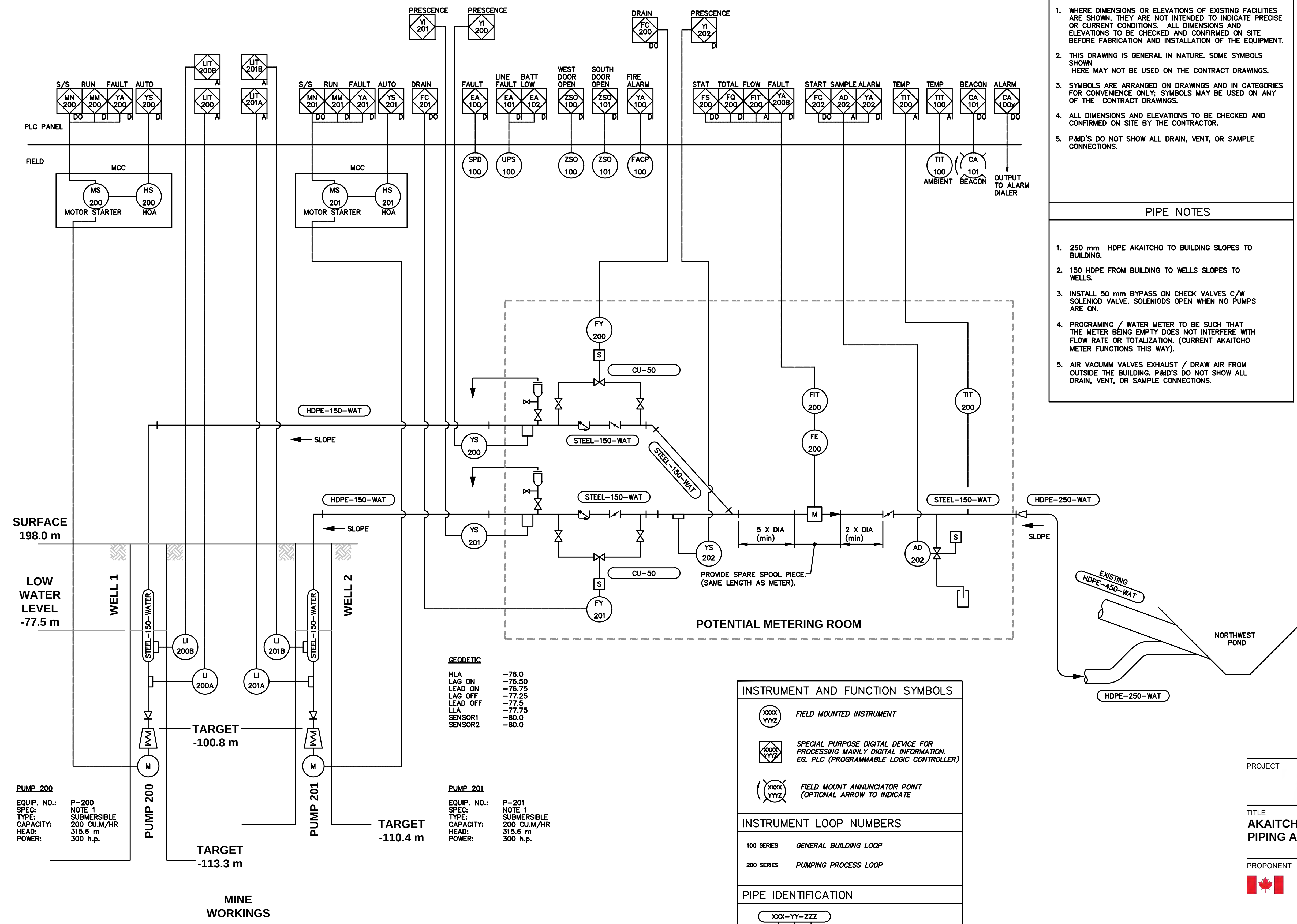
Relations Couronne-Autochtones et Affaires du Nord Canada

Government of Northwest Territories

Gouvernement des Territoires du Nord-Ouest

YYYY-MM-DD	2018-12-14
DESIGNED	S. Marsanich
PREPARED	D. Truong
REVIEWED	B. Boon
APPROVED	R. Schmidtke

PROJECT NO.	CONTROL	REV.	FIGURE
60581230		A	4.2-7



GENERAL NOTES

1. WHERE DIMENSIONS OR ELEVATIONS OF EXISTING FACILITIES ARE SHOWN, THEY ARE NOT INTENDED TO INDICATE PRECISE OR CURRENT CONDITIONS. ALL DIMENSIONS AND ELEVATIONS TO BE CHECKED AND CONFIRMED ON SITE BEFORE FABRICATION AND INSTALLATION OF THE EQUIPMENT.
2. THIS DRAWING IS GENERAL IN NATURE. SOME SYMBOLS SHOWN HERE MAY NOT BE USED ON THE CONTRACT DRAWINGS.
3. SYMBOLS ARE ARRANGED ON DRAWINGS AND IN CATEGORIES FOR CONVENIENCE ONLY; SYMBOLS MAY BE USED ON ANY OF THE CONTRACT DRAWINGS.
4. ALL DIMENSIONS AND ELEVATIONS TO BE CHECKED AND CONFIRMED ON SITE BY THE CONTRACTOR.
5. P&ID'S DO NOT SHOW ALL DRAIN, VENT, OR SAMPLE CONNECTIONS.

PIPE NOTES

1. 250 mm HDPE AKAITCHO TO BUILDING SLOPES TO BUILDING.
2. 150 HDPE FROM BUILDING TO WELLS SLOPES TO WELLS.
3. INSTALL 50 mm BYPASS ON CHECK VALVES C/W SOLENIOD VALVE. SOLENIODS OPEN WHEN NO PUMPS ARE ON.
4. PROGRAMING / WATER METER TO BE SUCH THAT THE METER BEING EMPTY DOES NOT INTERFERE WITH FLOW RATE OR TOTALIZATION. (CURRENT AKAITCHO METER FUNCTIONS THIS WAY).
5. AIR VACUMM VALVES EXHAUST / DRAW AIR FROM OUTSIDE THE BUILDING. P&ID'S DO NOT SHOW ALL DRAIN, VENT, OR SAMPLE CONNECTIONS.

PRIMARY ELEMENT SYMBOLS

WATER MAIN
INSTRUMENTATION SERVICE DUCT
PROBE
PUMP
PUMP MOTOR
METER
SAMPLING POINT

VALVES

GATE VALVE (NORMALLY OPEN)
N.C. *GATE VALVE (NORMALLY CLOSED)*
SOLENOID VALVE
DUCKBILL VALVE
CHECK VALVE
BUTTERFLY VALVE
AIR VALVE

INSTRUMENT AND FUNCTION SYMBOLS

FIELD MOUNTED INSTRUMENT
SPECIAL PURPOSE DIGITAL DEVICE FOR PROCESSING MAINLY DIGITAL INFORMATION. EG. PLC (PROGRAMMABLE LOGIC CONTROLLER)
FIELD MOUNT ANNUNCIATOR POINT (OPTIONAL ARROW TO INDICATE

INSTRUMENT LOOP NUMBERS

100 SERIES *GENERAL BUILDING LOOP*
200 SERIES *PUMPING PROCESS LOOP*

PIPE IDENTIFICATION

XXX-YY-ZZZ
COMMODITY
NOMINAL DIAMETER (mm)
LINE NUMBER

SOURCE:
AECOM PROJECT "GIANT MINE REMEDIATION PROJECT - AKAITCHO PUMPING STATION SUPPLY CONTRACT" - PROJECT No. 60527924 - SHEET No. P101, DATED 2017-09-18.

PROJECT
Giant Mine Remediation Project

TITLE
AKAITCHO INTERIM DEEP WELL PUMPING STATION PIPING AND INSTRUMENTATION DIAGRAM

PROPONENT
Crown-Indigenous Relations and Northern Affairs Canada
Relations Couronne-Autochtones et Affaires du Nord Canada
Government of Northwest Territories / Gouvernement des Territoires du Nord-Ouest

YYYY-MM-DD	2018-12-14
DESIGNED	S. Marsanich
PREPARED	C. Eros
REVIEWED	B. Boon
APPROVED	R. Schmidtke

PROJECT NO.	CONTROL	REV.	FIGURE
60581230		B	4.2-8

P:\60581230\900-CAD_GIS\910-CAD\30-FIGURES\G\00\60581230-FIG-00-0000-G-0428.dwg

4.3 Existing Effluent Treatment Plant

The existing ETP processes an average of 4,500 to 7,000 m^3 per day depending on the volume of the water stored in the Northwest Pond. These treatment rates are required to process the annual minewater pumped to the Northwest pond, as well as the season's collected surface runoff, over a four month period from June to September, as the plant is only operated during the open-water months (ice-free / non-freezing conditions).

The existing ETP currently treats water to meet requirements of the MDMER limits (Government of Canada 2002) and discharge limits (i.e., EQC) included in the previous expired Type A Water Licence N1L2-0043 (MVLWB 1998). Following receipt of the new water licence, the ETP will continue to operate whilst the new WTP is being commissioned. Based on data collected over the last five years the current ETP can continue to operate meeting the projects EQC's until approximately 2026, although some upgrades may be required. Both civil work upgrades to raise Dam 1, as well as process upgrade options aimed at improving the minewater effluent quality produced from the ETP, are being considered and will be assessed in future design work.

During this period, the existing ETP will be operated following current practices. The main components of the existing ETP are:

1. Contaminated Water Pumping and Storage
2. Chemical Dosing and Reaction Tanks
3. Settling and Polishing Ponds
4. Treated Effluent Discharge to Baker Creek

4.3.1 Contaminated Water Pumping and Storage

Water pumped from the underground at Akaitcho is transferred via overland piping to the Northwest Pond. Collected site surface water is pumped to the South and Central ponds, then moves to the North Pond via a pipeline, and finally into the Northwest Pond.

The Northwest Pond is the primary storage pond for Site water, and up to 650,000 m^3 of the pond is used for storage prior to treatment and release. Detailed site surface water movements are captured in Section 4.1. Water is reclaimed from the Northwest Pond for treatment in the existing ETP during the open water season, usually from July through September.

4.3.2 Chemical Dosing and Reaction Tanks

The existing ETP consists of two chemical treatment trains, a primary and secondary circuit, operating in a duty-standby configuration. The primary circuit (Trains A) has three agitating tanks in series and is fully automated; under normal operating conditions only this circuit is operated. A backup or secondary circuit (Train B) consists of three additional agitator tanks in series. Influent flow from the Northwest Pond can be split to enter either treatment train. A weir box at the end of either chemical treatment train draws gravity flow through the series of reaction tanks and into the discharge pipe.

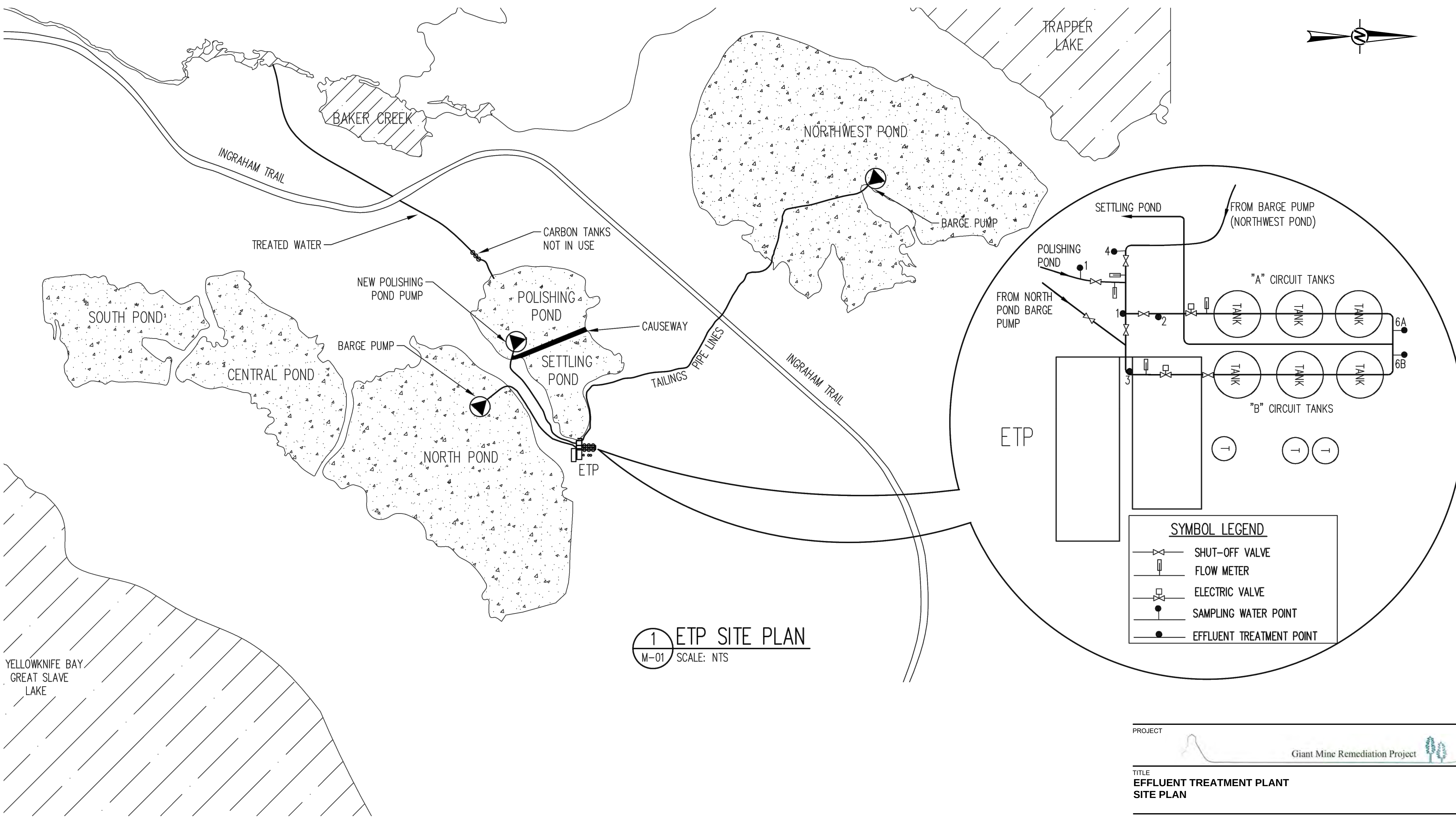
Minewater treatment in the chemical treatment train consists of reagent chemical addition as follows:

- A 60% solution of ferric sulphate is added to influent water prior to entering the first agitator tank. The ferric sulphate is ordered and brought to the site as solution ready for addition to the circuit; it is stored in large tanks adjacent to and inside the existing ETP building.
- The supply line to Train B is fitted with an in-line static mixer where ferric sulphate is added. Flow then continues to the first reactor in Train B.
- Ferric sulphate can also be injected into the supply line to Train A; this line is not fitted with an in-line static mixer (i.e., Train A is operated manually).

The ferric iron combines with arsenic to form amorphous ferric arsenate precipitates. Arsenic species are also removed from solution by adsorption on amorphous ferrihydrite (iron hydroxide) precipitates.

- Lime slurry is added to the first batch reactor of either train. The lime slurry and flocculent solution are prepared from dry reagents in the existing ETP building next to the tanks. Lime slurry is then added to the first tank to neutralize the acid generated by hydrolysis of the iron and maintain optimal pH for arsenic precipitation. The pH of the water leaving the first reactor tank is controlled to between 8.4 and 8.6. When the pH drops to 8.4, a pneumatic controlled pinch valve is opened and lime slurry is fed into the reactor tank until the pH reaches 8.6, at which time the pinch valve is closed.
- An anionic polymer is added to the weir box that draws effluent from the third batch reactor of either train. A polymeric flocculent is also added to increase the efficiency of solids settling. Settling efficiency in the ponds is greatly improved by the addition of flocculent in the existing ETP.
- The overflow effluent from the last of the three tanks in each circuit, containing water and precipitates, drains through a short pipeline to the north end of the Settling Pond.

The system is captured in Figures 4.3-1, 4.3-2, and 4.3-3.



SOURCE:
EFFLUENT TREATMENT PLANT OPERATING MANUAL / STANDARD OPERATING PROCEDURE (2008), DETON' CHO NUNA.
DRAWINGS BY: A.D. WILLIAMS ENGINEERING INC. CONSULTING ENGINEERS, 2008-03-05.

P:\60581230\900-CAD_GIS\910-CAD\30-FIGURES\G\00\60581230-FIG-00-0000-G-0431.dwg

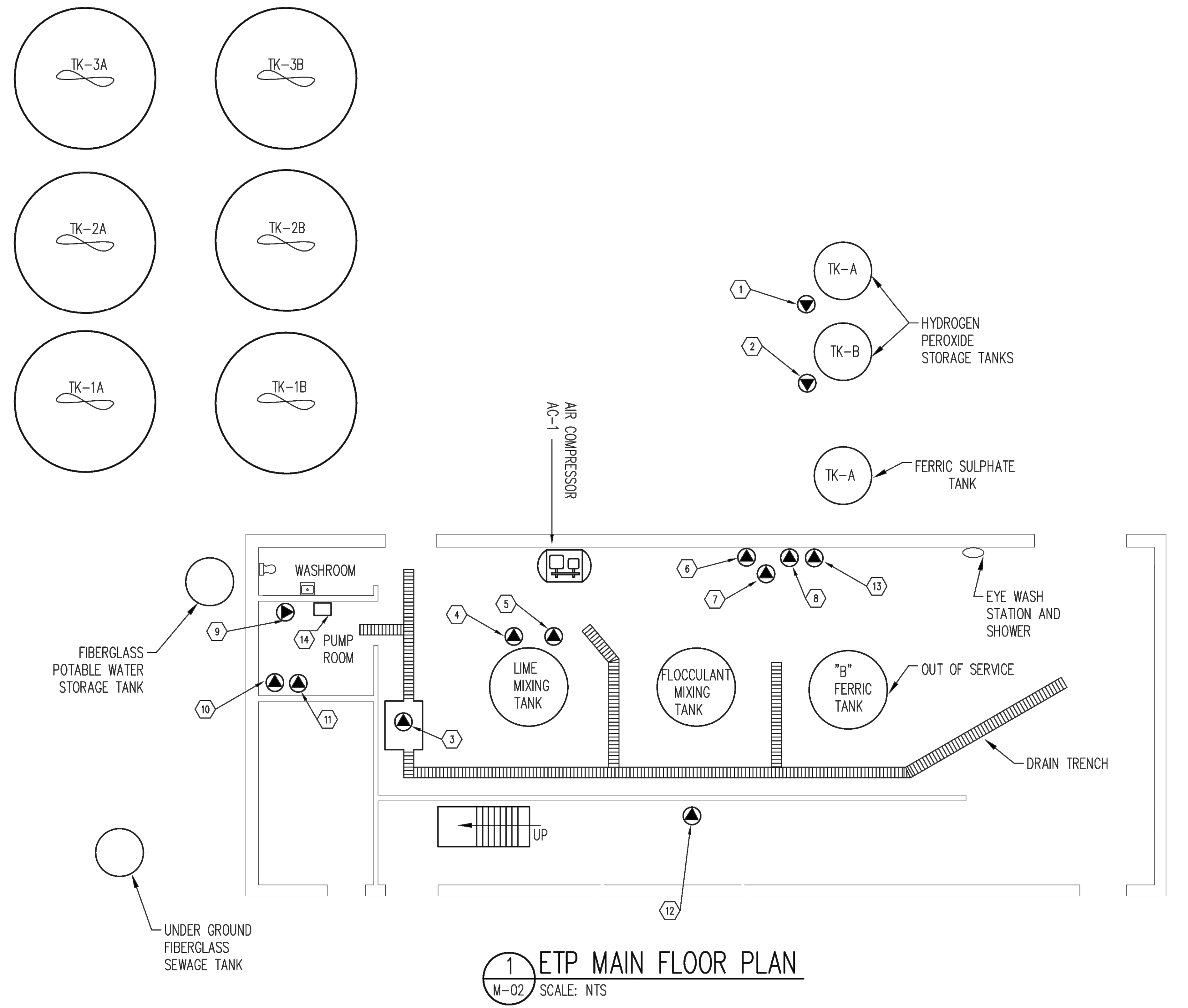
PROJECT
Giant Mine Remediation Project

TITLE
EFFLUENT TREATMENT PLANT SITE PLAN

PROPONENT
Crown-Indigenous Relations and Northern Affairs Canada
Relations Couronne-Autochtones et Affaires du Nord Canada
Government of Northwest Territories / Gouvernement des Territoires du Nord-Ouest

YYYY-MM-DD	2018-12-14
DESIGNED	S. Marsanich
PREPARED	C. Eros
REVIEWED	B. Boon
APPROVED	R. Schmidtke

PROJECT NO.	CONTROL	REV.	FIGURE
60581230		B	4.3-1



1 M-02 ETP MAIN FLOOR PLAN
SCALE: NTS

KEYNOTES:

1. P-1: PEROXIDE PUMP "A"
2. P-2: PEROXIDE PUMP "B"
3. P-3: SUMP PUMP
4. LIME SLURRY PUMP "1"
5. LIME SLURRY PUMP "2"
6. FLUCCULANT PUMP "A"
7. FLUCCULANT PUMP "B"
8. "A & B" FERRIC SULPHATE PUMP
9. POTABLE WATER PUMP
10. PROCESS WATER PUMP "1"
11. PROCESS WATER PUMP "2" (SPARE)
12. PRESSURE WASHER PUMP
13. SPARE FERRIC SULPHATE PUMP
14. ELECTRIC HOT WATER TANK

SOURCE:
EFFLUENT TREATMENT PLANT OPERATING MANUAL / STANDARD OPERATING PROCEDURE (2008), DETON' CHO NUNA.
DRAWINGS BY: A.D. WILLIAMS ENGINEERING INC. CONSULTING ENGINEERS, 2007-11-05.

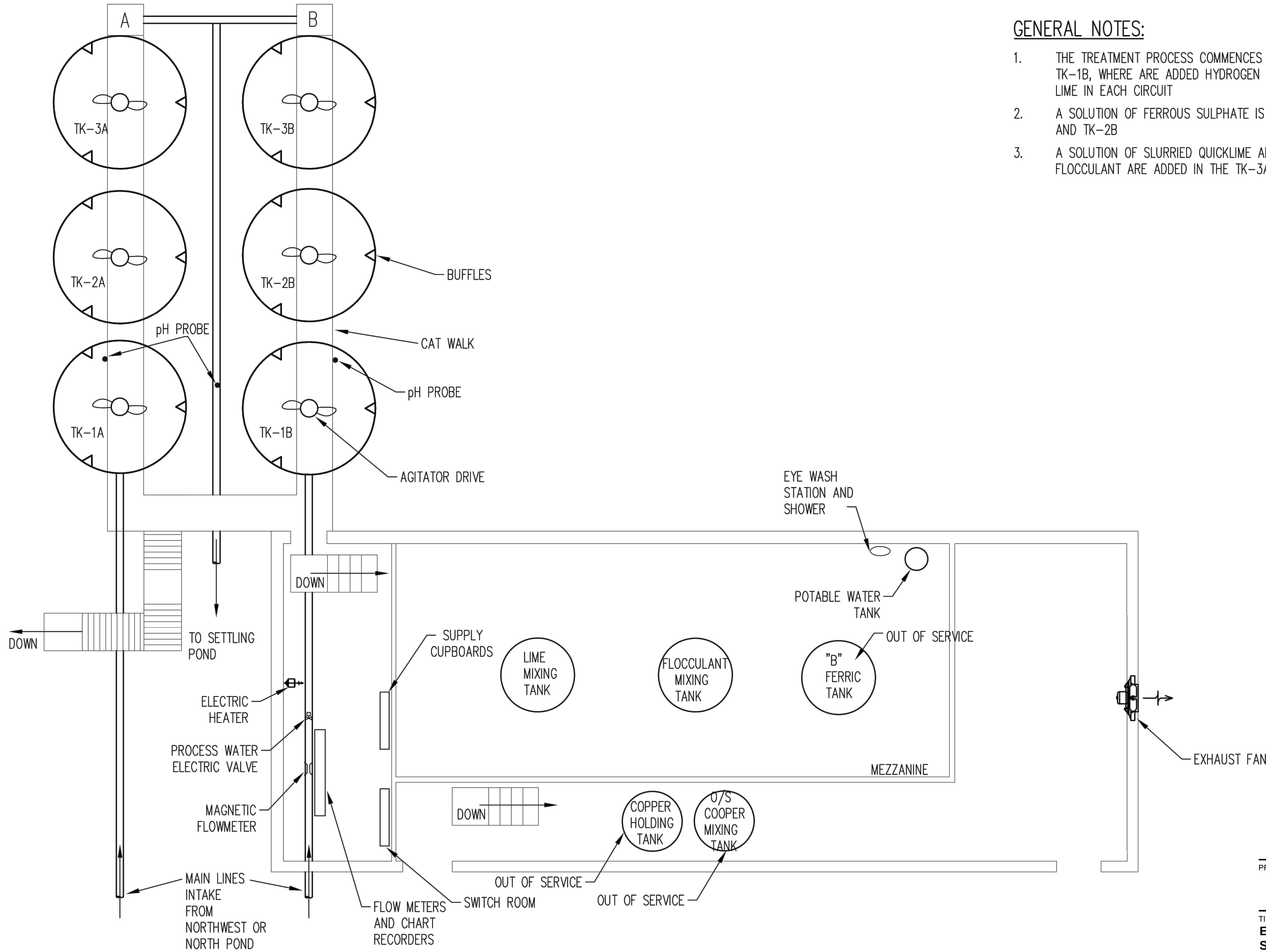
PROJECT
Giant Mine Remediation Project

TITLE
EFFLUENT TREATMENT PLANT
MAIN FLOOR LAYOUT

PROPONENT
Crown-Indigenous Relations and Northern Affairs Canada
Relations Couronne-Autochtones et Affaires du Nord Canada
Government of Northwest Territories / Gouvernement des Territoires du Nord-Ouest

YYYY-MM-DD	2018-12-14
DESIGNED	S. Marsanich
PREPARED	C. Eros
REVIEWED	B. Boon
APPROVED	R. Schmidtke

PROJECT NO.	CONTROL	REV.	FIGURE
60581230		B	4.3-2



GENERAL NOTES:

1. THE TREATMENT PROCESS COMMENCES IN TK-1A AND TK-1B, WHERE ARE ADDED HYDROGEN PEROXIDE AND LIME IN EACH CIRCUIT
2. A SOLUTION OF FERROUS SULPHATE IS ADDED IN TK-2A AND TK-2B
3. A SOLUTION OF SLURRIED QUICKLIME AND PERCOL 351 FLOCCULANT ARE ADDED IN THE TK-3A AND TK-3B

SOURCE:
EFFLUENT TREATMENT PLANT OPERATING MANUAL / STANDARD OPERATING PROCEDURE (2008), DETON' CHO NUNA.
DRAWINGS BY: A.D. WILLIAMS ENGINEERING INC. CONSULTING ENGINEERS, 2007-11-05.

PROJECT
Giant Mine Remediation Project

TITLE
EFFLUENT TREATMENT PLANT
SECOND FLOOR LAYOUT

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

Government of Northwest Territories / Gouvernement des Territoires du Nord-Ouest

YYYY-MM-DD	2018-12-14
DESIGNED	S. Marsanich
PREPARED	C. Eros
REVIEWED	B. Boon
APPROVED	R. Schmidtke

PROJECT NO.	CONTROL	REV.	FIGURE
60581230		B	4.3-3

P:\60581230\900-CAD_GIS\910-CAD\30-FIGURES\G\00\60581230-FIG-00-0000-G-0433.dwg

4.3.3 Settling and Polishing Ponds

Following treatment in the existing ETP, treated water is released to the Settling Pond and then to the Polishing Pond for final treatment as described below.

Quiescent conditions in the Settling Pond allow metal precipitates such as ferric arsenate to settle out of the water column and deposit onto the Settling Pond sediments. The settled material is referred to as a sludge. The sludge accumulates in the Settling Pond, where it overlays historically deposited tailings.

The Settling Pond is separated from the downstream Polishing Pond by a permeable rock-fill dyke called the Splitter Dyke. Clarified water from the Settling Pond is transferred to the Polishing Pond by limited gravity seepage through the Splitter Dyke and by pumping over the Splitter Dyke (Flow Pathway 8 and Flow Pathway 28).

Water levels of the Settling Pond are managed as a function of water levels in the Polishing Pond to maintain the stability of the Splitter Dyke following Action Levels specified in the Operation, Maintenance and Surveillance (OMS) Manual (Parsons 2019 forthcoming). Monitoring data available from 2010 to 2017 indicate that water levels of the Settling Pond have been managed between 173.0 m and 175.5 m during that period. The minimum freeboard water level is specified annually in the OMS Manual and is currently set as 174.6 m (Parsons 2019 forthcoming). The current specification is lower than historical specifications due to structural considerations at Dam 1. Storage characteristics of the Settling Pond are shown in Figure 4.3-4.

The Polishing Pond (contained north by Dam 1) provides the last opportunity for settling any precipitates carried over from the Settling Pond;, this further retention time allows for additional suspended solids removal. The Polishing Pond also allows some mixing of the water, smoothing out variations in the water quality, and allowing brief ETP process upsets to occur without producing water that is unacceptable for discharge. Additional details regarding the management of effluent discharge from the polishing pond is described in Section 4.3.4.

Water levels of the Polishing Pond are managed following Action Levels specified in the OMS Manual (Parsons 2019 forthcoming). Monitoring data available from 2010 to 2017 indicate that water levels of the Polishing Pond have been managed between 172.9 m and 174.5 m during that period. The minimum freeboard water level is specified annually in the OMS Manual and is currently set at 173.7 m (Parsons 2019 forthcoming). The current specification is lower than historical specifications. Storage characteristics of the Polishing Pond are shown in Figure 4.3-5.

Figure 4.3-4: Elevation-Storage Characteristics for the Settling Pond

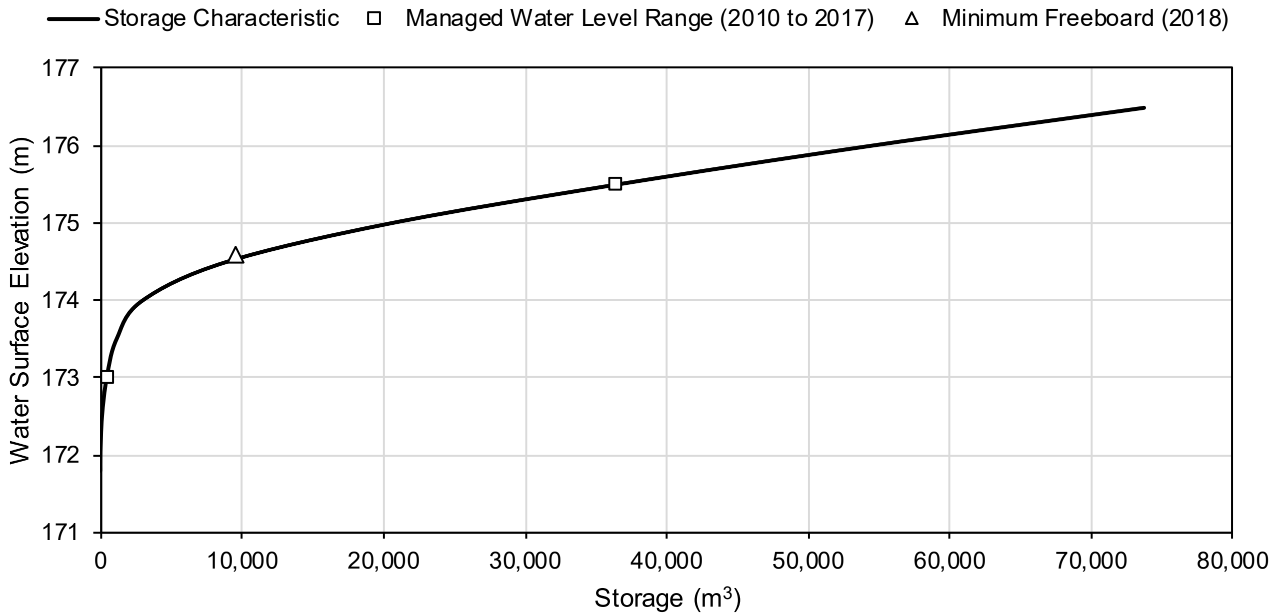
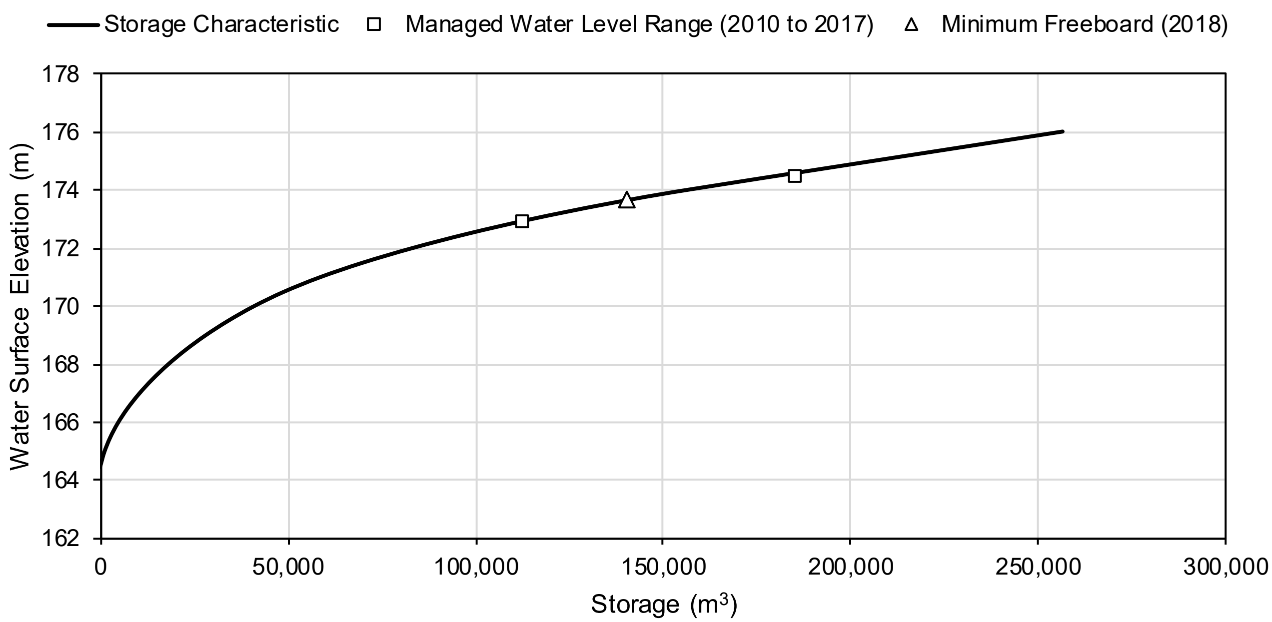


Figure 4.3-5: Elevation-Storage Characteristics for the Polishing Pond



4.3.4 Treated Effluent Discharge to Baker Creek

Following treatment in the Polishing Pond, final effluent is discharged through a siphon line (Flow Pathway 9) from the south end of the Polishing Pond to Baker Pond (i.e., Reach 6 of Baker Creek) and ultimately to Yellowknife Bay.

Treated effluent from the ETP is discharged into Baker Creek during open-water conditions, usually over a two- to three-month period between July and September unless higher water conditions at the Site necessitate an earlier/extended discharge period. On the request of Fisheries and Oceans Canada, the start of effluent discharge occurs after 1 July each year to avoid the spring spawning period for Arctic Grayling. Compliance with this request occurs with the exception of during high water conditions that necessitate early discharge (i.e., June) to mitigate potential flood risks to the underground mine.

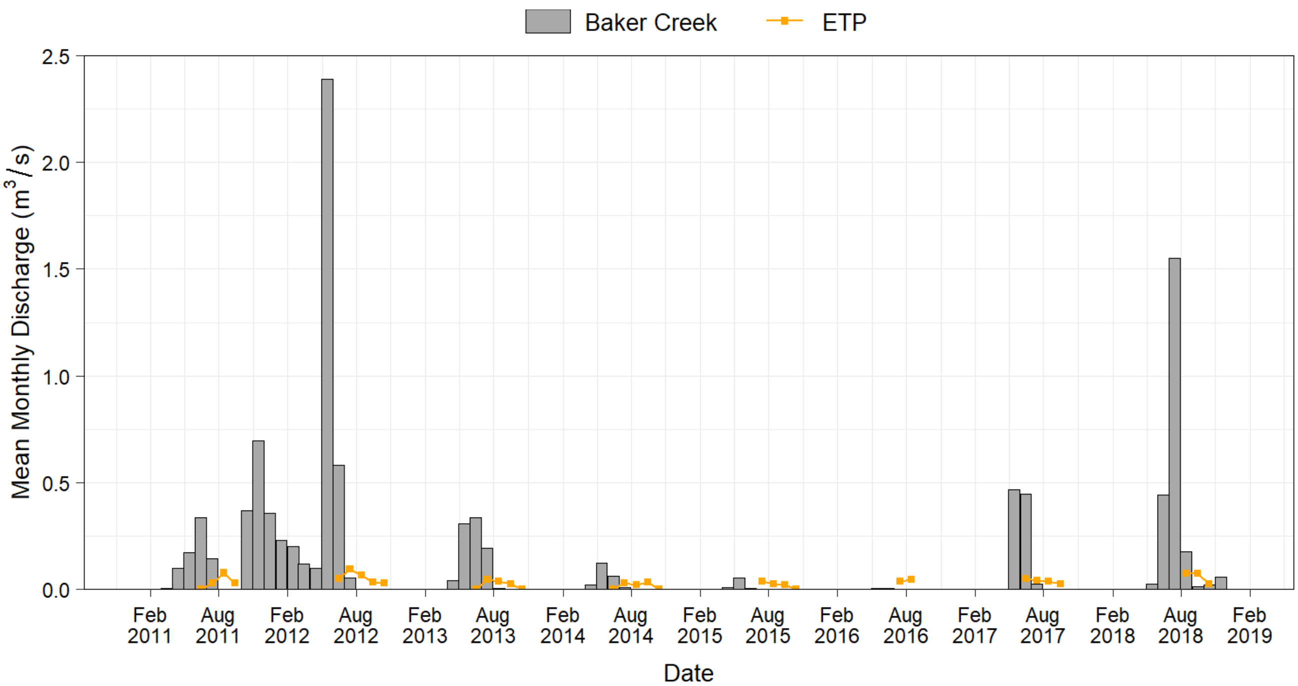
Treated effluent is not discharged until it is confirmed that water quality in the Polishing Pond meets discharge criteria and is not acutely toxic to fish; refer to Section 8 for an overview of water and toxicity monitoring programs. Water quality samples are collected from the discharge pipe from an autosampler, prior to discharge, to verify that water quality is in compliance with regulatory requirements (see Section 2 and Section 8.1).

In the event that water quality does not meet EQC, the capacity of the Polishing Pond provides an opportunity to contain water that does not meet the discharge limits and, if necessary, to recirculate the water to the North Pond (flow pathway #4 on Figure 4.1-1) until acceptable limits are attained. Alternatively, the water could also be recirculated to Northwest Pond or directly to the ETP for re-treatment (Flow Pathway 15, Figure 4.1-1).

Flow in Baker Creek upstream from the ETP discharge generally decreases through July, reaching baseflow conditions in August (Figure 4.3-6). In contrast, Baker Creek downstream of the ETP flows continually in summer due to the inputs of treated effluent from July to September (Figure 4.3-6).

There has been a general shift in the regional streamflow regime in the North Slave region in response to the increasing frequency of fall runoff events related to an increasing trend in September rainfall. For small basins such as Baker Creek, increased fall rainfall observed since the mid-1990s has resulted in infiltration of water into the upper soil layers, late-season recharge of wetlands and headwater lakes, and consequently higher winter baseflows and, since 1997, the proportion of annual stream flow has changed to 50% in spring and 20% in fall/winter (Kokelj et al. 2012; Spence et al. 2015).

Figure 4.3-6: Comparison of Flow in Baker Creek Upstream of the Site versus Treated Effluent from the Effluent Treatment Plant, 2010 to 2018



ETP = effluent treatment plant

4.4 Water Use

Freshwater has not been pumped to Site since production ceased in 2004. The mine is no longer in operation and does not use water to process ore or support mine activities. Water uses during existing conditions are summarized below, along with the corresponding source:

- Potable water: All potable water used on Site is trucked to the Site. The resulting black and greywater from C-Dry is pumped into the underground into the high test line. Sewage from trailers is trucked off Site.
- Dust and fire suppression and miscellaneous other uses: Water for dust and fire suppression and other Site uses, as required, is sourced from recycled treated water from the Polishing Pond.
- Underground stabilization works: Previous underground stabilization work has sourced water for paste backfill from the North and Polishing ponds. There are no current underground stabilization works activities.

The mean annual water use volume under existing conditions is up to 15,000 m^3 for dust and fire suppression (and other miscellaneous Site uses), if required, as summarized in Table 4.4-1.

Table 4.4-1: Mean Annual Water Use Volumes

Water Use	Source	Mean Annual Water Use Volume (m^3)
Potable Water	Trucked in	0[a]
Dust and Fire Suppression	Polishing Pond	15,000
Underground Stabilization Works	North Pond / Polishing Pond	0[b]
Total		15,000

Notes: a – Domestic water is trucked in and does not fall under water use.
b – There are no current underground stabilization works activities.

5 PHASE 2: ACTIVE REMEDIATION AND ADAPTIVE MANAGEMENT WATER MANAGEMENT SYSTEMS

This section describes water management at the Site during Phase 2, applicable until the initiation of Phase 3: Post-Closure (Section 6) and is organized as follows:

- surface water infrastructure, inclusive of TCAs and collection and conveyance infrastructure
- effluent treatment infrastructure, inclusive of the active and passive effluent management system
- expected water use

5.1 Surface Water Infrastructure and Management

5.1.1 General Description

During active remediation, local water from Developed Areas will be managed according to the Sediment and Erosion Management and Monitoring Plan (CIRNAC and GNWT 2019i). The active remediation and adaptive management phase includes the following milestones summarized in chronological order (timing is partially subject to procurement scheduling; timing of any changes in runoff management are subject to water quality from engineered structures meeting surface runoff quality criteria):

- In 2021, remediation of A1 Pit, A2 Pit, B1 Pit, and the South Pond begins.
- In 2024, remediation of A1 Pit, A2 Pit, and B1 Pit is complete. Remediation of B2 Pit, B3 Pit, B4 Pit, C1 Pit, Mill Pond, and the Central and North ponds begins.
- In 2026, remediation of B2 Pit, B3 Pit, B4 Pit, C1 Pit, and the South Pond is complete. Minewater is still pumped to the Northwest Pond and treated using the existing ETP. The foreshore tailings are capped.
- By October 2026, the new WTP and minewater intake wells are commissioned in the C-Shaft area and treated effluent is discharged directly to Yellowknife Bay. The Akaitcho Pumping System is decommissioned. The High Test System is decommissioned and drainage collected by the system reports to the mine pool in the vicinity of C-Shaft. The existing ETP remains on standby for one year following commissioning of the new WTP, and is demolished thereafter if the new WTP is functioning as designed. In 2027, remediation of the Mill Pond and the Central and North ponds is complete. Remediation of the Settling Pond, the Polishing Pond, and the Northwest Pond begins. Runoff from A1 Pit, A2 Pit, and B1 Pit areas is released to Baker Creek.
- In 2028, remediation of the Settling Pond and of the Polishing Pond is complete.
- In 2029, runoff from B2 Pit and C1 Pit areas is released to Baker Creek and runoff from B4 Pit area is released toward Trapper Creek. Runoff from the former South Pond area is released to Yellowknife Bay.
- In 2030, runoff from the Mill Pond cover is released to Baker Creek.
- In 2031, runoff from B3 Pit, the North Pond, the Settling Pond and the Polishing Pond areas is released to Baker Pond.
- In 2033, remediation of the Northwest Pond is complete and runoff from the Northwest Pond cover is released to Trapper Creek.

Adaptive management consists of a monitoring period during decommissioning activities against closure criteria, following milestones below:

- Freezing of the arsenic chambers has reached containment levels.
- Monitoring confirms closure activities meet requirements and if not, adaptative management activities occur.

Water management activities, further described in the following sub-sections, are illustrated in Figure 5.1-1 (representative of year 2024-2025), Figure 5.1-2 (representative of year 2028), and Figure 5.1-3 (representative of the adaptive management phase and of post-closure [discussed in Section 6] conditions). Water management activities are presented conceptually in flow diagrams in Appendix F through the remediation phases.

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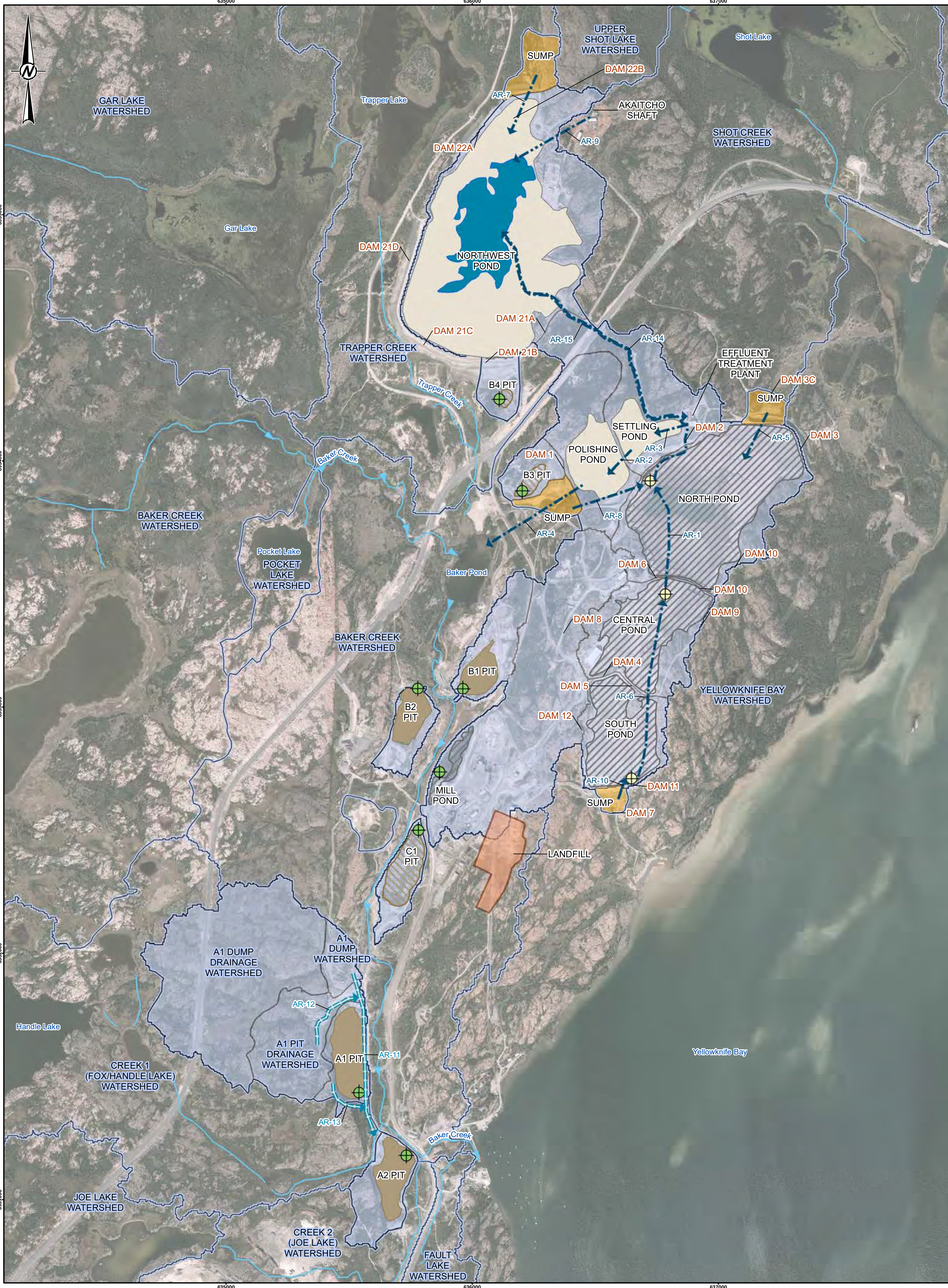

LEGEND

- PIT RUNOFF COLLECTION POINT (TO UNDERGROUND)
- TCA RUNOFF COLLECTION POINT

FLOW PATHS

- DITCH
- PIPE (PUMPED)
- WATERCOURSE

GIANT MINE WORKS

- NON-HAZARDOUS WASTE LANDFILL
- CLOSED PIT
- PIT CLOSURE IN PROGRESS
- POND - ACTIVE WATER TRANSFERS
- POND - CAPPING/REGRADING IN PROGRESS
- TCA POND (TYPICAL WETTED AREA)

SURFACE WATER WATERSHED TYPE

- MANAGED WATERSHED AREA
- UNMANAGED WATERSHED AREA
- SITE SUMP CATCHMENT

0 250 500

1:15,000 METRES

REFERENCE(S)

HYDROLOGY AND TRANSPORTATION DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA.
DATUM: NAD 83 PROJECTION: UTM ZONE 11

PROPONENT

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

Government of Northwest Territories / Gouvernement des Territoires du Nord-Ouest

PROJECT

Giant Mine Remediation Project

YYYY-MM-DD	2018-12-05
DESIGNED	JL
PREPARED	AA
REVIEWED	JL
APPROVED	NS

TITLE

ACTIVE REMEDIATION PHASE (SNAPSHOT: 2024-2025) WATER MANAGEMENT SYSTEMS

PROJECT NO.	CONTROL	REV.	FIGURE
13-1377-0015	30000	0	5.1-1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

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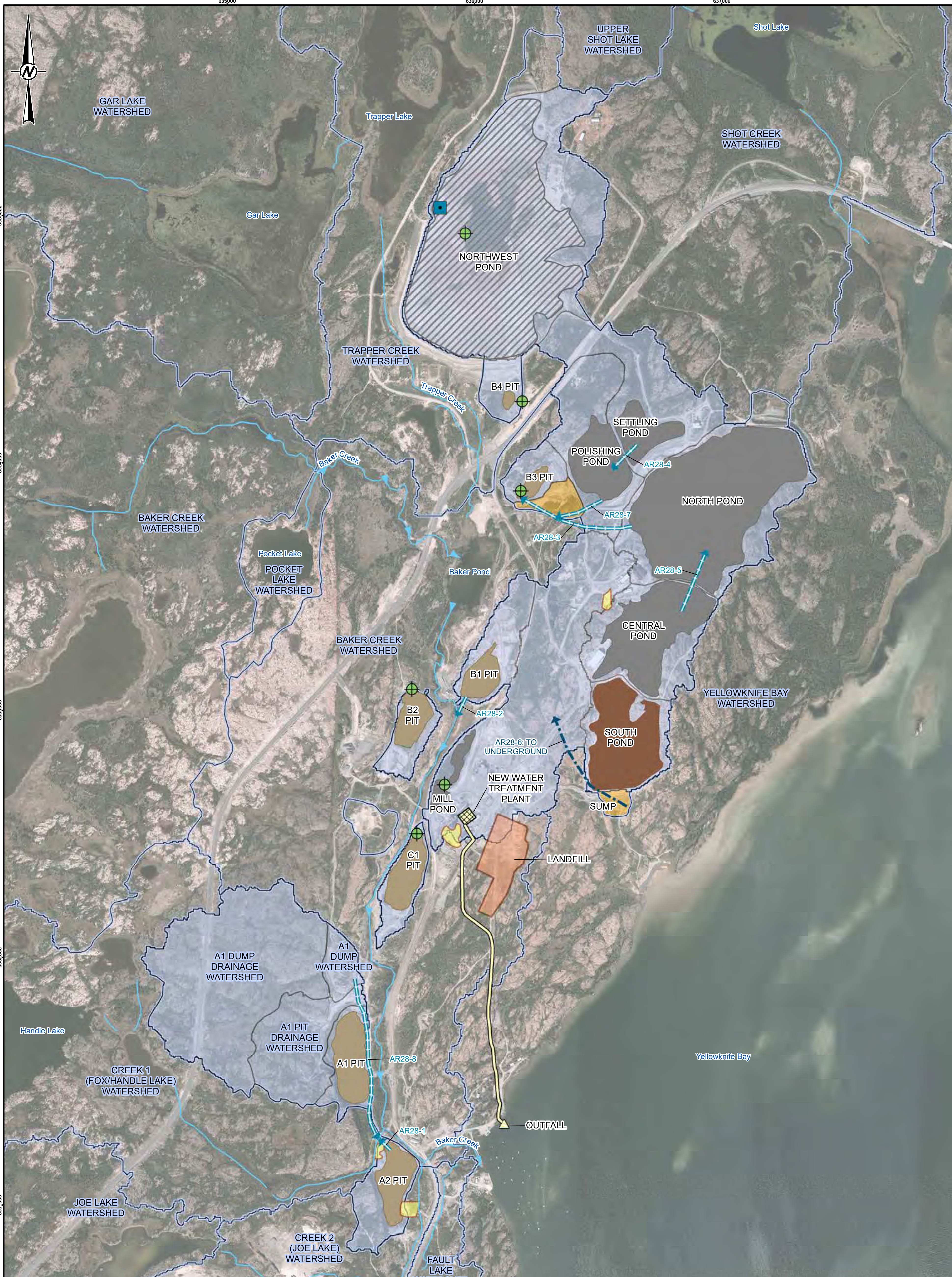


LEGEND

- PIT RUNOFF COLLECTION POINT (TO UNDERGROUND)
- SPILLWAY UNDER CONSTRUCTION
- TREATED EFFLUENT OUTFALL

SURFACE WATER FLOW CONVEYANCE

- DITCH / OUTLET CHANNEL / SPILLWAY
- PIPE (PUMPED)
- WATER TREATMENT OUTFALL PIPE
- WATERCOURSE

GIANT MINE WORKS

- CAPPED WITH ENGINEERED COVER
- NEW WATER TREATMENT PLANT
- NON-HAZARDOUS WASTE LANDFILL
- CLOSED PIT
- POND - CAPPING COMPLETED
- POND - CAPPING/REGRADING IN PROGRESS
- POND - RECLAMATION COMPLETED

SURFACE WATER WATERSHED TYPE

- MANAGED WATERSHED AREA
- UNMANAGED WATERSHED AREA
- SITE SUMP CATCHMENT

0 250 500

1:15,000 METRES

REFERENCE(S)

HYDROLOGY AND TRANSPORTATION DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA.
DATUM: NAD 83 PROJECTION: UTM ZONE 11

PROPONENT

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

Government of Northwest Territories / Gouvernement des Territoires du Nord-Ouest

PROJECT

Giant Mine Remediation Project

YYYY-MM-DD	2018-12-05
DESIGNED	JL
PREPARED	AA
REVIEWED	JL
APPROVED	NS

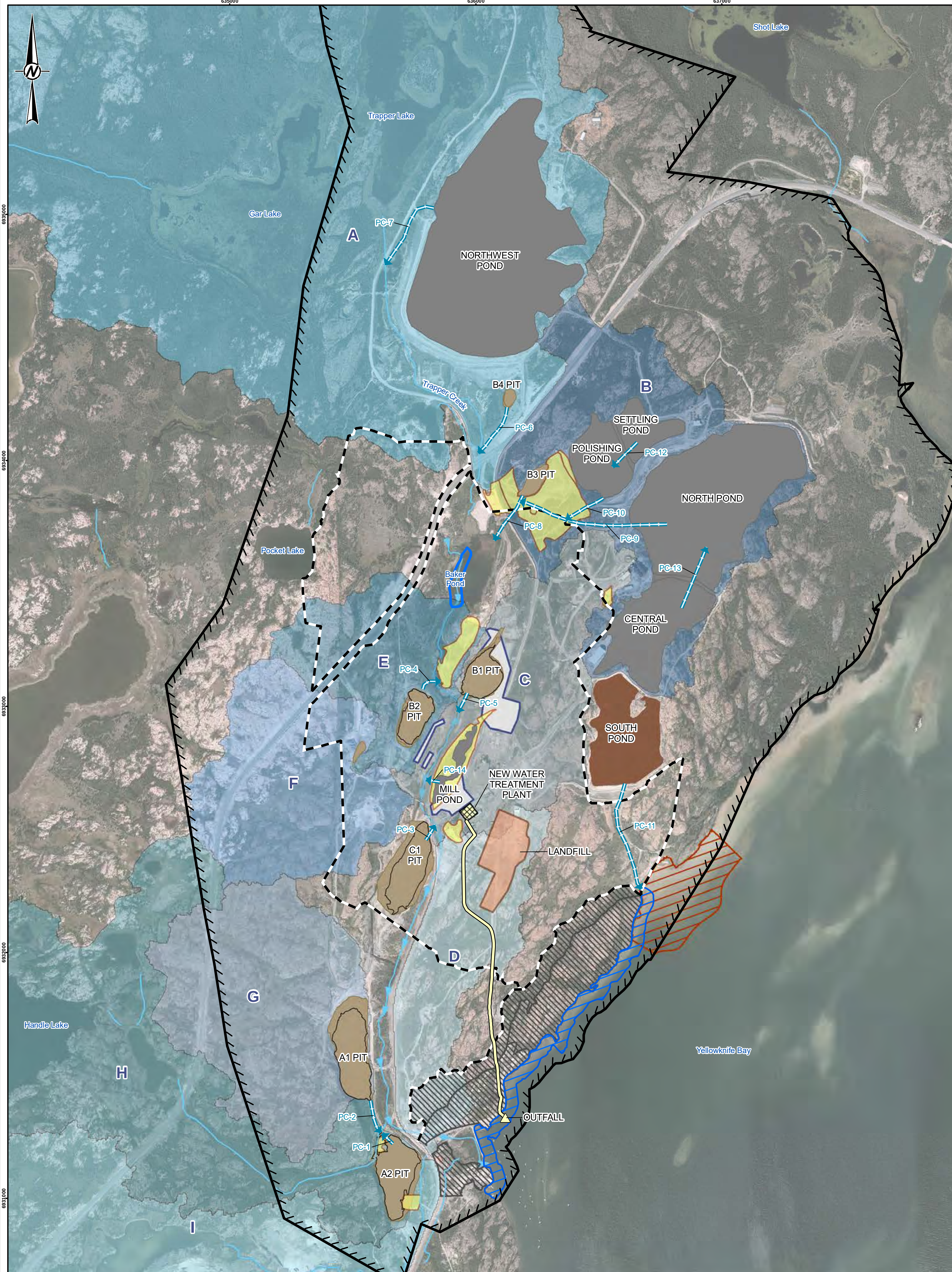
TITLE

ACTIVE REMEDIATION PHASE (SNAPSHOT: 2028) WATER MANAGEMENT SYSTEMS

PROJECT NO.	CONTROL	REV.	FIGURE
13-1377-0015	30000	0	5.1-2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B
25mm
0

PATH: I:\2013\13-1377\13-1377-0115\Mapping\MXD\TA30_Report\1313770115_30000_Fig5_1_3_PostClosurePhase_Rev0.mxd PRINTED ON: 2019-02-13 AT: 9:43:15 AM



LEGEND

- TREATED EFFLUENT OUTFALL
- FENCE
- GIANT MINE PROJECT BOUNDARY

SURFACE WATER FLOW CONVEYANCE

- DITCH / OUTLET CHANNEL / SPILLWAY
- WATER TREATMENT OUTFALL PIPE
- WATERCOURSE
- BAKER POND

MINE FACILITIES AT CLOSURE

- APPROXIMATE FORESHORE TAILINGS CAP
- APPROXIMATE SHORELINE CAP
- CAPPED WITH ENGINEERED COVER
- COVERED TAILINGS POND
- CLOSED PIT
- FINAL PIT WALLS
- FREEZE PAD
- NON-HAZARDOUS WASTE LANDFILL
- RECLAIMED TAILINGS POND
- SITE SUMP
- WATER TREATMENT PLANT
- REMEDIATED TO RESIDENTIAL SOIL QUALITY STANDARDS

MAJOR SPILL POINT WATERSHEDS

- A
- B
- C
- D
- E
- F
- G
- H
- I

0 250 500

1:15,000 METRES

REFERENCE(S)

HYDROLOGY AND TRANSPORTATION DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA.
DATUM: NAD 83 PROJECTION: UTM ZONE 11

PROPONENT

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

Government of Northwest Territories | Gouvernement des Territoires du Nord-Ouest

YYYY-MM-DD	2019-02-13
DESIGNED	JL
PREPARED	AA
REVIEWED	JL
APPROVED	NS

PROJECT

Giant Mine Remediation Project

TITLE

POST-CLOSURE PHASE WATER MANAGEMENT SYSTEMS

PROJECT NO.	CONTROL	REV.	FIGURE
13-1377-0015	30000	0	5.1-3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

5.1.2 Water Management of Pit Watersheds

Conceptual water management activities are provided in Table 5.1-1 by Pit watershed, from south to north. Drainage patterns will be re-established, subject to water quality monitoring results and Board approval, using common outlet channels to the extent possible for watersheds in the same general vicinity to minimize the number of direct discharge points to the receiving environment.

These sub-sections will be updated in future versions of the Water MMP with hydrotechnical design specifications following design criteria provided in Section 3.4.3, and operational requirements once this information becomes available.

Table 5.1-1: Water Management of Pit Watersheds

Watershed	Planned Remediation Works *	Water Management Activities *	Post-Remediation Configuration *
A2 Pit	• Remediation works at A2 Pit will be initiated in 2021 and will include partial or full backfilling of the pit with borrow material, and inclusion of a graded pit cover if needed	Water management will be required to divert runoff away from active remediation works and will include: • On-going runoff diversion of the upper A2 Pit watershed to Creek 2 by pipeline (Flow Pathway 32 on Figure 4.1-1) • Installation of a collection point on the north east side of the pit (i.e., near the future possible connection to Creek 1) with a hydraulic connection to the underground workings (Figure 5.1-1) • Progressive grading of the pit cover towards the collection point, should a pit cover be needed	• Remediation works in the A2 Pit watershed are expected to be completed by 2024. Following the completion of remediation works and confirmation that water quality from the pit cover (if required) meets runoff quality criteria (CIRNAC and GNWT 2019c), the A2 Pit watershed will then be reconnected to Baker Creek via outlet channel, thereby replacing the collection point and hydraulic connection to the underground workings (Flow Pathway AR28-1 on Figure 5.1-2). If no pit cover is selected, the runoff will continue to report to a collection point with a hydraulic connection to the underground. • Re-establishment of drainage patterns to Creek 1 is expected by 2027, subject to water quality monitoring results and MVLWB approval.
A1 Pit	• Remediation works at A1 Pit will be initiated in 2021 and will include partial or full backfilling with contaminated granular fill, and inclusion of a graded pit cover if needed	Water management will be required to divert runoff away from active remediation works, and will include: • Runoff collection and diversion from the upper A1 Pit and A1 Dump watersheds to Creek 1 by ditches (Flow Pathways AR-11, AR-12, and AR-13 on Figure 5.1-1) • Installation of a collection point on the south side of the pit (i.e., near the future connection to Creek 1) with a hydraulic connection to the underground workings (Figure 5.1-1) • Progressive grading of the pit cover towards the collection point, should a pit cover be needed	• Remediation works are expected to be completed by 2024. Following the completion of remediation works and confirmation that runoff quality from the pit cover (if required) meets runoff quality criteria (CIRNAC and GNWT 2019c). The A1 Pit watershed will be connected to Creek 1 via outlet channel, thereby replacing the collection point and hydraulic connection to the underground workings (Flow Pathway AR28-8 on Figure 5.1-2). If no pit cover is required the runoff will continue to report to the collection point and underground. Runoff from the A1 Dump watershed will be permanently diverted to Creek 1. • Re-establishment of drainage patterns to Creek 1 is expected by 2027, subject to water quality monitoring results, and MVLWB approval.
C1 Pit	• Remediation works at C1 Pit will be initiated in 2024 and will include partial or full backfilling with borrow material, and inclusion of a graded pit cover is needed	Water management will be required to divert runoff away from active remediation works, and will include: • Decommissioning of the diversion pipeline to Mill Pond (Flow Pathway 1 on Figure 4.1-1) • Installation of a collection point on the north side of the pit (i.e., near the future connection to Baker Creek) with a hydraulic connection to the underground workings (Figure 5.1-1) • Progressive grading of the pit cover towards the collection point should a pit cover be needed	• Remediation works are expected to be completed by 2026. Following the completion of remediation works and achievement of runoff quality criteria, the C1 Pit watershed will be reconnected to Baker Creek via outlet channel, thereby replacing the collection point and hydraulic connection to the underground workings (Flow Pathway PC-3 on Figure 5.1-3) • Re-establishment of drainage patterns to Baker Creek is expected in 2029, subject to water quality monitoring results, and MVLWB approval.

Table 5.1-1: Water Management of Pit Watersheds

Watershed	Planned Remediation Works *	Water Management Activities *	Post-Remediation Configuration *
Upper and Lower Sump	• An official remediation schedule has not yet been determined for this watershed, and this section will be updated in future versions of the Water MMP once the information becomes available • Remediation works at the Upper and Lower Sump watershed will be initiated in 2021 or later (i.e., to be determined such that the works are completed prior to initial remediation works at the Mill Pond) and will include backfilling and grading of the sumps, and general reclamation of the watershed	Water management will be required to divert runoff away from active remediation works, and will include: • On-going diversion of the Lower Sump watershed to the Upper Sump watershed (Flow Pathway 27 on Figure 4.1-1) while the Lower Sump watershed is being reclaimed • Decommissioning of the diversion pipeline from the Lower Sump to Upper Sump (Flow Pathway 27 on Figure 4.1-1) following remediation of the Lower Sump watershed • Initiation of remediation works of the Upper Sump watershed following completion of remediation works of the Lower Sump watershed • On-going diversion of the Upper Sump watershed to Mill Pond (Flow Pathway 26 on Figure 4.1-1) while the Upper Sump watershed is being reclaimed • Decommissioning of the diversion pipeline from the Lower Sump to Mill Pond (Flow Pathway 26 on Figure 4.1-1) following remediation of the Upper Sump watershed, once runoff quality criteria (CIRNAC and GNWT 2019c) are met	• Remediation works are expected to be completed by 2024 (i.e., prior to initial remediation works at the Mill Pond), subject to water quality results. Following the completion of remediation works, the Upper and Lower Sump watershed will drain to Baker Creek by gravity (Figure 5.1-1).
Mill Pond	• Remediation works at the Mill Pond will be initiated in 2024 and will include backfilling and placement and grading of the pond cover	Water management will be required to divert runoff away from active remediation works, and will include: • Decommissioning of the diversion pipeline to Central Pond (Flow Pathway 3 on Figure 4.1-1) following remediation works of upstream watersheds (i.e., B1 Pit, C1 Pit, and Upper and Lower Sump watersheds) • Installation of a collection point on the west side of the pond (i.e., near the future connection to Baker Creek) with a hydraulic connection to the underground workings (Figure 5.1-1) • Progressive grading of the backfill towards the collection point	• Remediation works are expected to be completed by 2027. Following the completion of remediation works and achievement of runoff quality criteria (CIRNAC and GNWT 2019c), the Mill Pond watershed will be reconnected to Baker Creek via outlet channel, thereby replacing the collection point and hydraulic connection to the underground workings (Flow Pathway PC-14 on Figure 5.1-3). • Re-establishment of drainage patterns to Baker Creek are expected by 2030, subject to water quality monitoring results, and MVLWB approval.
B2 Pit	• Remediation works at B2 Pit will be initiated in 2024 and will include partial or full backfilling with borrow material and possibly contaminated granular fill if additional capacity is required. A graded pit cover will be included if needed	Water management will be required to divert runoff away from active remediation works, and will include: • On-going runoff diversion of the upper B2 Pit watershed by ditch to Baker Creek (Flow Pathway 34 on Figure 4.1-1) • Installation of a collection point on the north side of the pit (i.e., near the future connection to Baker Creek) with a hydraulic connection to the underground workings (Figure 5.1-1) • Progressive grading of the backfill towards the collection point should a pit cover be needed	• Remediation works are expected to be completed by 2026. Following the completion of remediation works and achievement of runoff quality criteria (CIRNAC and GNWT 2019c), the B2 Pit watershed will be reconnected to Baker Creek via outlet channel, thereby replacing the collection point and hydraulic connection to the underground workings (Flow Pathway PC-4 on Figure 5.1-3). • Re-establishment of drainage patterns to Baker Creek is expected by 2029, subject to water quality monitoring results, and MVLWB approval.

Table 5.1-1: Water Management of Pit Watersheds

Watershed	Planned Remediation Works *	Water Management Activities *	Post-Remediation Configuration *
B1 Pit	• Remediation works at B1 Pit will be initiated in 2021 and will include partial or full backfilling with heavily contaminated granular fill in the frozen portion of the pit and contaminated granular fill in the non-frozen portion of the pit. A graded pit cover will be included if needed	Water management will be required to divert runoff away from active remediation works, and will include: • Decommissioning of the diversion pipeline to Mill Pond (Flow Pathway 2 on Figure 4.1-1) • Installation of a collection point on the south side of the pit (i.e., near the future connection to Baker Creek) with a hydraulic connection to the underground workings (Figure 5.1-1) • Progressive grading of the pit cover towards the collection point should a pit cover be needed	• Remediation works are expected to be completed by 2024. Following the completion of remediation works and achievement of runoff quality criteria (CIRNAC and GNWT 2019c), the B1 Pit watershed will be reconnected to Baker Creek via outlet channel, thereby replacing the collection point and hydraulic connection to the underground workings (Flow Pathway AR28-2 on Figure 5.1-2). • Re-establishment of drainage patterns to Baker Creek is expected by 2027, subject to water quality monitoring results, and MVLWB approval.
B3 Pit	• Remediation works at B3 Pit will be initiated in 2024 and will include partial backfilling with borrow material, grading, and the inclusion of a graded pit cover if needed	Water management will be required to divert runoff away from active remediation works, and will include: • Installation of a collection point on the south side of the pit (i.e., near the future connection to Baker Pond) with a hydraulic connection to the underground workings (Figure 5.1-1) • Progressive grading of the pit cover towards the collection point should a pit cover be needed	• Remediation works are expected to be completed by 2026. Following the completion of remediation works and achievement of runoff quality criteria (CIRNAC and GNWT 2019c), the B3 Pit watershed will be reconnected to Baker Pond via outlet channel, thereby replacing the collection point and hydraulic connection to the underground workings (Flow Pathway PC-8 on Figure 5.1-3). It is noted that runoff water quality at B3 Pit will depend on runoff water quality from the North Pond and from the Polishing Pond (Section 7.1-3) which will be managed through the B3 Pit watershed. • Remediation works are expected to be completed by 2026. Re-establishment of drainage patterns to Baker Pond is expected by 2031, subject to water quality monitoring results, and MVLWB approval.
B4 Pit	• Remediation works at B4 Pit will be initiated in 2024 and will include partial backfilling with borrow material, grading, and the inclusion of a graded pit cover if needed	Water management will be required to divert runoff away from active remediation works, and will include: • Installation of a collection point on the west side of the pit (i.e., near the future connection to Trapper Creek) with a hydraulic connection to the underground workings (Figure 5.1-1) • Progressive grading of the pit cover towards the collection point should a pit cover be needed	• Remediation works are expected to be completed by 2026. Following the completion of remediation works and achievement of runoff quality criteria (CIRNAC and GNWT 2019c), the B4 Pit watershed will be reconnected to Trapper Creek via outlet channel, thereby replacing the collection point and hydraulic connection to the underground workings (Flow Pathway PC-6 on Figure 5.1-3). • Re-establishment of drainage patterns to Trapper Creek is expected by 2029, subject to water quality monitoring results, and MVLWB.

Note: * = the need for pit covers will be determined during detailed design stages. Should pit covers be required, surface diversion structures may be routed over pits by incorporating them into pit covers. Water would otherwise be routed around pits.

5.1.3 Water Management of TCA Watersheds

Conceptual water management activities are provided in Table 5.1-2 by TCA watershed, from south to north. Drainage patterns will be re-established using common outlet channels to the extent possible for watersheds in the same general vicinity to minimize the number of direct discharge points to the receiving environment.

These sub-sections will be updated in future versions of the Water MMP with design parameters following design criteria provided in Section 3.4.3, and operational requirements once this information becomes available.

Table 5.1-2: Water Management of Tailing Containment Area Watersheds

TCA	Planned Remediation Works	Water Management Activities	Post-Remediation Configuration
South Pond	• Remediation works at the South Pond will be initiated in 2021 and will include relocation of tailings to the Central Pond, grading and placement of a cover at the TCA	Water management will be required to divert runoff away from active remediation works, and will include: • Installation of collection point on the south side of the TCA (i.e., near the future connection to Yellowknife Bay) (Figure 5.1-1) • Progressive grading towards the collection point • Diversion of runoff collected at the collection point to the Central Pond's collection point by pipeline (Flow Pathway AR-6 on Figure 5.1-1) during remediation works • Diversion of runoff from the Dam 11 Sump to the collection point (Flow Pathway AR-10 on Figure 5.1-1) during remediation works • Decommissioning of the collection point; runoff collection and diversion from the Dam 11 Sump to Central Pond by pipeline (Flow Pathway AR28-6 on Figure 5.1-2) following grading and cover placement activities in 2026	• Decommissioning of the Dam 11 Sump and re-establishment of drainage patterns towards Yellowknife Bay via an outlet channel (Flow Pathway PC-11 on Figure 5.1-3) once runoff quality criteria (CIRNAC and GNWT 2019c) are met. • Re-establishment of drainage patterns to Yellowknife Bay is expected by 2029, subject to water quality monitoring results, and MVLWB approval.
Central Pond	• Remediation works at the Central Pond will be initiated in 2024 and will include relocation of tailings from the South Pond, grading and placement of a cover at the TCA	Water management will be required to divert runoff away from active remediation works, and will include: • Installation of a collection point on the north side of the TCA (i.e., near the future connection to the North Pond) (Figure 5.1-1) • Progressive grading towards the collection point and decommissioning of the central runoff ditch (Flow Pathway 19 on Figure 4.1-1) • Diversion of runoff collected at the collection point to the North Pond's collection point by pipeline (Flow Pathway AR-1 on Figure 5.1-1) during remediation works • Decommissioning of the collection point and permanent runoff diversion to the North Pond by gravity via a swale connecting both Central Pond and North Pond watersheds (Flow Pathway AR28-5 on Figure 5.1-2) following grading and cover placement activities in 2027	• Re-establishment of drainage patterns to Baker Creek is expected by 2031, subject to water quality monitoring results and Board approval, in conjunction with re-establishment of drainage patterns at the North Pond.

Table 5.1-2: Water Management of Tailing Containment Area Watersheds

TCA	Planned Remediation Works	Water Management Activities	Post-Remediation Configuration
North Pond	• Remediation works at the North Pond will be initiated in 2024 and will include grading and capping of the TCA	Water management will be required to divert runoff away from active remediation works, and will include: • Installation of a collection point on the northwest side of the TCA (i.e., near the future connection to B3 Pit) (Figure 5.1-1) • Progressive grading towards the collection point • Diversion of runoff collected at the collection point to the Northwest Pond's collection point by pipeline (Flow Pathway AR-15 on Figure 5.1-1) during remediation works • Diversion of runoff from the Dam 1 Sump and from the Dam 3 Sump to the collection point (Flow Pathways AR-8 and AR-5 on Figure 5.1-1) during remediation works • Decommissioning of the collection point and of the Dam 3 Sump, and of the pipeline to the existing ETP (Figure 5.1-2) and permanent runoff diversion to the B3 Pit collection point by spillway (Flow Pathway AR28-7 on Figure 5.1-2) following grading and cover placement activities in 2027 • Re-establishment of drainage patterns to Baker Pond via spillway connecting to the B3 Pit outlet channel (Flow Pathway PC-8 on Figure 5.1-3) once runoff quality criteria (CIRNAC and GNWT 2019c) are met at B3 Pit	• Re-establishment of drainage patterns to Baker Creek is expected by 2031, subject to water quality monitoring results, and MVLWB approval.
Northwest Pond	• Remediation works at the Northwest Pond will be initiated in 2027 and will include grading and cover placement at the TCA	Water management will be required to divert runoff away from active remediation works, and will include: • On-going diversion of stored water to the existing ETP (Flow Pathway 5 on Figure 4.1-1) until remediation works begin • Installation of a collection point on the west side of the TCA (i.e., near the future connection to Trapper Creek) (Figure 5.1-2) connected to the underground workings by pipeline • Progressive grading towards the collection point and decommissioning of the Dam 22 B Sump and of the pipeline to the existing ETP (Flow Pathway 5 on Figure 4.1-1) • Re-establishment of drainage patterns to Trapper Creek via spillway (Flow Pathway PC-7 on Figure 5.1-3) once runoff quality criteria (CIRNAC and GNWT 2019c) are met	• Re-establishment of drainage patterns to Trapper Creek is expected by 2033, subject to water quality monitoring results, and MVLWB approval.
Settling Pond	• Remediation works at the Settling Pond will be initiated in 2027 and will include grading and cover placement at the TCA	Water management will be required to divert runoff away from active remediation works, and will include: • On-going diversion of runoff to the Polishing Pond (Flow Pathways 8 and 28 on Figure 4.1-1) until remediation works begin • Progressive grading towards the Polishing Pond • Re-establishment of drainage patterns towards the Polishing Pond via a swale (Flow Pathway AR28-4 on Figure 5.1-2) in 2028	• Re-establishment of drainage patterns to Baker Creek is expected by 2031, in conjunction re-establishment of drainage patterns at B3 Pit, subject to water quality monitoring results, and MVLWB approval.

Table 5.1-2: Water Management of Tailing Containment Area Watersheds

TCA	Planned Remediation Works	Water Management Activities	Post-Remediation Configuration
Polishing Pond	• Remediation works at the Polishing Pond will be initiated in 2027 and will include grading and capping of the TCA	Water management will be required to divert runoff away from active remediation works, and will include: • On-going discharge to Baker Creek by pipeline (Flow Pathway 30 on Figure 4.1-1) or to the existing ETP if water quality criteria are not met (Flow Pathway 15 on Figure 4.1-1) until remediation works begin • Construction of an outlet channel joining the North Pond's spillway to convey runoff from the Polishing Pond to the collection point of B3 Pit during remediation works (Flow Pathway AR28-7 on Figure 5.1-2) • Progressive grading towards the outlet channel (Flow Pathway AR28-7 on Figure 5.1-2) during remediation works • Re-establishment of drainage patterns to Baker Pond via the Polishing Pond's outlet channel through the North Pond's spillway and B3 Pit's outlet channel (Flow Pathway PC-10 on Figure 5.1-3) in 2031	• Re-establishment of drainage patterns to Baker Creek is expected by 2031, in conjunction re-establishment of drainage patterns at B3 Pit, subject to water quality monitoring results, and MVLWB approval.

5.1.4 Water Management Pond

A temporary water management pond may be required to provide contingency contact water storage. This will be determined during detailed design stages when remediation and water management activities will be refined. The temporary water management pond would be sited in an appropriate location based on topographical constraints and proximity to the new WTP. If required, details of such facilities and associated monitoring will be presented in relevant Design and Construction Plans.

5.1.5 Water Management of Baker Creek

During closure and reclamation, Baker Creek will be remediated by removing contaminated fine sediments where present and replacing with natural channel materials, reconstructing the channel and floodplain where diversions are required, and enhancing fish habitat features. The low flow channel will be sized to convey moderate floods (e.g., up to 2 to 5 year return period) and the floodplain breadth will be sufficient to convey the Probable Maximum Flood through the Site. Design and construction of fish habitat features are the topic of ongoing consultation with Fisheries and Oceans Canada and will require authorization under the Fisheries Act. Details will be submitted in the Baker Creek Design and Construction Plan and this management plan will be updated as necessary.

Baker Creek at the Site is divided into seven reaches from Baker Pond (Reach 6) to the mouth at Yellowknife Bay and area immediately upstream (Reach 0). Construction at Baker Creek is scheduled to start in 2026 and be completed in 2029. The seasonal construction schedule will consider low flow periods and opportunities for “in the dry” construction, to minimize the holding or diversion of water in the creek. The construction sequence will proceed in a downstream direction to minimize the risk of exposure of downstream remediated areas to contaminated sediments from upstream disturbance. Remediation downstream of the existing ETP discharge point (Baker Pond) will not occur until the ETP has been decommissioned, anticipated to occur in 2027.

5.1.5.1 Reach 6 (Baker Pond)

Remediation works at Baker Creek Reach 6 (Baker Pond) are anticipated to be initiated in 2026 and will include removal of fine sediments and tailings from Baker Pond and possible conversion of the eastern portion of Baker Pond into a wetland. Fine sediments and tailings in Jo Jo Lake, at the north end of Baker Pond, will be included in this activity. A narrow pond would remain along the west boundary of Baker Pond to convey Baker Creek flow from upstream to Baker Creek Reach 5. Water management will be required to divert runoff away from active remediation works, and is anticipated to include:

- Temporary berm structures in Baker Pond will be used to allow dewatering to facilitate excavation of fine sediments and tailings and replacement with uncontaminated material.
- Temporary diversion of the Trapper Creek inflow will be required during construction at the north end of Baker Pond.
- Conveyance of Trapper Creek and the North Pond spillway to Baker Pond will be accommodated in the design.
- The decision as to whether the remainder of Baker Pond is a treatment wetland or conventional wetland, or backfilled has yet to be made. This is the subject of a reclamation research plan included in the CRP and will also require an authorization from the Department of Fisheries and Oceans (Canada) (DFO).
- Dewatering of the construction area would be required and standard erosion and sediment control measures would be applied prior to release of water.

Re-establishment of drainage patterns at Baker Creek Reach 6 (Baker Pond) is expected in 2026.

5.1.5.2 Reach 5 (Downstream of Baker Pond)

Remediation works at Baker Creek Reach 5 (Downstream of Baker Pond) will be initiated in 2027 and will include removal of fine sediments from the reach adjacent to the Calcine Pond, B1 Pit and B2 Pit, an expansion of the channel and floodplain in the lower reach, and replacement of clean substrates. Water management will be required to divert runoff away from active remediation works, and will include:

- A temporary diversion from Baker Pond to downstream Reach 4 will be required to convey flow past the construction area.
- Instream construction will occur during a low flow period to allow portions of the channel to be dewatered to facilitate excavation of fine sediments and tailings and replacement with uncontaminated material.
- Dewatering of the construction area would be required and standard erosion and sediment control measures would be applied prior to release of water.
- Re-establishment of drainage patterns at Baker Creek Reach 5 is expected in 2027.

5.1.5.3 Reach 4 (Remediated Diversion)

Remediation works at Baker Creek Reach 4 (Remediated Diversion) will be initiated in 2027 and will include “in the dry” construction of the transition to downstream Reach 3, in the lower area of Reach 4 that was diverted and remediated in 2006. The lower area, located north of C1 Pit and south of the existing Mill Pond and future AR2 freeze pad, will be constructed while isolated from Baker Creek and will not be reconnected until the Reach 3 diversion and remediation is complete. Water management will be required to divert runoff away from active remediation works, and will include:

- Channel and floodplain construction will occur outside of the existing channel and allow work to be completed away from flowing water.
- Removal of the upstream plug connecting to Reach 4 will be completed either “in the dry” during a low flow period or with application of appropriate sediment controls.
- Dewatering of the construction area would be required and standard erosion and sediment control measures would be applied prior to release of water.

Re-establishment of drainage patterns at Baker Creek Reach 4 is expected in 2028, after completion of the works at Reach 3.

5.1.5.4 Reach 3 (C1 Pit Diversion)

Remediation works at Baker Creek Reach 3 (C1 Pit Diversion) will be initiated in 2027 and will include “in the dry” construction of new channel and floodplain in the area east of C1 Pit, continuous with the construction at lower Reach 4. Water management will be required to divert runoff away from active remediation works, and will include:

- Channel and floodplain construction will occur outside of the existing channel and allow work to be completed away from flowing water.
- Removal of the downstream plug connecting to Reach 2 will be completed either “in the dry” during a low flow period or with application of appropriate sediment controls.

- Dewatering of the construction area would be required and standard erosion and sediment control measures would be applied prior to release of water.

It is expected that construction at Reach 3 will be completed over two construction seasons. Re-establishment of drainage patterns at Baker Creek Reach 3 is expected in 2028.

5.1.5.5 Reach 2 (Natural Reach)

Remediation works at Baker Creek Reach 2 (Natural Reach) will be initiated in 2029 and will include removal of fine sediments from the reach adjacent to A1 Pit, removal of infilled portions of the channel at historical watercourse crossings, and replacement of clean substrates. Water management will be required to divert runoff away from active remediation works, and will include:

- A temporary diversion from Baker Pond to downstream Reach 1 will be required to convey flow past the construction area.
- Instream construction will occur during a low flow period to allow portions of the channel to be dewatered to facilitate excavation of fine sediments and tailings and replacement with uncontaminated material.
- Dewatering of the construction area would be required and standard erosion and sediment control measures would be applied prior to release of water.

Re-establishment of drainage patterns at Baker Creek Reach 2 is expected in 2029.

5.1.5.6 Reach 1 (A2 Pit Diversion)

Remediation works at Baker Creek Reach 1 (A2 Pit Diversion) will be initiated in 2029 and will include “in the dry” construction of new channel and floodplain in the area northeast of A2 Pit. Water management will be required to divert runoff away from active remediation works, and will include:

- Channel and floodplain construction will occur outside of the existing channel and allow work to be completed away from flowing water.
- Removal of the upstream plug connecting to Reach 2 and the downstream plug connecting to Reach 0 will be completed either “in the dry” during a low flow period or with application of appropriate sediment controls.
- Dewatering of the construction area would be required and standard erosion and sediment control measures would be applied prior to release of water.

Re-establishment of drainage patterns at Baker Creek Reach 1 is expected in 2029.

5.1.5.7 Reach 0 (Baker Creek Outlet)

Remediation works at Baker Creek Reach 0 (Baker Creek Outlet) will be initiated in 2029 and will include removal of fine sediments from the lowest reach of Baker Creek, and replacement with clean substrates. Water management will be required to divert runoff away from active remediation works, and will include:

- A temporary diversion from Baker Creek Reach 1 to Yellowknife Bay will be required to convey flow past the construction area.
- Temporary cofferdams will be required to prevent inflow from Yellowknife Bay.
- Instream construction will occur during a low flow period to allow portions of the channel to be dewatered to facilitate excavation of fine sediments and tailings and replacement with uncontaminated material.
- Dewatering of the construction area would be required and standard erosion and sediment control measures would be applied prior to release of water.

Re-establishment of drainage patterns at Baker Creek Reach 0 is expected in 2029.

5.2 Water Treatment Plant and Outfall System

The closure objectives for water treatment and outfall systems incorporate the applicable Report of EA Measures (MVEIRB 2013; INAC 2014). In particular, Measure 14 requires the new WTP to reduce arsenic in the treated effluent to the 10 micrograms per litre (µg/L). In addition to treating arsenic to 10 µg/L, effluent from the new WTP will be required to be non-acutely toxic, and meet MDMER limits, or lower, for parameters of potential concern (POPCs). The EQC are lower and more protective than the MDMER discharge limits; therefore, meeting EQC will automatically result in meeting MDMER discharge limits. The proposed EQC (CIRNAC and GNWT 2019c) were developed such that water quality objectives will be met in Yellowknife Bay at the edge of the mixing zone defined by the MVEIRB (Measures 12 and 13). Further information is provided in the EQC report (CIRNAC and GNWT 2019c).

For clarity, EQC are end-of-pipe limits and water quality objectives are in-lake targets (receiving environment). The term “water quality objectives” refers to a collective list of water quality objectives that are applicable for use in Yellowknife Bay, including site-specific water quality objectives developed for the Site, generic aquatic life water quality guidelines (CCME 1999), published water quality guidelines from other jurisdictions (BCMOE 2017), and Guidelines for Canadian Drinking Water Quality (Health Canada 2017). Selected water quality objectives are provided in the EQC report (CIRNAC and GNWT 2019c).

It is anticipated that the new WTP will be commissioned by 2026. The new WTP will operate year-round, treating influent to achieve EQC. Effluent will be discharged via a new conveyance pipe and outfall into Yellowknife Bay from a nearshore outfall system near the existing Baker Creek mouth. This option was selected based on engagement with affected parties and is further discussed in Section 5.8 of the CRP (CIRNAC and GNWT 2019a).

Pumping of water from the underground mine for treatment at surface and subsequent discharge will continue to control the mine pool water level to maintain access to the underground and to allow the underground mine to continue to act as a groundwater sink. Controlling the mine pool elevation will also keep arsenic trioxide storage areas dry during and immediately after the freeze program in the mine.

The new WTP will treat contaminated water from the mine pool. Completion of the freeze is expected to reduce groundwater infiltration in the arsenic trioxide storage areas. Further, it is expected that the quality of the surface water runoff from engineered components on the Site, which is currently treated, will improve and be suitable for release to the receiving environment. Over the longer term, while it is expected that water quality in the mine pool may improve, it will continue to need treatment. Given this, the new WTP will remain in operation as required.

5.2.1 Water Treatment Plant

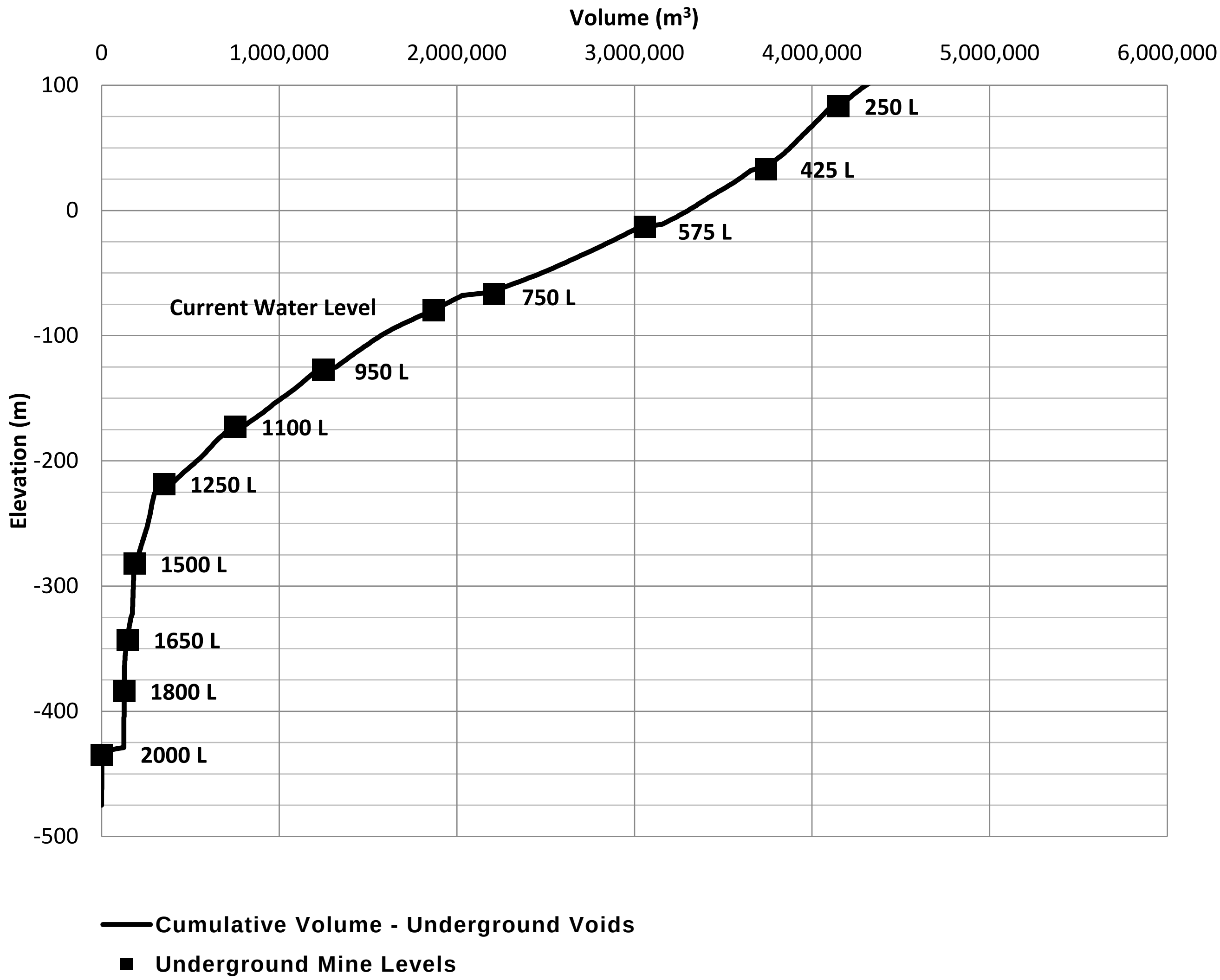
The preliminary design report (AECOM 2012) describes the full WTP system concept design. The report includes preliminary engineering design documents for the treatment train option. It also details how the selected configuration of the WTP combines important elements of water treatment with a small footprint and the ability to respond to variations in influent water quality and flow fluctuations. Further design of the WTP is underway.

5.2.2 Underground Equalization Storage

As surface storage of contaminated water is not considered a suitable option for Mine remediation, contaminated water will be directed underground for equalization storage in the mine pool, and the mine pool will be used to attenuate peak inflows during spring freshets and other periods of increased runoff. The objective of using temporary water equalization storage underground within the mine is to manage the flow to the WTP, such that the annual volume requiring treatment will be processed at a reasonably consistent rate each month. The treatment process will operate on a year-round basis to prevent significant fluctuations in the mine pool water level, which could lead to ground instabilities and the potential release of further contaminants. The depth to volume storage curve for the underground mine is shown in Figure 5.2-1.

The mine pool water level will be maintained at approximately 750 Level with seasonal fluctuations accommodated by underground equalization storage as presented in Figure 5.2-1. A Planned Minewater Level Raise Reclamation Research Plan (Appendix 5.1B in CIRNAC and GNWT 2019a) is being developed; this plan will provide further information on water level fluctuation.

Figure 5.2-1: Depth to Volume Storage Curve for the Underground Mine



5.2.3 Pumping System

Influent to the new WTP will be sourced from a new dual deep well pump system near the C Shaft area. The wells will be drilled from surface intersecting the mine pool. Each well will contain a 100 hp submersible turbine pump, which will include a variable speed drive, so it can be matched to inflows and plant needs.

The mine pumping systems will be reliably and carefully controlled to avoid interruptions or short-term fluctuations that would affect the performance of the plant. The pumping systems will be operated, maintained, and replaced from surface.

5.2.3.1 Volume and Rate of Water for Treatment

The two key design criteria for the construction of the WTP are the total annual flows into the mine and the maximum instantaneous flows for the WTP to process. These values form the basis of the design parameters listed in Table 5.2-1.

The estimated annual flows into the mine (flows rounded from Preliminary Design Report for the Water Treatment Plant, AECOM 2012) are:

- 630,000 m^3/yr (short-term average flow)
- 825,000 m^3/yr (short-term wet year peak flow)
- 405,000 m^3/yr (long-term average flow)
- 520,000 m^3/yr (long-term wet year peak flow)

* Note: future design work will update the assumptions.

Wet Year Peak Flow

The annual mine groundwater and infiltration increases in a wet year to a short-term wet year peak month flow of 280,173 m^3/mo (136 litres per second [L/s] including downtime and contingency) and a long-term wet year peak month flow of 127,818 m^3/month (62 L/s including downtime and contingency).

Instead of establishing a WTP with design capacity to handle the wet year peak month flows of 136 L/s, equalization storage within the mine pool will be used. Approximately 177,000 m^3 of storage will be used for early wet years to accommodate seasonal storage of water, such as during freshet.

Using the equalization storage, the estimated maximum flows for the WTP to process (AECOM 2012), with 10% plant downtime (e.g., membrane cleaning, backwashing) and a 20% contingency, are as follows: The maximum flow into the new WTP based on the short-term peak wet year flow is estimated to be 34 L/s; and the long-term average flow is estimated at 17 L/s. The short-term design flow will be accommodated by two parallel trains designed for 17 L/s each. Future pump optimization designs may update these assumptions.

Average Flow

Once the arsenic chambers are frozen, the site surface is remediated, and the reduced long-term flow rates are established, the average treatment flow rate required will be 16.7 L/s. Therefore, the process trains will operate in a duty-standby configuration (i.e., only one train in operation) to accommodate the design 17 L/s flow.

The maximum storage volume required in the long term is 0 m^3 per month. This is because the treatment plant has capacity to treat freshet and maintain the mine pool water level within a one month period.

Table 5.2-1: Design Criteria for the Water Treatment Plant

Item	Specification[(a)]
Short-term (until freeze is achieved)	
Average treatment flow rate	26.0 L/s
Peak wet year flow rate	33.9 L/s
Maximum equalization storage required	177,000 m^3
Long-term (post-freeze)	
Average treatment flow rate	16.7 L/s
Peak wet year flow rate	21.3 L/s
Maximum equalization storage required	0 m^3

Source: (a) AECOM 2012

5.2.3.2 Influent Quality

The WTP will source water from the C Shaft area. The design basis for the new WTP will consider the concentrations of minewater quality samples at the C-shaft and Akaitcho areas as well as the future predicted influent quality was reported in the EQC report (CIRNAC and GNWT 2019c).

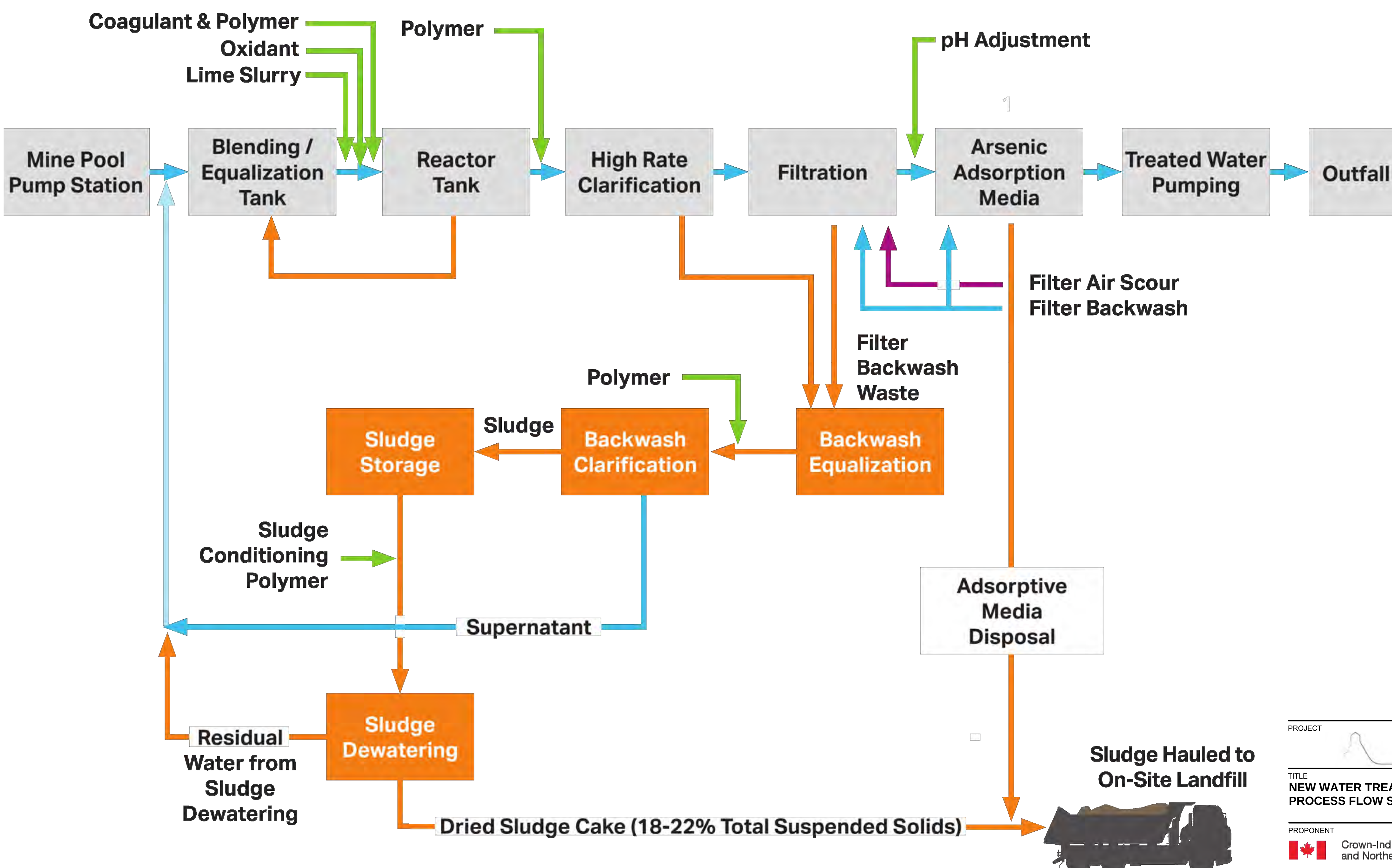
5.2.3.3 Effluent Quality Criteria

The proposed EQC are listed in Table 3.4-1 in Section 3.4.1. The development of the EQC is outlined in EQC Report (CIRNAC and GNWT 2019c). The values for EQC were selected such that they meet the applicable Report of EA Measures, are protective of the receiving environment, and are reasonably and consistently achievable (EQC Report; CIRNAC and GNWT 2019c).

5.2.3.4 Water Treatment Plant Design

The location of the new WTP, and associated deep well pump system, was selected to be the C Shaft area. This area was selected as it centralizes the long-term site infrastructure elements.

The new WTP will treat the future influent to meet the EQC. A schematic of the treatment process is provided in Figure 5.2-2, and the process stages are described in the following paragraphs.



PROJECT
Giant Mine Remediation Project

TITLE
NEW WATER TREATMENT PLANT
PROCESS FLOW SCHEMATIC

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

Government of Northwest Territories | Gouvernement des Territoires du Nord-Ouest

YYYY-MM-DD	2018-12-14
DESIGNED	S. Marsanich
PREPARED	C. Eros
REVIEWED	B. Boon
APPROVED	R. Schmidtke

PROJECT NO.	CONTROL	REV.	FIGURE
60581230		B	5.2-2

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Chemical Pre-treatment (Reactor Tank Stage)
Equalization and mixing of the influent with chemicals will be completed to support the sustainable operation of the downstream treatment processes. The chemical pre-treatment process will be similar to that of the existing ETP to precipitate metals and arsenic to traditional mining treatment standards. The specific chemicals and dosage rates will be determined based on final plant design and operation. This treatment stage is represented by the following stages in the flow schematic (Figure 5.2-2):

- blending/equalization tank
- addition of coagulant and polymer, oxidant, and lime slurry
- reactor tank
- addition of polymer

Clarification and Filtration
Clarification will be a gravity sedimentation process designed to remove a minimum of 95% of the particulate material from the process stream. The primary purpose of the clarification step is to condition the water sufficiently that the filtration process can function sustainably. Following clarification, the effluent will be filtered for further removal of the particulate matter from the process stream. Filtration will be designed to remove the majority of the remainder of the particulate matter from the process stream. The filtered water will have 99% of the particulate matter removed.

The precipitated waste material will be removed from the clarification process as a dilute sludge for further thickening. The other waste will be filter backwash, which will be typically an order of magnitude more dilute than clarifier sludge. These two waste process streams will be blended, equalized, and treated to further thicken the sludge while providing an effluent that is suitable for recycling to the head of the primary treatment process. The sludge will be dewatered to produce a sludge cake, meeting the definition of solid waste, such that it can be disposed of in the on-site landfill (See the CRP [CIRNAC and GNWT 2019a] and the Waste Management and Monitoring Plan [CIRNAC and GNWT 2019d] for more details). The clarification and filtration process is represented in the flow schematic (Figure 5.2-2).

Adsorption with Media – Specific Stage for Arsenic and Antimony Removal
The final step is a pH adjustment followed by adsorption with media. The adsorptive media is an ion exchange process that targets the removal of arsenic and antimony while allowing the other ions present in the process flow to pass. The specific chemical and dosage rates for the pH adjustment will be determined based on final plant design and operation. The adsorptive media is typically sensitive to the pH of the water, so provision for controlling the pH in the process is provided. This process is represented by the following stages in the flow schematic (Figure 5.2-2):

- pH adjustment
- arsenic adsorptive media

Further on-site pilot testing of the adsorptive media was completed in 2018 which will be used to further evaluate the suitability of media products for use in the WTP. These tests will be completed to finalize selection of the adsorptive media to be potentially used at the site. The results from the testing will be used to evaluate products and provide a recommendation for the media suppliers that could be used to meet the performance targets of the WTP. The testing will also confirm the suitability and volume of the waste adsorptive media, which will be disposed of in the on-site landfill (see the Waste Management and Monitoring Plan for additional information [CIRNAC and GNWT 2019d]).

Instrumentation and Testing

The new WTP will be fully automated based on process control logic developed from the pilot test results and engineering requirements developed during detailed design. The correct function of the WTP will be monitored with on-line analytical instrumentation. If measurements are recorded that do not meet the targeted water quality objectives, the control system will generate alarms to initiate operator intervention. Depending on the alarm category, the flow through the WTP will be stopped until the operator has remediated the concern.

The design of the control system will be configured in a fashion to confirm the quality of the treated water prior to discharge. Non-compliant water will be retained on site for further treatment. The direct monitoring for arsenic with an on-line analytical instrument is not typical, but some of the monitoring approaches being planned for the WTP are:

- pH monitoring throughout the treatment process
- turbidity and particle counters
- conductivity

In addition to the on-line analytical instrumentation, grab samples will be collected on a routine schedule for analysis at an off-site laboratory. These samples will provide quality assurance data to confirm that the instrumentation and automation within the WTP is meeting the design objectives for the treated water quality.

Supporting Infrastructure

The WTP has a wide variety of supporting infrastructure components, including Interim treated water storage with two below-ground concrete cells, each capable of storing approximately 800 m^3 of effluent. These will be used to monitor the effluent and equalize variations in effluent quality prior to discharge. Water from the effluent storage cell will be used to supply process and backwash water. One backwash pump, process pump, and return/recycle pump will be provided per train, and the pumping system will be designed such that each pump can supply either train. Similarly, up to four discharge pumps will be available to transfer the effluent to the outfall. In the event of a malfunction in the WTP resulting in the production of effluent that does not meet the discharge criteria, the effluent would be contained in the holding system. The effluent could be recycled through the plant or returned to underground storage.

Past 2026, the WTP is to provide water for closure activities including dust suppression, crushing, etc. Design of the plant needs to add a truckfill pump(s) and piping to effect this supply from the storage below the facility.

The infrastructure will also include process and mechanical piping, utilities including sewage holding tanks (to be pumped and disposed of off-site), electricity, process and mechanical equipment, instrumentation and controls, heating, ventilation, and air conditioning requirements, electrical systems, and civil and structural systems such as the building and foundations.

The WTP will produce a residual non-hazardous waste stream consisting of spent ion exchange media, sludge, and other process residuals as discussed above. The wastes produced from the WTP will be disposed of in the on-site Landfill, within the purpose-built WTP process residuals landfill cell. For more information see the CRP [CIRNAC and GNWT 2019a] and the Waste Management and Monitoring Plan [CIRNAC and GNWT 2019d]. The waste would also be suitable for off site disposal if a facility was identified to accept the waste.

5.2.4 Outfall

Year-round treatment precludes the use of Baker Creek and necessitates discharge to Yellowknife Bay, therefore treated water that meets the discharge criteria will be pumped through a pipeline to a new nearshore outfall system and into Yellowknife Bay. Figure 5.2-3 shows the schematics of the outfall system, and Figure 5.2-4 shows the map of the mixing zone.

5.2.4.1 Conveyance Pipeline

Treated effluent will be conveyed via pipeline to the outfall for discharge to Yellowknife Bay. The conveyance pipeline preliminary design is as follows (AECOM 2012):

- Alignment is assumed to follow the old water supply main alignment to Yellowknife Bay.
- Assumed Pipe details: high density polyethylene (HDPE) pipe with a diameter of 273 mm (nominal diameter of <10 inches; standard dimension ratio (SDR) 13.5 to resist possible pressure surge and vacuum from the pump; diameter and wall thickness sizing based on a velocity in the pipeline between 0.26 and 0.58 m/s with expected flow rate through the pipeline between 15 and 34 L/s; one valve and tee junction at either end of the pipeline to allow maintenance and repair; and, one additional tee junction at the high point for fitting an air valve.
- Soil cover over pipeline for protection against forest fire.
- Anticipated to be a heat traced system for freeze protection.

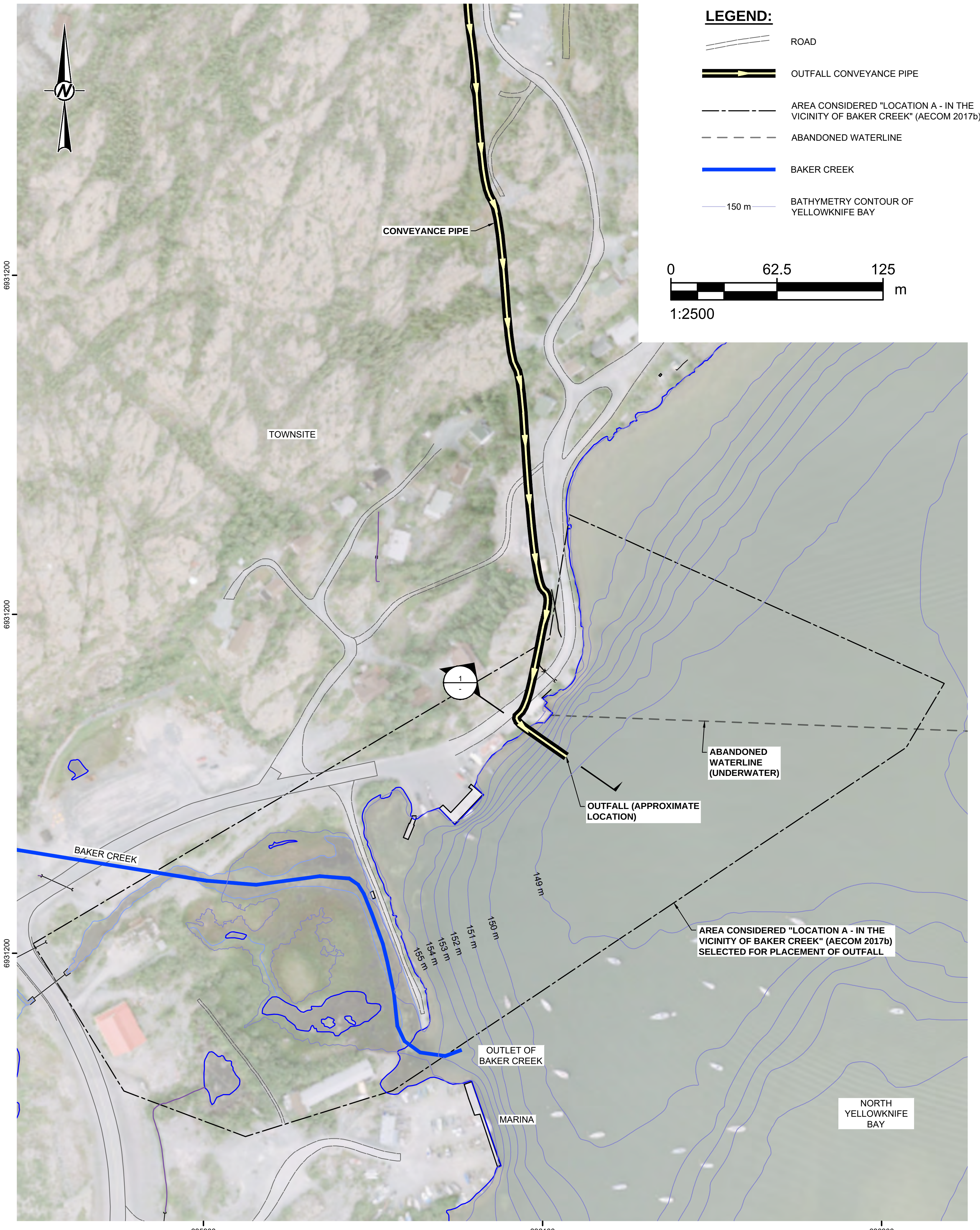
Further details on pump design and the sizing will be confirmed with detailed design once the alignment, length, and pressure head of the conveyance pipeline are finalized. Also considered with detailed design will be provision of accesses to insert probes for inspection and cleaning the internal walls of the pipe.

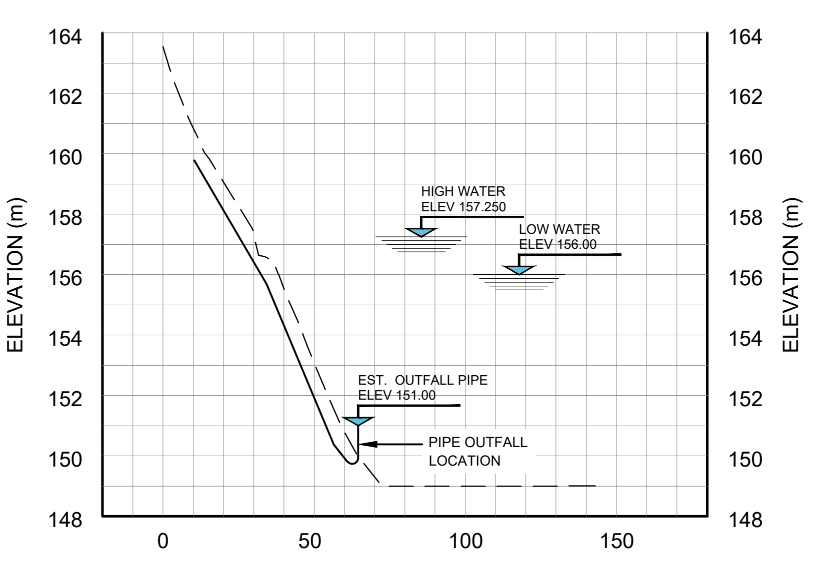
5.2.4.2 Outfall

Preliminary design for the single port outfall at Location A includes the following (AECOM 2017b):

- The in-lake outfall will be relatively short HDPE pipe, terminating at a 6 m depth of water to position the single port to avoid disturbing bottom sediments and ice and allow sufficient freeboard below the anticipated ice level).
- The nearshore outfall pipe will be weighted to overcome buoyancy to the extent required.
- The location of the outfall will be identified in such a way as to warn lake users about in the area. Details remain to be determined.
- The outfall line will likely be armoured to prevent ice damage and scour (e.g., riprap and bank embedment), and to meet engineering and fisheries habitat requirements.

Future engineering activities that will need to be confirmed with detailed design of the outfall (AECOM 2017b). This includes review of dredging and/or cover of the lake bottom at the outfall installation to mitigate sediment resuspension and meet Report of EA Measure 16.





SECTION 1

SCALE 1:2500 (H)
SCALE 1:250 (V)

PROJECT
Giant Mine Remediation Project

TITLE
PIPE OUTFALL LOCATION

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

Government of Northwest Territories
Gouvernement des Territoires du Nord-Ouest

YYYY-MM-DD	2018-12-14
DESIGNED	S. Marsanich
PREPARED	C. Eros
REVIEWED	B. Boon
APPROVED	R. Schmidtke

PROJECT NO.	CONTROL	REV.	FIGURE
60581230		E	5.2-3

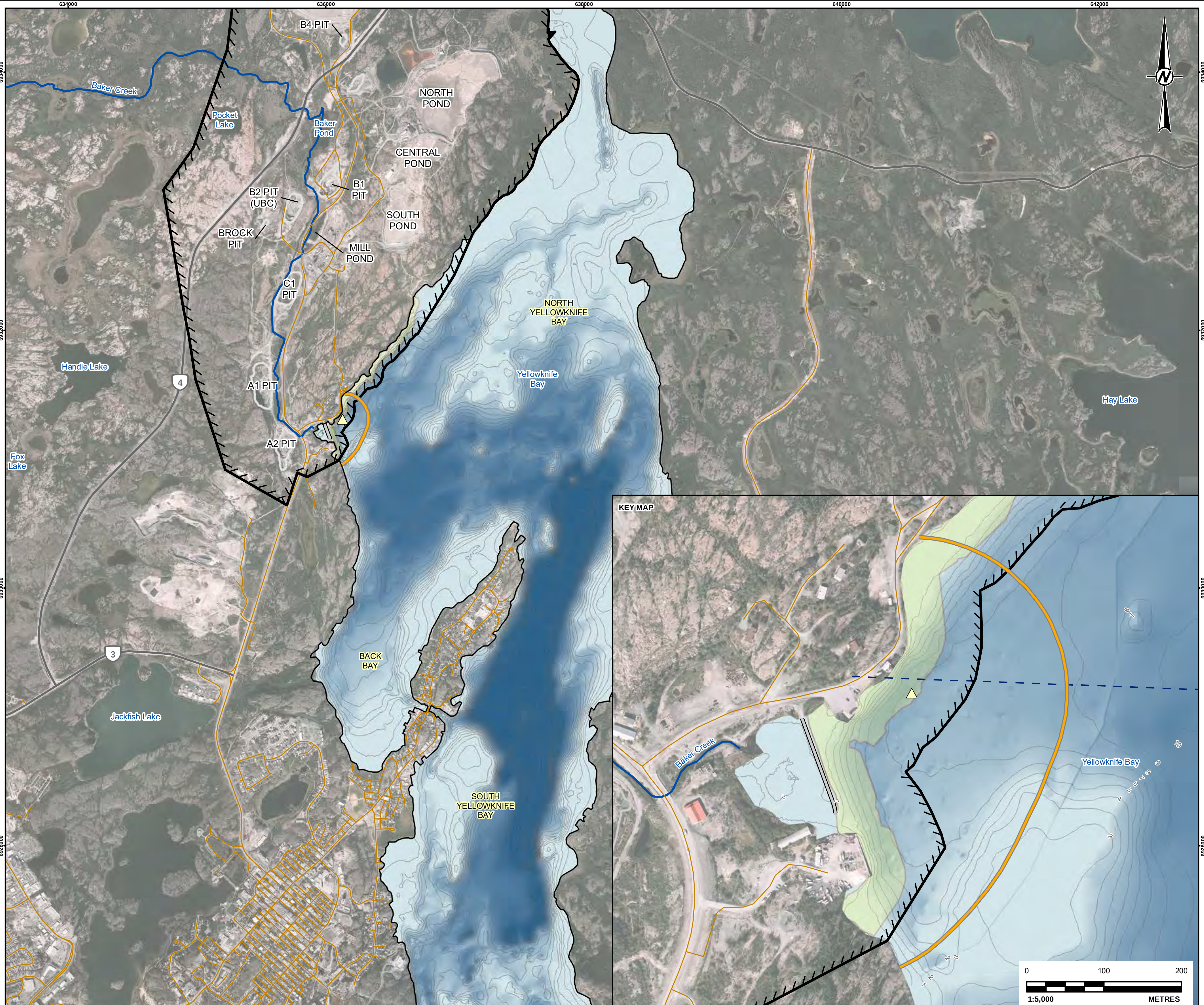
5.2.4.3 Outfall Mixing Zone

As outlined in MVLWB et al. (2017), the size of a mixing zone may be established on a case-by-case basis depending on factors including effluent discharge (e.g., quality, flow, outfall design etc.) and the receiving waters (e.g., quality, water uses, etc.). The size of mixing zones should be large enough to allow for initial dilution and mixing of the effluent, but small enough to avoid causing adverse effects to the receiving waterbody as a whole. Water quality objectives are typically applied at the edge of the mixing zone (MVLWB 2011), recognizing that conditions in the mixing zone should not cause acute toxicity to aquatic organisms. As noted above, Report of EA Measure 15 specifies that "Water quality changes due to effluent discharge will not reduce benthic invertebrate and plankton abundance or diversity beyond 200 metres (m) of the outfall." …and that "There is no increase in arsenic levels in Yellowknife Bay water at 200 m from the outfall." The GMRP has interpreted this to mean that a mixing zone with a radius of 200 m is acceptable for protection of water uses in Yellowknife Bay. As well, Measures 12 and 13 specify that water quality objectives should be met in the vicinity of the outlet of Baker Creek.

As outlined above, the decision to place the outfall in the vicinity of the outlet of Baker Creek was based on affected party engagement in which the majority of affected parties clearly communicated that they prefer the Project in part to keep the cumulative effects of contaminants from the Site in one place and keep any possible thin ice areas, should they develop, close to shore in a visible area.

The selected location also simplifies monitoring; to meet both Measures 15 (protection of water uses 200 m from the outfall), and Measures 12 and 13 (meet water quality objectives in the vicinity of Baker Creek), the GMRP is proposing a combined mixing zone that includes inflows from both the WTP effluent and Baker Creek. The conceptual combined mixing zone for Giant Mine is illustrated in Figure 5.2-4. The mixing zone area identified is defined by the extent of two overlapping mixing zones, each with a radius of 200 m into Yellowknife Bay, from the outlet of Baker Creek and the selected outfall location.

Water quality objectives will be met at the edge of the combined mixing zone; therefore, EQC were calculated for the WTP such that the influence of Baker Creek water quality in the mixing zone is incorporated (CIRNAC and GNWT 2019c). A comparison of the water quality in Baker Creek and in Yellowknife Bay is provided in the EQC Report (CIRNAC and GNWT 2019c); in general, concentrations of most parameters are higher in Baker Creek compared to Yellowknife Bay. Therefore, the influence of Baker Creek in the mixing zones results in lower allowable EQC for many parameters in minewater than if the influence of Baker Creek was not included in the mixing zone, because the assimilative capacity of the mixing zone is reduced due to Baker Creek inflow. A combined mixing zone allows for cumulative impacts of the mine site on Yellowknife Bay to be measured and assessed in one area, and for the calculation of EQC that are reasonably and consistently achievable for POPCs under various conditions. This approach is more conservative than having two separate mixing zones. A full description of the modelling and development of the EQC and the water quality objectives is found in the EQC Report (CIRNAC and GNWT 2019c). The AEMP for Yellowknife Bay and the SNP outline the monitoring program for the mixing zone area and Yellowknife Bay receiving environment.



LEGEND

- TREATED EFFLUENT OUTFALL
- BAKER CREEK
- BREAKWATER
- GIANT MINE PROEJCT BOUNDARY
- HISTORICAL WATER LINE (UNDERWATER)
- ISOBATH (1 m INTERVAL)
- HIGHWAY
- ROAD
- MIXING ZONE
- PIT BOUNDARY

REMEDIATION STRATEGY

- CAPPED WITH ENGINEERED COVER

WATER DEPTH (m)

0

22

0 1 2

1:30,000 KILOMETRES

REFERENCE(S)

HYDROLOGY AND TRANSPORTATION DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA.
DATUM: NAD 83 PROJECTION: UTM ZONE 11

PROJECT

Giant Mine Remediation Project

TITLE

GIANT MINE OUTFALL LOCATION AND MIXING ZONE

PROPONENT

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

Government of Northwest Territories / Gouvernement des Territoires du Nord-Ouest

YYYY-MM-DD	2018-12-13
DESIGNED	TH
PREPARED	AA
REVIEWED	TH
APPROVED	TH

PROJECT NO.	CONTROL	REV.	FIGURE
13-1377-0115	30000	0	5.2-4

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

5.3 Non-Hazardous Waste Landfill Facility

The proposed remedial plan includes the construction of a non-hazardous waste disposal facility that includes two separate disposal cells. One cell would be used for the disposal of non-hazardous building demolition and debris waste and the second cell would be used for the disposal of non-hazardous waste residuals generated from the ongoing operation of the WTP.

To assist in keeping the base of the landfill dry and suitable for vehicle traffic during operations the design of the landfill will include diversion of runoff around the facility and the grading of the landfill base and the construction of a sump at the downgradient end of the cell.

Surface water retention ponds will be used to collect surface water runoff which drains off the landfill cover for a temporary basis. Prior to discharge to the environment, testing will be completed to confirm water quality meets runoff criteria.

5.4 Passive Treatment Systems

Passive treatment of surface runoff is the subject of a Reclamation Research Plan (RRP) as identified in the CRP. Report of EA Suggestion 10 indicated that the Developer should investigate the potential advantages and disadvantages of engineered wetlands. The focus of research to date has been on a desktop study (Contango 2016) and field program (Contango 2017a) to assess feasibility, as well as a siting study (Contango 2018) to identify potential locations for treatment wetlands. Off-site pilot studies to assess treatment efficiencies are currently in progress (Contango 2017b). Permeable Reactive Barrier (PRB) systems could also be considered for passive treatments, particularly at locations where shallow subsurface flows with low flow rates are present.

Should treatment wetlands be constructed at the GMRP, locations upstream of receiving waterbodies (e.g., Baker Creek, Yellowknife Bay) will be selected based on flow and water quality characteristics to reduce total loadings of arsenic and other POPCs. Water management planning would be updated should a treatment wetland be constructed.

5.5 Water Use

During the active remediation and adaptive management phase, water use will include water consumption for GMRP activities related to work force, dust suppression, paste backfill, crushing, quarrying and contaminated soil remediation.

GMRP activities requiring water are summarized in Table 5.5-1, and are related to work force, dust suppression, paste backfill, crushing, quarrying and contaminated soil remediation. Potable water will continue to be trucked in, as was the case in Phase 1 (existing conditions).

Table 5.5-1: Activities For Each Water Use Components

Water Use Component	GMRP Activities
Camp / Sewage	• Work force consumption (sourced from off-site) • Sewage managed off-site
Dust Suppression	• Watering of road/laydown and freeze pad areas • Tailings maintenance, relocation, contouring, cover placement • Building demolition • Drilling including freeze installation and geotechnical investigations • Pit filling and cover placement • Landfill construction and operation
Paste Backfill	• Paste mixing • Dust suppression during excavation of tailings • Flushing of paste delivery pipes and hoses
Building Demolition	• Removal of hazardous materials (arsenic and asbestos) • Cleaning of building materials and abatement tools and equipment • Personnel decontamination (potable water)
Crushing	• Aggregate washing • Dust suppression
Borrow (Quarrying)	• Dust suppression • Drilling
Contaminated Soils Remediation	• Fissure washing (under consideration)

Water sources available for GMRP activities listed above were compiled and ranked based on their relative expected water quality, from Poor to Potable, as summarized in Table 5.5-2, to assign a water source to each GMRP activity during remediation:

- Minewater (i.e., untreated contact water temporarily stored in the North Pond, Northwest Pond, and/or underground workings) was ranked as having the worst quality on Site during remediation and was assigned a water quality grade of “Poor”.
- Polishing Pond water consists primarily of treated water but remains in contact with tailings as the pond is a former tailings pond. Thus, Polishing Pond water was ranked as having better water quality than minewater, but worse water quality than water from the ETP and the WTP, and was assigned a water quality grade of “Medium”.
- Water from the ETP and the WTP was assigned a water quality grade of “Clean”.
- Potable water from off-Site sources was assigned a water quality grade of “Potable”.
- A freshwater intake in Yellowknife Bay may be required for clean water, and it is proposed to be sited near the existing disturbed corridor, with final design details pending. This water has been assigned a water quality grade of “Clean”.

Table 5.5-2: Relative Water Quality of Available Water Sources

Conceptual Water Quality Grade	Corresponding Sources
Poor	-Minewater
Medium	-Polishing Pond
Clean	-ETP / WTP; Yellowknife Bay
Potable	-Trucked In

Based on the classifications provided above and activity-specific minimum water quality requirements and available water sources following the CRP and the water balance (Section 7), water sources were assigned to each GMRP activity throughout remediation, as summarized in Table 5.5-3 and as follows:

- Potable water will be trucked in throughout the GMRP for domestic use, and is therefore not considered as water use.
- Dust suppression activities require water quality equivalent to that of the Polishing Pond at a minimum, aside from building demolition which requires water quality equivalent to the existing ETP at a minimum. The volume of water required is expected to increase during active remediation and adaptive management from existing conditions. The volume of water required is expected to decrease following completion of crushing and quarrying activities. Actual required water quantities are currently not known and will be provided in the next versions of the Water MMP, once quantities become available.
- Paste backfill activities require water quality equivalent to that of the North Pond at a minimum. The volume of water required for paste backfill activities is expected to increase to approximately 84,000 m^3/yr during active remediation, from existing conditions.
- Building Demolition activities require water quality equivalent to that of the North Pond at a minimum. Water will be used to remove asbestos and arsenic materials as well as to clean building materials to allow for disposal as non-hazardous waste. Potable water will be required for personnel decontamination.
- Crushing activities require water quality equivalent to that of the Polishing Pond at a minimum. The volume of water required for crushing activities is estimated to be approximately 47,000 m^3/yr during active remediation. The proposed water source is the Polishing Pond until the new WTP is commissioned, and the new WTP afterward.
- Quarrying activities require water quality equivalent to that of the Polishing Pond or equivalent. The volume of water required for quarrying activities is estimated to be approximately 23,500 m^3/yr during active remediation.

Table 5.5-3: Estimated Water Use Quantities and Water Sources for GMRP Activities

GMRP Phase	Year	Total Water Use		Camp/Sewage[a]			Dust Suppression[c]			Paste Backfill			Crushing			Quarrying		
		m^3/yr	m^3/day	m^3/yr	m^3/day[b]	Water Source	m^3/yr	m^3/day[b]	Water Source	m^3/yr	m^3/day[b]	Water Source	m^3/yr	m^3/day[b]	Water Source	m^3/yr	m^3/day[b]	Water Source
Active Remediation	2021	184,111	1,203	0	0	Trucked In	30,000	196	Polishing Pond	83,611	546	North Pond	47,000	307	Polishing Pond	23,500	154	Polishing Pond
	2022	184,111	1,203	0	0	Trucked In	30,000	196	Polishing Pond	83,611	546	North Pond	47,000	307	Polishing Pond	23,500	154	Polishing Pond
	2023	184,111	1,203	0	0	Trucked In	30,000	196	Polishing Pond	83,611	546	North Pond	47,000	307	Polishing Pond	23,500	154	Polishing Pond
	2024	100,500	657	0	0	Trucked In	30,000	196	Polishing Pond	0	0	n/a	47,000	307	Polishing Pond	23,500	154	Polishing Pond
	2025	100,500	657	0	0	Trucked In	30,000	196	Polishing Pond	0	0	n/a	47,000	307	Polishing Pond	23,500	154	Polishing Pond
	2026	100,500	657	0	0	Trucked In	30,000	196	WTP/YK Bay	0	0	n/a	47,000	307	WTP/YK Bay	23,500	154	WTP/YK Bay
	2027	100,500	657	0	0	Trucked In	30,000	196	WTP/YK Bay	0	0	n/a	47,000	307	WTP/YK Bay	23,500	154	WTP/YK Bay
	2028	100,500	657	0	0	Trucked In	30,000	196	WTP/YK Bay	0	0	n/a	47,000	307	WTP/YK Bay	23,500	154	WTP/YK Bay
	2029	100,500	657	0	0	Trucked In	30,000	196	WTP/YK Bay	0	0	n/a	47,000	307	WTP/YK Bay	23,500	154	WTP/YK Bay
	2030	100,500	657	0	0	Trucked In	30,000	196	WTP/YK Bay	0	0	n/a	47,000	307	WTP/YK Bay	23,500	154	WTP/YK Bay
	2031	22,500	147	0	0	Trucked In	22,500	147	WTP/YK Bay	0	0	n/a	0	0	n/a	0	0	n/a
	2032	22,500	147	0	0	Trucked In	22,500	147	WTP/YK Bay	0	0	n/a	0	0	n/a	0	0	n/a
Adaptive Management	2033	22,500	147	0	0	Trucked In	22,500	147	WTP/YK Bay	0	0	n/a	0	0	n/a	0	0	n/a
	2034	22,500	147	0	0	Trucked In	22,500	147	WTP/YK Bay	0	0	n/a	0	0	n/a	0	0	n/a
	2035	22,500	147	0	0	Trucked In	22,500	147	WTP/YK Bay	0	0	n/a	0	0	n/a	0	0	n/a
	2036	22,500	147	0	0	Trucked In	22,500	147	WTP/YK Bay	0	0	n/a	0	0	n/a	0	0	n/a
	2037	22,500	147	0	0	Trucked In	22,500	147	WTP/YK Bay	0	0	n/a	0	0	n/a	0	0	n/a
	2038	22,500	147	0	0	Trucked In	22,500	147	WTP/YK Bay	0	0	n/a	0	0	n/a	0	0	n/a
	2039	22,500	147	0	0	Trucked In	22,500	147	WTP/YK Bay	0	0	n/a	0	0	n/a	0	0	n/a
	2040	22,500	147	0	0	Trucked In	22,500	147	WTP/YK Bay	0	0	n/a	0	0	n/a	0	0	n/a

Notes: a – Domestic water will be trucked in and does not fall under water use.
b – Conversion from [m^3/yr] to [m^3/day] assuming five months of water use per year during open water conditions.
c – Building demolition activities in the town site area require clean water. Water will be sourced from the existing ETP until the end of 2025, and from the WTP thereafter.

6 PHASE 3: POST-CLOSURE WATER MANAGEMENT SYSTEMS

Phase 3 represents the completion of adaptive management activities. Thus, water management activities applicable to the end of Phase 2, as described in Section 5 and illustrated in Figure 5.1-3, will be on-going and include:

- Re-established surface drainage patterns towards the natural receiving environment.
- Monitoring, including of the non-hazardous waste landfill, the freeze areas, and the site wide SNP and AEMP programs.
- Operation of the following facilities:
  - underground minewater pumping systems
  - WTP
  - outfall

Water use is not expected during this phase.

Additional information will be provided as the GMRP approaches Phase 3 in future versions of the Water MMP.

7 WATER BALANCE

This section of the Water MMP provides the Site-wide water balance from existing conditions to post-closure, originally developed as part of the EQC Report (CIRNAC and GWNT 2019c), and consisting of the following input:

- Three flow scenarios:
  - wet flow scenario, defined as a year with flows corresponding to the total annual precipitation of 493 mm equivalent to the 25-year return period, based on the 1973-1974 hydrologic year as recorded at the Yellowknife Airport
  - mean flow scenario (346 mm; long-term annual average; 1971-1972)
  - dry flow scenario (205 mm, 50-year return period conditions, 1946-1947)
- Existing condition operations.
- Watershed areas of Site watersheds.
- Elevation-area-storage characteristics of open pits and TCAs.
- Infiltration to underground workings and pumping from underground workings to surface.
- Consumptive uses.

A detailed description of methods and assumptions of the Site-wide water balance can be found in the EQC Report (CIRNAC and GNWT 2019c). This information will be migrated into future versions of the Water MMP following finalization of the EQC Report.

The current version of the Site-wide water balance is featured in the EQC Report (CIRNAC and GNWT 2019c). Future versions of the water balance will be migrated into this Water MMP.

8 MONITORING PROGRAMS

Routine monitoring of surface, sub-surface (minewater), and groundwater is completed at the Site daily, weekly, monthly, or quarterly depending on the regulatory and operational requirements. Detailed sampling requirements for each monitoring program are provided in the GMRP Standard Operating Procedures (SOP) for Effluent and Water Sampling (CIRNAC and GNWT 2019g).

The Water Licence will require regular, operational monitoring of volume of freshwater use, minewater quality, treated effluent discharge, water levels within tailings ponds to verify freeboard is maintained, and precipitation and runoff estimates. Tracking water movement and use will assist with the annual review of the water management systems and comparisons of expected versus actual water balances from year-to-year.

Substantial monitoring has occurred at the Site since operations ended in 2004. Under the umbrella of the Giant Mine Long-term Monitoring Program, multiple environmental monitoring programs and management plans are in place and have been effectively improved over time through adaptive management. For water, these programs can be categorized either as compliance monitoring, operational monitoring, or follow-up monitoring.

- **Compliance monitoring** – monitoring programs completed to satisfy regulatory requirements. Under the GMRP, these water-related programs include the SNP and AEMP under Water Licence MV2007L8-0031, along with the MDMER and Environmental Effects Monitoring (EEM) programs (Government of Canada 2002). The AEMP is designed to monitor the aquatic receiving environment downstream of the point where effluent is discharged into the environment. The AEMP was developed for the current point of discharge from the Polishing Pond into Baker Pond, and a separate program will be implemented for discharge from the new WTP into Yellowknife Bay. These monitoring programs are outlined under separate cover (CIRNAC and GNWT 2019e,f).
- **Operational monitoring** – a monitoring program to fill data gaps and assist with overall Site management. The Operational Monitoring Program (OMP) includes monitoring water quality at surface, groundwater, and minewater stations (see Section 8.2). A hydrology monitoring program is in place to identify and quantify surface flows, and operational monitoring of beaver activity (dams) and icing development on Baker Creek is completed to avoid surface and over-ice flooding. The OMP will expand to include other monitoring activities beyond water monitoring such as visual inspection of covers, fencing and other site components as the Project proceeds.
- **Confirmatory monitoring** – monitoring programs designed to assess the effectiveness of mitigation measures, evaluating the short-term and long-term effects on the physical, chemical, and biological components of the aquatic ecosystems affected by the Site, estimating the spatial extent of effects, and providing the necessary input for implementation of adaptive management. The GMRP has developed an AEMP that will be implemented under the new Water Licence.

Table 8.0-1 provides and overview of the water monitoring programs outlined above, with references to documents where more detailed program information can be found. A summary of monitoring for surface water, minewater, groundwater and hydrology are provided in Sections 8.1 to 8.4. Field methods, data tracking, quality assurance/quality control procedures, and reporting requirements are included in the Standard Operating Procedures for Effluent and Water Sampling (CIRNAC and GNWT 2019g).

Table 8.0-1: Current and Anticipated Water Monitoring Program

Monitoring Program	SNP	OMP	AEMP – Baker Creek	AEMP – Yellowknife Bay	MDMER/EEM	Other
Where to find it	Draft Water Licence	Standard Operating Procedures for Effluent and Water Sampling And WMMP	AEMP Study Design – Baker Creek	AEMP Study Design – Yellowknife Bay	MDMER provides basis for monitoring. Annual MDMER reports submitted to ECCC outline monitoring completed	Various
Content	• ETP/WTP discharge • Seeps, sumps (minewater) • Groundwater • Surface water • Minewater	• Groundwater • Surface water • Minewater • Surface runoff • Bulkhead seepage (underground) • Hydrometric Station 07SB013 at the outlet of Lower Martin Lake(b) • Beaver dam and icing inspections of Baker Creek • Water pumping volumes and TCA water levels	• Water quality in Baker Creek, Yellowknife River, and Yellowknife Bay(a) • Sediment quality in Baker Creek, Yellowknife Bay, Yellowknife River(a) • Toxicity testing (sublethal) in receiving environment • Baker Creek flow (hydrometric stations)	• Water quality in Yellowknife Bay and lake reference area (TBD)(a) • Sediment quality in Yellowknife Bay and lake reference area (TBD)(a) • Toxicity testing (sublethal) in receiving environment	• Treated effluent (ETP/WTP) • Surface water quality in a reference and exposure area • Toxicity testing (acute and sublethal) of treated effluent	• Infrastructure • Alternative Technologies to Reduce Arsenic Loading to the Aquatic Environment Reclamation Research Plan; components TBD • Other studies as requested by the MVLWB; components, as specified

(a) For the existing ETP, the receiving environment is Baker Creek downstream of the point of discharge and Yellowknife Bay at the mouth of the creek. Reference areas are Baker Creek upstream of the point of discharge and Yellowknife River. For the new WTP, the receiving environment will be Yellowknife Bay and a lake reference area will need to be defined.

(b) Funding is provided by CIRNAC-GMRP to ECCC for operation of this hydrometric station through an Inter-Departmental Letter of Agreement.

SNP = Surveillance Network Program; OMP = Operational Monitoring Program; AEMP = Aquatic Effects Monitoring Plan; MDMER = Metal and Diamond Mining Effluent Regulations; EEM = Environmental Effects Monitoring; ETP = effluent treatment plant; WTP = water treatment plant; TBD = to be determined.

8.1 Surface Water Monitoring

8.1.1 Water Quality

Surface water quality monitoring for the Site occurs within the SNP and OMP programs. All station and monitoring details for these programs are provided in the Standard Operating Procedures for Effluent and Water Sampling (SOP; CIRNAC and GNWT 2019g).

8.1.2 Baker Creek Inspections

As part of the OMP, beaver activity, ponding, ice dam development, and potential for surface water flooding at Baker Creek is monitored on a weekly basis throughout the year. Inspections at Baker Creek and Trapper Creek follow the GMRP Baker Creek Monitoring Checklist and Inspection Sheet. Inspections include recording all observations of snowmelt in and around the creek, beaver dam construction, increased streamflow, rising water levels, and ice dams. A weekly report is prepared for Baker Creek and any maintenance items are addressed as soon as possible (i.e., immediately after relevant permits and authorizations are received). Close to freeze-up it is imperative that Baker Creek is inspected regulatory, and beavers dams are removed from channel. With warmer winter temperatures, beaver dam removal is critical for minimizing ice dam development, over-ice flows, and spring floods. Beaver activity should also be observed and documented in accordance with the Wildlife and Wildlife Habitat Management and Monitoring Plan (CIRNAC and GNWT 2019h).

8.1.3 Hydrology Monitoring

The hydrology monitoring program is intended to provide supporting information for site characterization in the AEMP and operational monitoring. The program includes the installation of hydrometric stations for continuous water level measurements through the open water season (May/June until September). Water level surveys and discharge measurements are completed at each station to establish rating curves (relationship between water level and discharge), so that the time series of water levels at the stations can be converted to seasonal discharge.

The hydrology monitoring program includes six hydrometric stations along with a rain gauge and barometric pressure gauge. The hydrometric stations include two locations on Baker Creek, Trapper Lake and outlet, Pocket Lake and outlet, Mill Pond, and the Baker Creek tributary north of A2 Pit. Further details on the hydrology monitoring program are provided in the SOP for the Site (CIRNAC and GNWT 2019g).

8.2 Minewater Monitoring

Underground minewater movement and chemistry have been monitored since 1999 at the Site. The objectives of OMP in relation to the underground are to identify and characterize the principal sources of arsenic and other contaminants. It is important to monitor the amount of arsenic trioxide underground, since this water flows to the 750L high-test pipeline, Akaitcho pumping station, and into the Northwest TCA.

Minewater levels and quality are monitored through the C-Shaft Void. Water samples and pressure measurements are obtained through the same type of multi-port system that is used in the deep groundwater monitoring wells (Section 8.3). A total of 12 monitoring zones, extending to a depth of approximately 600 m (2000 Level), have been established within the C-Shaft where the mine levels intersect the shaft.

Underground sampling is conducted to monitor the amount of arsenic seeping from the bulkheads, as this water eventually flows to the 750 Level pipeline, Akaitcho pumping station, and into the Northwest Pond. The underground mine contractor is responsible for underground bulkhead inspections on a weekly basis, and monthly and quarterly minewater quality sampling is timed to coincide with the bulkhead checks. Samples are taken at seven underground locations:

- UBC Top sump
- Ramp sump drill water supply
- Bulkhead 14
- Bulkhead 36
- Bulkhead 50
- Bulkhead 68
- Bulkhead 68 bottom diamond drill hole (68DDH)

Further details on the minewater monitoring program are provided in the SOP for the Site (CIRNAC and GNWT 2019g).

8.3 Groundwater Monitoring

The GMRP has been monitoring groundwater at a range of depths since 1999. The groundwater monitoring network consists of 12 shallow standpipe wells to monitor the TCAs and basins, 17 shallow wells to monitor the former Calcine Pond and the Mill Pond, and 14 deep multi-port monitoring wells located outside the underground mine workings. In addition, 10 shallow wells were installed around the North, Central and South TCAs in 2016, and a series of 15 shallow drive points (up to 2 m deep) were installed throughout the site in September 2018. Wells are sampled in spring and fall, with water level (hydraulic head) measurements also collected in July and August. Further details on the minewater monitoring program are provided in the SOP for the Site (CIRNAC and GNWT 2019g).

8.4 Infrastructure Monitoring

8.4.1 Dams and Dykes

Dams and dykes associated with the TCAs are monitored and maintained regularly and the details of the operation, maintenance and surveillance of these dams and dykes are contained in the OMS Manual (Parsons 2019 forthcoming).

There are specific requirements for TCA water management and treatment, storage capacity of facility ponds, maximum pond water levels and hazard and alert levels (Parsons 2019 forthcoming). The OMS Manual details the surveillance requirements for the TCAs and associated dams and dykes including:

- procedures for visual inspection, how often these should be conducted and by whom
- procedures for reading geotechnical instrumentation, how often these should be read and the establishment of hazard and alert levels
- requirements for sampling and testing as per water licence requirements
- requirements for conducting topographic and bathymetric surveys
- procures for conducting annual dam safety inspections and dam safety reviews

Routine and preventive maintenance on dams and dykes is also conducted regularly (Parsons 2019 forthcoming). The OMS Manual also provides procedures for identifying, preparing for, and responding to an on-site emergency, including:

- identification of determined hazard and alert levels and specific actions which require implementation should these levels be reached
- emergency contacts and call-out procedures
- preventative and remedial responses to incidents
- identification of possible resources to assist with incidents

To enable the preparation of a water balance for site, records of yearly water inputs are maintained as part of the OMP and include:

- water volume discharged to the aquatic environment
- volumes of seepage pumped from sumps or other structures
- water elevations in the North, Settling, Polishing and Northwest Pond
- water volumes pumped from the underground workings
- water volumes transferred from the North Pond to the Northwest Pond
- water volumes treated at the effluent treatment plant
- water volumes transferred from the Northwest Pond to ETP
- water volumes from the ETP to the Settling and Polishing Ponds
- water quality sampling results

8.4.2 Pipelines and Pump Infrastructure

Pipelines and pumps are monitored and maintained regularly and the details of the operation, maintenance and surveillance of these dams and dykes are contained in the OMP.

8.4.3 Effluent Treatment Plant and Water Treatment Plant

The operation and maintenance of the ETP and the new WTP will be discussed in a separate manual, to be submitted to the MVLWB along with detailed designs for approval prior to construction of the WTP. As noted above, SNP 43-1 (treated effluent from the ETP) is sampled during discharge for compliance with MDMER/EEM requirements including acute and sublethal toxicity testing. Once the new WTP is commissioned, SNP 43-1 will be replaced with new station SNP 43-1A.

9 CONTINGENCY PLANNING

The MVLWB letter of submission requirements issued to the GMRP after the Environmental Assessment (MVLWB, 2014) and the MVLWB Standard Submission Guidelines (MVLWB, 2013) require contingency scenarios to be included in all management plans. Contingencies are defined by the MVLWB as a description of how the results of monitoring will be linked to those corrective actions necessary to ensure that a component continues to meet objectives, applicable policies, and is operating as designed.

The GMRP maintains an internal risk registry. This registry identifies all existing potential risks associated with the Site, and ranks them for acceptability. Risks may be associated with aging infrastructure, weather events, or other management concerns. Risks are tracked and managed through monitoring programs and implementation of mitigations. Risks that are deemed unacceptable are addressed. Good examples of past responses to unacceptable risks, are the demolitions of the Roaster Complex, A-Shaft headframe, and C-Shaft headframe; infrastructure monitoring deemed these buildings to have an unacceptable level of risk to human health and the environment and they were, therefore, deconstructed prior to more serious consequences occurring, such as structure collapse.

The GMRP has developed contingency scenarios for each management plan based on identified potential risks. In following the MVLWB's definition for contingency and following the methods implemented to date in managing risks, each contingency scenario outlines:

- a risk statement – a risk identified at the Site; each management plan includes risks specific to the area of management
- the phase(s) of the GMRP it applies to (Section 2.4.4)
- mitigations and monitoring undertaken regularly to monitor the identified risk
- an action level – the point at which the contingency scenario is initiated
- a contingency or response – what the GMRP will do should an action level be reached for a specified contingency.

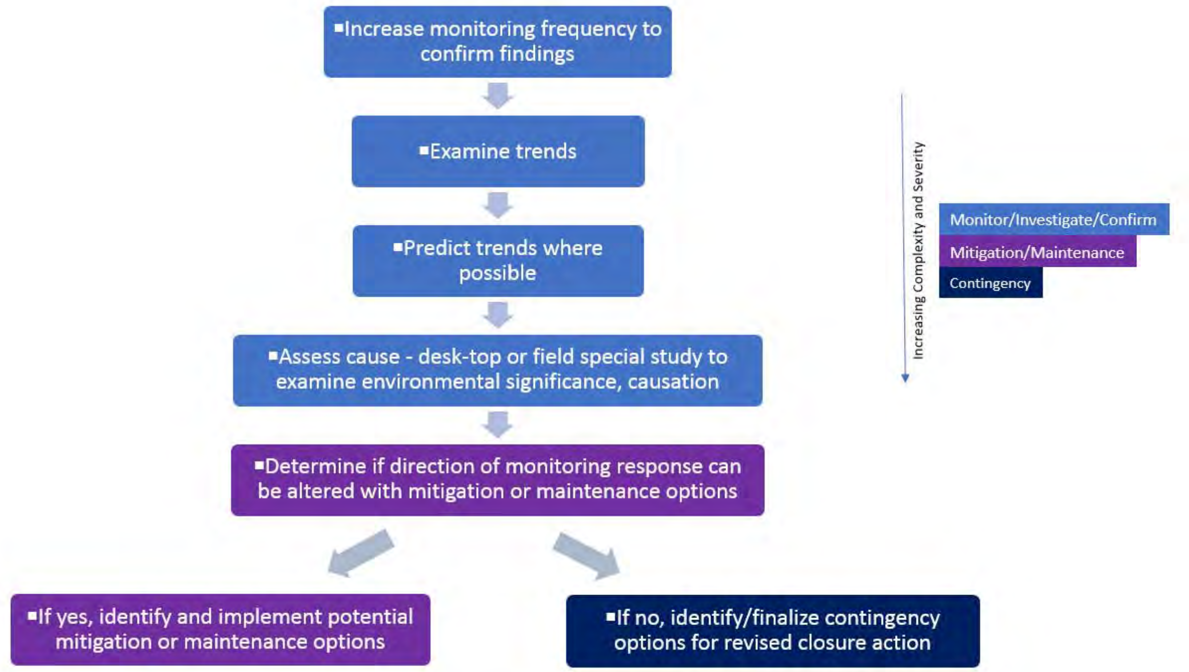
In addition to the known existing risks and contingencies, the GMRP is completing a Quantitative Risk Assessment (QRA; ongoing at the time of submission). The QRA is working to identify all the potential risks that will remain at the Site after remediation is complete. It will also identify the level of risk associated with each (low, medium, or high). Contingency scenarios will be developed for the risks identified in the QRA once complete. Risks will be updated in each management plan, as is relevant, moving forward.

Appendix G includes a table of contingencies specific to water management and monitoring. These scenarios and corresponding proposed action levels and responses are currently in draft form. Updated contingency scenarios will be provided with the updated management plans after issuance of the Water Licence.

In general, should monitoring or inspection indicate that the closure criteria may not be met, a series of actions would be initiated. An example of the generic types of actions that would be taken is outlined in Figure 9.0-1. The actions outlined in Figure 9.0-1 may not occur in sequential order. For example, observations of a more serious nature may require the activation of a contingency plan for immediate mitigation rather than additional monitoring and study.

This section focuses on contingencies for water management in relation to closure activities.

Figure 9.0-1: Sequence of Actions That Could Be Taken if Monitoring Suggests Closure Criteria May not Be Met



As noted above, adaptive management and maintenance actions are distinguished from specific closure contingencies, where the selected closure option fails to achieve the closure objectives. Some general contingencies for water management components are outlined in Table 9.0-1.

Table 9.0-1: General Contingencies and Response Plans for Selected Water Management Components of the Giant Mine

Item	Relevant Contingency
EQC is exceeded at discharge sampling location	• If Water quality data from any sample collected at **Surveillance Network Program** station 43-1 or 43-1a, once operational, exceeds the Effluent Quality Criteria or is determined acutely toxic the operator will: – Repeat sample on a rush-order basis If the re-sample also exceeds the EQC the operator will: – Cease discharge and begin re-circulation as necessary – Develop an action-response plan – Notify the MVLWB and an Inspector within 24 hours; and – Comply with the approved Standard Operating Procedure, and • Submit a detailed report on the occurrence to the MVLWB and an Inspector within 30 days.

Table 9.0-1: General Contingencies and Response Plans for Selected Water Management Components of the Giant Mine

Item	Relevant Contingency
Underground minewater level maintenance	• Continue to pump and treat using the two treatment trains instead of deferring to a duty-standby configuration, therefore maintaining the higher pumping and treatment capacity to keep minewater at the approved level. Post-closure there is additional capacity at the WTP as post closure only 1 train is required to meet water treatment requirements. The plant has been designed with capacity to undertake maintenance / repairs for 30% of the time, regular maintenance has been anticipated and accommodated in the design. In the long term low inflow rates for treatment. • Allow the minewater level to rise.[(b)] Confirmation of the depth and storage volume relationship in the mine will provide estimates of the allowable downtime of the treatment facility, and in turn allowable minewater level rise, in the event of catastrophic failure e.g., fire, earthquake. This provides time frames to implement a repair. • Akaitcho shaft wells will be capped, and available as backup if required. Adaptive management option for water quality and quantity (not an emergency backup, an adaptive management approach). Additionally a third intake identified in the C Shaft area, a new well could be developed in case of loss of one well. During this period one well would still operation. • If unable to meet EQC and WQO, the water can be recirculated within the system until targets are achieved. If required, can run at a reduced treatment capacity (e.g., double treat the water before discharge); in the long-term minewater equalization storage can be used whilst upgrades to the plant are implemented to over come this issue.
Flooding to underground (via pits or Baker Creek)	• Install additional dykes or other in-stream measures to direct flow away from the pits.[(a)]
Surface runoff/seepage quality from TCAs/pits/soil covers	• Collect and treat seepage/runoff water for a longer period, until quality/quantity is adequate for release.[(a)] • Install or enhance passive treatment processes in drainage networks.[(b)]
Contaminated soil/sediment removal to target concentrations and reduction in water quality concentrations	• Install sumps downstream of covers and collect water until runoff water quality improves.[(b)]
Achievability of WTP effluent quality criteria	• Implement alternative operations strategy, e.g., replace ion exchange media more frequently.[(a)] • Change treatment process, e.g., use different ion exchange media.[(a)] • Change outfall design to improve mixing.[(a, b)]

a) Contingencies proposed for closure period 2020 to 2030.
b) Contingencies proposed for long-term closure maintenance beyond 2030.

TCA = Tailings Containment Area; WTP = water treatment plant

10 REPORTING

This section of the Water MMP focuses on reporting requirements related to water management and water management infrastructure at the Site.

10.1 Water Licence

Reporting requirements for monitoring required by the MVLWB are set out in Water Licence MV2007L8-0031, and include monthly and annual reporting requirements. Once a Water Licence is issued, the licensee is required to submit all data related to the SNP program within 30 days following the month being reported. In addition, an Annual Water Report must be submitted to the MVLWB no later than 30 April of the year following the calendar year reported. This report provides a summary of activities and monitoring data from the GMRP and is also intended to help with the early identification of any emerging issues. The report should include response actions and contingency scenarios, since these are particularly useful in helping MVLWB staff and stakeholders to identify whether any issues have arisen over the past year.

The Annual Water Report also includes the following water-related activities undertaken during the previous calendar year:

i. A summary of updates or changes to the process or facilities required for the management of Water and Wastewater.

ii. A summary of any activity-specific updates to the Plan.

iii. The monthly and annual quantities in cubic metres (m^3) of water obtained for all purposes, identified by source location.

iv. The monthly and annual quantities in cubic metres of any Seepage or runoff collected or managed and its source (e.g., pits, tailings, Non-hazardous Landfill).

v. Monthly elevations of Water in the TCAs, prior to Reclamation of the TCAs, and any other Wastewater management ponds.

vi. Monthly and annual estimates and measurements of precipitation and runoff.

vii. Monthly and annual quantities in cubic metres (m^3) of minewater pumped from the underground.

viii. Monthly and annual quantities of treated wastewater discharged to the receiving environment.

ix. A comparison of water and wastewater quantities measured in the year to the water balance predictions for the year in the approved Water MMP, and an explanation of divergence between predictions and actual measurements.

x. An updated water balance if required as per the approved Water MMP.

xi. A summary and interpretation of water monitoring results, including any response or corrective action.

10.2 Metal and Diamond Mining Effluent Regulations

The reporting of treated effluent characterization and surface water quality monitoring results must be carried out as required under Part 2, Division 1 and Schedule 5 of the MDMER as follows:

- Quarterly reporting of treated effluent and water quality data on the electronic Regulatory Information Submission System (RISS) of Environment Canada within 45 days after the end of each calendar quarter.
- Annual reporting of treated effluent and water quality monitoring for the previous calendar year, submitted to the Authorization Officer at Environment Canada and the electronic RISS of Environment Canada by 31 March of the following year.

All effluent discharged to the environment is required to meet the MDMER Schedule 4 Authorized Limits for Deleterious Substances. The monthly average effluent concentrations for comparison with MDMER limits are calculated at SNP 43-1 according to the SOP (CIRNAC and GNWT 2019g).

11 REVIEW AND EVALUATION OF THE PLAN

The Water MMP will be reviewed and updated at a minimum frequency as agreed upon with the MVLWB, or if the licensee seeks changes to the Water MMP, or upon request of the MVLWB.

The proposed minimum frequency for review of the Water MMP is once a year, with updates as identified by the review.

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APPENDIX A

CONFORMITY TABLES

Proposed Type A Water Licence

Conditions of the proposed Type A Water Licence are summarized in Table A-1 along with sections of the Water MMP where each condition is addressed.

Table A-1: Proposed Water Licence Conditions

Condition	Corresponding Section in WMMP
Part G: Condition 1: The Licensee shall manage Water and Waste with the objectives of minimizing the impacts of the GMRP on the quantity and quality of Water in the Receiving Environment through the use of appropriate mitigation measures, monitoring, and follow-up actions.	**1.3, 2.4**
Part G, Condition 3: The Licensee shall comply with the **Water Management and Monitoring Plan**, once approved. The Plan shall comply with Schedule 3, Condition 1.	**WMMP**
Schedule 3, Condition 1: The Water Management and Monitoring Plan referred to in Part G, Condition 3 of this Licence shall include, but not be limited to, the following: a) Information regarding Water and Wastewater management, including:	
i. A summary, with appropriate maps or diagrams, of the components of the Water management system at key stages of Remediation and at post-closure including all the Water and Wastewater streams that report to and from it at each stage;	**5.0, 6.0, 7.0**
ii. A description of the Closure Activities that will influence the Water management system at the Site.	**2.4.3**
iii. A description of the process and facilities, including duration of use, intended for the purposes of:	
a. Obtaining Water from Yellowknife Bay for GMRP use;	**5.5**
b. The collection, storage, and management of surface water from the GMRP, including a description of how surface water management will change at key stages as site Remediation progresses;	**5.0, 6.0, 7.0**
c. The collection, storage, and management of any Wastewater resulting from the GMRP including a description of how Wastewater management will change at key stages as site Remediation progresses; and	**5.0, 6.0, 7.0**
d. The management of Sewage;	**4.2.2.2, 4.4, 5.2.3.4, 5.5**
iv. A description of the process and facilities for the treatment and Discharge of treated Wastewater to the Receiving Environment, including:	
a. A description of the existing ETP;	**4.3**
b. A description of the new WTP;	**5.2**
c. Plans for disposal of treatment residues;	**5.2.3.4, 5.3**
v. Any other information required to describe how Water and Wastewater will be managed such that the objectives listed in Part G, Condition 1 of this Licence are achieved.	**5.3**

Table A-1: Proposed Water Licence Conditions

Condition	Corresponding Section in WMMP
b) Water balance estimates for the Remediation and adaptive management phase and for the post-closure monitoring and maintenance phase. Annually, a comparison of monitoring results against modelled results is to be provided in the Annual Water Licence Report as per Part B, Condition 10, to identify divergence for a given year. An updated Water Balance will be submitted to the Board every three years after licence issuance.	**7.0 and the EQC Report (CIRNAC and GNWT 2018c)**
c) Information regarding monitoring activities including: i. Details of monitoring, including a rationale, for each component of the Water management system; including monitoring of surface Water, Groundwater and Minewater; ii. An explanation of how proposed monitoring will assess the risks identified in Schedule 3, Condition 1(e); iii. Linkages to other water quality monitoring programs required by this Licence; iv. Linkages to any Closure Objectives and Criteria that are satisfied in whole or in part by the management systems detailed in this Plan; v. An inspection plan for the water management system to verify that it is operating as designed (i.e., there should be a link to any relevant design plans) including rationale; and vi. Any other information about the monitoring that will be performed to meet the objectives in Part G, condition 1 of this Licence.	**8.0**
d) A description of maintenance or contingency activities that will be undertaken if monitoring results show that water management systems are not meeting Part G, Condition 1 of this Licence. The contingencies section of the Water Management and Monitoring Plan will include: i. Identified risks related to water management for each phase of the GMRP; ii. A threshold or action level to define the point at which monitoring indicates a response is necessary; and iii. Proposed response to be implemented if threshold exceeded.	**9.0**
e) Corrective or preventative actions taken during the year shall be reported in the Annual Water Licence Report as per Part B, Condition 10 of this Licence.	**10.0**

Post Environmental Assessment Information Package: Schedule 4 – Draft Water Management Plan Requirements

Information requirements for the Water MMP as defined in the Post EA information package request from MVLWB (MVLWB 2014) are provided in Table A-2.

Table A-2: Post EA Information Package Schedule 4 Information Requirements

Item	Corresponding Section in Water MMP
a) *Format:* See the MVLWB's Standard Outline for Management Plans attached as Appendix 1.	**This Water MMP**
b) *Notes on the content of the plan:* I. The main body of the management plan (i.e., section 6 of the Standard Outline) should contain information about the water management system including for example: a. A summary, with appropriate maps or diagrams, of the components of the water management system and all the water and waste streams that report to it. b. A description of the process and facilities for: i. Obtaining fresh water; ii. The collection, storage, and management of any surface run-off generated on site; iii. The collection, storage, and management of any wastewater resulting from mining activities; and iv. The treatment and discharge of wastewater.	**4.0, 5.0, 6.0, 7.0**
c. Water balance estimates for each year of the proposed licence.	**7.0 and the EQC Report (CIRNAC and GNWT 2018)**
II. The section on Monitoring and Evaluation (i.e., Section 7 of the Standard Outline) should contain: a. Information regarding monitoring and inspection including: i. Details of monitoring, including rationale, for each component of the water management system; ii. Details of groundwater monitoring, including rationale, for any wastewater that has the potential to bypass the water collection/containment system; iii. An inspection plan for the water management system to ensure that it is operating as designed (i.e., there should be a link to any relevant design plans) including rationale; and iv. Linkages to other monitoring plans if applicable.	**8.0**
III. The section on Contingencies (i.e., Section 8 of the Standard Outline) should contain: a. A description of how the results of monitoring will be linked to those corrective actions necessary to ensure that the water management system continues to meet the objectives of the Policy and is operating as designed.	**9.0**
IV. Site water management is likely to differ during the different project phases (i.e., construction, operations, closure, reclamation etc.). Therefore, describe these differences in each of the plan sections.	**4.0, 5.0, 6.0**

Giant Mine Remediation Project

Environment Assessment Measures and Suggestions

Measures from the Report of EA (MVEIRB 2013) as well as any amended Measures from the Final Decision Letter (AANDC 2014) that pertain directly to the Water MMP are summarized in Table A-3. Suggestions from the Report of EA (MVEIRB 2013) are summarized in Table A-4. Note the WMMP itself does not meet the measures alone; this table reports the management and monitoring relative to the measures.

Table A-3: Measures Relevant to the Water Management Plan

Measure			Corresponding Section in WMMP
Diversion of Baker Creek			
Measure 11	The Developer, with meaningful participation from the Oversight Body and other parties, will thoroughly assess options for, and the environmental impacts of, diversion of Baker Creek to a north diversion route previously considered by the Developer or another route that avoids the mine site and is determined appropriate by the Developer. Within one year of the project receiving its water licence, a report outlining a comparison of options including the current on-site realignment will be provided to the appropriate regulatory authorities, the Oversight Body and the public. Once informed by the advice of the Oversight Body and regulatory authorities, the Developer will determine and implement the preferred option. In doing so, the Developer will consider the advice of the Oversight Body, regulatory authorities, and the public, and will ensure that the primary considerations in selecting the option are to: a) Minimize the likelihood of Baker Creek flooding entering the arsenic chambers, stopes and underground workings, and b) Minimize the exposure of fish in Baker Creek to arsenic from existing contaminated sediments on the mine site, surface drainage from the mine site or tailings runoff. If off-site diversion is selected, the Developer will seek required regulatory approvals to implement the diversion within five years of receiving its initial water licence.	Final Decision Letter (AANDC 2014)	**2.4, 5.1.5**
Water Quality, Discharge, and Monitoring			
Measure 12	To prevent significant adverse impacts on Great Slave Lake from contaminated surface waters in the existing or former channel of Baker Creek, should it be rerouted to avoid the mine site, the Developer will ensure that water quality at the outlet of Baker Creek channel will meet site-specific water quality objectives based on the CCME *Guidance on the Site-Specific Application of Water Quality Guidelines in Canada.*	Final Decision Letter (AANDC 2014)	**2.4, 5.1.5, 8.0**

Table A-3: Measures Relevant to the Water Management Plan

Measure			Corresponding Section in WMMP
Measure 13	The Developer will design and, with the applicable regulators, manage the Project to ensure that, with respect to arsenic and any other contaminants of potential concern, the following water quality objectives are achieved in the vicinity of the outlet of the existing or former Baker Creek channel excluding Reach 0: a) Water quality changes due to discharge from the former channel of Baker Creek will not reduce benthic invertebrate and plankton abundance or diversity; b) Water quality changes due to discharge from the former channel of Baker Creek will not harm fish health, abundance or diversity; c) Water quality changes due to discharge from the former channel of Baker Creek will not adversely affect areas used as drinking water sources; d) Water quality changes due to discharge from the former channel of Baker Creek will not adversely affect any traditional or recreational users; and e) There is no increase in arsenic levels in Great Slave Lake due to discharge from the former channel of Baker Creek beyond the parameters described in Measure 12.	Final Decision Letter (AANDC 2014)	**2.4, 8.0**
Measure 14	The Developer will add an ion exchange process to its proposed water treatment process to produce water treatment plant effluent that at least meets Health Canada drinking water standards (containing no more than 10 µg/L of arsenic), to be released using a near shore outfall immediately offshore of the Giant mine site instead of through the proposed diffuser. The Developer will achieve this concentration without adding lake water to dilute effluent in the treatment plant.	Report of EA (MVEIRB 2013), page 152.	**5.2**

Table A-3: Measures Relevant to the Water Management Plan

Measure			Corresponding Section in WMMP
Measure 15	The Developer and regulators will design and manage the Project so that, with respect to arsenic and any other contaminants of potential concern: 1. Water quality at the outfall will meet the Health Canada Guidelines for Canadian Drinking Water Quality. 2. The following water quality objectives in the receiving environment are met: a) Water quality changes due to effluent discharge will not reduce benthic invertebrate and plankton abundance or diversity beyond 200 m of the outfall; b) Water quality changes due to effluent discharge will not harm fish health, abundance or diversity; c) Water quality changes due to effluent discharge will not adversely affect areas used as drinking water sources; d) There is no increase in arsenic levels in Yellowknife Bay water at 200 m from the outfall; and e) There is no increase in arsenic levels in Yellowknife Bay sediments at 500 m from the outfall.	Final Decision Letter (AANDC 2014)	**5.0**
Measure 16	Before construction, the Developer will model re-suspension of arsenic from sediments and resulting bioavailability in the vicinity of the outfall. If the modelling results indicate that the outfall may re-suspend arsenic from sediments, the Developer will modify the outfall design until operation does not cause re-suspension of arsenic from sediment.	Report of EA (MVEIRB 2013), page 154.	**5.0**
Measure 17	Before operating the outfall, the Developer will design and implement a comprehensive aquatic effects monitoring programme that is sufficient to determine if the water quality objectives listed in Measure 15 are being met. This programme will: 1. at a minimum, be able to identify any accumulation of arsenic over time in the water, sediment or fish in the receiving environment 2. include appropriate monitoring locations near Ndilo, in Back Bay and in Yellowknife Bay, with a focus on areas in the vicinity of the outfall and areas used by people. 3. include the establishment of a baseline for aquatic effects in Back Bay before beginning Project construction and installation of the outfall. *4.* be developed according to AANDC *Guidelines for Designing and Implementing Aquatic Effects Monitoring Programs for Development Projects in the Northwest Territories, June 2009*, with corresponding action levels and management response framework.	Report of EA (MVEIRB 2013), page 154.	**8.0**

Table A-4: Suggestions Relevant to the Water Management Plan

Suggestion			Corresponding Section in WMMP
Diversion of Baker Creek			
Suggestion 10	The Developer should investigate the potential advantages and disadvantages of adding an engineered wetland to the Project to reduce arsenic in surface drainage. This investigation should include possible locations in the channel that formerly contained Baker Creek and in the Baker Creek diversion. On completion, the Developer should make a public report of the results of this investigation and of any resulting changes to Project design. This should be completed before a water licence is issued for the Project.	Report of EA (MVEIRB 2013), page 135.	**Excluded from the Water MMP and included in a related Reclamation Research Plan in the CRP**

Developer Assessment Report Commitments

Commitments of the Developer Assessment Report (DAR) (INAC and GWNT 2010) are summarized in Table A-5 along with sections of the Water MMP where each condition is addressed.

Table A-5: Developer Assessment Report Commitments

Commitment			Corresponding Section in WMMP
Commitment 2	A detailed design for the remediation of Baker Creek will be prepared with active involvement from Aboriginal communities, Yellowknife residents, and government departments. The detailed design for the rehabilitation of Baker Creek will be based upon, among other things, flood carrying capacity, habitat creation, erosion resistance and the restoration of a natural hydrograph.	DAR Chapter 8, Table 8.4.2, Table 8.7.2	**5.1.5**
Commitment 5	Design of a new water treatment plant that will be based upon Best Available Technology for the separation of arsenic precipitates from the treated water.	DAR Chapter 6, Section 6.8.5	**5.2**
Commitment 8	Environment, Health and Safety plans for implementation of the Project will be developed, which include details regarding: • Emergency/Spill Response; • Erosion and sediment controls; • Dust management; • Building demolition; • Fuel management; • Protocols for vegetation surveys; and • Measures to respond to potential transportation incidents.	DAR Chapter 8, multiple sections.	**See plans identified in Section 1.4**
Commitment 9	Plans will be developed for the collection and management of contaminated water generated during remedial works (e.g., excavation water contaminated with arsenic or hydrocarbons).	DAR Chapter 8, Section 8.4.5	**5.0**
Commitment 25	Surface drainage (including spillways and conveyance structures) in remediated tailings areas will be designed to convey the selected PMP event. Designs will also accommodate increased surface flows associated with climate change (if any).	DAR Chapter 9, Section 9.2.3	**3.4.3**
Commitment 42	The in-stream rehabilitation of portions of Baker Creek will be carried out while the reach is dewatered whenever possible. In creek reaches where realignment is planned, remediation work can be carried out under dry conditions after creek flows have been diverted or during periods approved by DFO.	DAR Chapter 8, Table 8.4.6	**5.1.5**
Commitment 52	During extreme rainfall events, work stoppages will be implemented when remediation activities that could threaten water quality or the aquatic environment are being carried out.	DAR Chapter 9, Section 9.2.2.3	**9.0**
Commitment 65	Water draining from the tailings containment areas will be directed to the mine water collection system for treatment until such time that water quality meets the arsenic concentration discharge criterion. Direct discharge (e.g., to Baker Creek) of surface drainage that does meet the arsenic discharge criterion will not be permitted.	DAR Chapter 6, Section 6.6	**5.0**

Table A-5: Developer Assessment Report Commitments

Commitment			Corresponding Section in WMMP
Commitment 66	Monitoring wells will be installed within the sludge and tailings containment areas to permit long-term water level measurements and collection of pore water samples for analysis.	DAR Chapter 6, Section 6.6.7	**8.0**
Commitment 67	Water levels in the mine will be maintained significantly below the local static water level until such time that monitoring indicates it is suitable for release to the environment without treatment.	DAR Chapter 7, Section 7.2.3	**2.4, 5.2**
Commitment 68	The occurrence of an earthquake with a magnitude of 5.0 or greater will prompt a geotechnical inspection of the tailings covers, dams, conveyance channels and other potentially vulnerable structures.	DAR Chapter 9, Section 9.2.2.1	**9.0**
Additional Developer Commitments on the Public Record			
Commitment R1IR1	The Project Team commits to working with City of Yellowknife regarding the construction of the outfall/diffuser to avoid any periods in which the City of Yellowknife would also be constructing a new drinking water intake.	Round One: Information Request - North Slave Métis Alliance #08.	**5.2**
Commitment R1IR2	In addition, the Project Team will develop an Aquatic Effects Monitoring Program for operations at Giant Mine, utilizing INAC's 2007 "Guidelines for Designing and Implementing Aquatic Effects Monitoring Programs for Development Projects in the Northwest Territories."	Round One: Information Request – Yellowknives Dene First Nation #12	**8.0**
Commitment PR#353 p250	The Developer has committed to review best technologies for water treatment every 20 years (PR#353 p250); elements such as the WTP.	Technical Session	**2.2, 5.2**

APPENDIX B

ROLES AND RESPONSIBILITIES

Formally assigned roles and responsibilities will be provided in Table B-1 when available. At this time, these roles and responsibilities have not yet been defined. Update of this table is expected once the information becomes available, prior to commencement of remediation.

Table B-1: Roles and Responsibilities

Role	Company	Responsibility	Phone #	Email
Site Owner's Engineering Manager				
Site Owner's Project Manager				
Mine Manager				
Assistant Mine Manager				
Environmental Manager				
Security Supervisor				
Mine Technician				
Site Safety Supervisor				
Engineer of Record				

APPENDIX C

GIANT MINE ENVIRONMENT, HEALTH & SAFETY, AND COMMUNITY POLICY

Giant Mine Remediation Project

Environment, Health, Safety and Community Policy

Policy Owner: Environment, Health, Safety and Community Manager
Approval Date: February 2014

Preamble:

As committed to in the Developer's Assessment Report and during the Environmental Assessment Public Hearings, the Giant Mine Remediation Project (GMRP) will develop and implement an "Environmental Management System" that conforms with the requirements of ISO 14001 – the international Environmental Management Standard. Based on best practice in public sector operations and the mining sector, the GMRP has expanded the scope of the management system to include safety and community aspects. This policy was developed with input from engaged stakeholders and will guide the management of environment, health and safety and community aspects and issues for the duration of the project.

Purpose:

This Policy sets commitments for the management of environment, health and safety, and community (socio-economic and engagement) for the Giant Mine Remediation Project (GMRP). These commitments will guide the development and implementation of an integrated Environmental, Health, Safety and Community (EHSC) Management System that describes planning for, execution and continuous improvement of the environmental, health and safety, and community management and performance of the GMRP.

Policy Statement:

The GMRP is committed to:

- Protecting the environment and the health and safety of its employees; contractors and the general public;
- Engaging meaningfully with stakeholders;
- Delivering local social and economic benefits; and
- Being a recognized leader in EHSC management among public environmental remediation projects.
- To this end, GMRP will act in a manner that minimizes its negative impacts, maximizes its positive benefits, and continually seek ways to improve its performance.

Overall Commitments

In order to achieve these objectives, the GMRP is committed to the following:

- The GMRP will plan and execute in a manner that respects and cares for people and the environment.
- The GMRP will comply with all applicable environmental, health and safety, and community (socio-economic and engagement) regulatory, policy and other requirements.
- The GMRP will apply best management practices including best available technology and processes for environmental protection and public safety.
- The GMRP will promote a project-wide culture committed to continual improvement in environmental, health and safety, and community guided by the EHCS Management System.

Environment Commitments

- The GMRP will continually evaluate and apply ways to responsibly govern the use of its resources and reduce its negative impacts on air, water, land resources and biodiversity.
- The GMRP will minimize harmful releases of air contaminants, dust and halocarbons, and hazardous materials/dangerous goods.
- The GMRP will minimize waste.
- The GMRP will minimize disturbance or damage to heritage buildings, and Aboriginal archeological and burial sites

- The GMRP will minimize harmful water and sediment discharges.
- The GMRP will minimize disruption or damage to flora and fauna.

2 Health and Safety

The GMRP will achieve excellence in health and safety performance through a zero harm target for employees, contractors and the public.

3 Community

The GMRP will develop collaborative and mutually beneficial relationships with its stakeholders, and deliver local social and economic benefits.

- The GMRP will communicate effectively with the public regarding the nature and status of the project.
- The GMRP will meaningfully engage with stakeholders to address concerns and ensure that community land use expectations and traditional knowledge have been considered in closure planning.
- The GMRP will implement strategies to maximize the economic opportunities for Northerners and local Aboriginal people through employment and procurement.
- The GMRP will respect the rights of Aboriginal peoples.

Persons Affected:

This Policy applies to Federal and Territorial employees and contractors of the GMRP as well as visitors to the GMRP's operations. The GMRP will foster a culture that encourages safe, healthy and environmentally-responsible behaviour by clearly defining the responsibilities of all employees. Proactive employee involvement in these efforts will be encouraged.

Roles and Responsibilities:

Overall responsibility for the EHSC Policy rests with the Project Leader, Assistant Deputy Minister (ADM) Northern Affairs Program.

The Management Board exercises due diligence with respect to this Policy through regular review, discussion and endorsement of EHSC Management Systems, strategies and action plans, as well as performance, incident and audit reports.

The AANDC Giant Mine EHSC Manager is responsible for establishing and maintaining the practices, guidelines and internal controls pertaining to this Policy.

All Project Employees are required to adhere to the principles of this Policy and will actively promote its adoption by contractors, suppliers, partners and agents.

Policy Context:

This policy is intended as functional guidance at the project level. It is ultimately subservient to existing policies and authorities in place at departmental and government-wide levels.

This Policy is guided by AANDC’s CSP Contaminated Sites Management Policy (2006), Northern Contaminated Sites Program EHS Management Policy, and the Developer’s Assessment Report as well as the AANDC’s Sustainable Development Strategy.

Commitments are guided by the critical strategic planning documents for the GMRP including the Project Charter, Project Execution Plan (PEP), and Performance Measurement Strategy, which is part of the PEP.

APPENDIX D

EXISTING PROJECT ENVIRONMENT

Existing Project Environment

D1.0 ATMOSPHERIC

Background information on air quality can be found in the CRP (CIRNAC and GNWT forthcoming a).

D1.1 Climate Means

Climate data from the Yellowknife Airport meteorological station are available and climate means for the 1943 to 2017 and 2007 to 2017 time periods for Yellowknife, NWT are summarized in Table 1.1-1. The 2007 to 2017 means are used to summarize recent conditions (within the last eleven years), for comparison with the 1942 to 2017 long-term mean.

Table 1.1-1: Climate Annual Means for Yellowknife, NWT

Climate Variable	Long-Term Mean (1943–2017)	Recent Mean (2007–2017)
Air temperature (°C)	-4.8	-3.7
Total snowfall (cm)	140.5	155.2
Total rainfall (mm)	157.7	173.8
Total precipitation (mm)	270.5	283.0

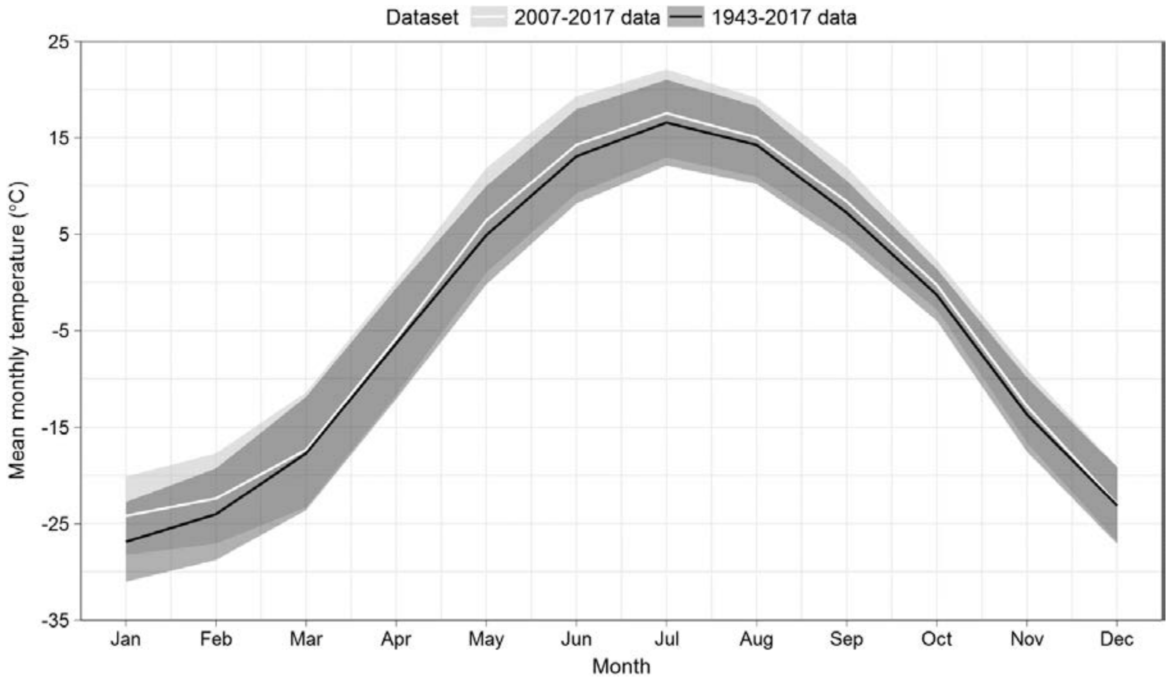
Source: ECCC 2017.

°C = degrees Celsius; cm = centimetre; mm = millimetre.

D1.2 Air Temperature

Long-term mean (1943-2017) and recent mean (2007-2017) temperatures are shown in Figure 1.2-1.

Figure 1.2-1: Yellowknife Airport Temperatures, 1943 to 2017 and 2007 to 2017 Monthly Means (Lines) and Minima and Maxima (Ribbons)

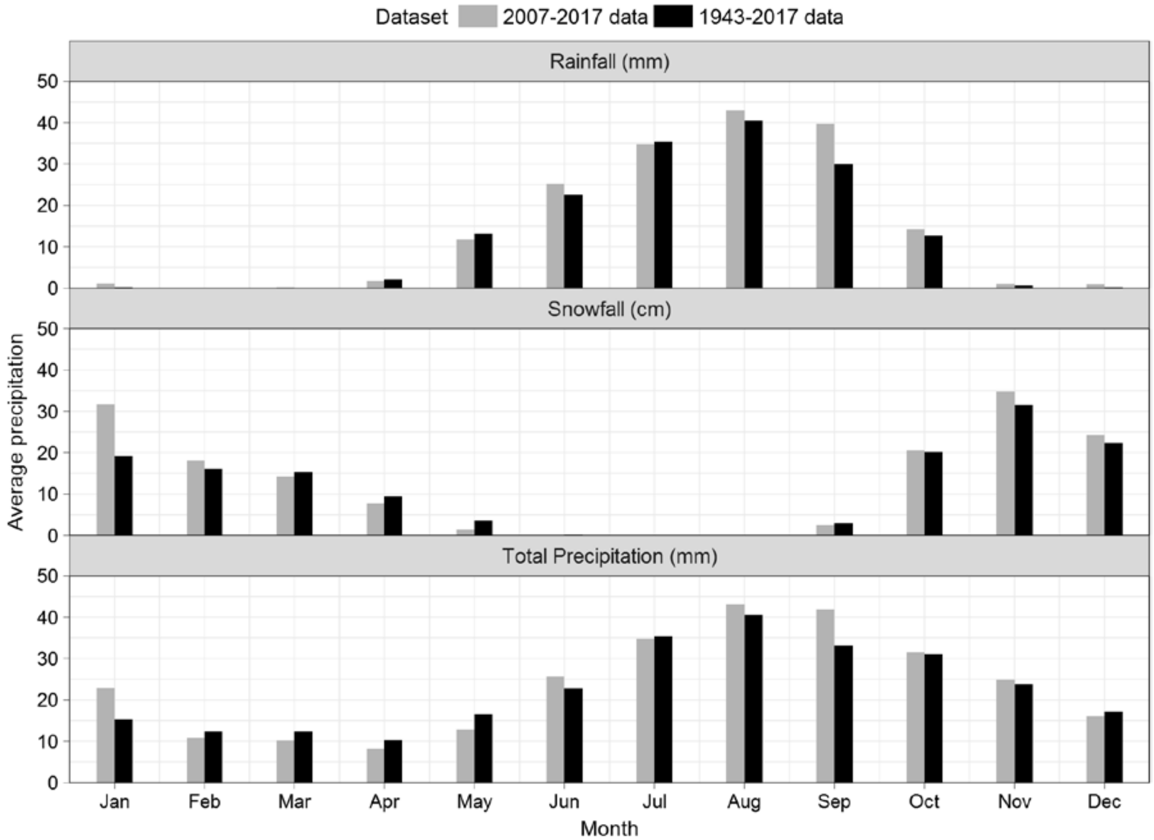


Data source: ECCC 2017
°C = degrees Celsius

D1.3 Precipitation

Monthly mean precipitation recorded at the Yellowknife Airport meteorological station is shown in Figure 1.3-1. The estimated probable maximum precipitation (PMP) for the Site, over a 24-hour period at a single point, is 328 mm.

Figure 1.3-1: Yellowknife Airport Monthly Mean Precipitation, 1943 to 2017 and 2007 to 2017



Data source: ECCC 2017
mm = millimetre; cm = centimetre

D2.0 PHYSICAL

D2.1 Hydrology

Baker Creek originates at Duckfish Lake, located approximately 25 km northwest of the Site (Wight 1973). Baker Creek flows south and southeast from Duckfish Lake, through a series of wetland ponds and bedrock outcrops and into a marsh that is separated by a breakwater from Yellowknife Bay. The drainage area of Baker Creek at the Outlet of Lower Martin Lake (Hydrometric Station 07SB013) is estimated as 121 square kilometres (km^2) (WSC 2017).

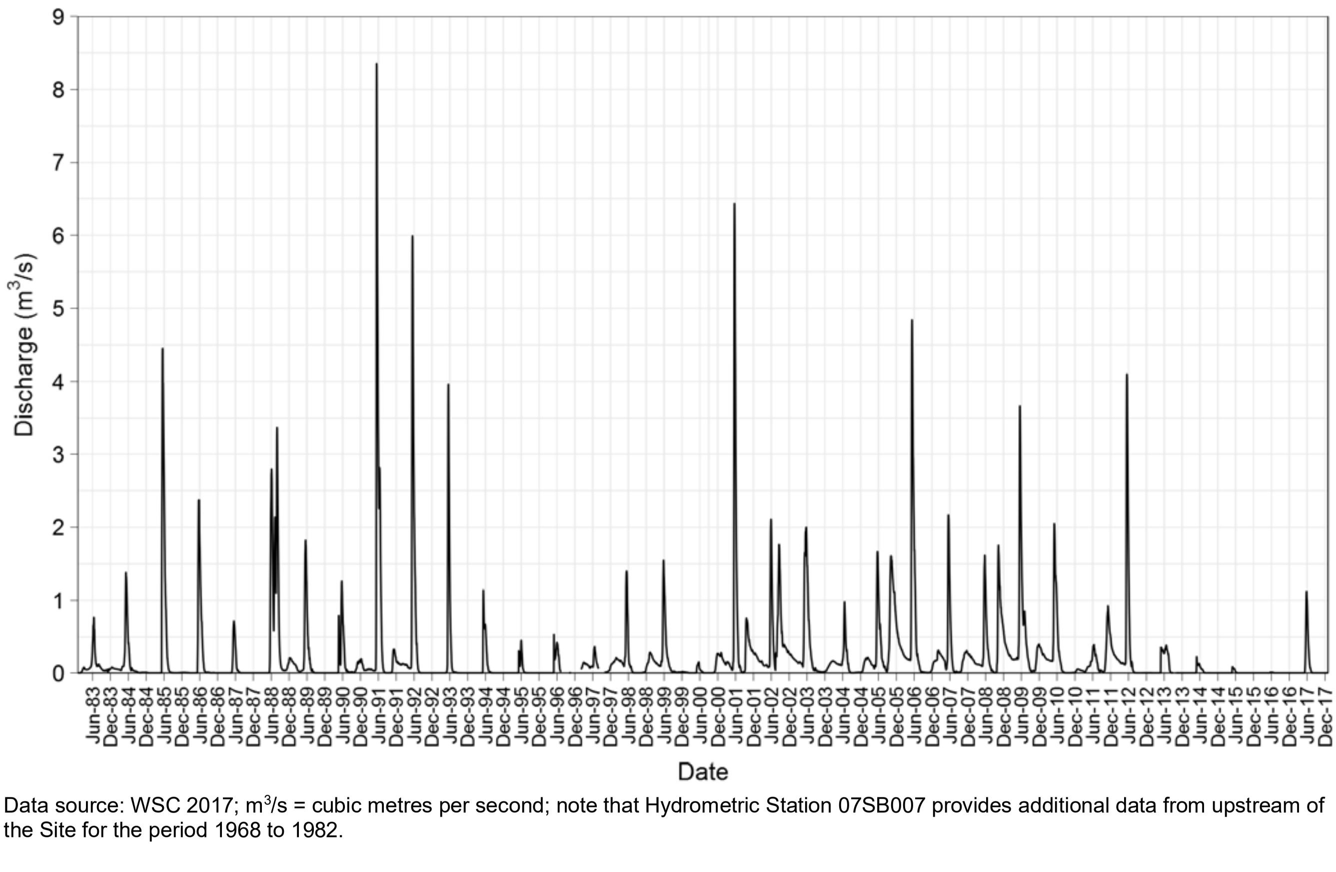
Baker Creek flows are variable throughout the year, and downstream of Lower Martin Lake it flows seasonally. In late summer, fall and winter, there are often periods with no flow within the creek above the Site and through the Site (Figure 2.1-1).

Peak discharge historically occurred during spring freshet, with 76% of the Baker Creek annual stream flow in May and June compared to 8% between October and March. Between 1983 and 2016, peak creek discharges ranged from 0.011 cubic metres per second (m^3/s) in 2016 to 8.35 m^3/s in 1991 (WSC 2017), excluding treated effluent. However, there has been a shift in the regional streamflow regime related to an increasing trend in

September rainfall and, since 1997, the proportion of annual stream flow has changed to 50% in spring and 20% in fall/winter (Kokelj et al. 2012; Spence et al. 2015).

In general, surface runoff on the Site is controlled by outcropping bedrock on the southwest and southeast side of the project boundary (Figure 5.0-1; Golder 2009). Trapper Creek and Baker Creek collect runoff and convey water flow eastward and southward through the Site. Creation of the Northwest, South, Central, and North ponds and the Settling and Polishing ponds altered the direction of natural runoff. Construction of the Northwest Pond required the relocation of Trapper Creek. Dam 11 at the South Pond has redirected the natural runoff from the pond area, which was originally towards Yellowknife Bay; water in this area is now pumped, towards the north and Baker Creek. The open pits have small individual catchment areas that direct surface water underground; this water is pumped back to surface and treated at the ETP before being discharged into Baker Creek. Details of the existing water management at the Site are provided in Section 6.0.

Figure 2.1-1: Baker Creek Hydrograph at Outlet of Lower Martin Lake (Hydrometric Station 07SB013) 1983 to 2017



Data source: WSC 2017; m^3/s = cubic metres per second; note that Hydrometric Station 07SB007 provides additional data from upstream of the Site for the period 1968 to 1982.

D2.2 Hydrogeology

Water level monitoring across the network of groundwater monitoring wells indicates that a shallow perched groundwater flow system exists across portions of the Site, where the underlying deeper bedrock has been dewatered by the underground workings. Shallow groundwater (i.e., generally 1 to 20 metres below ground surface [mbgs]) on the eastern perimeter of the Site may be flowing towards Great Slave Lake. Shallow groundwater is monitored through the groundwater program; seepage from engineered structures is captured in sumps to reduce contamination of surface water and groundwater.

The water level in the underground mine workings is presently maintained just below the 750 Level (-66.7 metres above sea level [masl]). At this level, the partially dewatered mine acts as a hydraulic sink for the adjacent area, resulting in hydraulic gradients in the deep bedrock being directed towards the underground workings. Water within the mine pool is hydraulically contained by the associated pumping necessary to maintain the water level just below the 750 Level, keeping arsenic-affected water in the underground and preventing migration away from the mine workings through groundwater flow.

The bedrock surrounding the mine has a relatively low hydraulic conductivity. As such, while the underground mine water management system collects lateral groundwater inflow, a significant portion of the collected water and associated water quality of that mine water is from infiltration from surface water ponds and creeks and from recharge from precipitation (including snowmelt).

D2.3 Permafrost

Permafrost is soil or rock that remains below 0 degrees Celsius (°C) throughout the year. Permafrost is evident in some areas at the Site. A maximum permafrost depth of 85 m was measured in the B Shaft area of the Site, in a location with 18 m of overburden (Bateman 1949), and permafrost at the Mill was reported down to 82 m (McDonald 1953). No permafrost was found in the upper levels of the B3 area that mostly consist of bedrock (Espley 1969), but it has been noted that the arsenic dust chambers that were constructed above 76 m were, at that time, located within permafrost. Evidence of ice lensing was found when re-aligning Reach 4 of Baker Creek in 2006. Permafrost was noted at the bridge abutments when replacing the UBC Bridge in 2018.

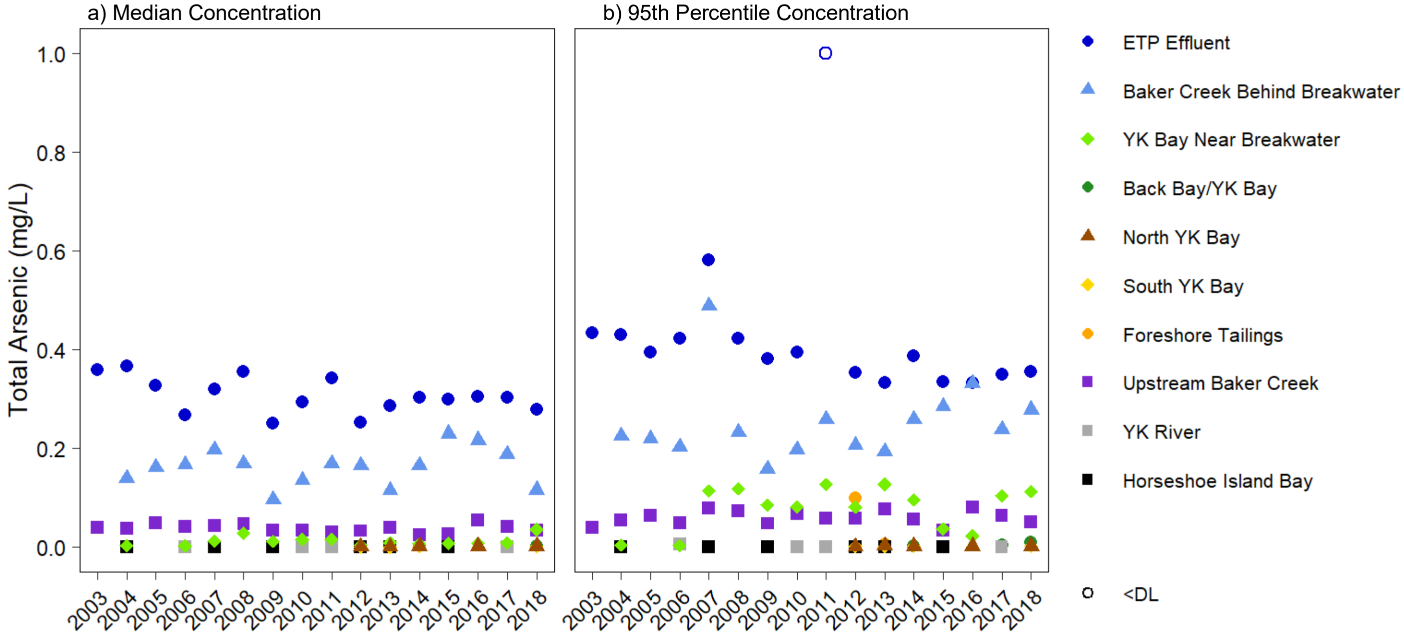
Historical observations and ground temperature measurements (SRK 2005a, 2006; INAC and GNWT 2010) show that the thermal regime that existed at the Site has been disturbed by mining activities. This included a combination of underground activities, which introduced heat, and removal of insulating layers of overburden that exposed more bedrock that acted as a heat source (INAC and GNWT 2010). Additional information on permafrost in the Yellowknife area can be found in the CRP (CIRNAC and GNWT forthcoming a)

D3.0 CHEMICAL

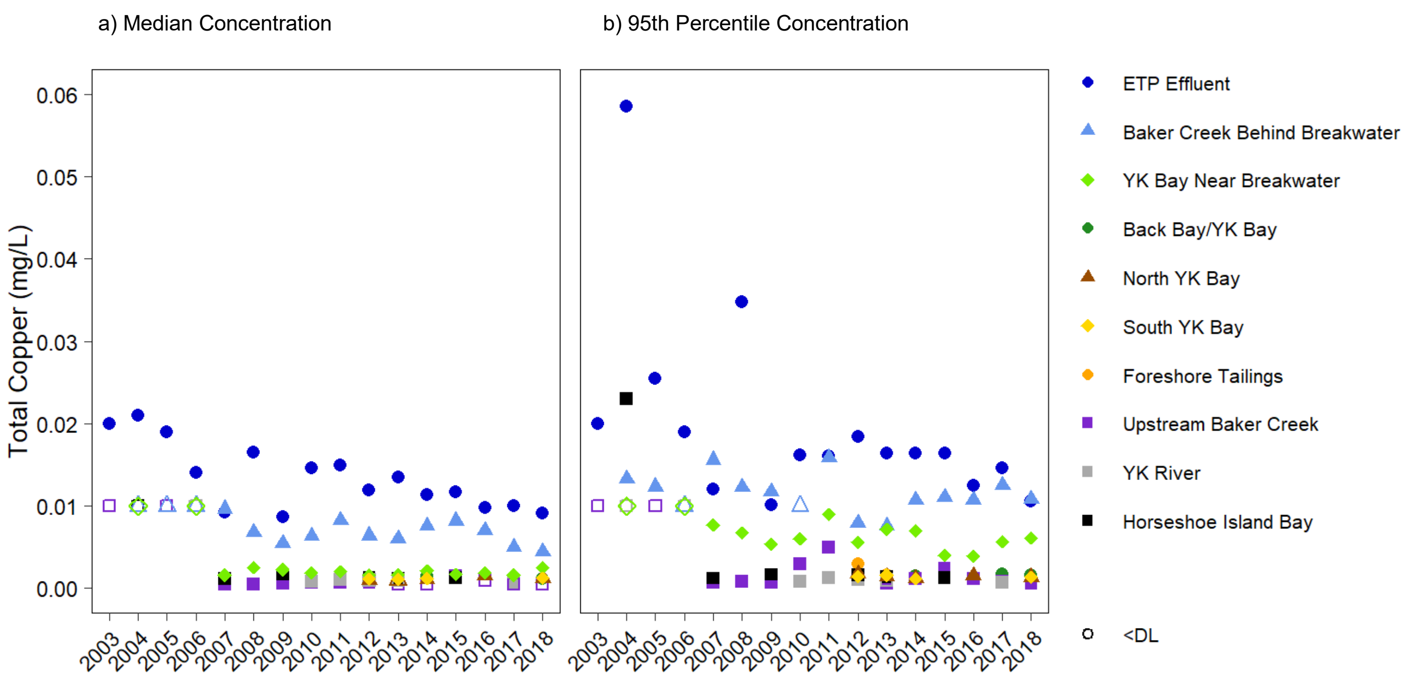
D3.1 Surface Water Quality

When effluent is discharged to Baker Creek each summer, the creek contains elevated concentrations of metals (e.g., arsenic and copper) and total dissolved solids and its constituent ions (e.g., chloride and sulphate) (Figure 3.1-1 and Figure 3.1-2). Concentrations tend to be highest near the existing ETP discharge and decrease with distance downstream (Golder 2016b).

Figure 3.1-1: Total Arsenic and Copper Concentrations, 2011 to 2017

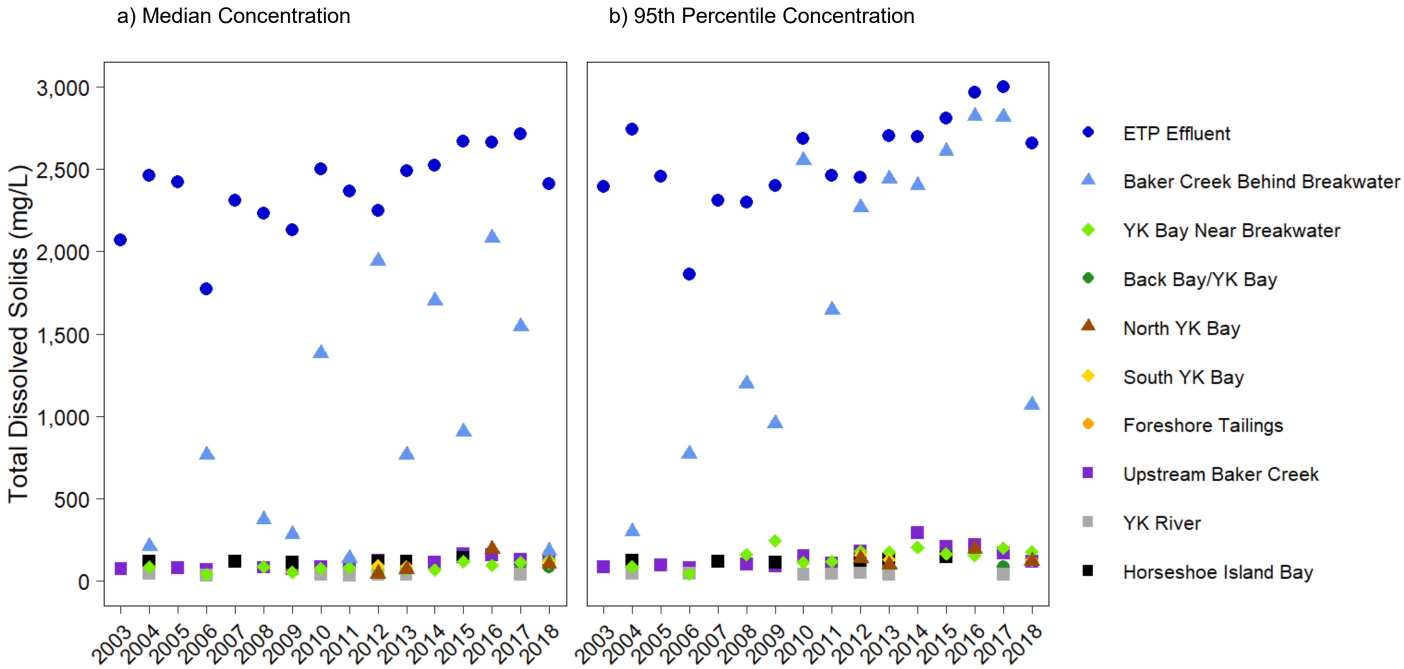


Note: Non-detectable values exist for total arsenic at higher values than are shown (e.g., at 1 mg/L).
ETP = effluent treatment plant; YK = Yellowknife; mg/L = milligrams per litre



ETP = effluent treatment plant; YK = Yellowknife; mg/L = milligrams per litre

Figure 3.1-2: Total Dissolved Solids Concentrations, 2011 to 2017



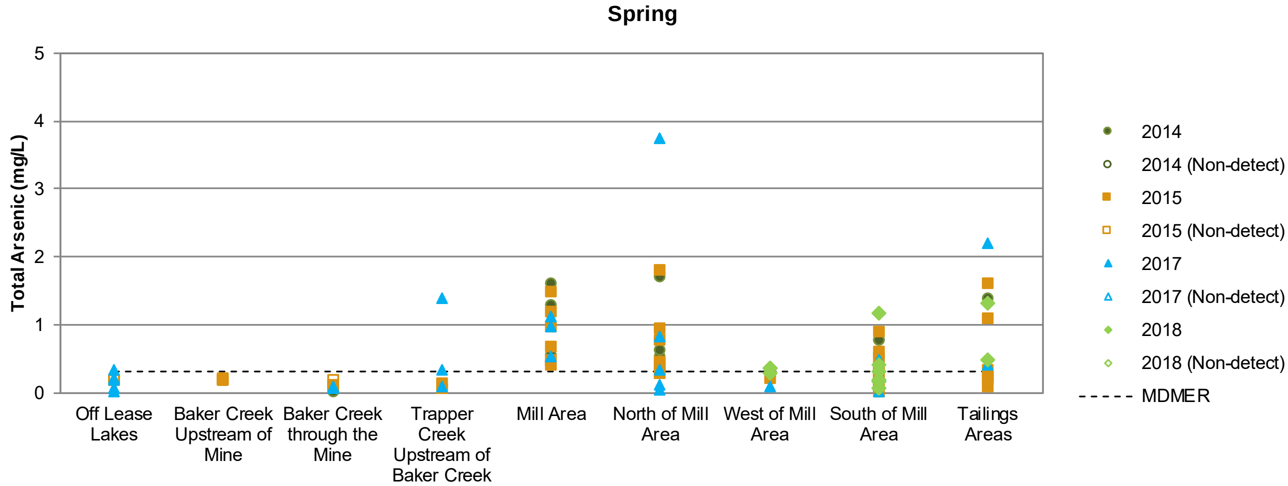
ETP = effluent treatment plant; YK = Yellowknife; mg/L = milligrams per litre

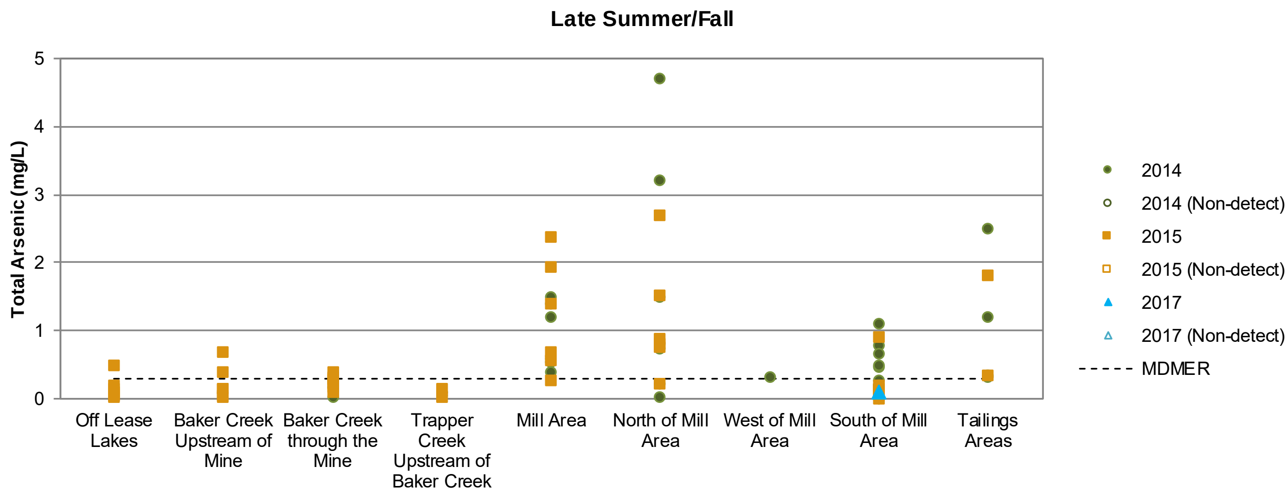
Runoff Water Quality: Much of the surface runoff is collected on Site and treated. The patterns of surface runoff water quality in recent years (2014, 2015, 2017 and 2018) are generally characterized as follows (Golder 2016d):

- runoff is generally neutral pH, moderately to well oxygenated, and highly conductive
- runoff on Site contains elevated concentrations of metals, ions, and nutrients.
- the highest concentrations of metals and ions were measured in runoff from near the Mill area

Plots for key parameters (arsenic and chloride) in runoff samples are provided in Figure 3.1-3 and Figure 3.1-4.

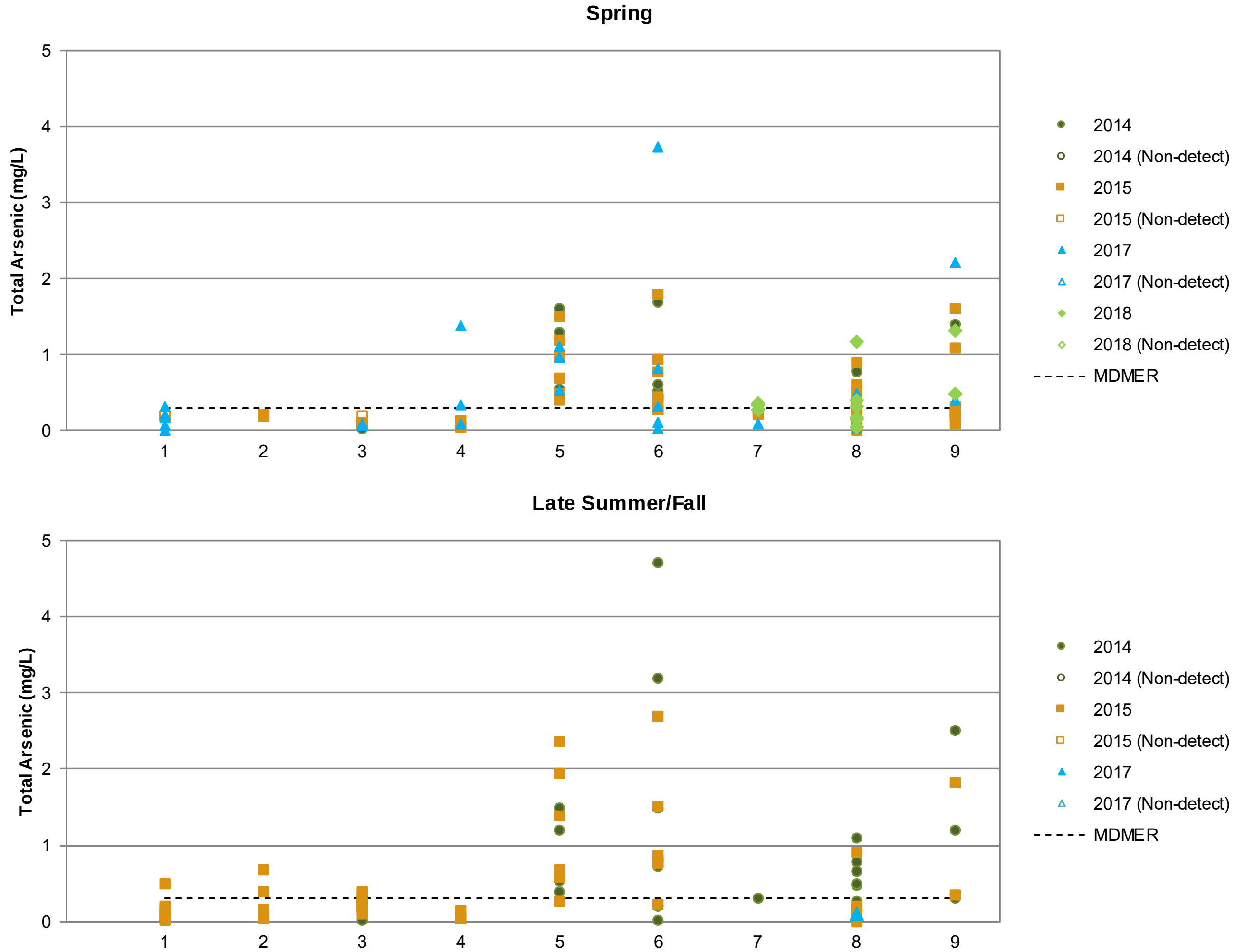
Figure 3.1-3: Concentrations of Arsenic in Surface Runoff





mg/L = milligrams per litre; MDMER = Metal and Diamond Mining Effluent Regulations

Figure 3.1-4: Concentrations of Chloride in Surface Runoff



mg/L = milligrams per litre

Seepage Water Quality: Seepage from dams is collected in sumps and pumped back to the TCAs. In general, seepage water quality is similar to minewater quality (Section 5.3.2) with elevated concentrations of metals, chloride and sulphate. In recent years, dry conditions meant seepage to the sumps was limited. Updated chemistry for the sumps is provided in the appendices to the Effluent Quality Criteria report (CIRNAC and GNWT forthcoming c). Shallow lateral infiltration includes infiltration from the Northwest Pond to Trapper Creek, from the Mill Pond to Baker Creek, and from the South Pond, the Central Pond, and the North Pond to Yellowknife Bay.

D3.2 Mine Water Quality

As water percolates from the surface downwards through the mine, it interacts with local mine components, resulting in variable concentrations of arsenic from various parts of the surface and underground mine . Monitoring has been completed in these areas to identify quantity and quality of water flowing into the underground mine. The key contact areas include:

- The mine walls and surrounding bedrock: water samples collected from boreholes and fractures at the extremities of the mine have relatively low arsenic concentrations, ranging from 0.018 to 0.063 milligrams per litre (mg/L). Interaction with the mine workings nearer to the ore zones leads to further increases in arsenic concentrations, in the range of 0.5 mg/L.
- Stopes backfilled with waste rock and tailings: seepage from stopes that are backfilled with tailings typically have arsenic concentrations ranging from 0.1 to 6.8 mg/L (with one outlier of 20 mg/L), while seepage from stopes that contain waste rock have arsenic concentrations ranging from 0.2 to 1.6 mg/L.
- Deep groundwater: groundwater is characterized by very high total dissolved salts content, and high calcium, sodium and chloride concentrations. The deep groundwater appears to contribute to the sodium/chloride released to the mine.
- Arsenic trioxide dust in sealed underground chambers: water that infiltrates into the sealed underground chambers that store the arsenic trixoide is characterized by very high arsenic and antimony concentrations, slightly acidic pH, and high magnesium, sulphate and ammonia concentrations. Arsenic concentrations in seeps close to dust-filled chambers are in the range of 4,000 mg/L. Approximately 90 to 95% of the arsenic enters the mine drainage system between C-Shaft and 1000 feet north of B-Shaft (1000 North), which is the area of the mine beneath the arsenic chambers (a negligible proportion of arsenic load originates from south of C-Shaft).
- Tailings ponds and the settling/polishing pond: Water from the tailings and polishing pond enters the mine via direct infiltration. The tailings seepage tends to have arsenic concentrations in the range of 4 to 6 mg/L, as well as elevated concentrations of sodium, chloride, ammonia and nitrate. Approximately 5 to 10% of arsenic entering the mine is from north of the arsenic dust storage areas, and can be attributed primarily to seepage from the Northwest Pond. Arsenic concentrations in the Northwest Pond water are typically around 15 mg/L, and can vary from 10 to 20 mg/L.

APPENDIX E

EXISTING COLLECTION AND CONVEYANCE INFRASTRUCTURE

A comprehensive inventory of the Site's collection and conveyance infrastructure is provided in Table E-1 (ditches, pipelines, and natural drainages), and Table E-2 (culverts), along with a description of operational status (i.e., active or inactive), intended function, and other relevant parameters, as applicable.

Table E-1: Ditches and Pipelines

ID	Infrastructure	Status	Water Type	Function
1	Pipe	Active	Contact	C1 Pit to Mill Pond
2	Pipe	Active	Contact	B1 Pit to Mill Pond
3	Pipe	Active	Contact	Mill Pond to Central Pond
4	Pipe	Active	Contact	Sump to North Pond
5	Pipe	Active	Contact	North Pond to Northwest Pond
6	Pipe	Active	Contact	Northwest Pond to Treatment Plant
7	Pipe	Active	Contact	Treatment Plant to Settling Pond
8	Pipe	Active	Contact	Settling Pond to Polishing Pond
9	Pipe	Active	Treated	Treatment Plant to Baker Creek
10	Pipe	Not Observed	Contact	Managed Watershed to Underground
11	Pipe	Active	Contact	Sump to Mill Pond
12	Pipe	Active	Contact	Sump to Northwest Pond
13	Pipe	Active	Contact	Underground to Northwest Pond
14	Pipe	Active	Contact	Underground to Northwest Pond
15	Pipe	Active	Contact	Polishing Pond to Treatment Plant
16	Pipe	Active	Contact	Sump to South Pond
17	Pipe	Active	Non-Contact	Managed Watershed to A1 Pit
18	Pipe	Active	Contact	Sump to North Pond
19	Ditch	Active	Contact	Central Pond Ditch
20	Pipe	Active	Contact	Central Pond to North Pond
21	Pipe	Active	Contact	South Pond to Central Pond
22	Pipe	Active	Contact	Managed Watershed to Mill Pond
23	Ditch	Active	Non Contact	Managed Watershed to A1 Pit
24	Pipe	Active	Non Contact	Overland Drainage to Baker Creek
25	Pipe	Active	Contact	Internal Mill Pond Transfer
26	Pipe	Active	Contact	Lower Sump to Upper Sump
27	Pipe	Active	Contact	Upper Sump to Mill Pond
28	Pipe	Active	Contact	Settling Pond to Polishing Pond
29	Natural Drainage	Not Active	Non-Contact	Local Infiltration
30	Natural Drainage	Active	Non-Contact	Drainage to Baker Creek
31	Natural Drainage	Active	Non-Contact	Drainage to Baker Creek
32	Pipe	Active	Non-Contact	Discharge to Baker Creek
33	Pipe	Active	Non-Contact	Discharge to Baker Creek
34	Ditch	Active	Non-Contact	Discharge to Baker Creek
35	Pipe	Not Active	Non-Contact	Overland Drainage to A1 Pit
36	Natural Drainage	Active	Non-Contact	Discharge to Baker Creek
37	Ditch	Active	Non-Contact	Overland Drainage to A1 Pit
38	Ditch	Active	Non-Contact	Overland Drainage to A1 Pit
39	Ditch	Active	Non-Contact	Overland Drainage to A1 Pit
40	Ditch	Active	Non-Contact	Overland Drainage to A1 Pit

Table E-1: Ditches and Pipelines

ID	Infrastructure	Status	Water Type	Function
41	Ditch	Active	Non-Contact	Overland Drainage to A1 Pit
42	Ditch	Active	Non-Contact	Overland Drainage to A1 Pit
43	Ditch	Active	Non-Contact	Overland Drainage to A1 Pit
44	Ditch	Not Active	Non-Contact	Discharge to Baker Creek
45	Ditch	Not Active	Non-Contact	Overland Drainage to Baker Creek
46	Ditch	Not Active	Non-Contact	Discharge to Baker Creek
47	Natural Drainage	Active	Non-Contact	Discharge to Baker Creek
48	Ditch	Not Active	Non-Contact	Discharge to Baker Creek
49	Ditch	Not Active	Non-Contact	Local Infiltration
50	Ditch	Active	Non-Contact	Discharge to Baker Creek
51	Natural Drainage	Active	Non-Contact	Overland Drainage to Mill Pond
52	Natural Drainage	Active	Non-Contact	Discharge to Baker Creek
53	Ditch	Active	Non-Contact	Overland Drainage to Mill Pond
54	Natural Drainage	Active	Contact	Overland Drainage to Sump
55	Ditch	Active	Contact	Managed Watershed to Sump

Table E-2: Culverts

ID	Diameter (mm)	Material	Flow Type	Status	Runoff Type	Function
C1	380	HDPE	Pumped	Active	Contact	Pipe - Sump to NW Pond
C2	380	HDPE	Pumped	Active	Contact	Pipe - Sump to NW Pond
C3	380	None	No Flow	Inactive	Contact	None
C4	380	None	Infiltration	Inactive	Contact	None
C5	600	Metal	Gravity	Active	Non-Contact	Trapper Creek drainage
C6	900	Metal	Pumped	Active	Contact	Pipe - Transfer between N and NW ponds
C7	900	Metal	Pumped	Active	Contact	Pipe - Transfer between N and NW ponds
C8	900	Metal	Pumped	Active	Contact	Polishing Pond to Treatment Plant
C9	900	Metal	No Flow	Inactive	None	None
C10	900	Metal	Pumped	Active	Contact	Pipe - Treatment Plant to NW Pond
C11	900	HDPE	Pumped	Active	Contact	Pipe - N Pond to Treatment Plant
C12	N/A	--	Gravity	--	None	None
C13	3000	Metal	Gravity	Active	Contact	C1 Pit to Mill Pond
C14	3500	Metal	No Flow (blocked)	Active	Contact	Managed Watershed to Mill Pond
C15	240	HDPE	Gravity	Active	Contact	Managed Watershed to Mill Pond
C16	N/A	None	Infiltration	Inactive	None	None
C17	N/A	None	Pumped	Active	Contact	Mill Pond to Central Pond
C18	N/A	None	Pumped	Active	Contact	Mill Pond to Central Pond
C19	1200	Metal	Gravity	Active	Non-Contact	Trapper Creek drainage
C20	900	Metal	Gravity	Active	Non-Contact	Trapper Creek drainage
C21	N/A	None	No Flow	Inactive	None	None
C22	N/A	None	No Flow	Inactive	None	None
C23	900	Metal	Pumped	Active	Contact	Polishing Pond to Baker Creek
C24	900	Metal	Pumped	Active	Contact	Polishing Pond to Baker Creek
C25	N/A	--	Gravity	--	None	None

Table E-2: Culverts

ID	Diameter (mm)	Material	Flow Type	Status	Runoff Type	Function
C26	350	Metal	Gravity	Active	Non-Contact	Overland Drainage to Baker Creek
C27	1200	Metal	Gravity	Active	Non-Contact	Overland Drainage to Baker Creek
C28	600	Metal	Gravity	Active	Non-Contact	Overland Drainage to Baker Creek
C29	600	Metal	Gravity	Active	Non-Contact	Local Tributary Crossing
C30	3100	Metal	Gravity	Active	Non-Contact	Baker Creek Crossing
C31	600	Metal	Gravity	Active	Non-Contact	Local Tributary Crossing
C32	220	HDPE	Gravity	Active	Non-Contact	Local Tributary Crossing
C33	600	Metal	Gravity	Active	Non-Contact	Local Tributary Crossing
C34	N/A	Metal	Gravity	Active	Non-Contact	Baker Creek Crossing
C35	N/A	Metal	No Flow	Inactive	None	None
C36	N/A	Metal	No Flow	Inactive	None	None
C37	N/A	None	No Flow	Inactive	None	None
C38	600	Metal	Gravity	Active	Non-Contact	Trapper Creek drainage
C39	800	Metal	Gravity	Active	Non-Contact	Trapper Creek drainage
C40	600	Metal	Gravity	Active	Non-Contact	Trapper Creek drainage
C41	N/A	None	Pumped	Active	Contact	Pipe - Transfer between N and NW ponds
C42	N/A	None	Infiltration	Inactive	None	None
C43	900	Metal	No Flow (blocked)	Inactive	None	None
C44	900	Metal	No Flow (blocked)	Inactive	None	None
C45	N/A	None	Infiltration	Inactive	None	None
C46	600	Metal	Gravity	Active	Non-Contact	Overland Drainage to Baker Creek
C47	900	Metal	Gravity	Active	Non-Contact	Overland Drainage to Baker Creek
C48	800	Metal	Gravity	Active	Non-Contact	Trapper Creek drainage
C49	2500	Metal	Gravity	Active	Non-Contact	Trapper Creek drainage
C50	N/A	HDPE	Pumped	Active	Contact	Pipe - Underground to NW pond

APPENDIX F

CONCEPTUAL FLOW DIAGRAMS

Conceptual flow diagrams representative of the existing condition phase (i.e., Phase 1), active remediation / adaptive management phase (i.e., Phase 2) are presented below. These diagrams will be continuously updated in this Water MMP to reflect water management activities based on the most current information available.

Figure F-1: Existing Conditions (2011 to 2020)

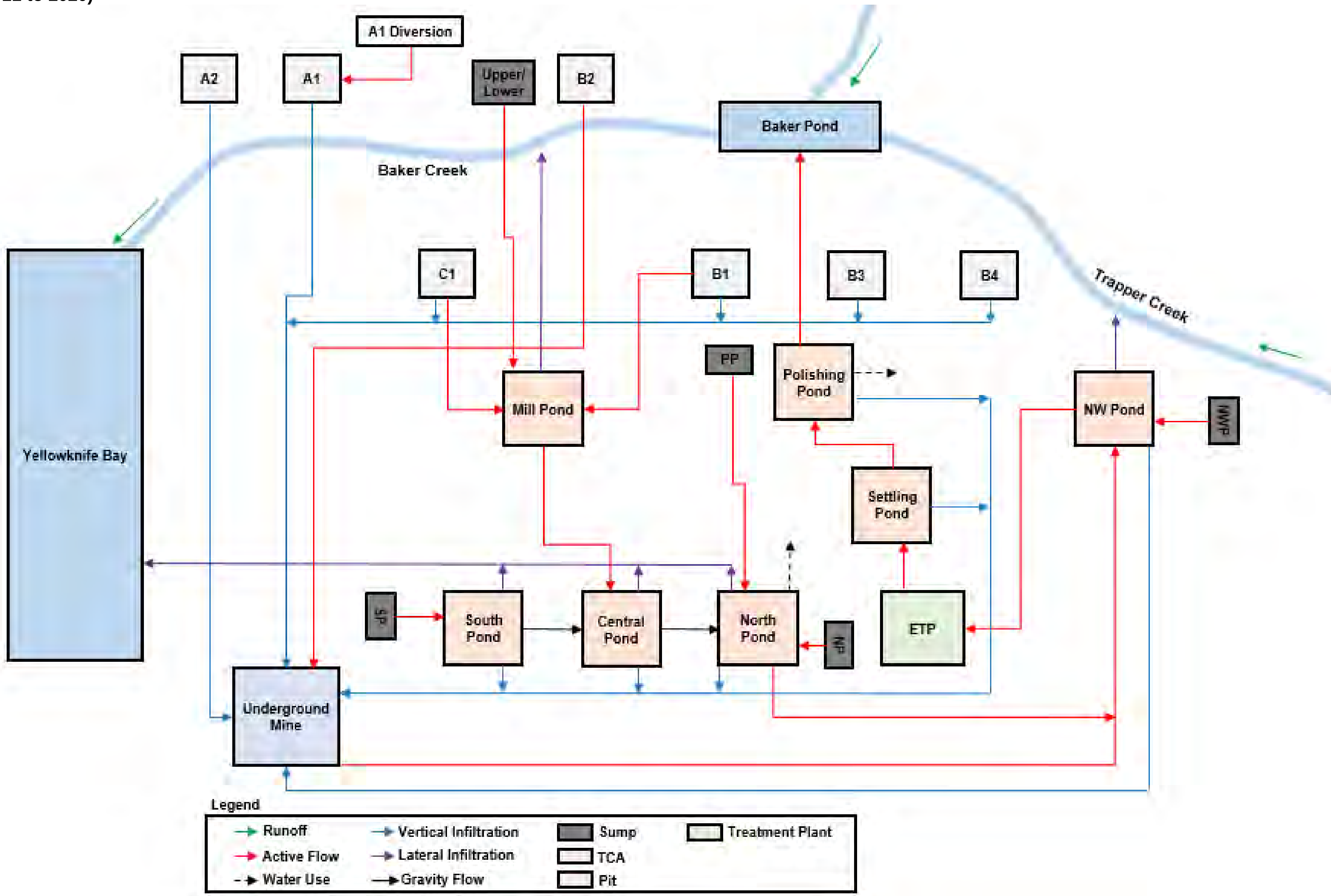


Figure F-2: Active Remediation (2021 to 2023)

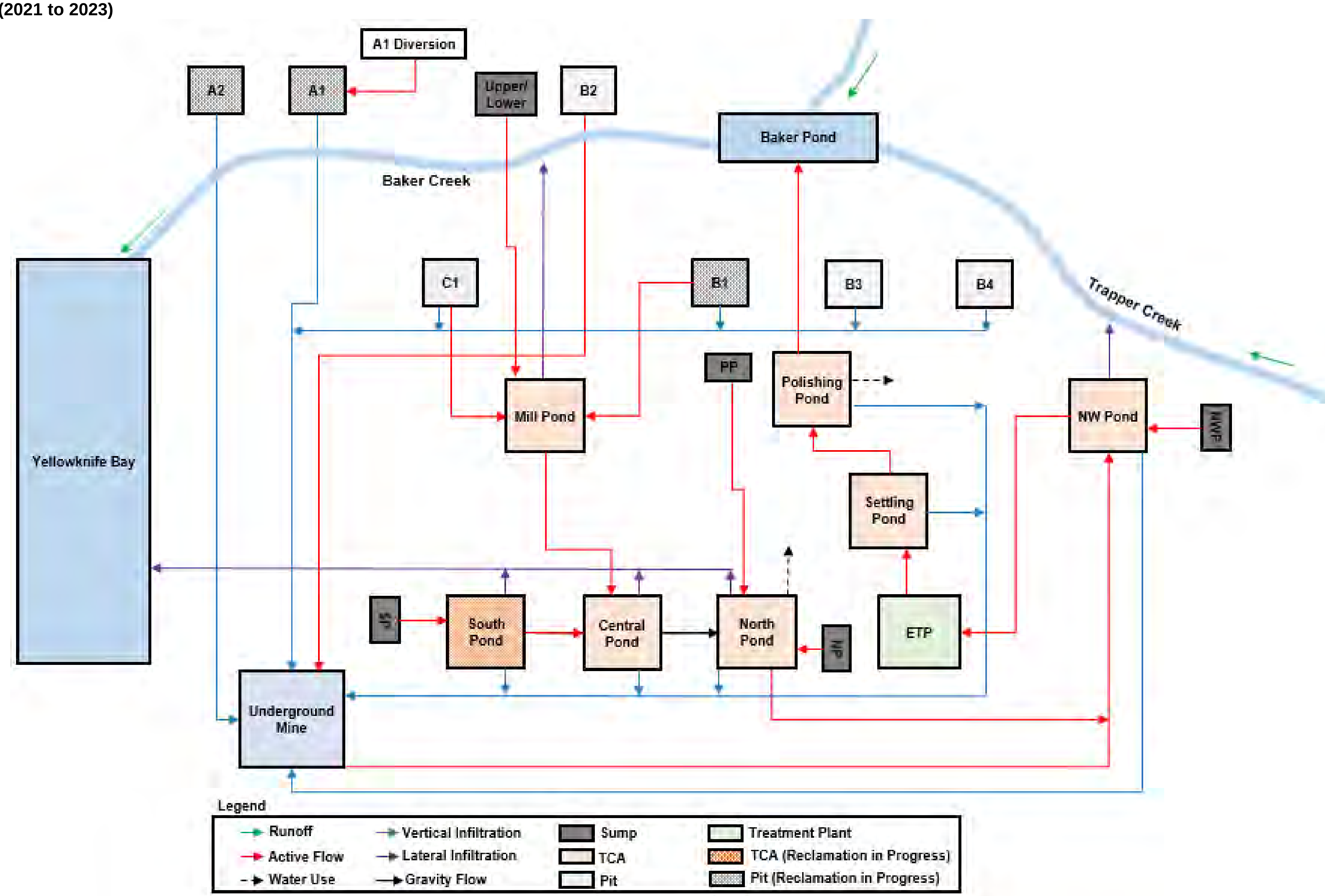


Figure F-3: **Active Remediation (2024 to 2025)**

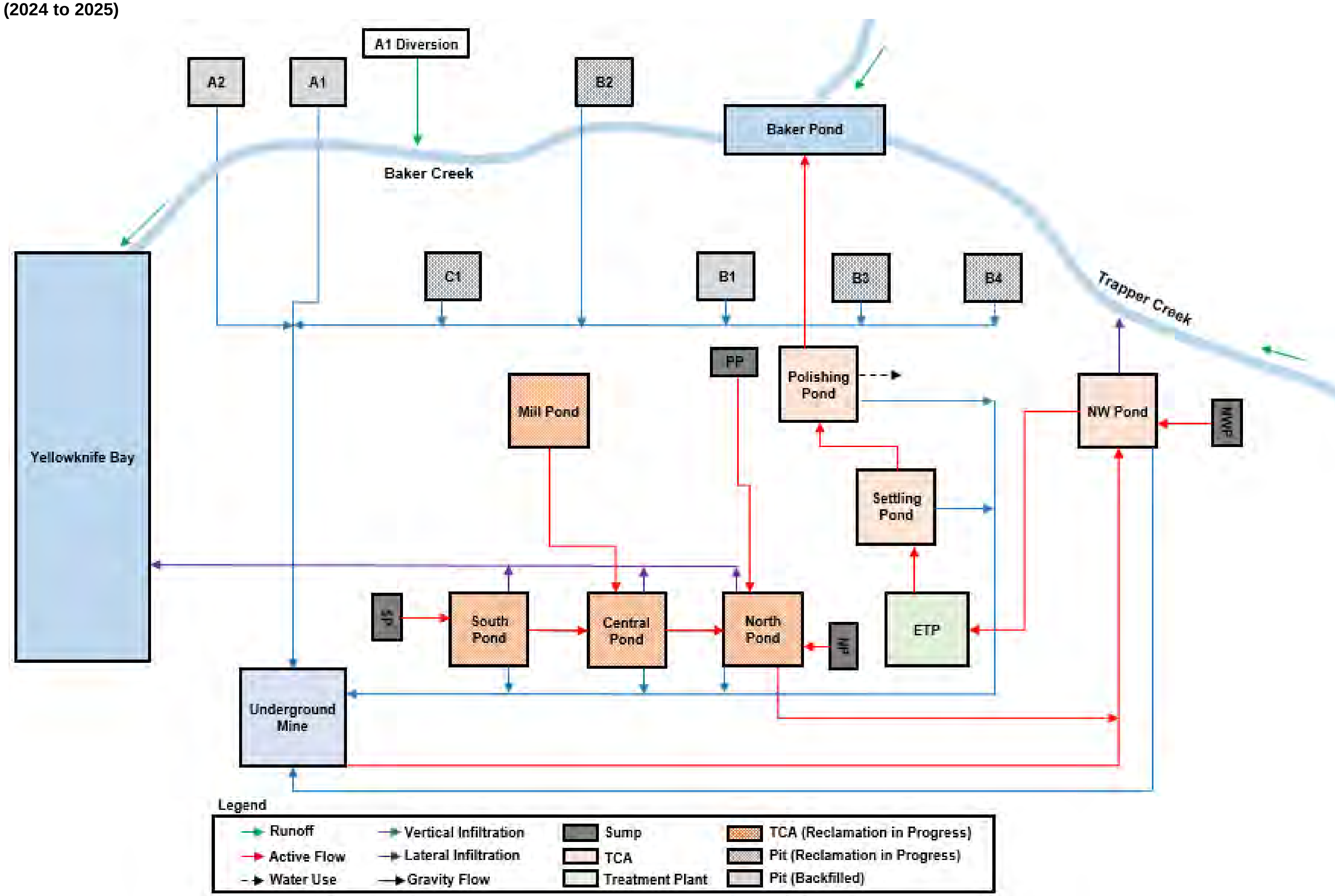


Figure F-4: Active Remediation (Early 2026)

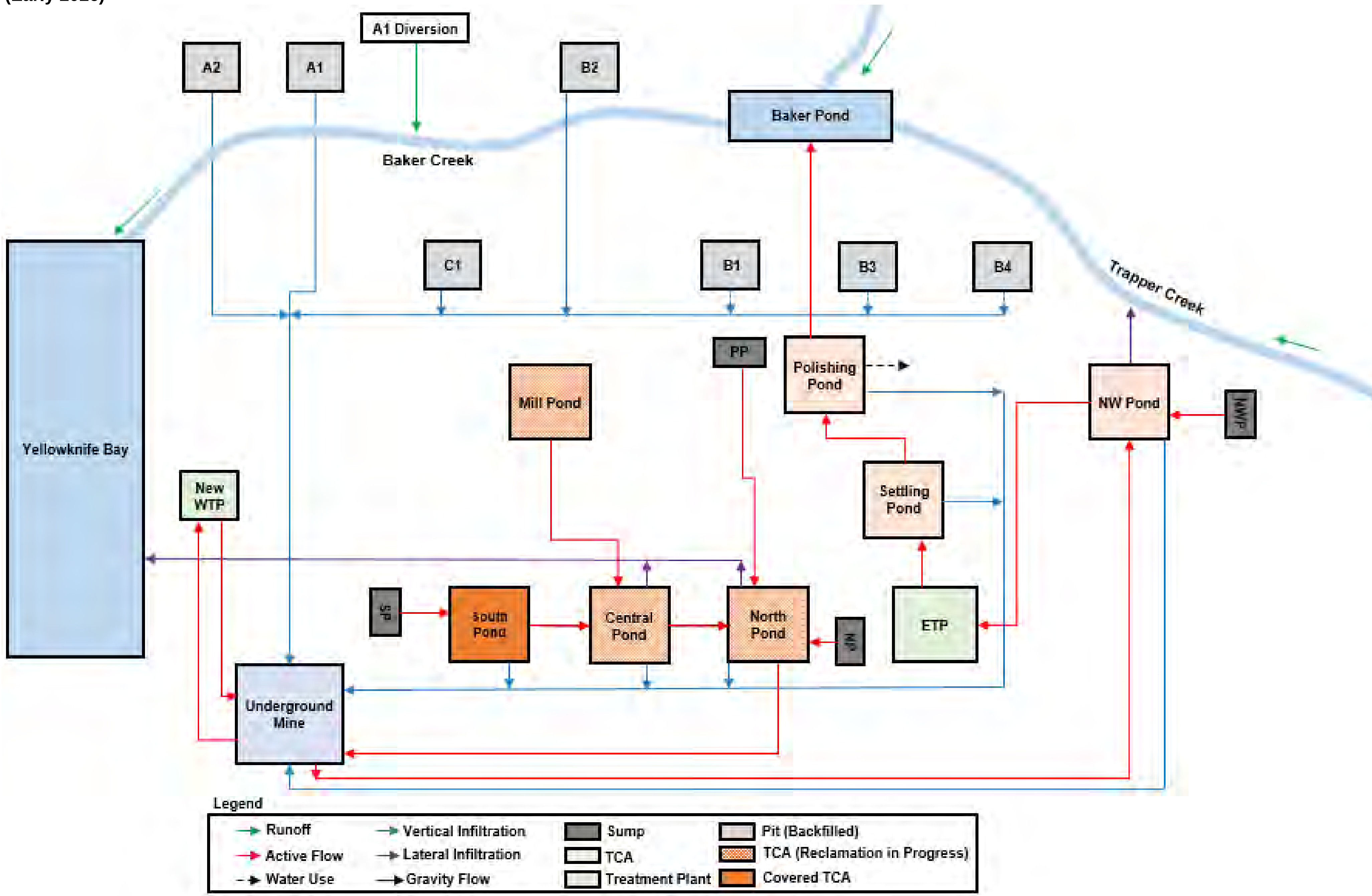


Figure F-5: Active Remediation (Late 2026)

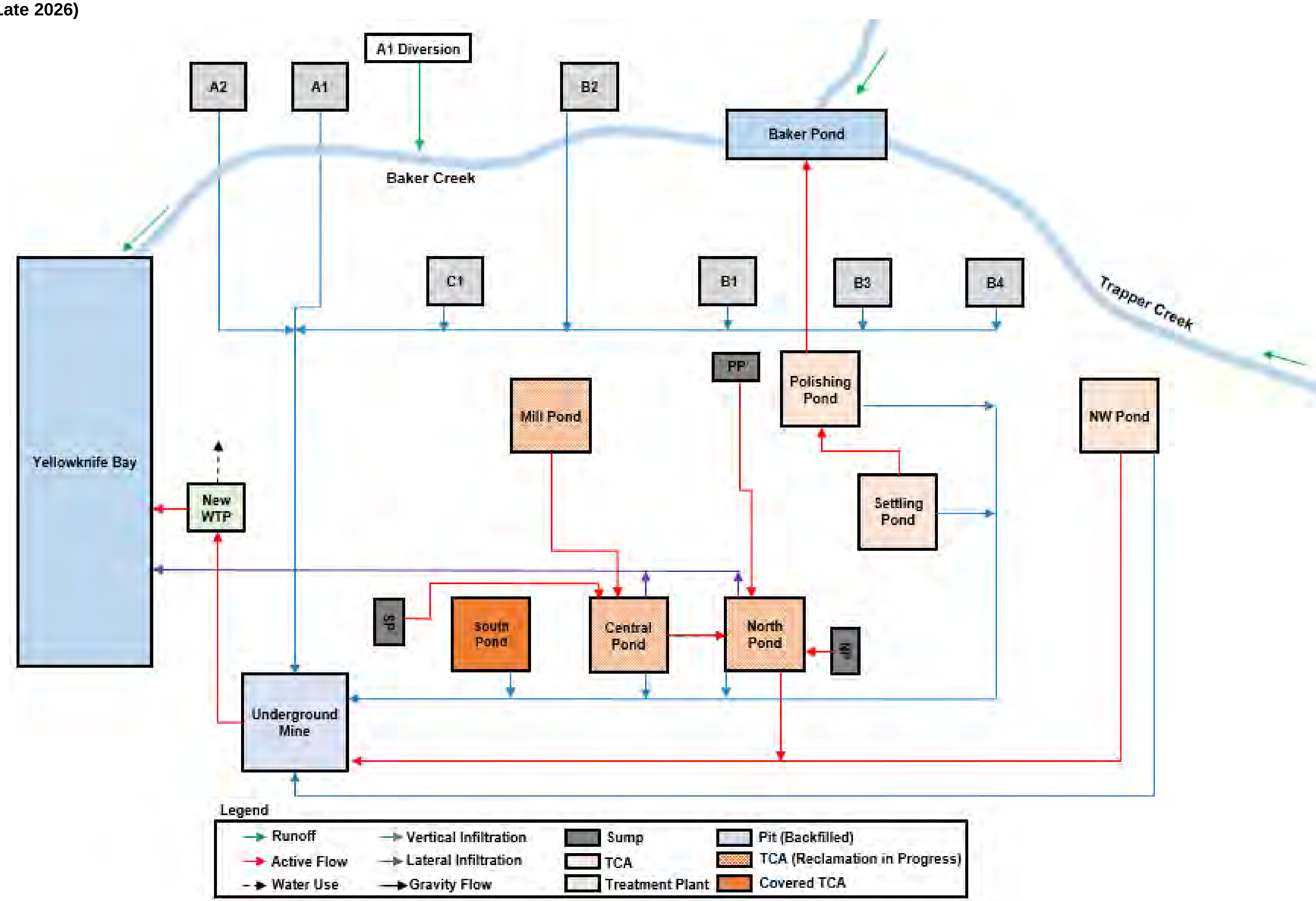


Figure F-6: Active Remediation (2027)

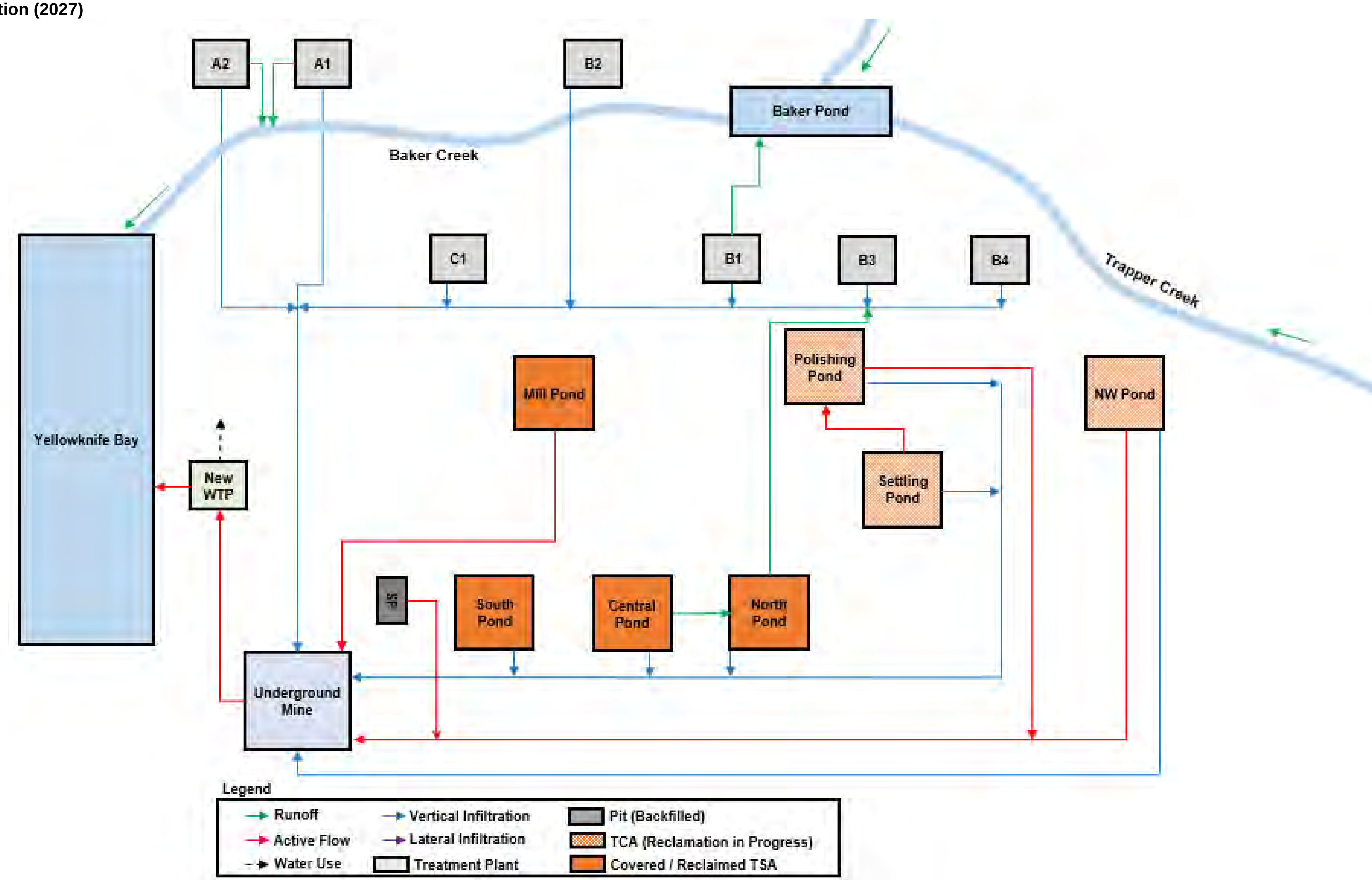


Figure F-7: Active Remediation (2028)

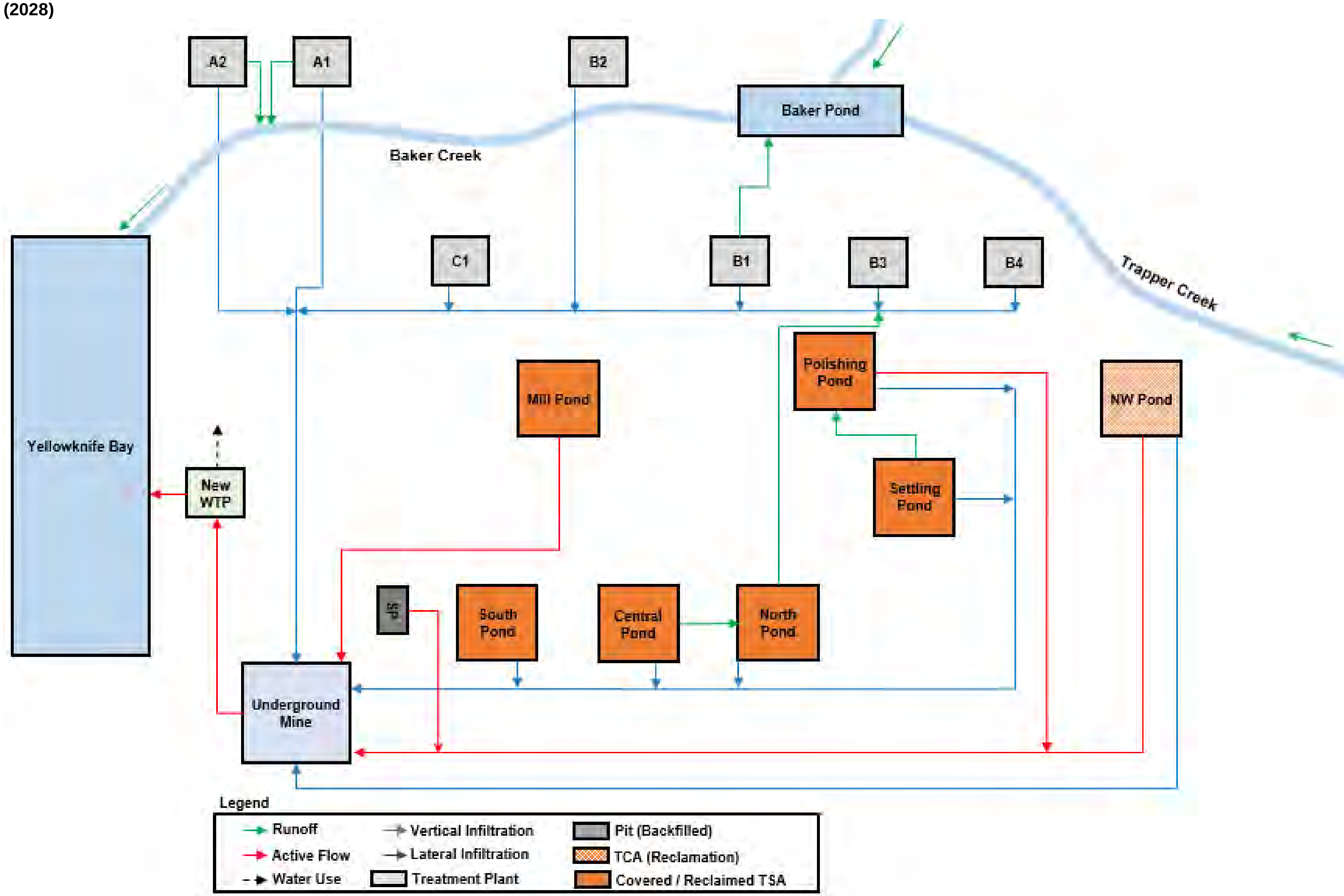


Figure F-8: Active Remediation (2029)

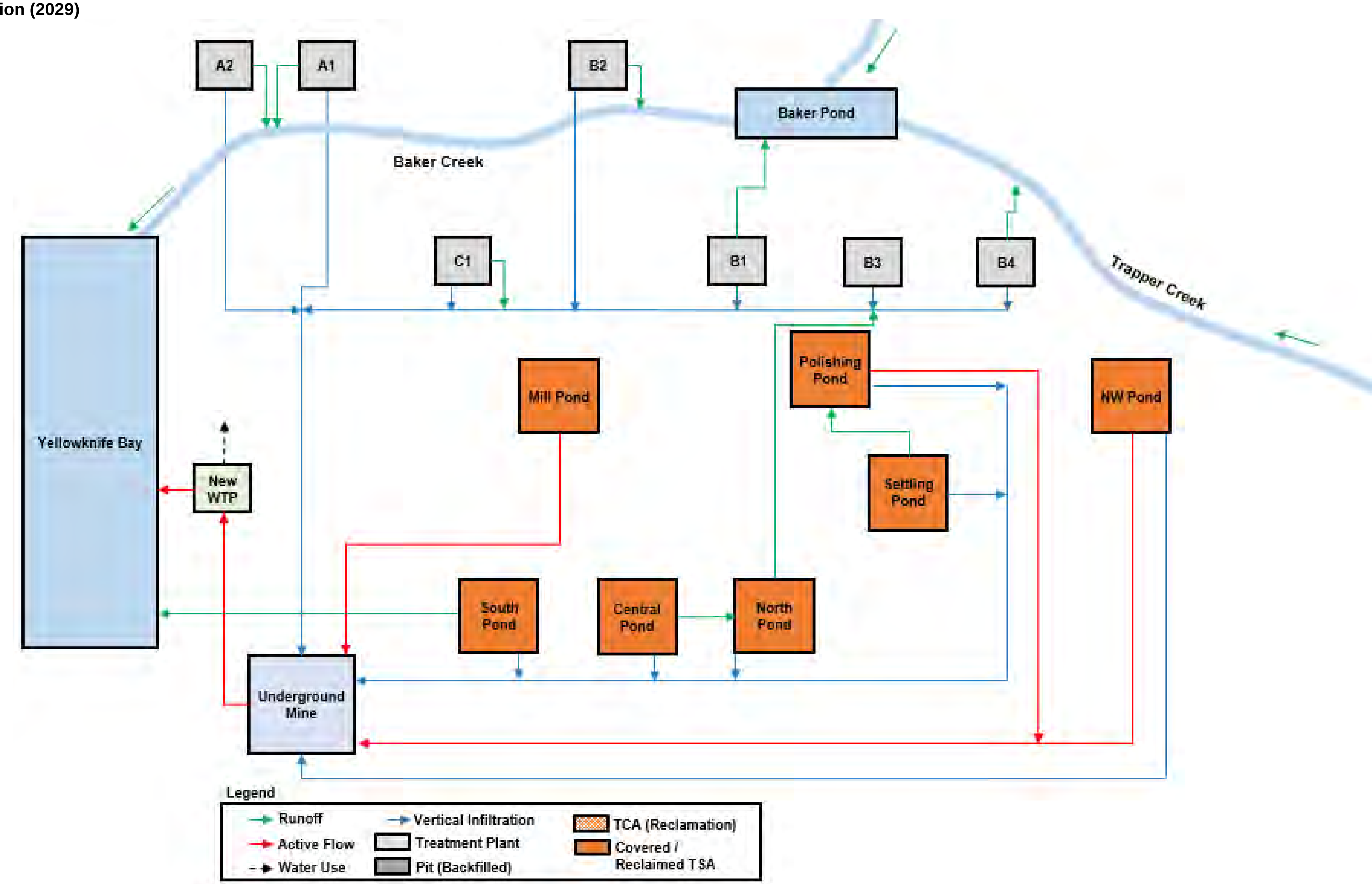


Figure F-9: Active Remediation (2030)

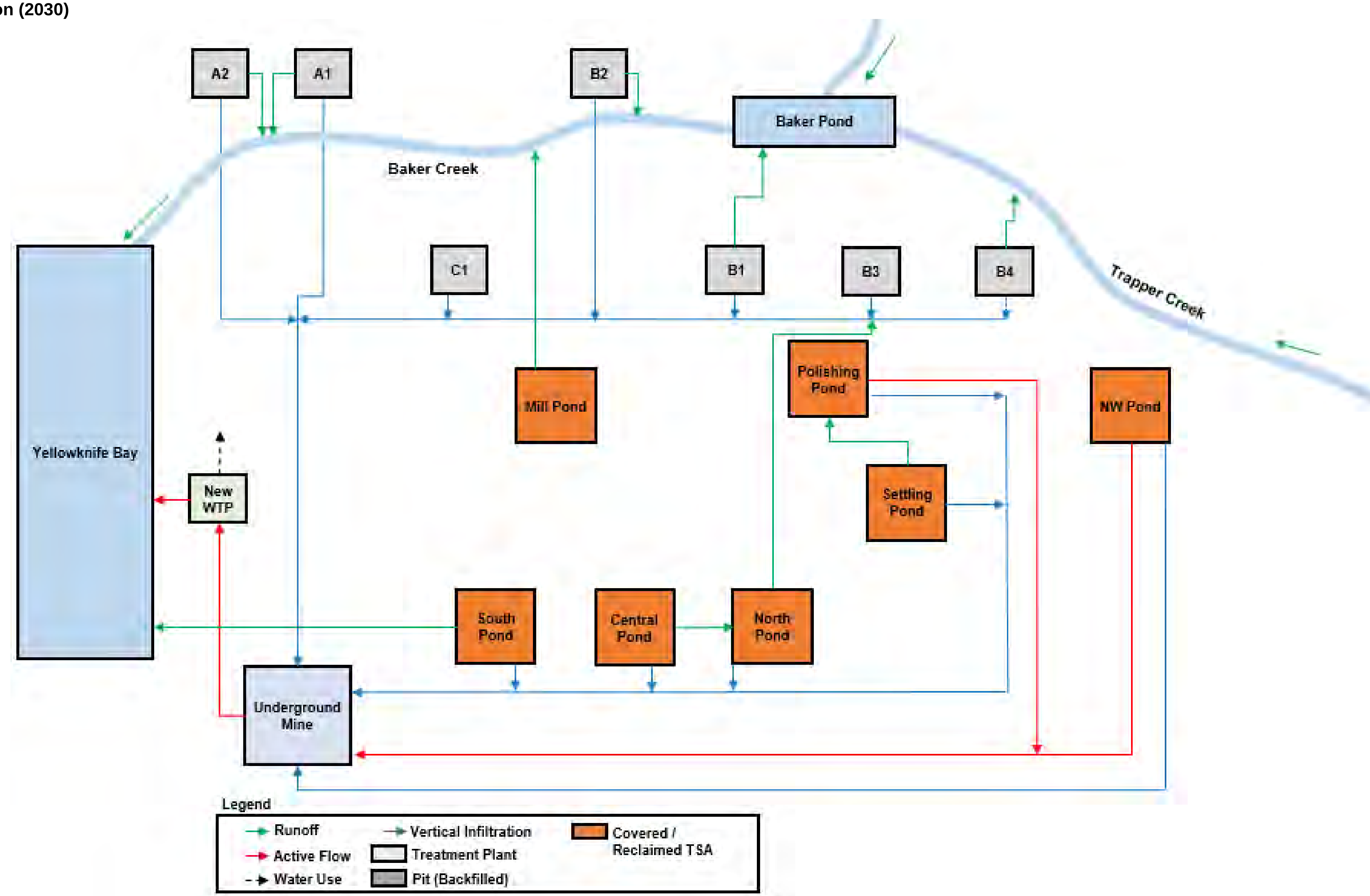


Figure F-10: Active Remediation (2031 to 2032)

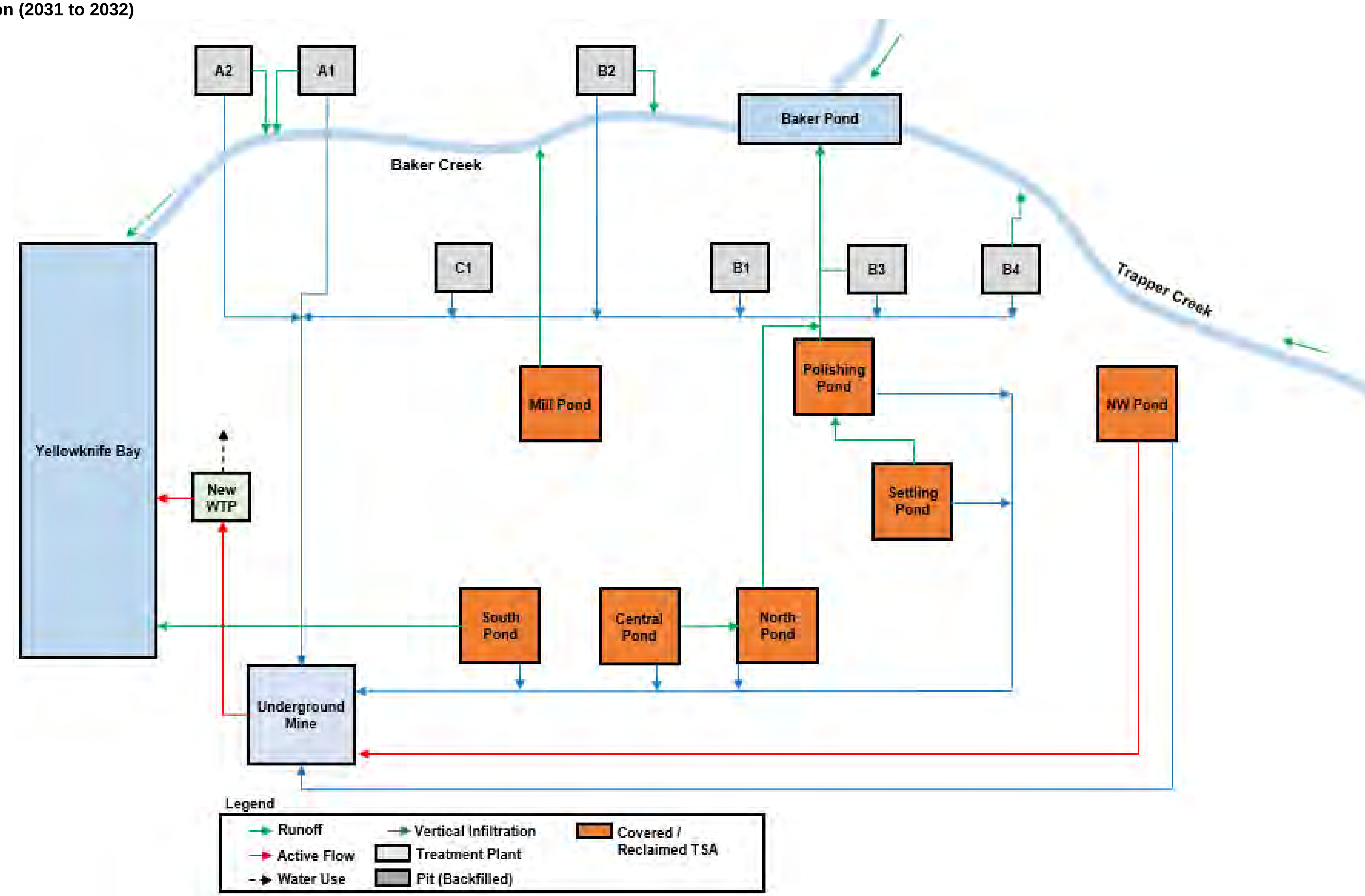
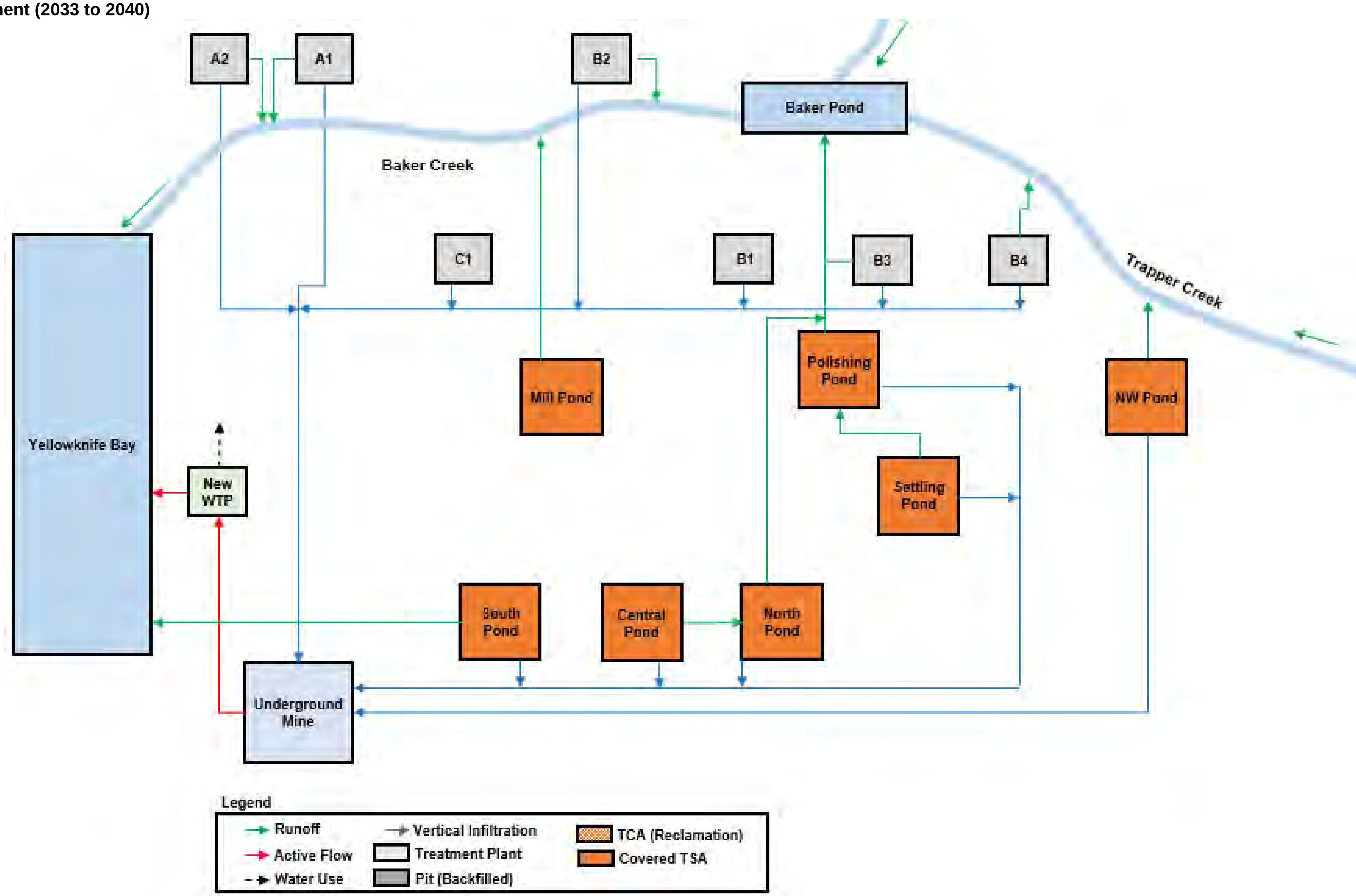


Figure F-11: Adaptive Management (2033 to 2040)



APPENDIX G

CONTINGENCIES

Risk Statement	Relevant Phases	Mitigations/Monitoring	Initiatiation Point of Contingency	Contingency/Response	Link to Other Plans
Physical disturbance of calcine (man made or natural) leads to As contribution to Baker Creek	1-3	•Till cover over calcine •Regular inspections of calcine pond	•visual inspections indicate degradation of the cover or visible deposition in the creek	•Secure calcine pond cover • Contain the flow by dyking with earth or other barriers, construction of an interceptor trench or underflow dam, etc., and use materials found in the spill containment kits located onsite • monitor and assess extent of contamination in Baker Creek	Erosion
Fire due to arson/accident in asbestos or other contaminated areas leads to contamination of Baker Creek	1-3	• Site security	•Detection of fire	• Initiate Fire Management Plan • Contain the flow by dyking with earth or other barriers, construction of an interceptor trench or underflow dam, etc., and use materials found in the spill containment kits located onsite • monitor and assess extent of contamination in Baker Creek	Waste
flooding overtops dykes at C1 or B1 pits, leads to partial flooding of mine	1-3	• regular, visual inspections of Baker Creek and curlverts • regular review of upstream flow gauge (operated by Environment Canada)	•Monitoring shows water level approaching top of dykes, culverts or signs of overflow (aufeis) •review of upstream flow gauge indicates flows over 100-year event and increasing	•Initiate Emergency Response Plan • prepare , build up tempoary dykes as necessary, divert flow away from pits • initiate supercrest or other back-up pumps and opearte ETP at maximum treatment capacity	OMS
Control room fire due to electrical short/arson leads to ETP plant shut down	1-3	• Part of site security rounds • ETP is staffed 24-7 • Fire extinguishers in place • SOP for manually operating plant	•Detection of fire	•Initiate Fire Management Plan •After fire is extinguished, initiate manual operation of plant if possible •Repair control room to restore function store water underground and in Northwest Pond	-
Sustained arsenic loading exceeds plant capacity to the point of releasing non-compliant water	1-3	• Adequate mine-water storage capacity on site (e.g. underground, northwest pond) • use of both treatment trains at ETP	•Monitoring indicatespotential to release non-compliant water	•Return water to mine pool or NWP for re-treatment •store water underground or in NWP until performance has improved	-

Risk Statement	Relevant Phases	Mitigations/Monitoring	Initiatiation Point of Contingency	Contingency/Response	Link to Other Plans
Failure of ETP infrastructure leads to inability to treat water, requiring emergency expenditure and possible release of untreated water into the environment	1-2	•Inventory of spare parts on hand and operating elements all upgraded. •New tanks in Train A, Train B (old) as spare tank •review of status of equipment prior to start-up, replace or order back up parts as required	•Monitoring of infrastructure indicates potential failure	•Use secondary treatment line until repairs can be made •Shut down underground pumps to stop minewater flow •If untreated water is released, initiate Emergency Spill Response Plan •Block entry to waterways - construct interceptor trench or direct flow towards a low area or construct berm • Contain the flow by dyking with earth or other barriers, construction of an interceptor trench or underflow dam, etc., and use materials found in the spill containment kits located onsite • monitor and assess extent of contamination in Baker Creek	Spills
Failure of water line due to any cause or breakage leads to release of untreated water to the highway and/or mine site in area of ETP.	1-2	•C&M Contractor inspects line regularly during shifts. Pumps and flows are metred	•Inspections indicate immenent failure or breakage is detected	•Initiate Emergency Spill Response Plan •Shut down underground pumps to stop minewater flow •Block entry to waterways - construct interceptor trench or direct flow towards a low area or construct berm • Contain the flow by dyking with earth or other barriers, construction of an interceptor trench or underflow dam, etc., and use materials found in the spill containment kits located onsite • monitor and assess extent of contamination in receiving environment	Spills
Storage capacity of Northwest pond is exceeded, leading to potential release of untreated water or additional water management costs.	1-2	Regular inspections of TCA's to ensure freeboard is maintained	•Storage nears capacity	•Initiate Emergency Response Plan •re-routel water to mine for storage shutdown all minewater pumps, •Block entry to waterways - construct interceptor trench or direct flow towards a low area or construct berm • Contain the flow by dyking with earth or other barriers, construction of an interceptor trench or underflow dam, etc., and use materials found in the spill containment kits located onsite • monitor and assess extent of contamination in receiving environment	Spills

Risk Statement	Relevant Phases	Mitigations/Monitoring	Initiatiation Point of Contingency	Contingency/Response	Link to Other Plans
Baker Creek culvert at Hwy 4 ices & freshet flows seep to A2 pit & hinder fish passage	1-3	•Monitoring culvert condition and steaming ice accumulation to maintain flow, every Spring.	•Inspections indicate immenent failure, or failure is detected	steam out ice accummulation coordinate with DFO and GNWT	-
Spill contaminates waterways • Diesel fuel • Gasoline • Waste •Hydraulic Oil Oil	1-3	•Effective fuel and oil handling procedures in place	•Detection of spill	•Initiate Emergency Spill Response Plan •Stop flow of product at source to prevent further contamination of waterways Deploy containment boom/skimmers and apply absorbent materials found in spill containment kits located onsite • monitor and assess extent of contamination in receiving environment	Spills
Beaver dam causes flooding of Baker Creek outside its channel, contaminated soil is eroded		routine visual inspections of Baker Creek	evidence of beaver dam is observedc	trap beavers and remove dams with necessary regulatory authorizations	