Baffinland Iron Mines Corporation

Aquatic Effects Monitoring Plan
BIM-5200-PLA-0023

Rev 2

DOCUMENT REVISION RECORD

Issue Date	Revision	Prepared By	Approved By	Issue Purpose
May 27, 2014	0	Jim Millard	Oliver Curran	Part I, Item 2 of Type A Water Licence No. 2AM-MRY1325
October 30, 2015	1	William Bowden	Jim Millard	Part I, Item 2 of Type A Water Licence No. 2AM-MRY1325 Amendment No.1
March 31, 2016	2 (Unapproved)	Andrew Vermeer	Jim Millard	CREMP Design Revision recommended by Minnow
May 1, 2019	2 (Unapproved)	Amanda McKenzie	Christopher Murray	Further CREMP Design Revision following 2017 Freshwater Workshop and Phase 2 Update
July 31, 2020	2 (Unapproved)	Amanda McKenzie	Christopher Murray	Incorporated a trigger action response plan (TARP); removed component studies designs from appendices
May 14, 2021	2 (Unapproved)	Amanda McKenzie	Christopher Murray	Incorporated QIA comments on the TARP
March 28, 2022	2 (Unapproved)	Minnow/KP	Connor Devereaux	Incorporated regulatory agency comments received on Phase 2 Proposal draft in the September 2021 Water Licence Amendment Application
March 31, 2022	2 (Unapproved)	Connor Devereaux	Francois Gaudreau	Updated AEMP benchmarks for water and TARP wording for water quality assessment based on ECCC recommendations from the Phase 2 Proposal draft (September 2021 Water Licence Amendment Application). Incorporated potential oil and grease sampling (contingent upon visual assessment of sheen) in water quality monitoring component. Updated AEMP benchmarks for sediment quality at lake stations.
March 31, 2024	2 (For Approval)	Connor Devereaux	Martin Beausejour	Updated to reflect the responses that Baffinland provided to intervener comments on the AEMP (and related programs) Added TARP tables. Removed reference to Phase 2, Milne Port Railway. Updated to new management plan number – BAF-PH1-830-P16-0039 to BIM-5200-PLA-0023

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ABBREVIATIONS

AEMP .... Aquatic Effects Management Plan
AMP .... Adaptive Management Plan
AQNAMP........ Air Quality & Noise Abatement Management Plan
ARD .... Acid Rock Drainage
Baffinland .... Baffinland Iron Mines Corporation
BMI .... benthic macroinvertebrate
BOD........ biochemical oxygen demand
CCME .... Canadian Council of Ministers of the Environment
CEAA .... Canadian Environmental Assessment Agency
CES .... Critical Effect Sizes
COO........ Chief Operations Officer
CREMP .... Core Receiving Environment Monitoring Program
DFO .... Fisheries and Oceans Canada
DQO .... Daily Quality Objectives
ECCC........ Environment and Climate Change Canada
EDA .... Exploratory Data Analysis
EEM........ Environmental Effects Monitoring
ERP........ Early Revenue Phase
ETMF........ Exposure Toxicity Modifying Factors
FC........ Faecal Coliform
FDP........ final discharge points
FEIS .... Final Environment Impact Statement
HSE........ Health, Safety and Environment
IIBA .... Inuit Impact Benefit Agreement
INAC........ Indigenous and Norther Affairs Canada
IQ .... Inuit Qaujimajatuqangit
ISP .... Inuit Stewardship Plan
KP........ Knight Piésold Ltd.
kPa .... kilopascal
LEL........ Lowest Effect Level
LSA .... Local Study Area
m^3 .... cubic metres
MDL .... method detection limit
MDMER........ Metal and Diamond Mining Effluent Regulations
Mtpa .... million tonnes per annum
NIRB .... Nunavut Impact Review Board
NLCA .... Nunavut Land Claims Agreement
NSC .... North/South Consultants Inc.
NWB........ Nunavut Water Board
PC........ Project Certificate
PDA .... Project Development Area

PEL .... Probable Effect Level
PWP .... Polishing Waste Stabilization Ponds
QIA .... Qikiqtani Inuit Association
ROM .... Run-of-Mine
RSA .... Regional Study Area
SD .... Sustainable Development
SDA .... Statistical Data Analysis
SEL .... Severe Effect Level
SSWQO .... Site-specific Water Quality Objective
TARP .... Trigger Action Response Plan
TEWG .... Terrestrial Environment Working Group
TP .... total phosphorus
TSS .... total suspended solids
VEC .... Valued Ecosystem Components
WOE .... Weight-of-Evidence
WQO .... Water Quality Objectives
WWTF .... Wastewater Treatment Facility

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

This Aquatic Effects Monitoring Plan (AEMP) describes the approach used by Baffinland Iron Mines Corporation (Baffinland) to monitor the effects of the Mary River Project (the 'Project') on the freshwater environment. The AEMP is designed to:

- Detect short and long-term effects of the Project's activities on the aquatic environment resulting from the Project[1]
- Provide data to evaluate the accuracy of impact predictions
- Identify mitigation measures to avert or reduce unforeseen environmental effects
- Provide data to assess the effectiveness of mitigation measures

The AEMP focuses on the key impacts to freshwater environment Valued Ecosystem Components (VECs) as identified in the Final Environmental Impact Statement (FEIS) and its addendums (Baffinland, 2013a, 2018). The freshwater VECs are:

- Water quantity
- Water and sediment quality
- Freshwater biota and fish habitat

The AEMP has been structured to serve as an overarching 'umbrella' that provides an opportunity to integrate results of individual but related aquatic monitoring programs. The AEMP focuses on assessment of water and sediment quality, primary productivity (phytoplankton), benthic invertebrate community structure and fish (specifically Arctic char) within streams and lakes potentially affected by Project activities. Development of individual monitoring programs/studies under the umbrella of the AEMP has allowed for the application of a common platform in terms of study design and sampling protocols.

The following are the component studies that comprise the AEMP:

- **Environmental Effects Monitoring (EEM) Program,** as required under the Metal and Diamond Mining Effluent Regulations (MDMER) (MOJ, 2020).
- **Core Receiving Environment Monitoring Program (CREMP),** which includes monitoring of the core mine site area (water, sediment, phytoplankton, benthic invertebrates and fish).
- **Targeted Studies:**
    - **Lake Sedimentation Monitoring Program,** evaluating baseline and project-influenced lake sedimentation rates.
    - **Dustfall Monitoring Program,** evaluating dustfall rates in proximity of the Project, including the Tote Road, Milne Port and Mine Site.
    - **Stream Diversion Barrier Study**, an initial study evaluating potential for fish barriers under natural conditions and due to Project-related stream diversions.

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[1] Short-term is on the scale of annual, versus long-term which is multi-year.

1.1.1 COMPONENT STUDIES

The EEM Program is a legal requirement for metal and diamond mines operating in Canada, including the Mary River Project, under the MDMER. The EEM Program focuses on evaluating potential effects to aquatic environments that receive mine effluent discharges. It has been included under the umbrella of the AEMP and follows a federal regulatory requirement related to but separate from that of the CREMP and targeted studies. EEM study designs and data reports are submitted to Environment and Climate Change Canada (ECCC) every three years as per the MDMER. The results compliment annual monitoring results from the CREMP.

The CREMP forms the backbone of the AEMP. The CREMP is a detailed aquatic monitoring program intended to complement the EEM Program required under the MDMER with the monitoring of effects of multiple stressors on the aquatic environment, including the discharge of mine effluents and treated sewage effluent as well as ore dust deposition. The CREMP includes the monitoring of water, sediment, phytoplankton, benthic invertebrates and fish in streams and lakes near the Mine Site.

Specific effects monitoring (or targeted monitoring) is defined as monitoring conducted to address a specific question or impact and/or studies that are relatively confined in terms of spatial and/or temporal scope. Targeted environmental studies relate to specific environmental concerns that require further investigation or follow-up but are not anticipated to be long-term components of the core monitoring program. The Lake Sedimentation Monitoring, Dustfall Monitoring, and the Stream Diversion Monitoring represent current targeted studies.

This AEMP is a living document that will be updated periodically throughout the life of the Project to account for the close-out of shorter-term monitoring programs, changes in study designs that are driven by the findings of monitoring or changes to the Project, and new information in the field of aquatic effects monitoring including updated toxicological data.

1.2 RELATIONSHIP TO OTHER MANAGEMENT PLANS AND MONITORING PROGRAMS

Project activities have the potential to affect site water quality, fish habitat, vegetation, and other environmental components. Therefore, this Plan must be viewed in consideration with the Environmental Management and Monitoring Plans for the Project as listed and described in Table 1.1. The AEMP components and the relationship of the AEMP to the Water Licence and other aquatic monitoring activities are shown on Figure 1.1.

This Plan should be used in conjunction with the Fresh Water Supply, Sewage and Wastewater Management Plan (FWSSWMP) (BIM-5200-PLA-0022) Surface Water and Aquatic Ecosystem Management Plan (SWAEMP) (BIM-5200-PLA-0009) Metal and Diamond Mining Effluent Regulations Emergency Response Plan (BIM-5200-PLA-003) and the Sampling Program – Quality Assurance and Quality Control (QA/QC) Plan (BIM-5200-PLA-0004).

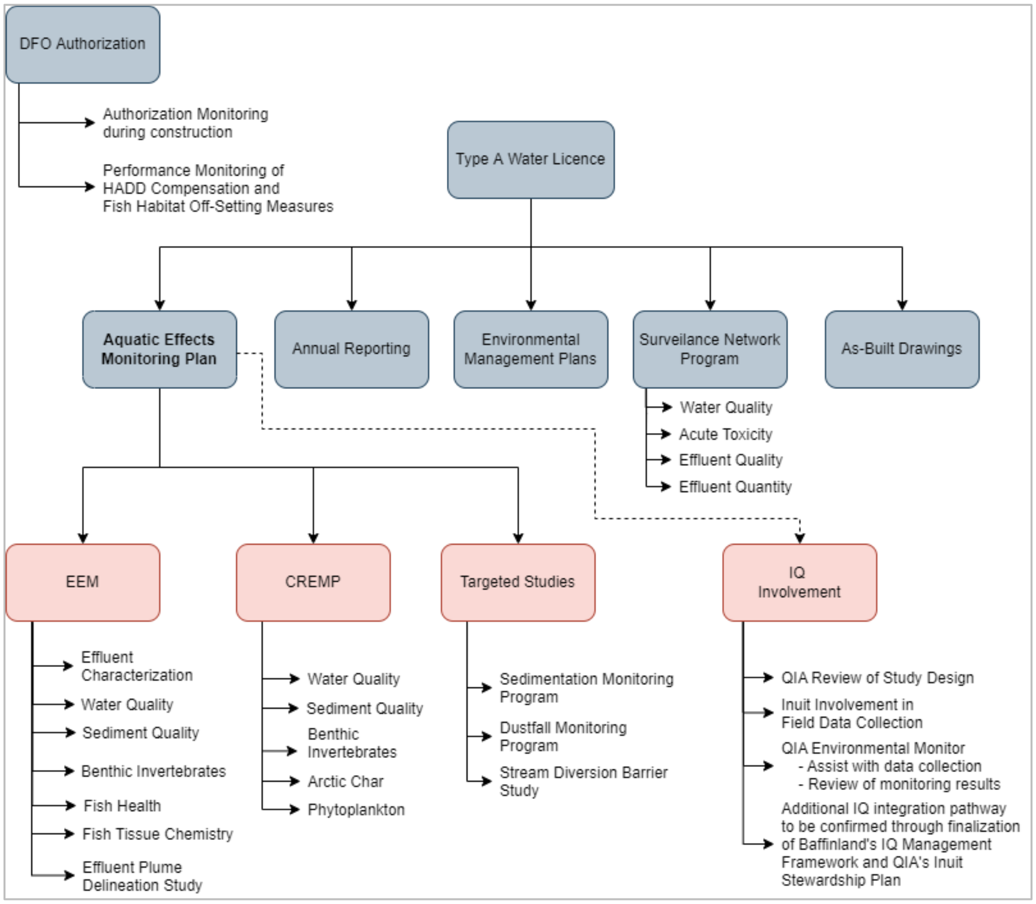

FIGURE 1.1 AEMP COMPONENTS AND RELATIONSHIP TO OTHER MONITORING PROGRAMS

TABLE 1.1 RELATIONSHIP TO OTHER MANAGEMENT PLANS

Referenced Management Plan	Document Reference Number	Information Provided by Referenced Plan
Air Quality and Noise Abatement Management Plan	BIM-5200-PLA-0005	Describes mitigation measures to limit adverse impacts to air quality and noise, and monitoring programs to determine the effectiveness of mitigation. Includes the dustfall monitoring program and dust mitigation protocol.
Environmental Protection Plan	BIM-5200-PLA-0003	Provides relevant environmental protection measures.
Surface Water and Aquatic Ecosystems Management Plan	BIM-5200-PLA-0009	Describes monitoring and mitigation measures to limit adverse impacts to receiving waters, aquatic ecosystems, fish and fish habitat from runoff and surface water interacting with project infrastructure.
Fresh Water Supply, Sewage and Wastewater Management Plan	BIM-5200-PLA-0022	Describes plans for managing fresh water supplies and the disposal of effluents (sewage, oily water, and mine contact water). Describes monitoring of effluent discharges, including those regulated under MDMER.

1.3 REGULATORY REQUIREMENTS

This Plan is required by the following Project authorizations:

- Project Certificate No. 005 issued by the Nunavut Impact Review Board (NIRB, 2020)
- Type A Water Licence No. 2AM-MRY1325 issued by the Nunavut Water Board (NWB or the Board, 2015)
- Commercial Lease - Q13C301 (Commercial Lease) with the Qikiqtani Inuit Association (QIA, 2013)

Project Certificate (PC) Condition #21 outlines requirements for this AEMP (from NIRB, 2020):

The Proponent shall ensure that the scope of the Aquatic Effects Monitoring Plan (AEMP) includes, at a minimum:

a. *monitoring of non-point sources of discharge, selection of appropriate reference sites, measures to ensure the collection of adequate baseline data and the mechanisms proposed to monitor and treat runoff, and sample sediments; and*
b. *measures for dustfall monitoring designed as follows:*
   i. *To establish a pre-trucking baseline and collect data during Project operation for comparison;*
   ii. *To facilitate comparison with existing guidelines and potentially with thresholds to be established using studies of Arctic char egg survival and/or other studies recommended by the Terrestrial Environment Working Group (TEWG); and,*
   iii. *To assess the seasonal deposition (rates, quantities) and chemical composition of dust entering aquatic systems along representative distance transects at right angles to the Tote Road and radiating outward from Milne Port and the Mine Site.*

The AEMP addresses Part (a) of PC Condition #21. Part (b) overlaps with the current dustfall monitoring program described in the Air Quality and Noise Abatement Management Plan (Baffinland, 2020). Interpretation of the dustfall monitoring data in relation to the aquatic environment forms part of the lake sedimentation targeted study described in Section 3.4.1.

Part I of the Type A Water Licences outlines conditions related to general and aquatic effects monitoring. Schedule G of the Commercial Lease with the QIA identifies the Aquatic Effects Monitoring Plan as a key monitoring program.

Tables of concordance with the applicable regulatory approvals are provided in Appendix B.

1.4 VERSION HISTORY

The current Water Licence (Amendment No. 1; NWB, 2015) approved a 2013 AEMP Framework. The initial (Revision 0) version of the AEMP was submitted to the NWB on June 27, 2014.

On October 30, 2015, Revision 1 of the AEMP was submitted to the NWB for approval. The purpose of this submission was to satisfy the condition stated in Part I, Item 2 of the Amended Licence requiring Baffinland to submit to the NWB for approval in writing a revised version of the AEMP 60 days following the issuance of the Amended Licence.

In 2015, Minnow Environmental Inc. (Minnow) was contracted to assist Baffinland in completing the field work and reporting requirements of the AEMP. After completing the CREMP field work in 2015, Minnow proposed several modifications to the CREMP to provide greater efficiencies to the program and improve the program’s ability to achieve its objectives (i.e., to evaluate short- and long-term effects of the Project on aquatic ecosystems). Minnow’s recommendations proposed modifications to the CREMP water quality, sediment quality and benthic community monitoring programs in study lakes and streams as well as modifications to the fish population monitoring program in study lakes (Minnow, 2016).

In April 2016, Baffinland submitted Revision 2 of the AEMP to the NWB for review and approval. Revision 2 of the AEMP incorporated nearly all of Minnow's recommendations for modifying the CREMP Study Design. Following the submission of the revised AEMP, Baffinland received feedback and comments from both Environment and Climate Change Canada (ECCC) and Indigenous and Northern Affairs Canada (INAC; now Crown-Indigenous Relations and Northern Affairs Canada [CIRNAC]), including concerns regarding the rationale for select recommendations proposed by Minnow.

On November 8 and 9, 2017, Baffinland chaired the 2017 Freshwater Workshop in Iqaluit, NU with regulators and stakeholders (ECCC, CIRNAC, Government of Nunavut, NWB, QIA) to discuss the Project's freshwater monitoring programs and Minnow's proposed modifications to the CREMP. Considering discussions and feedback received prior to and during the 2017 Freshwater Workshop, Baffinland has incorporated several of Minnow's recommendations into the current revision of this document for final regulatory review and approval.

The current update to the AEMP (Revision 2) incorporates adaptive management mechanisms consistent with Baffinland's draft Adaptive Management Plan (Section 2.3). Additionally, Section 6 contains the Trigger Action Response Plan (TARP) tables relevant to the AEMP program. The current document also incorporates a reorganization of the document to align with similar changes made to Baffinland's other environmental monitoring and management plans, and two rounds of comments from the QIA (QIA, 2020a,b), comments received from ECCC (2021), and outcomes from a Freshwater Workshop held on February 15, 2022, that included QIA, ECCC, and CIRNAC representation.

2.0 PLANNING

2.1 OBJECTIVES

The goal of this Plan is to protect aquatic ecosystems by meeting the objectives and performance indicators identified in Table 2.1.

TABLE 2.1 OBJECTIVES AND PERFORMANCE INDICATORS

Objective	Performance Indicators
Detect short-term and long-term effects of the Project's activities on the aquatic environment resulting from the Project	• Water quality including AEMP benchmarks, deleterious substances, effluent characterization • Acute Lethality Testing • Critical effect sizes for Arctic char and benthic invertebrates • Fish tissue study (if required under MDMER) • Chlorophyll a
Evaluate the accuracy of impact predications	
Assess the effectiveness of planned mitigation measures	
Identify additional mitigation measures to avert or reduce unforeseen environmental effects	

2.2 CONSIDERATION OF INUIT QAUJIMAJATUQANGIT

2.2.1 INUIT USE OF FRESHWATER IN THE PROJECT AREA

Inuit use of the freshwater environment in the region includes harvesting of Arctic char and consumption of water, ice and/or snow from these waterbodies for drinking. Information from various sources on fishing areas used by Inuit suggest that nearly all fishing in the region occurs in river-lake systems that support sea run Arctic char. This includes information collected in the mid-1970s for the Inuit Land Use and Occupancy Project (Brody, 1976), community information collected in the mid-1980s for the Nunavut Atlas (Riewe, 1992), fish harvest locations assessed during the Nunavut Wildlife Harvest Study (Priest and Usher, 2004), and information collected in the late 2000s as part of the Mary River Project IQ Study (KP, 2014a,b). The systems examined in these studies are outside of the Project area.

Freshwater environments located near the Project Mine Site and Tote Road support landlocked populations of Arctic char. The lakes in the Project area that support landlocked Arctic char have typically been fished by Inuit only on an opportunistic, occasional frequency (KP, 2010 and 2014b; Riewe, 1992). Inuit have historically and continue to use Milne Inlet as an entrance to the interior of northern Baffin Island. Phillips Creek (from Katiktok to Milne Inlet) and the upper reaches of the Ravn River (south of Katiktok Lake) are important travel corridors both for interior access for caribou hunting and for inter-community travel between Pond Inlet and Igloolik. Fishing and freshwater resources identified in the region by the Tusaqtavut Studies (QIA, 2019a,b) indicated 12 subsistence values within 250 m of the Project footprint. The Tusaqtavut studies also recorded community perspectives that the current Project is impacting land and resource use from the community perspective, including dust impacts to water quality along the Tote Road, limitation of access to fishing areas, and avoidance of Project areas by wildlife due to impacts to fish habitat and diminished water quality (QIA, 2019a,b).

2.3 ADAPTIVE MANAGEMENT

2.3.1 DEFINING ADAPTIVE MANAGEMENT

Adaptive management is a planned and systematic process for continuously improving environmental management practices by learning about the outcomes from the evaluation of environmental monitoring data and by adjusting decisions and actions accordingly (Canadian Environmental Assessment Agency, 2016). Adaptive management provides flexibility to identify and implement mitigation measures or to modify existing ones during the life of a project. Baffinland has drafted an Adaptive Management Plan (AMP) that provides the framework by which adaptive management is to be incorporated into Project operations (Baffinland, 2020). The adaptive management process outlined in this plan includes a planning phase followed by iterative phases of implementing and monitoring the actions included in the plan(s), evaluating the effectiveness of actions included in the plans based on results of monitoring and other feedback mechanisms, and adjusting management strategies and actions and responses based on the evaluation of monitoring information. This cycle is then intended to begin anew with implementation of a revised plan, subsequent monitoring, and integration of information from the previous cycle in the evaluation of outcomes. This cycle can occur in real-time or over an extended period according to the nature of the situation or area of focus. In this way, a properly designed and well-implemented adaptive management process progressively diminishes uncertainty as management strategies and processes are refined throughout a project's operational lifecycle.

Monitoring and responding to potential effects of Project activities in the short-term is addressed in a Trigger Action Response Plan (TARP) described in Section 5.0. The TARP identifies the pre-defined actions to be taken should thresholds be exceeded. A series of escalated actions to be implemented in response to the identification of potential Project-related effects are detailed in Section 5.0. Longer term review of and response to monitoring data is addressed in an annual review of plan effectiveness in Section 6. The latter includes an annual comparison of Project-related effects against impact predictions made in the FEIS (Baffinland, 2012) and associated addendums (Baffinland 2013, 2018).

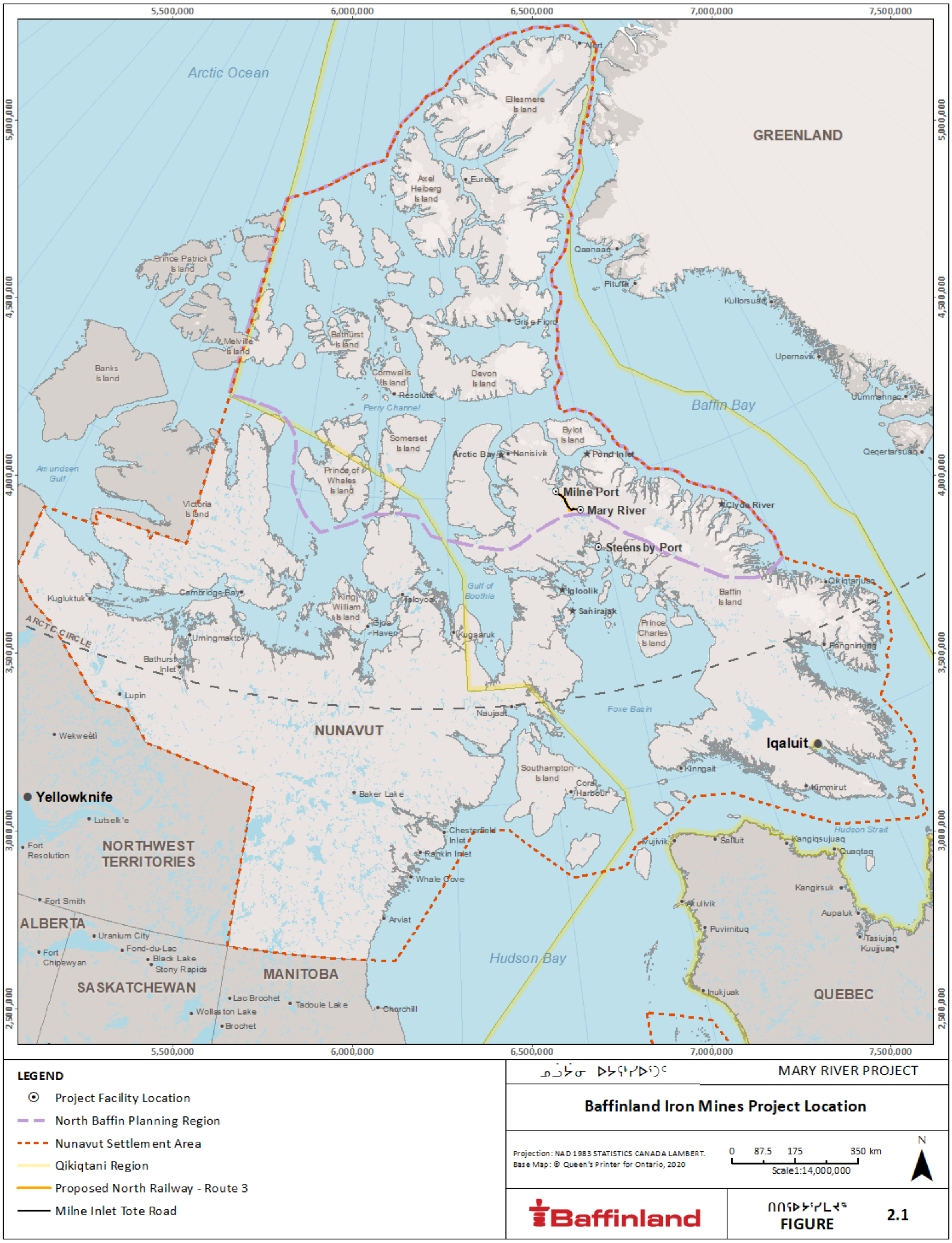

FIGURE 2.1 PROJECT SITES AND LOCATION MAP

2.3.2 WATER MANAGEMENT FACILITIES AND FINAL DISCHARGE POINTS

The ponds designed to collect and manage surface water runoff at the Mine Site, the corresponding water licence SNP stations and Final Discharge Points (FDPs) under the MDMER, and the receiving water bodies are summarized in Table 2.2 and are shown on Figure 2.2.

TABLE 2.2 EFFLUENT DISCHARGES FROM EXISTING AND FUTURE MINE SITE WATER MANAGEMENT FACILITIES

Station/FDP	Station Name	Description	Receiving Water
MS-06	Ore Stockpile Pond	Collects runoff from the ore crusher pad.	Mary River
MS-07	KM106 Stockpile Pond	Collects runoff from the footprint of the ROM Stockpile located near KM 106 of the Mine Haul Road.	Mary River
MS-08	Existing WRF Pond	Collects runoff from the WRF Facility	Mary River
MS-09 (Not Constructed)	Future WRF West Pond	Future pond will collect runoff from the west side of the WRF facility	Camp Lake Tributary 1
MS-10 (Not Constructed)	Future Sheardown Lake Tributary 1 (SDLT-1) Pond	Future pond will collect runoff from the current Ore Stockpile Facility and future Phase 2 rail loadout area.	Mary River
MS-11	KM105 Pond	Collects runoff from the Mine Haul Road	SDLT-1

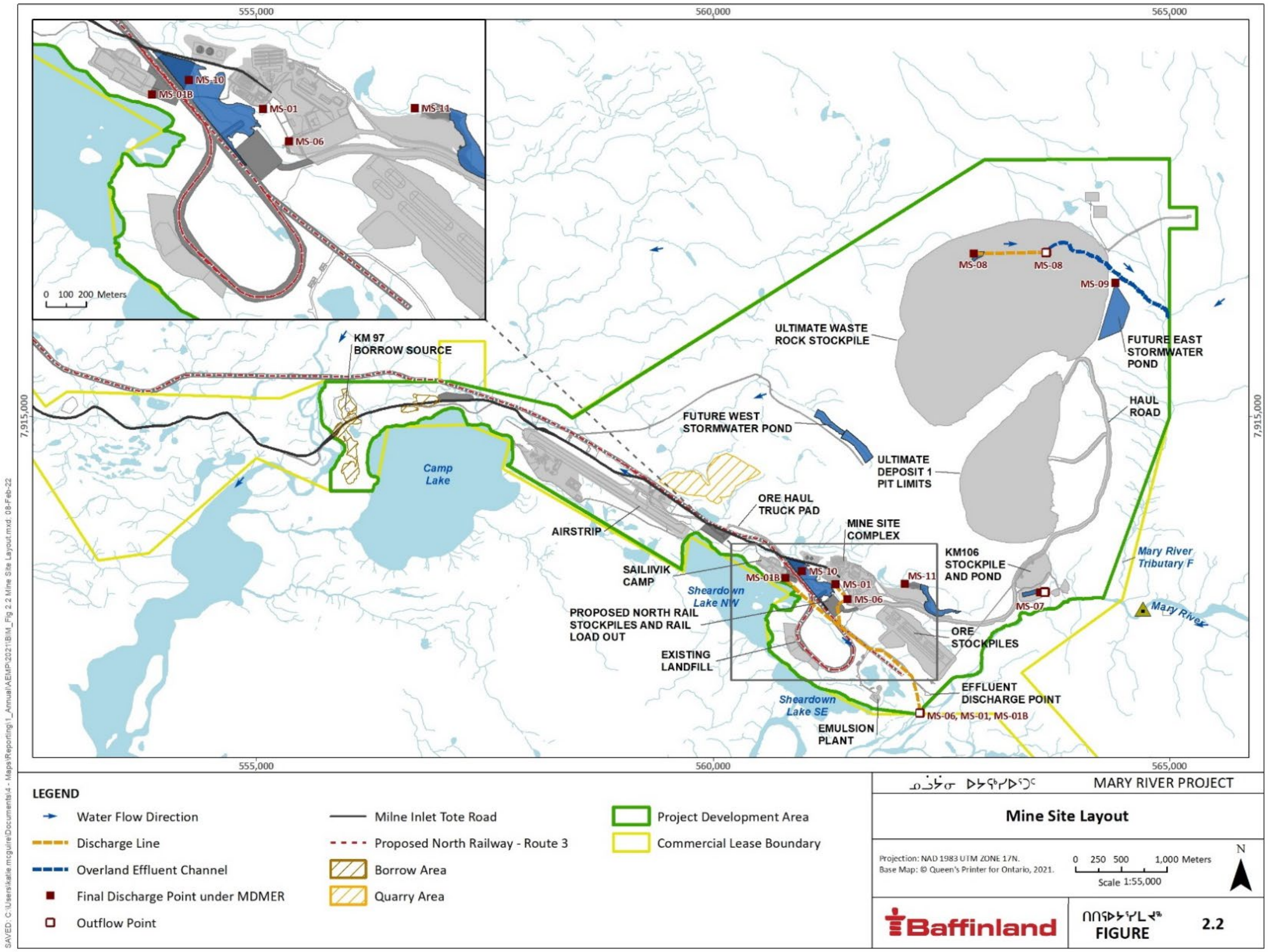

FIGURE 2.2 MINE SITE LAYOUT

A site water balance process flow diagram showing stormwater management at the Mine Site is presented in an appendix of the Freshwater Water and Surface Water Management Plan.

2.3.3 STREAM DIVERSIONS

The development of the open pit, a waste rock stockpile, and associated water management facilities (ditches, berms and settling ponds) will result in catchment modifications of five streams in the Mine Site Area (Baffinland, 2012). The streams that will be affected by these catchment modifications are shown on Figure 2.3. Of these five affected streams, SDLT-1 was predicted to be sufficiently affected as to warrant a targeted study as part of this AEMP, and thus an Initial Stream Diversion Monitoring Program was conceived to monitor these streams, focusing mainly on SDLT-1.

2.3.4 WATER QUANTITY

Article 20 Inuit Water Rights of the Nunavut Land Claims Agreement (NLCA) formally recognizes the importance of water quantity and flow to the Inuit. Under the NLCA, Inuit require compensation if a project or activity will substantially affect the quantity of water flowing through Inuit-Owned Lands. Therefore, water quantity has been identified as a VEC. The water quantity VEC can be defined as the spatial and temporal variability of the volume of water within the Regional Study Area (RSA) that may be subject to alteration by Project activities.

Conditions applying to water use and management have been outlined in Part E of the Type A Water Licence. These conditions are to be adhered to throughout the applicable timeframe of this licence. Compliance with these thresholds is addressed in the Fresh Water Supply, Sewage and Wastewater Management Plan. A discussion of the Project's effects on the freshwater VECs follows.

Key Issues and Pathways for Water Quantities

Key issues identified for freshwater quantity include:

- Water withdrawal;
- Water diversion (stream diversion or changes to flow patterns in a specific watershed); and
- Runoff or effluent discharge.

Key Indicators and Thresholds

The key indicators for water quantity include:

- Water withdrawn for consumption (measured in cubic metres - m^3); and
- Streamflow increase or decrease (measured as a percent change of mean).

Diversions, Drainage Flows (Runoff) and Effluent Discharges

Diversions, drainage flows and effluent discharges that pertain mainly to the Mine Site potentially result in effects to fish habitat due to reduction or increase in flows from the site activities. The potential effects, and monitoring of these effects, are addressed in the Stream Diversion Barrier study (Section 3.4.3).

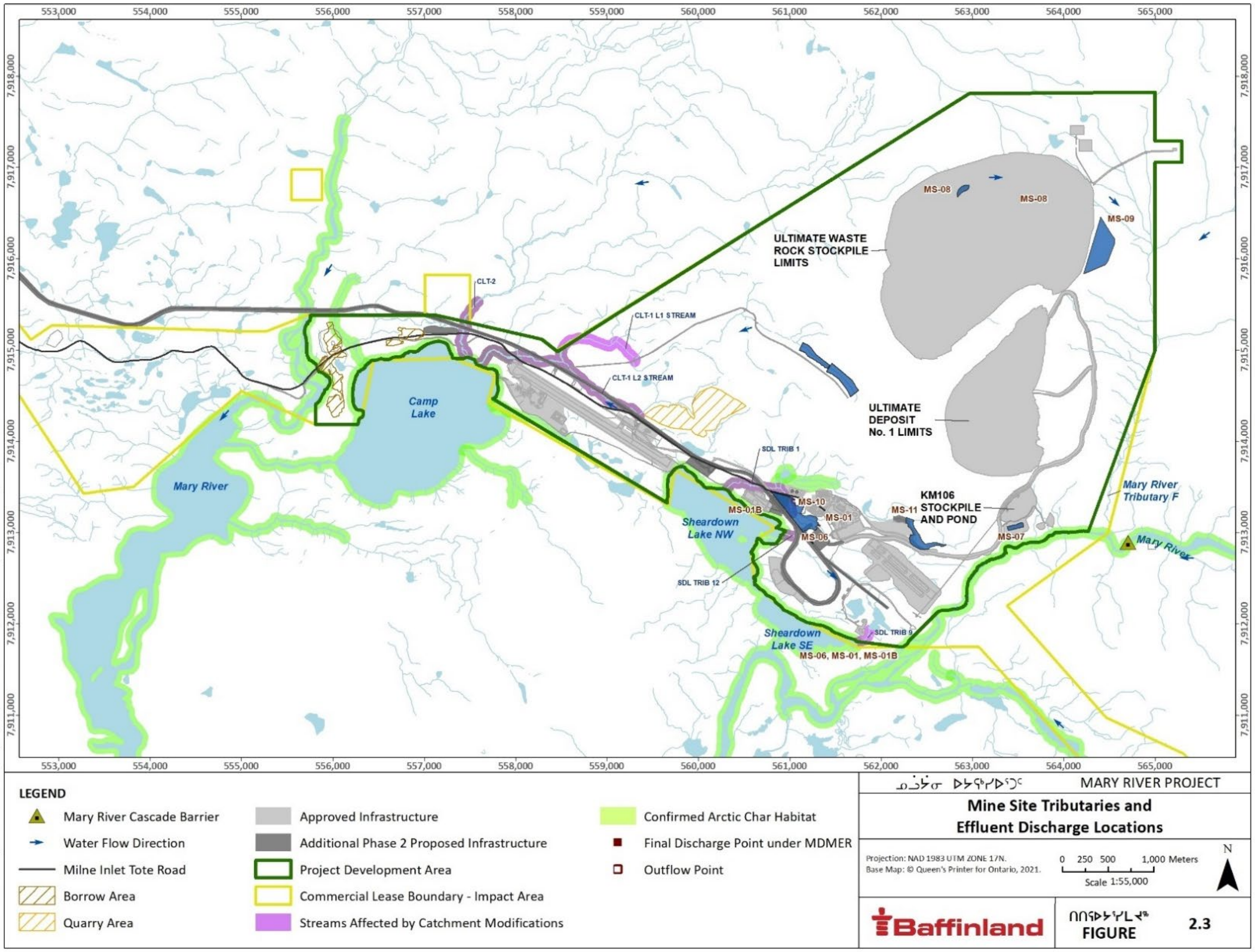

FIGURE 2.3 MINE SITE TRIBUTARIES AND EFFLUENT DISCHARGE LOCATIONS

2.3.5 WATER AND SEDIMENT QUALITY VEC

Key Issues and Pathways for Water and Sediment Quality

Key issues considered for the surface water and sediment quality VEC are summarized in Table 2.3.

2.3.6 FRESHWATER BIOTA AND HABITAT

Key Issues and Pathways for Freshwater Biota

Arctic char (*Salvelinus alpinus*) is the primary freshwater species of interest regarding potential effects of the Project on the aquatic environment. Potential linkages between the Project components/activities and Arctic char are presented on Figure 2.4. These linkage pathways can be categorized into three key issues as follows:

- Key Issue #1: Potential effects on the health and condition of Arctic char
- Key Issue #2: Potential effects on Arctic char habitat
- Key Issue #3: Potential effects on direct mortality of Arctic char

2.3.6.1 POTENTIAL EFFECTS ON THE HEALTH AND CONDITION OF ARCTIC CHAR

Project-related changes in water and/or sediment quality have the potential to affect the health and condition of Arctic char. The major pathways of effects are based on the residual effects identified in the water and sediment quality assessment. Linkages considered for potential effects include three general categories:

- Point source discharges including treated sewage effluent, waste rock facility runoff, ore stockpile runoff, mine pit water, run-of-mine stockpile runoff, and exploration drilling runoff
- Aqueous non-point sources including effects related to sediment and erosion, release of blasting residues, general site runoff, and development of quarries and borrow pits
- Dust emissions and introduction to surface waters

Effects considered under this key issue relate to sub-lethal effects of Project-related changes in water and/or sediment quality on fish health and condition.

2.3.6.2 POTENTIAL EFFECTS ON FISH HABITAT

Project activities with the potential to affect Arctic char habitat include the following:

- Placement of Project infrastructure in waterbodies (e.g., water intakes, sewage outfalls, stream crossings, lake encroachments, laydown areas)
- Various Project-related effects pathways that may alter other aquatic biota that are food sources for Arctic char or form a component of the food web and thus may affect the productive capacity of their habitat (i.e., lower trophic level biota)
- Project-related effects on sedimentation rates that may result in alteration of habitat quality (e.g., due to dust deposition)
- Project-related changes to hydrology and subsequent effects on aquatic habitat (e.g., water withdrawal, stream diversion)
- Project-related effects on fish passage, with subsequent effects on the availability of habitat, including:
    - Stream crossing construction and operation
    - Changes in hydrology that may alter hydraulic conditions necessary for fish passage (e.g., stream velocities, water depth)

Most of these key issues relate to construction activities in or near waterbodies.

TABLE 2.3 KEY ISSUES FOR WATER AND SEDIMENT QUALITY

Pathway	Key Issues	Location	Project Phases
Surface runoff	Uncontrolled runoff at construction site Erosion and sediment entrainment Site drainage control Spills and contamination Drainage from quarry sites	All	Construction Operation Closure
Discharges from secondary containment	Fuel depots/storage - contact water may be contaminated with hydrocarbon/petroleum products	Milne Port, Mine Site, Railway construction, Steensby Port, Quarry sites	Construction Operation Closure
Discharge of brine used for drilling in permafrost	Salinity of the discharge	Railway tunnels	Construction
Pooling water in landfarm	Pooling water maybe contaminated with hydrocarbon/petroleum product and may require treatment prior to discharge	Milne Port Mine Site Steensby Port	Construction Operation Closure
Pooling water in landfill	Pooling water maybe contaminated with metals, hydrocarbon/petroleum product and may require treatment prior to discharge	Milne Port Mine Site Steensby Port	Construction Operation Closure
Treated sewage effluent discharges	Effectiveness of treatment - pH, flows, Biochemical oxygen demand (BOD), Faecal Coliform (FC), TSS, nutrient, metals, oil and grease	Sheardown Lake Mary River outfall	Construction Operation Closure
Treated oily water treatment plant discharge	Effectiveness of treatment - pH, flows, TSS, metals, oil and grease	Mary River outfall	Construction Operation Closure
Dustfall	TSS in runoff, sediment deposition on stream and lake bottoms, metals	Mine Site	Construction Operation Closure
Run of mine ore stockpile contact water	Metals, TSS, blasting residue (ammonia, nitrate)	Mary River	Operation
Ore stockpile contact water	Metals, TSS, blasting residue (ammonia, nitrate)	Mary River	Operation
Mine pit dewatering	Metals, TSS, blasting residue (ammonia)	Camp Lake Tributary	Operation
Waste rock facility runoff - west pond and east pond	Acid Rock Discharge (ARD), metals, TSS, blasting residue (ammonia)	Camp Lake Tributary	Operation Closure Post-closure
Mine pit water	ARD, metals	Open pit	Post-closure

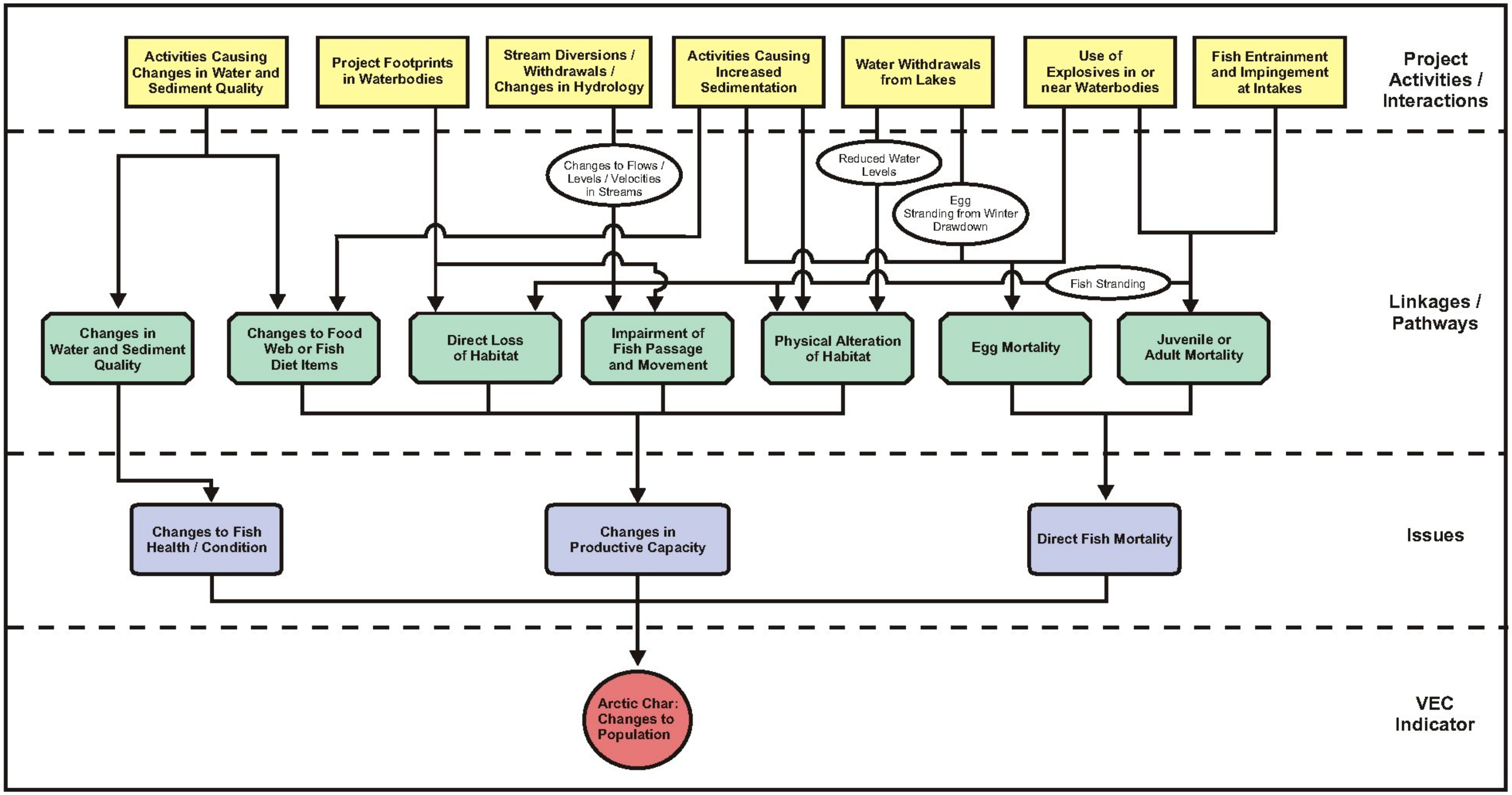

FIGURE 2.4 PROJECT ACTIVITIES/PATHWAYS OF POTENTIAL EFFECTS TO ARCTIC CHAR

The following changes associated with Mine Site development over the life of the Project also have the potential to affect fish and fish habitat:

- Water withdrawn from Camp Lake for domestic and industrial consumption discharged (after treatment) to the Mary River
- Water withdrawal from Camp Lake could potentially affects lake water levels and outflow discharge
- Altered drainage patterns where the Mine Site infrastructures/facilities are located. Most site runoff redirected to Mary River and as a result, less runoff discharged to Sheardown Lake and Camp Lake. Lower flows in these systems, including tributaries, could create barriers to fish passage.
- Mine dewatering, will be directed to the WRF sedimentation pond or to other permitted containment structures, as required.

2.3.6.3 POTENTIAL EFFECTS ON DIRECT FISH MORTALITY

Project-related activities with the potential to cause direct mortality of Arctic char include the following:

- Effects of sedimentation on mortality of eggs
- Potential egg stranding related to winter drawdown at water source lakes
- Blasting in or near Arctic char habitat
- Placement of Project infrastructure in Arctic char habitat (i.e., potential spawning areas)
- Potential for entrainment and/or impingement of Arctic char eggs and juveniles at water intakes
- Potential fish stranding related to water diversions and/or alterations in discharge or water levels

Potential effects of sedimentation on survival (hatching success) of Arctic char eggs are addressed through monitoring sediment deposition rates in Sheardown Lake as a target study (Section 3.4.1). Potential for winter drawdown to cause egg stranding is addressed through monitoring of water levels as the primary indicator, supported by information on Arctic char population monitoring (e.g., year class strengths, recruitment) under the CREMP. Potential effects of blasting in or near Arctic char habitat is addressed through the blasting management and monitoring program. The potential for placement of Project infrastructure to cause direct mortality of Arctic char (i.e., placement of infrastructure on fish eggs) is addressed through mitigation and management, specifically through avoidance of potential spawning areas and/or by adherence to timing windows to avoid the egg incubation period. Potential for entrainment and impingement of fish at water intakes is mitigated through adherence to DFO's *Interin Code of Practice: End-of-pipe fish protection screens for small water intakes in freshwater (DFO, 2020)*). The final potential pathway of effect list above is addressed through the target study to confirm fish passage at Mine Site area streams affected by water diversions (Section 3.4.3).

2.3.6.4 POTENTIAL EFFECTS OF BLASTING ON FISH

Blasting is conducted to support the construction and operation phases of the Project. The concern for potential effects on fish due to blasting overpressure mainly arises for the railway construction. Effects of blasting on free-swimming Arctic char and their eggs is to be mitigated through the implementation of a detailed blasting management plan developed in accordance with DFO's blasting guidelines (Wright and Hopky, 1998). Baffinland applies a more stringent overpressure threshold of 50 kPa instead of the published 100 kPa threshold identified by Wright and Hopky (1998).

2.3.6.5 STREAM AND RIVER CROSSING CONSTRUCTION AND LAKE ENCROACHMENT

Construction activities at watercourse crossings along railways, railway access roads, Project service roads and the Tote Road have the potential to cause the following effects:

- Stranding of Arctic char due to the need for isolation of the watercourses. This effect to be mitigated using appropriate timing windows for construction when possible and through fish salvage operations when required.
- Potential impediments to fish passage at stream crossings due to changes in water levels, flows and/or velocities. This potential pathway of effect to be addressed through follow-up monitoring at selected stream crossings (i.e., a subset) to evaluate fish passage as per Stream Diversion Barrier Study monitoring described in Knight Piésold (2014c); also Section 3.4.3.

2.3.7 POTENTIAL ISSUES AND CONCERNS BY PROJECT COMPONENT

Potential effects on aquatic ecosystems are presented below for each of the Project components within the two geographical areas for the construction and operation phases of the Project. Since abandonment and reclamation activities are similar in nature to construction activities, the concerns identified for the construction phase are also relevant to the closure phase.

2.3.7.1 MINE SITE (WATER MANAGEMENT AREA 48)

The Mine Site includes the infrastructure required to support mining activities (camp, maintenance shops, fuel depots, Wastewater Treatment Facility (WWTF), laydown areas, waste handling and storage facilities, landfill site and landfarm, and explosives storage, manufacture, and use). The freshwater supply for the Mine Site is drawn from Camp Lake. Several quarries and borrows have been identified/developed within the Mine Site area to provide aggregate material for site development and ongoing operations and maintenance.

Potential aquatic effects at the Mine Site are listed in Table 2.4. The locations of all controlled discharges from the Mine Site are presented in Section 3.

TABLE 2.4 POTENTIAL RESIDUAL EFFECTS TO THE MINE SITE AQUATIC ENVIRONMENT

VEC	Concern	Pathway	Indicator
Water Quantity	Withdrawal of water from Camp Lake		Volume withdrawn
	Flow diversion from Sheardown Lake		Visual - water level
Water and Sediment Quality	Earthworks	Surface runoff discharging to Camp Lake, Sheardown Lake, lake tributaries and Mary River	TSS, dust, spills
	Construction activities		TSS, dust, spills
	Site drainage		TSS, dust, spills
	Quarry site drainage		TSS, dust, spills, residual ammonia
	Fuel tank farms	Discharges from secondary containment areas to receiving environment - surface drainage	Hydrocarbons
	Waste storage area		Metals
	Bermed storage area		Metals, hydrocarbon
	Landfarm		Metals, hydrocarbon
	Landfill		Metals, hydrocarbon

VEC	Concern	Pathway	Indicator
	Treated Sewage Effluent (exploration camp)	Outfall to Sheardown Lake	BOD, TSS, nutrient
	Treated Sewage Effluent (main camp)	Outfall to Mary River	BOD, TSS, nutrient
	Treated Effluent from Oily Water Treatment Plant	Outfall to Mary River	TSS, hydrocarbon
	Waste rock stockpile drainage	Discharge to Camp Lake tributary	TSS, metals, nutrients
	Waste rock stockpile drainage	Discharge to Mary River	TSS, metals, nutrients
	ROM stockpile drainage	Discharge to Mary River	TSS, metals, nutrients
	Ore stockpile drainage	Discharge to Mary River	TSS, metals, nutrients
	Mine pit dewatering	Discharge to Camp Lake tributary	TSS, metals, nutrients/blasting residues
	Mine pit water post closure	End of life mine life pit water quality	Metals
	Dust	TSS in runoff	TSS
Freshwater Biota and Fish Habitat	Footprint of facilities in water bodies - water crossings	Loss of habitat - crossing of Mary River , Camp Lake tributaries	Percentage of habitat lost, amount of habitat compensation
	Integrity of water crossing	Alteration of habitat	Erosion, blockage
	Fish passage	Alteration of habitat	Blockage, barrier
	Water diversions - changes in streams	Alteration or loss of habitat	Low flow and barrier to fish passage
	Changes in water and sediment quality (point and non-point sources)	Effects on Arctic char health and condition; effects on lower trophic level biota (Arctic char habitat)	Arctic char health and condition; population metrics; benthic invertebrate community metrics
	Dust Deposition	Alteration of habitat	Increased sediment deposition in streams and lakes Benthic invertebrate community metrics
		Deposition on Arctic char eggs - reduced egg survival	Sedimentation rates in Arctic char spawning habitat
Groundwater quality	Landfill	Seepage in groundwater	Metals

2.3.7.2 MILNE PORT (WATER MANAGEMENT AREA 48)

Milne Port currently serves as the main staging area for material and equipment required for the construction activities at the Mine Site, as well as the shipping point for the Project. The site includes fuel depots, camps and WWTF, laydown areas, maintenance facilities, and temporary waste transit areas. Two sites have been approved for use as a freshwater supply for Milne Port: Phillip's Creek during summer and KM 32 Lake during the winter and summer. Quarries and borrow pits have been identified/developed near Milne Port to provide aggregate for the site development and ongoing operations and maintenance. At Milne Port, runoff from the ore stockpiles is directed to two (2) surface water management ponds. Discharge criteria for the effluent and runoff water quality are presented in the Type A Water Licence.

- Milne Port Ore Stockpile Facility Pond - East (monitoring station MP-05)
- Milne Port Ore Stockpile Facility Pond - West (monitoring station MP-06)

General site drainage at Milne Port, excluding ore management and containment areas, is directed to a series of swales located along the shoreline of Milne Inlet (ocean). Effluent from water treatment plants (sewage, oily water) and surface water management ponds are discharged to Milne Inlet without contacting any bodies of freshwater. As a result, site drainage and effluent discharge at Milne Port have negligible effects on the freshwater receiving environment. The concerns for freshwater aquatic effects during the construction, operation and closure of the Milne Port site are listed below:

Water Quantity

- Withdrawal of water from and KM 32 Lake year round
- Water and Sediment Quality
- Quarry management (runoff quality, residual ammonia from blasting activities)
- Construction of water intakes - TSS/turbidity
- Spills caused by accidents and malfunctions

Freshwater Biota and Fish Habitat

- Low magnitude effects to fish and fish habitat related to water quality changes

2.3.7.3 TOTE ROAD (WATER MANAGEMENT AREA 48)

The Tote Road connects Milne Port to the Mine Site. Routine maintenance of the Tote Road will be conducted over the life of the Project to support the transport of ore and materials between the Mine Site and Milne Port. This maintenance may include repairing of water crossings, regrading of the road, and ongoing maintenance of surface water management structures (i.e., roadside swales, ditches). Several borrow sources and quarries have been identified/developed along the length of the Tote Road to support routine maintenance activities. The concerns for potential aquatic effects during construction, operation, maintenance and closure of the Tote Road are related to:

Water and Sediment Quality

- Dustfall from road traffic and related effects on water quality
- Dustfall generated by ore stockpiling and handling
- Drainage management from borrow sources

Freshwater Biota and Fish Habitat

- Construction and ongoing maintenance of stream crossings
- Changes in water quality that may affect biota
- Bank erosion, stability, blockage, integrity of the water crossing, fish passage

2.3.7.4 SOUTHERN RAILWAY (WATER MANAGEMENT AREAS 48 AND 21)

The longer-term plans for the Project involve the transportation of iron ore from the Mine Site to Steensby Port by railway. The concerns for potential aquatic effects occur mainly during the construction period of the railway embankment. Construction camps will be established at the onset of the construction period. Water and Wastewater will be managed from the construction camps as per the Freshwater Supply, Sewage and Wastewater Management Plan. Domestic water supply and water required for construction activities will be drawn from various local lakes. Quarries will be developed along the Southern Railway alignment to provide the necessary rock and aggregate required for the rail embankments, stream crossings and bridge construction.

The concerns for potential aquatic effects during construction, operation and closure of the railway are related to the loss or alteration of fish habitat:

Water Quantity (Potable Water and Construction Activities)

- Water withdrawals affecting downstream flows

Water and Sediment Quality

- Surface runoff water quality (Total Suspended Solids (TSS), spills, dust)
- Quarry management (runoff water quality, TSS, and ammonia)

Freshwater Biota and Fish Habitat

- Stream/river crossings - flow velocity, TSS, erosion, fish stranding, fish passage and integrity of the water crossing
- Lake and river encroachment - loss of habitat, TSS (construction)
- Changes in water quality (e.g., dust, sewage effluent) - effects on Arctic char health and condition/habitat
- Blasting near water (blasting overpressure)

2.3.7.5 STEENSBY PORT (MANAGEMENT AREA 21)

The longer-term plans for the Project involve the sizing and stockpiling of iron ore at Steensby Port prior to being loaded into ore carriers for shipment. Steensby Port will contain large infrastructure required for ongoing support of the port, the railway operation, and the Mine Site.

At the Steensby Port site, surface drainage will be directed toward Steensby Inlet. Treated sewage effluent and treated oily water will be discharged to Steensby Inlet. As a result, site drainage and effluent discharge will have minimal effects on the freshwater receiving environment.

The concerns for potential freshwater aquatic effects during the construction, operation and closure of the Steensby port are related to:

Water Quantity

- Withdrawal of water from 3 KM Lake (dust suppression and other minor uses) and ST347 Lake (permanent camp)

Water and Sediment Quality

- Quarry management (runoff quality, ARD potential, residual ammonia from blasting activities)
- Construction of water intakes - TSS/turbidity
- Spills caused by accidents and malfunctions

Freshwater Biota and Fish Habitat

- Stream/river crossings - flow velocity, TSS, erosion, fish stranding, fish passage and integrity of the water crossing
- Lake and river encroachment - loss of habitat, TSS (construction)
- Construction of water intakes - avoidance of spawning areas

The discharge criteria for the effluent and runoff water quality are presented in the Type A Water Licence.

3.0 COMPONENT STUDIES

3.1 ADAPTIVE MANAGEMENT

Consistent with the adaptive management strategies described in Section 5, trigger action response plans (TARPs) have been developed for key project activities and related monitoring plans. This includes the identification of low, moderate, and high action responses that correspond to low, moderate, and high-risk conditions. Table 5.2 outlines the monitoring and response requirements for the AEMP.

Monitoring programs associated with the TARP focus on short-term detection of impacts and immediate to short-term responses. These short-term impacts and responses are intended to provide immediate feedback pertaining to the effectiveness of mitigation measures, allowing changes to be made in real-time. They also generate most of the monitoring data that feeds into annual reporting, which includes analysis and reporting of annual monitoring data along with trend analyses using historical monitoring data.

The review of trends over time through the annual review process will inform adaptive management in the long term. This may include triggering of plan updates as described in Section 5.

Baffinland is committed to continuous improvement of its work activities with the aim of reducing risks to the environment and improving operational safety and efficiency. The strategy employed at Baffinland is regular monitoring supported by operational change and adoption of additional mitigation measures if warranted.

As per the requirements of Baffinland's HSE Management Framework, Baffinland will conduct and document management reviews of this Plan on a regular basis. Such reviews will ensure integration of monitoring results for this Plan with other aspects of the Project and implementation of necessary adjustments as required. These reviews also provide a formal mechanism to assess effectiveness of management in achieving Baffinland's objectives and maintaining ongoing compliance with Project permits and authorizations. Thresholds are defined in the Adaptive Management Plan as specified performance indicators that define environmental conditions and trigger actions. The thresholds may be staged such that specific actions are associated with different levels of concern including, for instance, early warning thresholds to initiate precautionary responses, thereby minimizing the potential for adverse effects associated with higher thresholds. For the AEMP, the term benchmark is used throughout this document rather than threshold.

3.1.1 PROCESS FOR DEVELOPING WATER AND SEDIMENT QUALITY BENCHMARKS

The Mine Site occurs within an area of potential metal enrichment and therefore generic water quality and sediment guidelines established for all areas within Canada may naturally be exceeded at waterbodies located near the Mine Site. Thus, the selection of appropriate benchmarks must consider established water and sediment quality guidelines, such as those developed by the Canadian Council of Ministers of the Environment (CCME), as well as site-specific natural enrichment and other factors such as Exposure Toxicity Modifying Factors (ETMF), including pH, water hardness, dissolved organic carbon, etc. (CCME, 2007).

The assessment of surface water and sediment quality data over the life of the Project is on-going and the identified benchmarks may change throughout this process as more data becomes available and updates to guidelines occurs. For example, an AEMP benchmark established early on in the life of the mine may require updating to a Site-specific Water Quality Objective (SSWQO) based on newly published literature which has become available or implementation of site-specific toxicity tests conducted to further understand ETMF or resident species toxicity. The iterative, cyclical, nature of modification of benchmarks under an AEMP is well established (MacDonald et al., 2009).

3.1.1.1 WATER QUALITY BENCHMARKS

The substances originally selected for benchmark development in surface waters for the Project Mine Site for the AEMP were as follows:

- Metals/Metalloids: Al, As, Cd, Cr, Co, Cu, Fe, Pb, Ni, Ag, Tl, V, Zn (total concentrations)
- General Parameters and Nutrients: Chloride, Sulphate, Ammonia, Nitrite, Nitrate

In addition, numerous parameters were identified for monitoring under the Exploratory Data Analysis (Step 1 of Assessment Framework), including pH, DO, hardness, TSS, alkalinity, Mg, P, K, Total Organic Carbon (TOC) and Dissolved Organic Carbon (DOC), to assist with the evaluation of potential effects from the Project and track potential changes in water quality over time. If monitoring shows changes in concentrations of these substances over time, benchmarks may be developed for the additional parameter(s) in the future.

The AEMP water quality benchmarks were originally developed taking baseline data from Mine Site area lakes and creeks/rivers into consideration (Tables 3.1 and 3.2, respectively). In most cases, the AEMP benchmarks for individual parameters were the same between lakes and creeks/rivers, with the vast majority of selected benchmarks reflecting generic water quality guidelines (i.e., Canadian Water Quality Guideline or surrogate). Where parameter concentrations at the time of baseline naturally exceeded available guidelines, or parameters for which less than 5% of values were above laboratory method detection limits, other methods were applied for the development of AEMP benchmarks (Intrinsik 2013). Federal Environmental Quality Guidelines (FEQG) and certain Canadian Water Quality Guidelines (i.e., CCME) have been updated since the original development of benchmarks for the Baffinland AEMP, and therefore some modifications of the original AEMP benchmarks have been reflected, accordingly, for cobalt, lead, manganese, strontium, and zinc in this revision of the AEMP that supersede the previously applied benchmarks (Tables 3.1 and 3.2).

TABLE 3.1 WATER QUALITY BENCHMARKS FOR MINE SITE LAKES

Parameter	Units	Water Quality Guideline	Camp Lake	Mary Lake	Sheardown Lake	Selected Benchmark	Benchmark Method [2]
Metals [3]							
Aluminium	mg/L	0.1	0.026	0.137	0.179 (Shallow) 0.173 (Deep)	CL = 0.1 ML = 0.13; SDL shall/deep = 0.179/0.173	A (CL), B (ML/SDL)
Arsenic	mg/L	0.005	NC	0.00018	0.0001	0.005	A
Cadmium	mg/L	0.0001 (CL) 0.00006 (ML) 0.00009 (SDL)	NC	0.000023	0.000017	0.0001 (CL) 0.00006 (ML) 0.00009 (SDL)	A
Chromium $^{+3}$	mg/L	0.0089	NC	0.005	NC	0.0089	A
Cobalt	mg/L	Variable (FEQG)	NC	NC	0.0002	CL / SDL = 0.0009 ML = 0.0011	D
Copper (dissolved)	mg/L	Variable (FEQG)	0.0023	0.0025	0.0012	CL = 0.0028 ML = 0.0027 SDL NW = 0.0029 SDL SE = 0.0021	D
Iron	mg/L	0.3	0.0421	0.173	0.211	0.3	A
Lead (dissolved)	mg/L	Variable (FEQG)	0.000334	0.00013	0.00026	CL = 0.00500 ML = 0.00430 SDL NW = 0.00485 SDL SE = 0.00455	D
Nickel	mg/L	0.025	0.000941	0.00080	0.000973	0.025	A
Manganese (dissolved)	Mg/L	Variable (FEQG)	0.00195	0.00647	NW – 0.00136 SE – 0.01425	CL / SDL = 0.410 ML = 0.360	D
Silver	mg/L	0.0001	NC	NC	0.0000104	0.0001	A
Strontium	mg/L	2.5	NC	NC	NC	2.5	D
Thallium	mg/L	0.0008	NC	NC	0.0001	0.0008	A
Vanadium	mg/L	0.006	NC	0.00146	0.001	0.006	A
Zinc (dissolved)	mg/L	Variable (CCME)	0.0037	0.0030	0.00391	CL = 0.0125 ML = 0.0170 SDL NW = 0.0125 SDL SE = 0.0110	D
Water Quality Parameters							
Chloride (Cl^-)	mg/L	120	4	13	5	120	A
Ammonia (NH_3+NH_4)	mg N/L	0.855[4]	0.84	0.32	0.44	0.855	A
Nitrite (NO_2^-)	mg N/L	0.060	0.1[5]	0.1[5]	0.1[5]	0.060	A
Nitrate (NO_3)	mg N/L	3	NC	0.11	NC	3	A
Sulphate	mg/L	218	3	7	5	218	A

NOTES:

1. NC = Not Calculable; CL = Camp Lake; ML = Mary Lake; SDL = Sheardown Lake; NW = northwest; SE = southeast; CCME = Canadian Council of Ministers of Environment guideline; FEQG = Federal Environmental Quality Guidelines.
2. Method A = Water Quality Guideline from CCME/B.C. MOE; Method B = 97.5%ile of Baseline; Method C = 3* MDL; Method D = updated Federal Environmental Quality Guideline or CCME (benchmark presented considers modifying factors of pH, hardness, and/or DOC, but TARP will be based on the direct concentration of the parameter relative to the presented benchmark).
3. Total metals unless otherwise noted.
4. Assumes temperature at 10 degrees Celsius (C), and pH of 8.
5. These values are elevated detection limits, and hence, the guideline has been selected as the AEMP benchmark.

TABLE 3.2 WATER QUALITY BENCHMARKS FOR MINE SITE STREAMS

Parameter	Units	Water Quality Guideline	Camp/Sheardown Lake Tributaries	Mary River[3]	Selected Benchmark	Benchmark Method [2]
Metals[4]						
Aluminum	mg/L	0.1	0.179/0.354	0.97	CLT = 0.179 SDLT = 0.350 MR = 0.966	B
Arsenic	mg/L	0.005	0.00012	0.00013	0.005	A
Cadmium	mg/L	0.00008 (CLT) 0.00006 (MR)	NC	0.00002	CLT = 0.00008 MR = 0.00006	A
Chromium $^{+3}$	mg/L	0.0089	0.0015/0.0020	0.005	0.0089	A
Cobalt	mg/L	Variable (FEQG)	0.007	0.0004	CLT/SDLT = 0.0012 MR = 0.0011	D
Copper (dissolved)	mg/L	Variable (FEQG)	0.0034	0.0025	CL = 0.0048 SDLT = 0.0044 MR = 0.0036	D
Iron	mg/L	0.3	0.326/0.543	0.874	CLT = 0.326 SDLT = 0.543 MR = 0.874	B
Lead (dissolved)	mg/L	Variable (FEQG)	0.000333	0.00076	CL = 0.00605 SDLT = 0.00625 MR = 0.00420	D
Manganese (dissolved)	mg/L	Variable (FEQG)	0.021/0.007	0.013	CLT/SDLT = 0.440 MR = 0.370	D
Nickel	mg/L	0.025	0.00168/0.0025	0.0018	0.025	A
Silver	mg/L	0.0001	NC	0.0001	0.0001	A
Strontium	mg/L	2.5	NC	NC	2.5	D
Thallium	mg/L	0.0008	0.0002	0.0002	0.0008	A
Vanadium	mg/L	0.006	NC	0.002	0.006	A
Zinc (dissolved)	mg/L	0.007	0.00470.0057	0.0129	CL = 0.0155 SDLT = 0.0165 MR = 0.0170	D
Water Quality Parameters						
Chloride (Cl^-)	mg/L	120	23	21.55	120	A
Ammonia (NH_3+NH_4)	mg N/L	0.855[5]	0.60	0.60	0.855	A
Nitrite (NO_2^-)	mg N/L	0.060	0.095[6]	0.06	0.060	A
Nitrate (NO_3)	mg N/L	3	0.118	0.14	3	A
Sulphate	mg/L	218	6	8	218	A

NOTES:

1. NC = Not Calculable; CLT = Camp Lake Tributary; MR = Mary River; SDLT = Sheardown Lake Tributary; CCME = Canadian Council of Ministers of Environment guideline; FEQG = Federal Environmental Quality Guidelines.
2. Method A = Water Quality Guideline from CCME/B.C. MOE; Method B = 97.5% percentile of Baseline; Method C = 3* MDL; Method D = updated Federal Environmental Quality Guideline or CCME benchmark presented considers modifying factors of pH, hardness, and/or DOC, but TARP will be based on the direct concentration of the parameter relative to the presented benchmark.
3. One sample (outlier) containing chemical concentrations orders of magnitude above other values was not included in the calculations for Mary River.
4. Total metals unless otherwise noted.
5. Assumes temperature at 10 degrees Celsius (C), and pH of 8.0.
6. 97.5th percentile was being driven by elevated detection limit; therefore, the guideline was selected.

3.1.1.2 SEDIMENT QUALITY BENCHMARKS

The parameters selected for sediment quality benchmark development applicable to Project Mine Site area lakes were as follows:

- Arsenic
- Cadmium
- Chromium
- Copper
- Iron
- Lead
- Manganese
- Mercury
- Nickel
- Phosphorus
- Zinc

The higher of the average between the CCME/surrogate upper and lower effect guideline, 97.5th percentile of natural baseline concentration, or average between the 97.5th percentile of baseline and reference lake concentration was selected as the AEMP benchmark applicable to each individual study area lake (Table 3.3).

3.2 NUTRIENT/EUTROPHICATION INDICATORS AND BENCHMARKS

The AEMP indicator selected to reflect potential Project-related effects on phytoplankton abundance in freshwater is the aqueous concentration of chlorophyll-*a* (North/South Consultants Inc. [NSC], 2014a). Chlorophyll-*a* is the most widely used indicator of phytoplankton abundance and is relatively easy to sample. In addition, chlorophyll-a concentrations generally show lower analytical variability and analysis is more cost-effective than for biomass and community composition endpoints. Chlorophyll-a monitoring for the AEMP also considers related/supporting information regarding nutrients (phosphorus and nitrogen), measures of water clarity (i.e., TSS, turbidity, Secchi disk depth), and temperature for the analysis of effects on phytoplankton as part of the reporting process.

TABLE 3.3 SEDIMENT QUALITY BENCHMARKS (INTRINSIK, 2015)

Jurisdiction, Type of Guideline and Statistical Metric		Hg	As	Cd	Cr	Cu	Fe	Mn	Ni	P*	Pb	Zn
CCME (2014)	ISQG	0.17	5.9	0.6	37.3	35.7	NGA	NGA	NGA	NGA	35	123
	PEL	0.486	17	3.5	90	197	NGA	NGA	NGA	NGA	91.3	315
Ontario (OMOE, 2008)	LEL	0.2	6	0.6	26	16	20,000	460	16	600	31	120
	SEL	2	33	10	110	110	40,000	1100	75	2,000	250	820
97.5th Percentiles of Baseline for Lake Areas and Lake-Specific Benchmarks												
Camp Lake (2007 - 2014) (N=20)		<0.1	5.1	<0.5	85	50	47,637	3,362	72	1480	23	96
AEMP Benchmark – Camp Lake		0.33A	11.5A	2.1A	89C	84C	67,866C	3,441C	72B	1,962C	63A	219A
Sheardown Lake NW (2007-2014, excluding 2008) (N=39)		<0.1	7.4	<0.5	94	60	55,378	4,754	82	2,160	24	97
AEMP Benchmark - Sheardown Lake NW		0.33A	11.5A	2.1A	94B	89C	71,736C	4,754B	82B	2,302C	63A	219A
Sheardown Lake SE (2007 - 2014) (N=11)		<0.1	2.0	1.0	79	56	34,400	657	66	1,278	18	63
AEMP Benchmark - Sheardown Lake SE		0.33A	11.5A	2.1A	86C	87C	61,247C	2,089C	66B	1,861C	63A	219A
Mary Lake (2007 - 2014) (N= 17)		<0.1	4.6	<0.5	99	39	49,840	4,486	69	1,575	26	138
AEMP Benchmark – Mary Lake		0.33A	11.5A	2.1A	99B	79C	68,967C	4,486B	69B	2,010C	63A	219A
97.5th Percentile of Reference Lake 3 Values												
Reference Lake 3 (2015 – 2021) (N=70)		0.08	7.9	0.3	94	118	88,095	3,521	65	2,444	57	122

NOTES:

1. Abbreviations are as follows: ISQG = Interim Sediment Quality Guideline; PEL = Probable Effect Level; LEL = Lowest Effect Level; SEL = Severe Effect Level; NGA = no guideline available; Hg = mercury; As = arsenic; Cd = cadmium; Cr = chromium; Cu = copper; Fe = iron; Mn = manganese; Ni = nickel; P = phosphorus; Pb = lead; Zn = zinc.
2. Metal concentration units are in mg/kg (dry weight) unless otherwise noted.
3. As recommended by Minnow, arsenic, copper and iron sediment quality benchmarks may be modified in the future to account for the elevated levels of these metals observed in sediments of Reference Lake 3 during the 2015 CREMP field program.
4. *=N for phosphorus is lower than other elements / parameters.
5. For benchmarks, A = guideline is based on average between the sediment quality guideline upper and lower effect level (CCME or Ontario).
6. For benchmarks, B = guideline is based on 97.5% percentile of baseline data.
7. For benchmarks, C = guideline is based on average between the 97.5th percentile of baseline and reference lake concentration
8. Where mercury and cadmium were not detected in any samples in a given area, the detection limit was used in place of the 97.5% percentiles.

An AEMP benchmark for chlorophyll-*a* of 3.7 µg/L has been selected for the Mine Site area lakes based on maintaining the trophic status at the time of baseline (i.e., oligotrophic). Specifically, the benchmark represents the average of the upper and lower ranges of trophic boundaries for lakes based on chlorophyll-a as designated and/or adopted in the scientific literature (Table 3.4).

TABLE 3.4 DERIVATION OF THE BENCHMARK FOR CHLOROPHYLL-*A*

Reference	Chlorophyll *a* (µg/L)	
	Maximum Oligotrophic	**Minimum Mesotrophic**
OECD (1982) and AENV (2014)	2.5	2.5
Wetzel (2001)	4.5	3.0
Nürnberg (1996)	3.5	3.5
Carlson (1977)	2.6	2.6
Swedish EPA (2000)	5.0	5.0
USEPA (2009)	2.0	2.0
University of Florida (2002)	3.0	3.0
Galvez-Cloutier R. and M. Sanchez. (2007)	3.0	3.0
Ryding and Rast (1989)	8.0	8.0
Average	3.8	3.6
Average of Upper / Lower Range	3.7	

3.3 BENTHIC MACROINVERTEBRATE INDICATORS AND BENCHMARKS

Unlike water or sediment quality where protection of aquatic life guidelines is often used as the basis for development of triggers or thresholds for effects assessment, no generic benchmarks for benthic invertebrate community endpoints exist. Instead, the magnitude of change relative to baseline conditions and/or to expected background conditions at a specified Critical Effect Size (CES) can be adopted as a basis for evaluating project-related effects to benthic invertebrates. A CES of two standard deviations below an applicable baseline mean or reference area mean has been adopted as the benchmark for the Baffinland AEMP based on adoption of values/rationale used for federal EEM studies under the MDMER. Under the MDMER approach, confirmed project-related effects to benthic invertebrates reflect the results of two consecutive surveys.

3.4 ARCTIC CHAR INDICATORS AND BENCHMARKS

Assessment of potential Project-related effects on fish under the AEMP focuses on non-lethal evaluation of Arctic char health at Mine Site area lakes. The fish health survey targeted Arctic char primarily because this species is the most abundant in the mine's regional lakes, sufficient baseline catch and measurement data exist to allow temporal comparisons, and because Arctic char are also important as an Inuit subsistence food source. The approach employed for Arctic char health evaluation closely mirrored the approach developed for the federal EEM program based on non-lethal sampling methods to limit monitoring-related effects on the fish population size. Similar to the benthic invertebrate community analysis, CES were incorporated as AEMP benchmarks for the basis of determining effects on Arctic char health. Where adequate sample sizes allow, the CES were applicable for comparisons of existing data to baseline conditions and background/reference conditions. A CES of 25% or 10% below the baseline or reference area central tendency have been adopted as the benchmark for Baffinland AEMP fish health study based on adoption of values/rationale used for federal EEM studies under the MDMER (Table 3.5). The applicability/appropriateness of these benchmarks will be reviewed routinely and, if appropriate, modified over time as per EEM technical guidance.

TABLE 3.5 FISH METRICS AEMP BENCHMARKS

Effect Indicators	Non-Lethal Survey	(Threshold) Fish Effect Endpoint	CES[2]	Statistical Test
Growth	*Length of YOY (age 0) at end of growth period	Length and weight of YOY (age 0) and age 1+ at end of growth period	>25% lower	ANOVA
	*Weight of YOY (age 0) at end of growth period			ANOVA
	*Length and weight of 1+ fish			ANOVA
Reproduction	*Relative abundance of YOY (% composition of YOY)	Relative abundance of YOY (% composition of YOY)	>25% lower	Kolmorgorov-Smirnov test performed on length-frequency distributions with and without YOY included; OR proportions of YOY can be tested using a Chi-squared test.
Condition	*Weight-at-length	Condition	>10% lower	ANCOVA
Survival	*Length-frequency distribution	Length or age frequency distribution	>25% lower	2-sample Kolmorgorov-Smirnov test

NOTES:

1. Metrics indicated with an asterisk are endpoints used for determining effects as designated by statistically significant differences between existing data and baseline data and/or existing background (reference) data.
2. CES (Critical Effect Size) are expressed as a percentage of the reference means.

3.5 EFFECTS PREDICTIONS

Adaptive management includes short-term and longer-term review and response cycles[2] (Section 2.3). The thresholds described above are applied under the TARPs to guide short-term adaptive management (Appendix C)). Effects predictions from the FEIS and addendums are thresholds that are appropriate for longer-term review and response cycles, such as the annual review of regulatory compliance and unexpected effects. The effects predictions from the FEIS and addendums are intended as the basis of comparison to the Project's performance as described in Section 6.1 Annual Review of Compliance and Unanticipated Effects. Baffinland may also identify the need for further adaptive management when unanticipated effects or effects that exceed FEIS predictions occur.

[2] Short-term is on the scale of annual, versus long-term which is multi-year.

3.6 EEM UNDER MDMER

As a metal mine, the discharge of mine effluents at the Mary River Project is regulated by the MDMER. These regulations, administered under the federal *Fisheries Act*, apply to mining and milling operations that have discharged effluent(s) at a rate greater than 50 m^3/day. Baffinland triggered the MDMER (MMER at the time) regulations on July 10, 2015, triggering EEM studies at the Mary River Project. The MDMER monitoring program provides a mechanism for evaluating environmental effects and responding to unexpected effects of contact water discharges on the aquatic environment. The EEM program consists of effluent volume and quality studies, receiving environment water quality studies and biological studies. Effluent monitoring includes chemistry assessment and toxicity sampling conducted at prescribed frequencies for all applicable effluent discharges as per Table 3.6. (Each location is described further in Table 3.7.

TABLE 3.6 COMPONENTS OF EFFLUENT MONITORING UNDER THE MDMER

Component	Frequency
Deleterious substances monitoring	Weekly during discharge.
Effluent characterization	Once per calendar quarter, at least one month after the previous quarterly sample; on effluent samples tested for acute lethality.
Acute lethality testing (Rainbow Trout and Daphnia magna)	Monthly; additional testing if effluent found to be acutely lethal.
Sublethal toxicity testing (fish, invertebrate species, plant species, algal species in freshwater and marine water)	Quarterly during discharges (generally once annually at Mary River) concurrent with effluent characterization samples. Testing is completed only at the FDP that contributes the highest loadings of deleterious substances taking receiving environment dilution factors into account, which as of the third EEM cycle completed in 2023 at the Project is FDP MS-08 at the waste rock facility. Sublethal toxicity testing data are used to inform biological effects and are not used for evaluating regulatory compliance. After the third year of monitoring, Baffinland was able to reduce the frequency of sampling to once per calendar quarter on the test species that was most sensitive to effluent over the previous three years (*Lemna minor*).
Effluent volume monitoring	Total monthly volume of effluent deposited from each FDP for each month during which there was a deposit (discharge).

Adaptive management is built into the effluent monitoring component of the MDMER sampling program. If a monthly effluent sample is determined to be acutely lethal by an acute lethality test, the following additional actions are required:

- Effluent characterization testing on each failing sample
- Acute lethality testing of grab samples from the same final discharge point twice monthly (but not less than seven days apart)

The regular frequency of acute lethality sampling can be resumed if the effluent is not acutely lethal in three consecutive tests. Additionally, the frequency of acute lethality testing at a given FDP may be reduced to once each calendar quarter if the effluent from that FDP is determined not to be acutely lethal for 12 consecutive months.

If any of the following has occurred, Baffinland shall notify an ECCC inspector without delay and report the results in writing to the inspector within 30 days:

- MDMER Discharge Limits in Schedule 4 are or have been exceeded

- Effluent pH is less that 6.0 or greater than 9.5
- An effluent is acutely lethal

If any of the above have occurred over the year, the causes of non-compliance must be described in the annual report to ECCC along with remedial measures that are planned or that have been implemented.

The objective of the MDMER EEM biological studies is to determine whether mine effluent is causing effects on fish, fish habitat (e.g., benthic invertebrate food resources), and/or the human use of fisheries resources (e.g., mercury and selenium in fish tissues; Environment Canada 2012). The objective of EEM biological studies is to determine whether mining activity is causing an effect on fish, benthic invertebrate communities and/or the use of fisheries resources (based on mercury and/or selenium accumulation in fish tissues). Each EEM biological study collectively includes the preparation of a study design document, field survey(s) implementation, preparation of an interpretive report document, and electronic data submission. All these tasks are required to be conducted within a 36-month period, the timeframe of which is referred to as a “Phase”. Within each EEM phase, mines must submit a biological monitoring Study Design to the federal Minister of Environment and Climate Change (i.e., ECCC) for regulatory approval at least six months prior to field study implementation. The Study Designs are developed considering relevant site characterization information, previous biological monitoring results and recommendations, regulator comments and recommendations from the Mine’s previous EEM Study Designs, and previous EEM Interpretive Reports, the newly issued MDMER (Government of Canada 2023), and the most recent technical guidance (Environment Canada 2012).

For mines that have more than one FDP, the receiving environment that has the greatest potential to show adverse environmental impacts as determined through evaluation of greatest total monthly loadings of deleterious substances and the manner in which effluent mixes within the receiving environment serves as the focus for EEM biological studies (Government of Canada 2023). This is determined through the EEM study design for each cycle. Currently effluent is discharged into Mary River directly or via Trib F, as well as into SDLT. Table 3.7 contains information about all established FDPs at the project. Additional future development of the Mine Site may necessitate discharge of treated effluent to Camp Lake Tributary 1 (Figure 3.1; or other, yet-to-be-determined waterbodies.

TABLE 3.7 MARY RIVER PROJECT CURRENT AND ANTICIPATED FINAL DISCHARGE POINTS

Discharge Source	Effluent Final Discharge Point Identifier	Coordinates (NAD 83)		Receiving Waterbody	Existing AEMP Receiving Environment Downstream Monitoring Locations				
		Latitude	Longitude		Water Quality	Sediment Quality	Phytoplankton	Benthic Invertebrates	Fish
Waste Rock Facility (East Pond[1])	MS-08	71˚20'24.7"	79˚13'18.4"	Unnamed Tributary to Mary River (Mary River Tributary-F)	Mary River Tributary-F (FO-01) Mary River (MS-08-DS, EO-10)	Mary Lake	Mary River Tributary-F (FO-01) Mary River (EO-10)	Mary River (E0-01) Mary River Tributary-F (EEM only)	Mary River (EEM only) and Mary Lake
Ore Stockpile (Crusher) Pond	MS-06	71˚18'06.4"	79˚15'29.7"	Mary River	Mary River (EO-20 and EO-21)	Mary Lake	Mary River (EO-20 and EO-21)	Mary River (EO-20)	Mary River (EEM only) and Mary Lake
KM105 Pond	MS-11	71° 18' 45.7"	79° 15' 47.5"	Sheardown Lake Tributary 1	SDLT-1 (D1-00 and D1-05)	Sheardown Lake NW	SDLT-1 (D1-00 and D1-05)	SDLT1-R1	Sheardown Lake NW
Run-of-Mine Stockpile Facility	MS-07	71° 18' 41.4"	79° 13' 18.7"	Mary River	Mary River (EO-03 and EO-21)	Mary Lake	Mary River (EO-03 and EO-21)	Mary River (EO-01)	Mary River (EEM only) and Mary Lake

NOTES:

1. An interim sedimentation pond has been constructed to contain runoff from the waste rock stockpile generated during Early Revenue Phase operations.

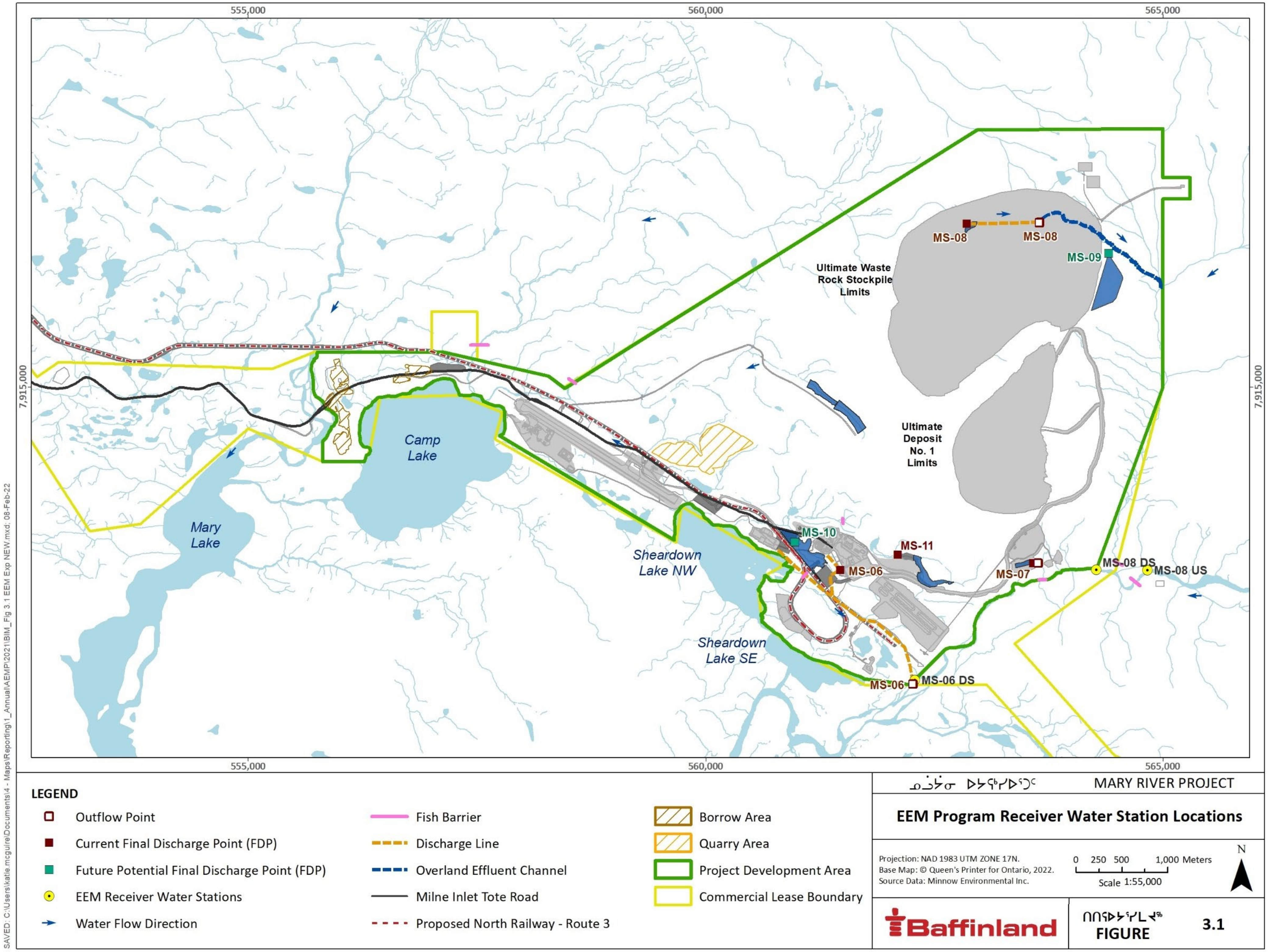

FIGURE 3.1 CURRENT AND FUTURE FDP STATION LOCATIONS

3.7 CREMP STUDY DESIGN

3.7.1 CREMP OVERVIEW

The CREMP has been established to monitor and track effects of the Project on aquatic environments within and adjacent to the Project. The CREMP is designed to implement follow-up monitoring to validate predictions to aquatic valued ecosystem components (VECs) and key indicators that include:

- Water quantity
- Water and sediment quality
- Freshwater biota (benthic invertebrates, phytoplankton, and Arctic char)

While the EEM program is designed to characterize effluent quality and determine potential effects on biota occurring within freshwater environments that receive mine effluent discharges, the CREMP is designed to evaluate potential effects to water quality, sediment quality, and freshwater biota on a larger geographic scale for a greater range of contaminant pathways (e.g., non-point source dust deposition, changes in water flow due to diversions, cumulative effluent discharges from mining operations and sewage treatment facilities) than EEM studies. Based on the FEIS, potential aquatic effects at the Mine Site were predicted to be confined to Mary River, Camp Lake, Sheardown Lake and their associated tributaries (Figure 2.1), and therefore sampling under the CREMP targets these waterbodies. Mary Lake is the ultimate receiving water for these drainage areas, but this lake was of sufficient size that no detectable effects were predicted for this waterbody under the FEIS. Nevertheless, the CREMP includes monitoring in Mary Lake to confirm this prediction. Overall, the CREMP includes monitoring at the following watercourses/waterbodies for the rationales provided below:

- Camp Lake Tributaries and Sheardown Lake Tributaries. These tributaries may be affected by dust deposition, runoff and water diversions over the course of mine operations, and Camp Lake Tributary 1 will receive treated waste rock stockpile runoff effluent via West Pond in the future.
- Sheardown Lake. Changes in water quality due to airborne dust dispersion and surface runoff, sewage effluent discharges from the exploration camp during the original mine construction, and changes in hydrology may affect conditions at Sheardown Lake, as well as potential changes in productivity in tributaries to Sheardown Lake.
- Camp Lake. Surface runoff from tributaries affected by dust deposition, mine effluent (future West Pond), water diversions and withdrawals, as well as changes in water quality due to airborne dust dispersion may affect this lake over the course of operations.
- Mary River. Airborne dust dispersion and reception of treated mine and Sewage Treatment Plant effluents discharged to multiple locations along the river over the course of operations.
- Mary Lake. As the ultimate receiving waters for flow from Camp Lake, Sheardown Lake and Mary River, Mary Lake reflects the cumulative receiver for all surface waters draining from the Mine Site over the course of operations.

In 2015, Reference Lake 3 was established as the reference lake for the CREMP to assist in identifying mine influenced changes to water, sediment and freshwater biota of Mine Site area lakes relative to a representative background system (Tables 3.8, 3.9 and 3.10). Streams used as reference areas for the CREMP include an unnamed tributary to the Mary River and two unnamed tributaries to Angajurjualuk Lake, all of which are located southeast of the Mine Site (Tables 3.8, 3.9 and 3.10). An area of Mary River located well upstream of current mine activity (i.e., G0-09) serves as a reference area for the mine-exposed portion of Mary River (Table 3.8).

3.7.2 WATER QUALITY

The key pathways of potential effects of the Project on water quality include:

- Water quality changes related to discharge of treated effluent from ore and related rock storage areas, collected site runoff, etc. to freshwater systems (e.g., immediate receiving environments including Mary River, Sheardown Lake Tributary 1 and Camp Lake Tributary 1)
- Water quality changes related to discharge of treated sewage effluent (primarily nutrients and total suspended solids [TSS]) to freshwater systems (e.g., immediate receiving environments including Mary River and, historically, Sheardown Lake NW)
- Water quality changes due to non-point source deposition of dust in lakes and streams (e.g., Mine Site area in zone of dust deposition)
- Water quality changes due to non-point sources including site runoff and aerial deposition of Ammonium Nitrate Fuel Oil (ANFO) explosives (e.g., near Mine Site)

The key question related to the pathways of effect is:

- *What is the estimated mine-related change in contaminant concentrations in the exposed area?*

The primary issue of concern with respect to water quality is related to the combined effects on metal and TSS concentrations from mine effluent discharges and aerial deposition of ore dust on water quality in lakes, streams and rivers adjacent to site operations. In addition, the discharge of treated sewage effluent also has the potential to cause eutrophication of Mary River based largely on greater potential inputs of total phosphorus (TP) to the system.

Water quality monitoring includes collection of in situ field measures, visual evaluation of surface water (oil) sheen, and water chemistry sampling at lake, stream, and river stations representing both mine-exposed and reference waterbodies. Power analysis of the baseline water quality from the mine-exposed lakes indicated that data from a minimum of three stations was sufficient to detect a difference equidistant between the AEMP benchmark and 97.5th percentile of baseline data at high probability (i.e., $\alpha = \beta = 0.1$) when assessing for annual changes in water chemistry relative to pre-mine conditions. Accordingly, water chemistry will be monitored from three stations at each of Camp Lake, Sheardown Lake NW, Sheardown Lake SE and Reference Lake 3, and from six stations at Mary Lake for the CREMP (Tables 3.8, 3.9, and 3.10; Figure 3.2). Three sampling events, including a winter ice-cover (April to May) and summer (July to early August) and fall (late August to September) open-water periods, will be conducted annually at each lake except Reference Lake 3. Due to accessibility and associated personnel safety concerns, no winter sampling event will be conducted at Reference Lake 3, which is located approximately 60 km south of the Mine Site. During each winter, summer, and fall sampling event, field measures of water temperature, dissolved oxygen, pH, specific conductance and turbidity will initially be taken as a vertical profile at one metre (m) intervals at a designated profile station for each lake as follows:

- Camp Lake – Station JL0-07
- Sheardown Lake NW - Station DL0-01-2
- Sheardown Lake SE - Station DL0-02-3
- Mary Lake (North Basin) - Station BL0-1A
- Mary Lake (South Basin) - Station BL0-9
- Reference Lake 3 (NW Basin) - Station REF03-3

In addition, the field measures will include determination of Secchi depth at each lake profile station. Temperature and dissolved oxygen data from the profile station will be reviewed while in the field and used to guide the subsequent water chemistry sampling approach independently for the sampling event and study lake. In cases in which no thermal stratification or oxycline development is apparent at the lake during the sampling event, a single water chemistry sample will be retrieved from near the surface of the water column (i.e., approximately 2 m below the surface) at each sampling station on the respective lake. In cases in which thermal stratification or oxycline development is apparent at the lake during the sampling event, two water chemistry samples will be retrieved at each sampling station on the respective lake, including one near the surface and the other near the bottom. The water chemistry samples will be submitted to an accredited laboratory for analysis using standard methods. Parameters to be included in the chemistry analysis include: hardness, alkalinity, TSS, Total Dissolved Solids (TDS), nutrients (total ammonia, nitrate, nitrite, total phosphorus, total Kjeldahl Nitrogen, TOC, DOC), phenols, bromide, chloride, and sulphate, and total and dissolved metals (including aluminum, arsenic, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, thallium, uranium, and zinc). In the event that oil sheen is observed on the water surface at any lake station, oil and grease sampling will also be conducted for analytical determination of total hydrocarbon concentrations and the source of the sheen will be immediately investigated.

Water quality monitoring will be conducted at a total of 17 stream stations (including 13 mine-exposed stations and four reference stations) and 13 river stations (including ten mine-exposed stations and three reference stations; Figure 3.2). Similar to sampling conducted at lakes, water quality sampling at streams and rivers will be conducted three times per calendar year, corresponding to spring freshet (early July), summer (late July to early August) and fall (late August to September) sampling events. The same in situ field measures, excluding Secchi depth and including visual evaluation of surface water (oil) sheen, will be collected near the bottom of the water column at each stream and river sampling station during each sampling event. Water chemistry samples will be retrieved near the middle of the water column at each stream and river water quality station. The water chemistry samples will be submitted to the same accredited laboratory and analyzed for the same parameters indicated above for samples retrieved from lakes. Also similar to sampling conducted at lakes, in the event that oil sheen is observed on the water surface at any stream/river station, oil and grease sampling will also be conducted for analytical determination of total hydrocarbon concentrations and the source of the sheen will be immediately investigated.

Water quality data will be compared to AEMP benchmarks and/or applicable water quality guidelines for the protection of aquatic life, to data collected at applicable reference areas, and to baseline water quality data. The interpretation of data relative to AEMP benchmarks may prompt additional weight of evidence analysis to determine links to mine-related operations as outlined in the TARP (Section 5).

TABLE 3.8 CREMP REFERENCE AND MINE-EXPOSED STATIONS FOR THE MARY LAKE SYSTEM

Study System	Water Body	Representative Water Quality Station [d]			Reference Area used for each Study Component [a, b, c]				
		Station Identifier	Easting	Northing	Water Quality	Sediment Quality	Phytoplankton	Benthic Invertebrates	Fish
Reference Areas	Lotic Reference	CLT-REF3	567004	7909174	Y	-	Y	-	-
		CLT-REF4	568533	7907874	Y	Y	Y	Y	-
		MRY-REF3	585407	7900061	Y	-	Y	-	-
		MRY-REF2	570650	7905045	Y	-	Y	-	-
	Reference Lake 3	REF-03-W1	575642	7852666	Y	Y	Y	Y	Y
		REF-03-W2	574836	7852744	Y		Y		
		REF-03-W3	574158	7853237	Y		Y		
	Mary River Reference	G0-09-A	571264	7917344	Y	-	Y	-	-
		G0-09	571546	7916317	Y	Y	Y	Y	-
		G0-09-B	571248	7914682	Y	-	Y	-	-
Mary River and Mary Lake System	Mary River	G0-03	567204	7912587	Mary River G0-09 Average	Mary River G0-09 Average	Mary River G0-09 Average	Mary River G0-09 Average	Not Applicable
		G0-01	564459	7912984					
		F0-01	564483	7913015					
		E0-21	562444	7911724					
		E0-20	561688	7911272					
		E0-10	564405	7913004					
		E0-03	562974	7912472					
		C0-10	560669	7911633					
		C0-05	558352	7909170					
	Mary Lake (North Basin)	BL0-01	554691	7913194	Reference Lake 3	Reference Lake 3	Reference Lake 3	Reference Lake 3	Not Applicable
		BL0-01-A	554300	7913378					
		BL0-01-B	554369	7913058					
		BL0-05	554632	7906031					
		BL0-06	555924	7903760					
		BL0-09	554715	7904479					

NOTE:

1. Bold indicates lake water quality stations selected by Minnow for *in situ* profiling.

TABLE 3.9 CREMP REFERENCE AND MINE-EXPOSED STATIONS FOR THE CAMP LAKE SYSTEM

Study System	Water Body	Representative Water Quality Station [d]			Reference Area used for each Study Component [a, b, c]				
		Station Identifier	Easting	Northing	Water Quality	Sediment Quality	Phytoplankton	Benthic Invertebrates	Fish
Reference Areas	Lotic Reference	CLT-REF3	567004	7909174	Y	-	Y	-	-
		CLT-REF4	568533	7907874	Y	Y	Y	Y	-
		MRY-REF3	585407	7900061	Y	-	Y	-	-
		MRY-REF2	570650	7905045	Y	-	Y	-	-
	Reference Lake 3	REF-03-W1	575642	7852666	Y	Y	Y	Y	Y
		REF-03-W2	574836	7852744	Y		Y		
		REF-03-W3	574158	7853237	Y		Y		
Camp Lake System	Camp Lake Tributaries	I0-01	555470	7914139	Lotic Reference Average	CLT-REF4	Lotic Reference Average	CLT-REF4	Not Applicable
		I0-02	554640	7913850					
		J0-01	555701	7913773					
		K0-01	557390	7915030					
		L0-01	557681	7914959					
		L1-02	558765	7915121					
		L1-05	558040	7914935					
		L1-08	561076	7915068					
		L1-09	558407	7914885					
		L2-03	559081	7914425					
	Camp Lake	JL0-02	557615	7914750	Reference Lake 3	Reference Lake 3	Reference Lake 3	Reference Lake 3	Reference Lake 3
		JL0-07	556800	7914094					
		JL0-09	556335	7913955					

NOTE:

1. Bold indicates lake water quality stations selected by Minnow for *in situ* profiling.

TABLE 3.10 CREMP REFERENCE AND MINE-EXPOSED STATIONS FOR THE SHEARDOWN LAKE SYSTEM

Study System	Water Body	Representative Water Quality Station [d]			Reference Area used for each Study Component [a, b, c]				
		Station Identifier	Easting	Northing	Water Quality	Sediment Quality	Phytoplankton	Benthic Invertebrates	Fish
Reference Areas	Lotic Reference	CLT-REF3	567004	7909174	Y	-	Y	-	-
		CLT-REF4	568533	7907874	Y	Y	Y	Y	-
		MRY-REF3	585407	7900061	Y	-	Y	-	-
		MRY-REF2	570650	7905045	Y	-	Y	-	-
	Reference Lake 3	REF-03-W1	575642	7852666	Y	Y	Y	Y	Y
		REF-03-W2	574836	7852744	Y		Y		
		REF-03-W3	574158	7853237	Y		Y		
Sheardown Lake System	Tributary 1	D1-00	560329	7913512	Lotic Reference Average	CLT-REF4	Lotic Reference Average	CLT-REF4	Not Applicable
		D1-05	561397	7913558					
	Tributary 9	D9-1	561848	7911860					
	Tributary 12	D12-1	560953	7912988					
	Sheardown Lake NW	DD-Hab9-Stn1	560259	7913455	Reference Lake 3	Reference Lake 3	Reference Lake 3	Reference Lake 3	Reference Lake 3
		DL0-01-2	560353	7912924					
		DL0-01-7	560525	7912609					
	Sheardown Lake SE	**DL0-02-3**	561046	7911915	Reference Lake 3	Reference Lake 3	Reference Lake 3	Reference Lake 3	Reference Lake 3
		DL0-02-4	561511	7911832					
		DL0-02-6	560756	7912167					

NOTE:

1. Bold indicates lake water quality stations selected by Minnow for *in situ* profiling.

3.7.3 SEDIMENT QUALITY

The key pathways of potential effects of the Project on sediment quality include:

- Sediment quality changes related to discharge of treated effluent from ore stockpile and other surface runoff to freshwater systems (e.g., immediate receiving environments including Mary River, Sheardown Lake Tributary 1 and Camp Lake Tributary 1);
- Sediment quality changes related to discharge of treated sewage effluent (primarily nutrients and TSS) to freshwater systems (e.g., immediate receiving environments including Mary River and, historically, Sheardown Lake NW);
- Sediment quality changes due to direct deposition of dust in lakes and streams (Mine Site area in zone of dust deposition); and
- Sediment quality changes due to dust deposition on land and subsequent runoff into lakes and streams (Mine Site area in zone of dust deposition).

The key question related to the pathways of effect is:

- *What is the estimated mine-related change in contaminant concentrations in the exposed area?*

The primary issue of concern with respect to sediment quality is the effect of ore dust containing elevated metals entering lakes, streams and rivers near the Mine Site through direct aerial deposition and/or transfer from deposition on land via surface runoff. As such, the CREMP sediment quality monitoring program focuses upon waterbodies (lakes and streams) located closest to the sources of ore dust. Sediment quality monitoring under the CREMP includes sampling of sediment for physical characterization and metal chemistry at lake, stream, and river study areas reflecting both mine-exposed and reference waterbodies. Within lake environments, sediment quality monitoring stations have been established within shallow littoral and/or deep profundal habitat based on a 12 m deep cut-off, the value of which was used to define lake zonation during baseline characterization studies (KP 2014a, 2015). Five (5) littoral and three (3) profundal sediment quality monitoring stations will be sampled at each of Camp, Sheardown NW and Mary mine-exposed lakes and at Reference Lake 3, which serves as a comparable background (reference) area. Because the majority of Sheardown Lake SE is less than 12 m deep, sediment quality monitoring will be conducted at five (5) littoral stations within this lake. Thus, the resulting sample size of 37 lake sediment quality monitoring stations reflects 25 littoral stations and 12 profundal stations (Figure 3.3; Table 3.11). Concurrent with benthic invertebrate community sampling conducted at the same locations, sediment quality sampling at littoral stations potentially allows linkages to be drawn between metal concentrations in sediment and effects on benthic invertebrates. Because greatest accumulation of depositing material occurs with the deep basin(s) of lakes, monitoring of sediment quality at profundal stations provides the optimal basis for temporal tracking of metals in sediment of the mine-exposed lakes. Sediment quality monitoring at lakes will occur at an annual frequency.

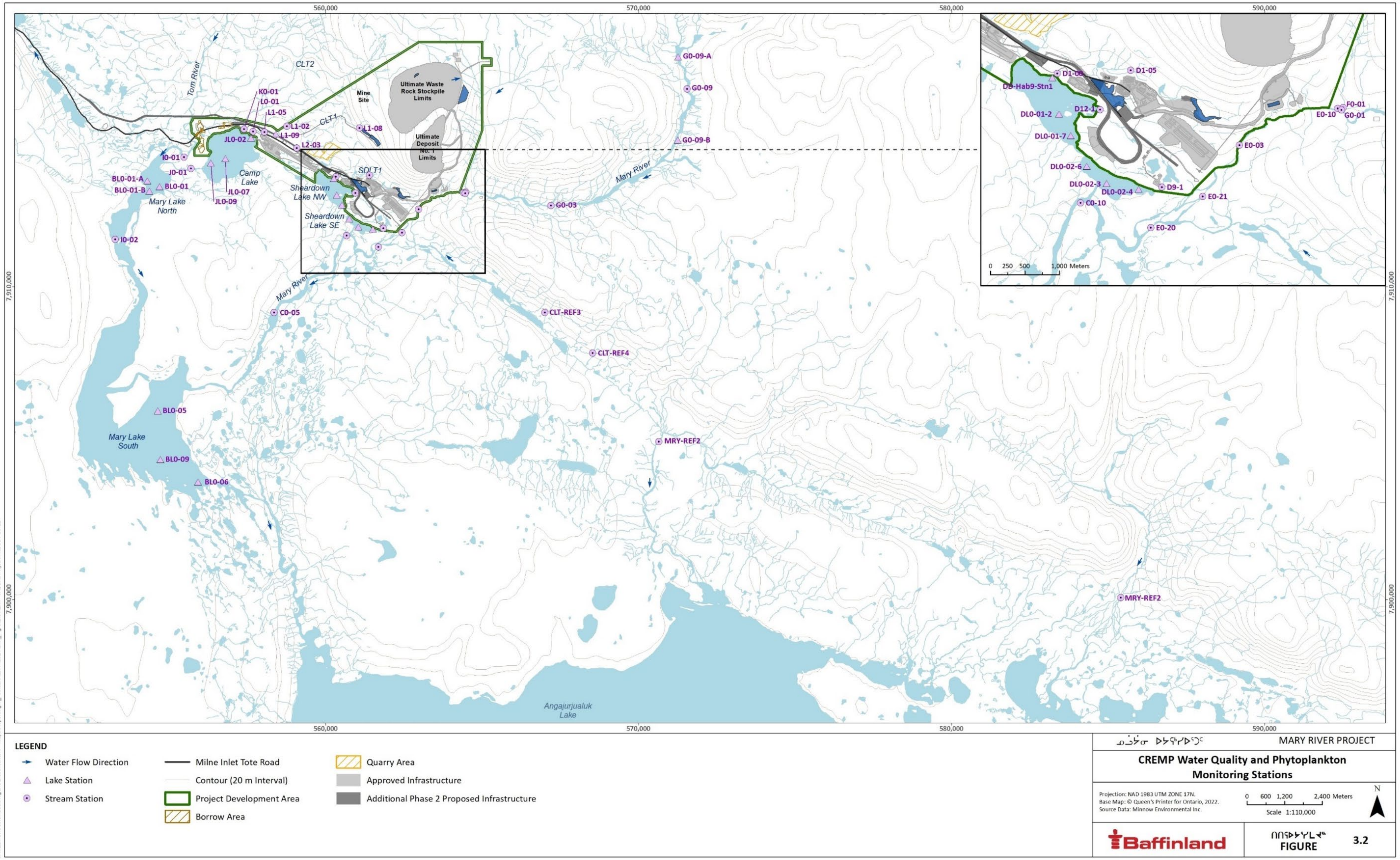

FIGURE 3.2 CREMP WATER QUALITY AND PHYTOPLANKTON MONITORING STATIONS

TABLE 3.11 PROFUNDAL SEDIMENT QUALITY STATIONS

Lake	Station ID	Depth (m)	Sediment Profundal Station Description
Camp Lake	JLO-14	26.5	Central basin - east (inlet area)
	JLO-07	32.7	Central basin - middle
	JLO-11	28.8	Central basin - west (outlet area)
Sheardown Lake NW	DLO-01-5	23.1	Central basin - north
	DLO-01	20.8	Central basin - middle
	DLO-01-2	18.6	Central basin - south
Mary Lake	BLO-12	21.7	South basin - near Mary River Inlet
	BLO-10	18.7	South basin -middle
	BLO-08	26.7	South basin - near lake outlet

Within streams and rivers, sediment quality sampling will be conducted at three stations from each of eight stream and five river study areas that are used to assess mine-related effects to benthic invertebrate communities. The stream sediment sampling locations include Camp Lake Tributary 1 upstream and downstream areas, Camp Lake Tributary 2 upstream and downstream areas, Sheardown Lake tributaries 1, 9 and 12, and an unnamed tributary to Mary River (referred to as CLT-REF2) serving as the stream reference area. The river sediment sampling locations include Mary River G0-03, G0-01, E0-20, and C0-05 mine-exposed study areas and G0-09 upstream reference area. All stream and river study areas were previously observed to contain limited depositional habitat and a general absence of substantial accumulation of fine sediments (KP 2015; Minnow 2016a,b, 2017, 2018). As a result, sediment sampling for chemical characterization is limited to the shoreline and interstices of large, coarse substrate material (e.g., cobbles, boulders) within the applicable study areas. Sediment quality monitoring at streams and rivers is required on a three-year frequency following initiation of the stream and river sediment quality monitoring in 2017.

Sampling of sediment at study lakes will be conducted using gravity coring equipment. At each sediment monitoring station, the surficial two centimetres of sediment will be sampled from a minimum of three core samples to form a composite sample. Sampling of sediment at stream/river stations will be conducted by visually identifying locations containing fine-grained material at the sediment surface and using a silicon/plastic spoon to collect this material. One sample, representing a composite of a variable, recorded, number of grabs using the spoon, will be collected at each stream/river station. Following collection, sediment samples from lake and/or stream/river stations will be shipped to an accredited analytical laboratory for analysis of percent moisture, particle size, TOC content and total metals (including mercury). The sediment quality data will be compared to applicable AEMP benchmarks, reference area data and to baseline sediment quality data. The interpretation of data relative to AEMP benchmarks may prompt additional weight of evidence analysis to determine links to mine-related operations as outlined in the TARP (Section 5).

3.7.4 PHYTOPLANKTON

The key pathways of potential effects of the Project on phytoplankton include:

- Water quantity changes related to water withdrawal, diversions, runoff, and discharge of treated effluent to freshwater systems;

- Water quality changes related to discharge of treated effluent originating from ore or other waste stockpile runoff to freshwater systems (e.g., immediate receiving environments including Mary River, Sheardown Lake Tributary 1 and, under future operations, Camp Lake Tributary 1);
- Water quality changes related to discharge of treated sewage effluent (primarily nutrients and TSS) to freshwater systems (e.g., immediate receiving environments including Mary River and, historically, Sheardown Lake NW);
- Water quality changes due to direct deposition of Project-related dust to lakes, streams and rivers (Mine Site area in zone of dust deposition); and
- Water quality changes due to non-point sources, such as site runoff and use of ANFO explosives (Mine Site).

The key question related to the pathways of effect is:

- *What are the combined effects of point and non-point sources on phytoplankton abundance in Mine Area lakes?*

The primary issue of concern with respect to the phytoplankton community is related to nutrient enrichment and eutrophication, though effects on water clarity (e.g., changes in TSS) could also affect primary productivity. Lakes may be more vulnerable to eutrophication than streams and rivers, and therefore cumulative influences of enrichment on area lakes was a primary concern under the CREMP. Chlorophyll-a is the primary pigment of phytoplankton (i.e., algae and other photosynthetic microbiota suspended in the water column), and therefore aqueous chlorophyll-a concentrations serve as a surrogate for evaluating the amount of photosynthetic microbiota in aquatic environments under the CREMP. Chlorophyll-a samples will be collected at the same stations, same time, same frequency (i.e., three-times annually) and using the same methods and equipment as used for the collection of water chemistry samples (Section 3.3.2). As soon as reasonably possible but within 48 hrs, water samples will be filtered through a 0.45-micron cellulose acetate membrane following which the membrane filter will be frozen prior to shipment. The filters will later be shipped to an accredited analytical laboratory for chlorophyll-a analysis using standard methods.

The chlorophyll-a data will be compared to the AEMP benchmark (i.e., 3.7 µg/L), to data collected at applicable reference areas, and to available baseline data. The interpretation of data relative to an assessment framework and AEMP benchmarks may prompt additional weight of evidence analysis to determine links to mine-related operations as outlined in the TARP (Section 5).

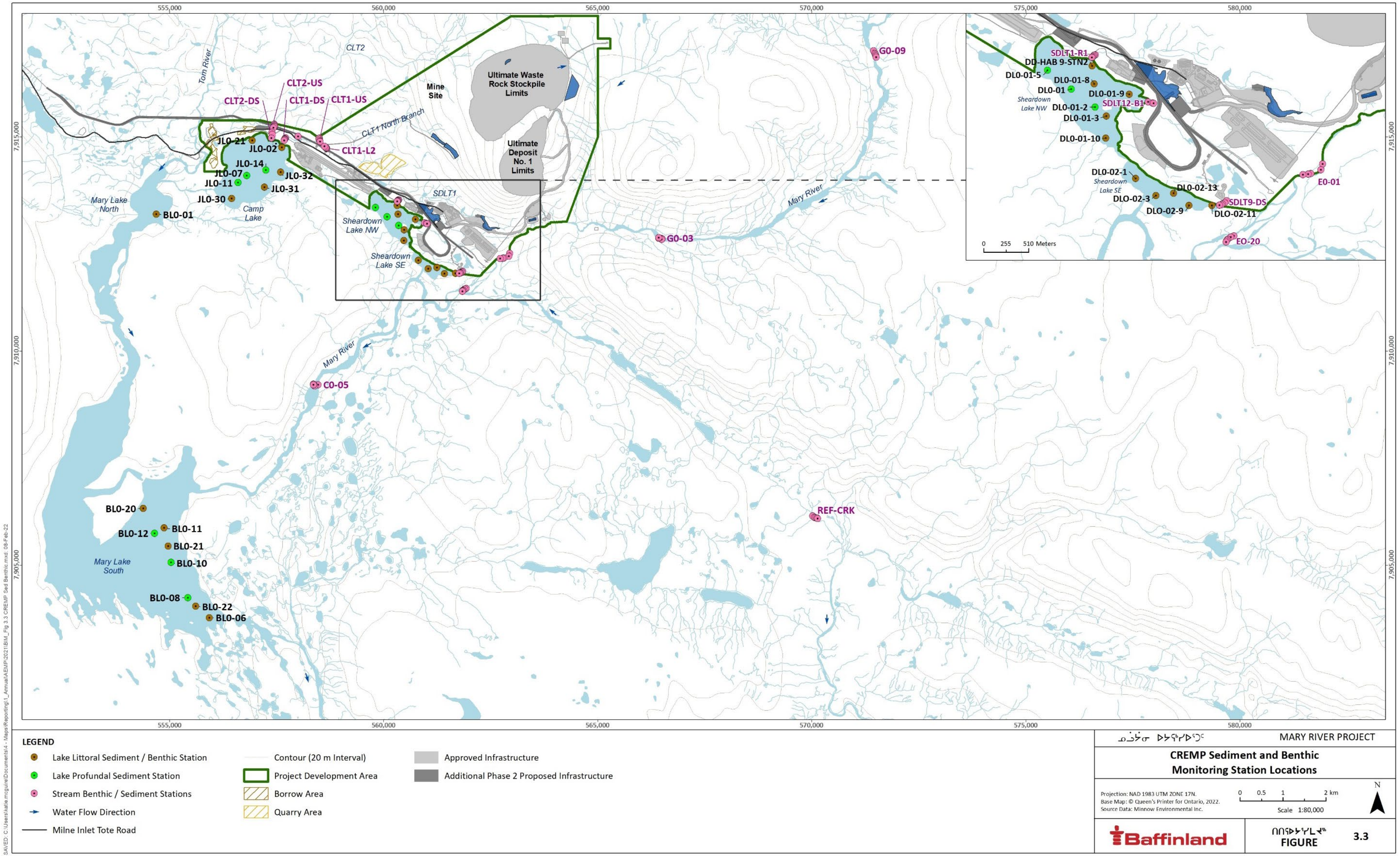

FIGURE 3.3 CREMP SEDIMENT AND BENTHIC MONITORING STATION LOCATIONS

3.7.5 BENTHIC INVERTEBRATES

The key pathways of potential effects of the Project on benthic invertebrate communities include:

- Water quality changes related to discharge of treated effluent from ore stockpile and other waste runoff to freshwater systems (e.g., immediate receiving environments including Mary River, Sheardown Lake Tributary 1 and, in the future, Camp Lake Tributary 1)
- Water quality changes related to discharge of treated sewage effluent (primarily nutrients and TSS) to freshwater systems (e.g., immediate receiving environments including Mary River currently and, historically, Sheardown Lake NW)
- Water quality changes due to deposition of dust in lakes and streams (Mine Site in zone of dust deposition)
- Water quality changes due to non-point sources, such as site runoff and aerial deposition of ANFO explosives residue (Mine Site)
- Changes in water levels and/or flows due to water withdrawals, diversions, and effluent discharges (i.e., alteration or loss of aquatic habitat)
- Changes in sediment quality due to effluent discharge and/or dust deposition
- Sedimentation in aquatic systems related to dust deposition
- Effects of the Project on primary producers

The key question related to the pathways of effect is:

- *What are the combined effects of point and non-point sources, aquatic habitat loss or alteration, sedimentation, and changes in primary producers on benthic invertebrate abundance and community composition in Mine Area lakes?*

Benthic invertebrate communities are often used as indicators of aquatic ecosystem health because individual groups and/or species of benthic invertebrates exhibit differing sensitivities to anthropogenic stressors and respond in relatively predictable ways to these stressors, and because benthic invertebrates show relatively limited mobility that results in effective integration of effects at the local community level. In addition, benthic invertebrates are an important food resource for fish. Therefore, the monitoring of benthic invertebrate communities represents a primary tool for evaluating potential Project-related effects on aquatic biota and fisheries resources.

The CREMP benthic invertebrate community (benthic) survey incorporates both control-impact and a before-after approaches to evaluate potential Project-related effects to benthic biota of lakes, streams and rivers. Within lake environments, benthic sampling will be conducted at five (5) littoral stations at each of Camp, Sheardown NW, Sheardown SE and Mary mine-exposed lakes, as well as at Reference Lake 3, which serves as a comparable background (reference) area (Figures 3.3 and 3.4). The same littoral stations will be used to collect sediment quality samples (see Section 3.3.3) to allow potential linkages to be drawn between sediment quality and influences on benthic invertebrate communities. In total, 25 benthic samples will be collected among the five study lakes as part of the CREMP study. Benthic sampling will be conducted using a petite-Ponar grab sampler at study lakes. A single sample, consisting of a composite of five grabs that have each been field sieved using a 500 µm mesh, will be collected at each lake benthic station. Streams and rivers sampled for benthic invertebrates will include Camp Lake Tributary 1 at one area within the north branch of the system and two areas within the main stem (upper L2 area and lower DS area), Camp Lake Tributary 2 at areas located upstream and downstream of the Milne Inlet Tote Road, Sheardown Lake Tributaries 1, 9, and 12 near their respective outlets, an unnamed tributary to Angajurjualuk Lake to serve as a comparable stream reference area, and Mary River upstream (two areas) and downstream (three areas) of the Mine Site (Figure 3.3). At each stream and river study area, benthic sampling will be conducted at five (5) stations except for Sheardown Lake Tributary 12, where only three stations will be sampled due to limited habitat available for sampling. Overall, the number of stations sampled from stream environments totals 43 (including five reference stations) and from river environments totals 25 (including five reference stations; Figure 3.3). Benthic samples will be collected at stream and river study areas using a Surber sampler outfitted with 500-µm mesh. One sample, representing a composite of three Surber sampler grabs, will be collected at each stream and river benthic station. To the extent possible, water velocity and substrate characteristics at each stream and river station should be standardized among respective mine-exposed and reference study area stations to minimize natural influences on community variability.

Benthic samples will be submitted to a qualified laboratory and processing of benthic invertebrate samples to a taxonomic resolution of lowest practical level (typically genus or species) utilizing up-to-date taxonomic keys for invertebrates retained by the 500 µm mesh. Benthic data will be evaluated separately for lake, stream, and river habitats. The benthic invertebrate communities will be evaluated based on primary endpoints used for EEM (Section 3.2), including abundance (or density; average number of organisms per square metre), taxonomic richness (number of taxa, as identified to lowest practical level), Simpson's Evenness Index, and the Bray-Curtis Index of Dissimilarity. Additional comparisons based on percent composition of dominant/indicator taxa, functional feeding groups (FFG), and habit preference groups (HPG; percent composition of taxa and groups were calculated as the abundance of each respective group relative to the total number of organisms in the sample) may also be conducted for the analyses but are not requirements. Statistical comparisons will be conducted between mine-exposed and reference study areas (for like habitat), and between existing conditions and baseline conditions for individual study areas, using methods consistent with those used for EEM (e.g., Environment Canada 2012). Accordingly, a difference in benthic invertebrate communities will be defined as a significant difference between any paired mine-exposed and reference areas at a p-value of 0.10. For each endpoint that differs significantly, a magnitude of difference will be calculated between study area means. Because the benthic survey was designed to have sufficient power to detect a difference (effect size) of ± two standard deviations, the magnitude of the difference will be calculated to reflect the number of reference/baseline mean standard deviations using equations provided by Environment Canada (2012). A Critical Effect Size (CES) for the benthic invertebrate community study of ± 2 SD reference/baseline standard deviations will be used to define ecologically relevant effects, which is analogous to differences beyond those expected to occur naturally between two areas that are uninfluenced by anthropogenic inputs (i.e., between pristine reference areas; see Environment Canada 2012). The interpretation of data relative to CES may prompt additional weight of evidence analysis to determine links to mine-related operations as outlined in the TARP (Section 5).

Benthic invertebrate community sampling will be conducted as described above in the month of August on an annual basis. This annual timing reflects the month in which benthic invertebrate sampling has consistently been conducted since commercial operations commenced, as well as the most frequent timing used during baseline benthic studies. This seasonal timing is also ecologically appropriate based on optimal maturity of invertebrate life stages to allow taxonomic resolution to lowest practical level, and best reflects the Mine Site effluent discharge regime (i.e., discharge during the open-water season only), hydrology (i.e., ice-free conditions), and dust deposition (i.e., greatest deposition rates during the open-water season).

3.7.6 FISH (ARCTIC CHAR) HEALTH

Key questions developed to guide the design of the fish monitoring program are reflected in the key pathways of potential residual effects of the Project on Arctic char, which include:

- Water quality changes related to discharge of treated effluent from ore stockpiles and other waste runoff to freshwater systems (e.g., immediate receiving environments including Mary River, Sheardown Lake Tributary 1 and, in the future, Camp Lake Tributary 1)
- Water quality changes related to discharge of treated sewage effluent (e.g., immediate receiving environments including Mary River currently and Sheardown Lake NW historically)
- Water quality changes due to deposition of dust in lakes and streams (Mine Site in zone of dust deposition)
- Water quality changes due to non-point sources, such as from site runoff and aerial deposition of ANFO explosives residue (Mine Site)
- Changes in water levels and/or flows due to water withdrawals, diversions, and effluent discharges (i.e., alteration or loss of aquatic habitat)
- Dust deposition (i.e., sedimentation) at Arctic char spawning areas (habitat) and on Arctic char eggs
- Effects of the Project on primary and secondary producers.

The key question related to the pathways of effect is:

- *What are the combined effects of point and non-point sources, sedimentation, habitat loss or alteration, and changes in primary or secondary producers on Arctic char in Mine Area lakes (Sheardown Lake NW and SE, Camp Lake, and Mary Lake) and streams?*

Fish compose key components of aquatic ecosystems, are important ecological indicators that integrate natural and anthropogenic changes in systems over time and are highly valued as a subsistence food resource for Inuit. Therefore, the monitoring of fish health represents a primary tool for evaluating potential Project-related effects on aquatic biota and fisheries resources. Historical baseline studies indicated that Arctic char is the only fish species present at Mine Site area lakes (and most streams and rivers) in adequate abundance to meet the sample sizes recommended for fish health surveys. In addition, sufficient baseline catch and measurement data exist for this species to allow application of a before-after statistical evaluation. Therefore, fish health monitoring for the CREMP focuses on the assessment of Arctic char populations in lakes adjacent to the Mine Site.

The Arctic char health survey incorporates both control-impact and a before-after approaches to evaluate potential Project-related effects to fish health at study area lakes. The study area lakes will include each of Camp, Sheardown NW, Sheardown SE and Mary mine-exposed lakes and Reference Lake 3 as a comparable background (reference) area (Figure 3.4). The approach employed for the Arctic char health survey will closely mirror the recommended EEM approach for non-lethal sampling (Environment Canada 2012). Accordingly, the Arctic char health survey will target the non-lethal collection of approximately 100 juvenile Arctic char from nearshore lake habitat, and 50 adult arctic char from littoral/profundal lake habitat. Juvenile Arctic char will be collected from each study lake shoreline area using a battery powered backpack electrofishing unit, whereas adult Arctic char will be captured from deeper offshore areas using experimental (gang index) gill nets approximately 2 metres high and possessing bar mesh sizes ranging from 38 to 76 mm (1.5” to 3”) set on the bottom for short durations (i.e., less than two hours) during daylight hours. Arctic char used for the study will be subject to assessment of deformities, erosions, lesions, and tumors (DELT), visible incidence of external and/or internal parasites, and measurements of length and weight using a non-lethal approach.

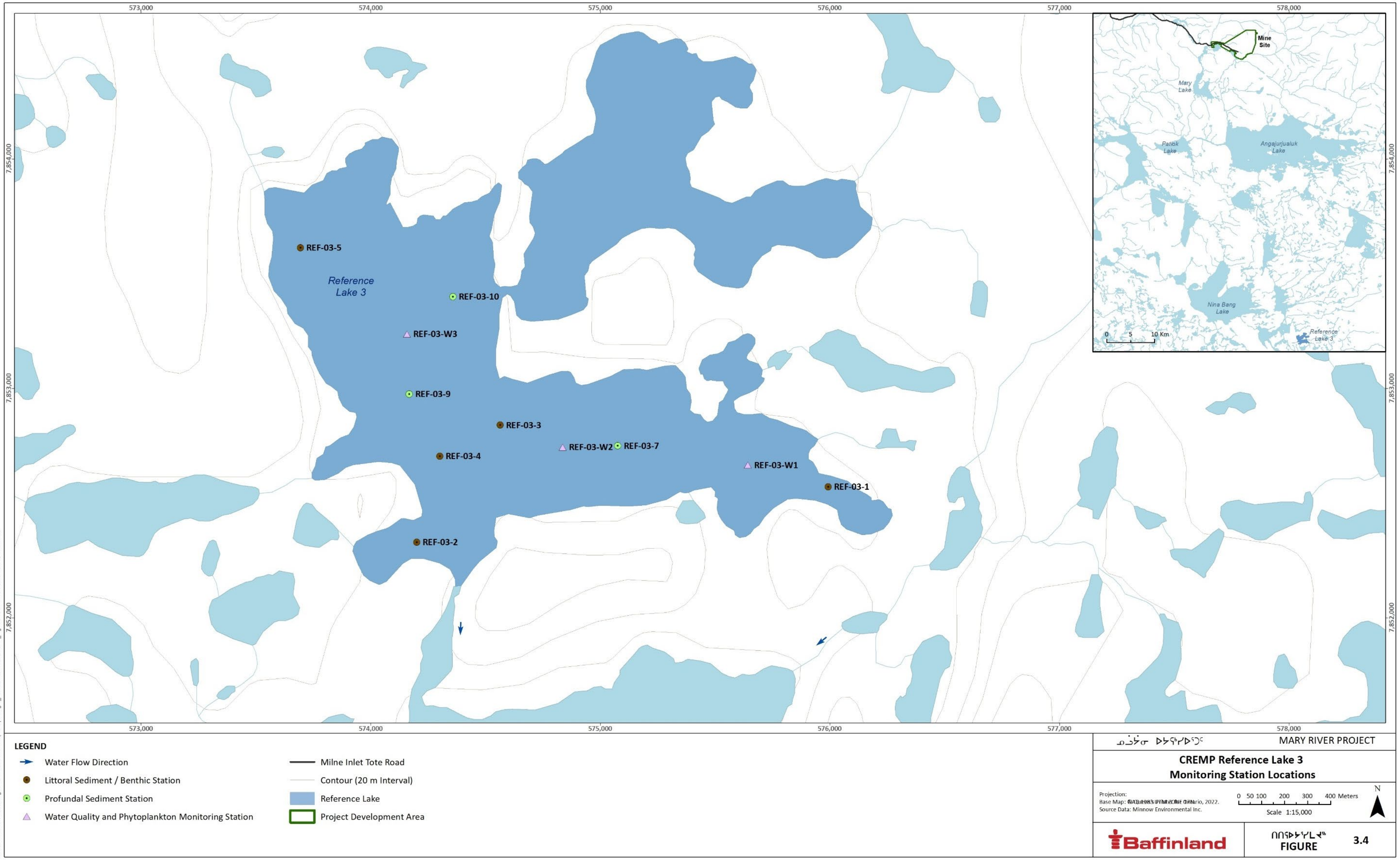

FIGURE 3.4 CREMP REFERENCE LAKE 3 MONITORING STATION LOCATIONS

Data analysis will include comparison of fish catch data based on total catch and catch-per-unit-effort (CPUE) for each sampling method. These data will be compared between mine-exposed and reference lakes, as well as between the recently collected data and baseline data for individual lakes. Arctic char health will be assessed separately for juveniles and adults. Data from juvenile fish will be assessed to determine presence of young-of-the-year (YOY) individuals, which will be assessed separately from other juveniles. Fish size endpoints of fork length and fresh body weight will be summarized separately for YOY, juveniles (1+ age category), and adults by study area, and these measurement endpoints will then be used as the basis for evaluating four response categories (survival, growth, reproduction, and condition; Table 3.5). The data analysis will include comparisons of Arctic char health between mine-exposed and reference lakes for any given year, as well as between yearly data and baseline data for individual lakes, using statistical approaches approved for EEM studies (i.e., Environment Canada 2012). Similar to the CES applied to the benthic invertebrate community survey, a difference at absolute magnitude greater than 10% (condition) or 25% (YOY size) in the negative direction will be used to define ecologically relevant differences between study lakes and study periods consistent with those recommended for EEM (Table 3.5; Environment Canada 2012). Finally, an a priori power analysis will be completed to determine appropriate fish sample sizes for future surveys as recommended by Environment Canada (2012). The interpretation of data relative to CES may prompt additional weight of evidence analysis to determine links to mine-related operations as outlined in the TARP (Section 5).

Arctic char health monitoring will be conducted as described above in the month of August on an annual basis. This annual timing reflects the month in which fish health sampling has consistently been conducted since commercial operations commenced, as well as the most frequent timing used during baseline Arctic char collections and body measurements.

3.8 TARGETED STUDIES

As described in Section 1, initiation of monitoring for specific effects (or targeted monitoring) through specialized programs and studies has been included in the CREMP to address specific questions or potential impacts from the Project. These programs or studies are more confined in terms of spatial and/or temporal scope compared to the EEM and CREMP studies. These targeted monitoring studies relate to specific environmental concerns that require further investigation or follow-up but are not anticipated to be components of the core monitoring program. The Lake Sedimentation Monitoring Program, Dustfall Monitoring Program, and the Stream Diversion Barrier Study represent the targeted monitoring studies identified to date under the AEMP.

3.8.1 LAKE SEDIMENTATION MONITORING PROGRAM

Lake sedimentation monitoring is conducted to evaluate and track potential effects of sediment accumulation related to the introduction of dust and other sources of suspended solids (e.g., erosion) at surface waters located near the Project (NSC, 2014c). Sedimentation rates will be monitored in Sheardown Lake NW through deployment of sediment traps, the locations and methods of which are described in NSC (2014c) and Minnow (2021). In brief, the program will involve year-round deployment of sediment traps in Sheardown Lake NW at three locations characterized by different habitat features to provide total dry weight deposition and dry bulk density of depositing sediment to allow calculation of deposition rate and depth of sediment accumulation. The sediment traps will be emptied and redeployed after ice-off and in fall to provide measures of seasonal (i.e., open-water and ice-cover season) deposition rates and accumulation. Sedimentation monitoring was initiated in 2013 and has continued on an annual basis thenceforth. Through comparisons of the measured sedimentation at Sheardown Lake NW to sedimentation amounts known to adversely affect salmonid egg survival available from published literature, the lake sedimentation monitoring program provides a strong scientific basis for the determination of sediment deposition effects on Arctic char egg survival at Sheardown Lake NW.

Dustfall monitoring data collected under the Dustfall Monitoring Program (described in Section 3.4.2), may be used to assist in the interpretation of data collected under the Lake Sedimentation Monitoring Program.

3.8.2 DUSTFALL MONITORING PROGRAM

The amended NIRB Project Certificate No. 005 included requirements for dustfall monitoring. In 2013, Baffinland implemented a Dustfall Monitoring Program as part of the TEMMP that meets the requirements under the Project Certificate Condition #21 (Baffinland, 2014). A description of this program is included in the Air Quality Management Plan. The dustfall monitoring program consists of operating dustfall buckets positioned along transects oriented in a radial fashion from main development areas that include Milne Port, the Milne Inlet Tote Road and the Mine Site, and those positioned at representative reference dustfall monitoring stations. Under this program, dustfall measurements (the amount of dustfall per unit time) are completed monthly and, if sufficient volume of dustfall material is collected, dustfall material is analyzed to determine the metals composition of the dust. The dustfall monitoring data are used to estimate annual deposition (rates, quantities) and chemical composition of dust potentially entering aquatic systems within and near the Project operations.

3.8.3 INITIAL STREAM DIVERSION BARRIER STUDY

A streamflow reduction barrier study was identified as a follow-up program in the FEIS (Baffinland, 2012), following which this Initial Stream Diversion Barrier Study was developed by Knight Piésold (2014c). The primary objectives of this study are to monitor the effects of both increases and reductions in streamflow at several Mine Site streams and to further understand how Project-related reductions in streamflow may result in the creation of fish barriers that have the potential to occur at low flows. The monitoring program may identify the need for mitigation measures to address Project-related fish stranding.

Initial monitoring conducted under this study in 2013 focused on obtaining a better understanding for baseline flow conditions and the frequency and duration of the occurrence of natural fish barriers and fish stranding in five (5) Mine Site streams (see Figure 2.3) including:

- CLT-1
- CLT-2
- SDLT-1
- SDLT-9
- SDLT-12

This initial study was exploratory in nature with the following objectives (which contribute to the primary objectives stated above):

- Develop an understanding of low-flow conditions that may result in barriers to fish passage within two (2) tributaries of Camp Lake and three (3) tributaries of Sheardown Lake.
- Document fish presence throughout the stream length of each tributary under various flow conditions, including during spring freshet when high water velocities may prevent fish passage, and during late fall to document the downstream passage of fish to overwintering habitat found in lakes.

The monitoring involved visual assessment of potential barriers and obstructions to upstream/downstream fish passage at each tributary by an experienced fish biologist. The combination of visual observations of barriers, fish presence and associated flows at the time of the survey will be used to determine the conditions in which fish migration will be limited within each tributary under various flow conditions. Other monitoring programs implemented by Baffinland are intended to augment interpretation and predictions under the Stream Diversion Barrier Study, including hydrology monitoring and the freshwater biota monitoring undertaken as part of the CREMP.

A reduced production rate associated with the ERP has resulted in a considerably smaller mining footprint (open pit and waste rock stockpile) than was originally envisioned during the FEIS development, resulting in no substantial Project-related stream diversions. As a result of the negligible requirement for stream diversions, the Stream Diversion Barrier Study has been discontinued. The resumption of this study will be dependent upon the schedule and size set forth for any future development. The approved full production (rail) phase of the Project may result in meaningful reductions in streamflow and therefore monitoring under this study will be required, and re-initiated, to identify potential Project-related fish barriers and fish stranding. Baffinland will initiate a Stream Diversion Barrier Study similar in scope to that described herein approximately one year prior to the start of the full production (rail) phase of the Project.

3.9 QUALITY ASSURANCE AND QUALITY CONTROL

Each of the monitoring programs composing the AEMP follows standard Quality Assurance/Quality Control (QA/QC) measures as follows:

- Staffing the Project with experienced and properly trained individuals
- Ensuring that representative, meaningful data are collected through planning and efficient research
- Using standard protocols for sample collection, preservation, and documentation
- Calibrating and maintaining all field equipment

Various additional QA/QC measures are implemented for each of the component studies, as described below.

3.9.1 WATER AND SEDIMENT QUALITY

A strict QA/QC program is in place to ensure that high quality and representative data are obtained in a manner that is scientifically defensible, repeatable, and well documented. This program aims to ensure that the highest level of QA/QC standard methods and protocols are used for the collection of all environmental media samples. Quality assurance is obtained at the project management level through organization and planning, and the enforcement of both external and internal quality control measures. In addition to the QA/QC measures listed above, the following QA/QC procedures and practices will be implemented for the water and sediment quality monitoring programs under the CREMP:

- Internal Quality Control:
    - Collection of duplicate, blank, and travel blank samples to be submitted for analysis with routine samples at an accredited analytical laboratory (approximately 10% of overall number of samples)
- External Quality Control:
    - Employing fully accredited analytical laboratories for the analysis of all samples
    - Determining analytical precision and accuracy based on interpretation of data from the analytical reports for the blind duplicate, blank, and travel blank samples

The field sampling protocols for the water and sediment quality monitoring programs under the CREMP are presented within an appendix of the original Water and Sediment Quality CREMP Study Design (KP 2014a,b). The quality of the data obtained for a project is assessed via adherence to the pre-set Data Quality Objectives (DQOs). DQOs provide a means of assessing whether the data in question are precise, accurate, representative, and complete. The results from QA/QC samples will be reviewed to determine if sample contamination occurred. These data will also be used to determine if the contamination occurred during collection, handling, storage, or shipping. Upon receipt from the laboratory, the data will be uploaded into a database along with copies of field notes, photos, Sample Receipt Confirmations, spreadsheet (e.g., Microsoft Excel) data, and Certificates of Analysis.

3.9.2 BENTHIC INVERTEBRATE SURVEY

Replicate sub-samples will be collected in the field at each benthic station to integrate the spatial variability in community features that is naturally encountered in the environment. Accordingly, five replicate sub-samples will be collected at lake benthic stations, and three replicate sub-samples will be collected at stream and river benthic stations, under the CREMP. Appropriate QA/QC measures related to processing and identification of benthic samples, outlined in EEM technical guidance, will be followed at the laboratory (Environment Canada, 2012). These measures will incorporate the proper steps related to re-sorting, sub-sampling and maintenance of a voucher collection, as needed. The voucher collection will be taxonomically analysed by a second qualified invertebrate taxonomist.

Benthic samples will be sorted with the use of a stereomicroscope. Samples will be washed through a 500-micron sieve and sorted entirely except in the following instances: those samples with large amounts of organic matter (i.e., detritus, filamentous algae) and samples with high densities of major taxa. In these cases, samples will be first washed through a large mesh size sieve (3.36 mm), to remove all coarse detritus, leaves, and rocks. Large organisms retained in the sieve will be removed from the associated debris. The remaining sample fraction will be sub-sampled quantitatively, if necessary. For QA/QC evaluation, the sorted sediments and debris will be re-preserved and retained for up to six months following submission of reports under the CREMP or EEM programs. For those samples that were sub-sampled, sorted and unsorted fractions will be re-preserved separately. Sorted organisms will be re-preserved.

All invertebrates will be identified to the lowest practical level, usually genus or species level. Chironomids and oligochaetes will be mounted on glass slides in a clearing media prior to identification. In samples with large numbers of oligochaetes and chironomids, a random sample of no less than 20% of the selected individuals from each group will be removed from the sample for identification, up to a maximum of 100 individuals.

3.9.3 FISH

Standard QA/QC technical procedures will be utilized for all field sampling, laboratory analysis, data entry and data analysis related to the fish health assessment. When required, fish ages will be determined by experienced technicians and a minimum of 10% of fish ageing structures that are processed will be independently and blindly aged by a second technician. All data that are entered electronically will undergo a 100% transcription QA/QC by a second person to identify any transcription errors and/or invalid data.

3.9.4 DATA EVALUATION

All data will be entered into an electronic database with controlled access. Screening studies will be employed to check for transcription errors or suspicious data points. An individual not responsible for entering the data will confirm that the data entered adequately reflect the original data sheets/reports.

4.0 ROLES AND RESPONSIBILITIES

The personnel responsible for implementing this plan and their respective roles are described in Table 4.1.

TABLE 4.1 ROLES AND RESPONSIBILITIES FOR AEMP

Position	Responsibilities
Chief Operations Officer (COO)/General Manager	• Responsible for providing oversight for all Project operations and allocating the necessary resources for the operation, maintenance and management of Project infrastructure
Environmental Manager / Superintendent	• Manage all on-site aquatic effects monitoring programs at the Project • Conduct inspections and monitoring to ensure compliance with applicable regulations and commitments • Report incidents to senior management and the appropriate regulatory agencies and stakeholders • Provide training sessions to operational departments on the appropriate mitigation measures and strategies for managing surface water flows and effluents at the Project • The on-site Environmental Superintendent is responsible for data management and reporting related to the Aquatic Effects Monitoring Plan
Environmental Coordinator	• Implementation of the field components of specific programs under the Aquatic Effects Monitoring Plan • Provide training to staff conducting field work under this plan
QIA Manager of Project Compliance and Monitoring	• Directs QIA's onsite environmental resources • Liaise with Baffinland's Environmental Manager/ Superintendents • Reviews regulatory submissions on behalf of the QIA
QIA Environmental Monitor (IIBA)	• Monitors implementation of commitments, environmental compliance, and QIA interests • Participate in routine compliance inspections and monitoring alongside Baffinland staff • Participate follow-up corrective action undertaken regarding non-compliance events including spills • Presents annual monitoring reports to communities as requested • The core responsibilities of this position are described further in the IIBA
All Departmental Supervisors	• Responsible for reading and understanding applicable sections of this Plan and directing departmental personnel on the requirements to understand applicable sections • Report any visual observations, or reports, of suspected aquatic ecosystem effects to the Environment Department • Assist in implementing appropriate mitigation measures
All Project Personnel	• All Project personnel will be responsible to comply with the requirements of the Plan as appropriate • Report any visual observations of suspected aquatic ecosystem effects to their respective supervisors • Assist in implementing appropriate mitigation measures

5.0 DATA ASSESSMENT AND RESPONSE FRAMEWORK

5.1 STEPS IN DATA ASSESSMENT AND RESPONSE

Monitoring data collected through the AEMP requires a systematic data evaluation process, as well as management responses that will be taken, in response to certain data evaluation outcomes. A common assessment (data evaluation) and management response framework will be implemented. This multi-step process includes the following.

Step 1 - Data Management and Evaluation

This step includes QA/QC of the data comparison of data to AEMP benchmarks and to reference (i.e., background) and/or baseline data, and review of the data using various tools such as Exploratory Data Analysis (EDA) and Statistical Data Analysis (SDA), to determine if a change from background and/or baseline is occurring. Upon reception of analytical data from the laboratory, water quality and sediment quality data will be evaluated relative to applicable AEMP benchmarks (Tables 3.1, 3.2 and 3.3). Based on evaluation of ambient conditions (e.g., considering turbidity and evaluation of ratios between total and dissolved metals concentrations) and considering available historical information, an assessment of potential Project-related influence on aquatic conditions will be conducted before the end of the calendar year, and ahead of the AEMP annual report deadline. A change may be detected statistically or qualitatively, relative to benchmarks, baseline values and/or spatial or temporal trends. A change may be statistically significant, but professional judgement will also be applied using the various evaluation tools to qualitatively assess for changes based on a weight-of-evidence analysis.

If Step 1 does not detect change, then no additional action is required (e.g., continued monitoring as specified within the EEM or CREMP, as applicable). If a change is observed, then further evaluation of the data for that/those indicator(s) will be carried out as specified under the MDMER for EEM studies, or as outlined under Step 2 below for CREMP studies.

Step 2 - Determining Whether the Observed Change is Mine-Related

Step 2 involves determining if the changes in the indicator(s) of concern are due to the Project or due to natural variability or other causes. Project activities with the potential to induce an observed change on water quality will be reviewed annually (e.g., as part of an overall trend analysis, if required), and those on sediment quality or on biota will be assessed annually corresponding with respective sampling frequency, to identify potential Project-related causes or sources. This could include evaluating effluent quality, discharge regime/rates, and loading, dust deposition, and other point/non-point sources as required. Also, any evidence of potential natural causes (i.e., a major erosional event such as a slumping riverbank) will be investigated. Field data sheets and site personnel will be a source of this information.

Evaluation of a Project-related change will be addressed using EDA and subsequently using SDA, if required, on an annual basis as part of an Annual Report. For instance, EDA may include plotting of data to visually assess potential data trends over time, and to evaluate spatial differences, extent, and pattern of observed changes. The EDA will also include comparisons of data from Mine Site streams to data from reference streams and comparisons of Mine Site Lakes to reference lake(s). This will further assist with determining whether the observed changes may be due to natural variability or the Project. Graphical analyses may be used to confirm assumptions required for statistical testing (normality, sample size, independence). Differences in fish and other biotic endpoints between mine-exposed and reference areas will be preferentially tested using pair-wise Student's t-tests and/or single factor analysis of variance (ANOVA) and post-hoc testing, as appropriate. Prior to conducting t-test and/or ANOVA statistical tests, the data will be evaluated for normality and homogeneity of variance to ensure that applicable statistical test assumptions will be met. In instances in which normality cannot be achieved through data transformation, non-parametric Mann-Whitney U-tests (pair-wise comparisons) and/or Kruskal-Wallis H-tests (multiple group comparisons) will be used to evaluate the data. Similarly, in instances in which variances of normal data could not be homogenized by transformation, pair-wise comparisons will be conducted using Student's t-tests assuming unequal variance. SDA will be used as outlined in the individual assessment frameworks and can be applied to the parameters of interest to test the primary hypothesis for the effects of mine-related change. These tests may include formal trend analyses (e.g., Kendall tests) to determine whether a change over time is significant.

If the Step 2 analysis concludes that changes in water quality, sediment quality, or biological endpoints, are, or are likely, due to the Project, the assessment will proceed to Step 3. If it is concluded the observed differences relative to background and/or baseline conditions are not due to the Project, no management response will be required (i.e., continued monitoring as specified within the CREMP). As indicated previously, these analyses, which also incorporate a qualitative weight-of-evidence assessment that considers historical information and all available analytical water, sediment and biological monitoring information, will be conducted each year as part of the CREMP and summarized in the Annual Report. Within the annual CREMP report, all instances in which an AEMP benchmark for water quality or sediment quality have been exceeded will be identified along with an evaluation of whether the exceedance reflected a Project-related cause, the degree to which biological effects may have occurred associated with the exceedance, and recommended follow-up actions and/or implemented mitigation that has been applied to address the exceedance (as required) will be provided based on the determination of action level (Step 3).

Step 3 - Determine Action Level

If the evaluation conducted in Step 2 has indicated with some certainly that the measured change is Project-related, Step 3 involves determination of the action level associated with the observed monitoring results through comparisons to benchmarks. Three (3) levels of action have been identified: low, moderate, and high. The general gradient of progression in response for these action levels range from increased monitoring and data analysis (e.g., trend analysis), to identification of possible sources, to risk assessment and/or mitigation. The specifics for each aquatic component (water and sediment quality, phytoplankton, benthic invertebrates and Arctic char) are summarized in Table 5.1 and are described further in each of the component study designs. Below is a generic description of each of the levels of response.

If an AEMP benchmark is not exceeded, a **low action response** may be undertaken and could include any number of potential responses, including the following:

- Evaluate temporal trends
- Identify likely source(s) and potential for continued contributions
- Confirm the site-specific relevance of benchmark and establish a site-specific benchmark, if necessary
- Further evaluation of data (for example, for water quality, review dissolved metals data or supporting variables)
- Based on evaluations, determine next steps

If an AEMP benchmark is exceeded and it is concluded to be Project-related, a **moderate action level response** will be undertaken and could include, in addition to analyses identified for a low action response, the following:

- Consider a Weight-of-Evidence (WOE) evaluation and/or risk assessment, that incorporates assessment of other monitoring results collectively with the indicator that has changed, to evaluate effects on the ecosystem
- Evaluate the need for and specifics of increased monitoring (e.g., increasing the extent, duration, frequency, number and/or type of samples collected)

- Evaluate the need for and specifics of additional monitoring (e.g., confirmation monitoring) and/or modifications to the CREMP
- Consider results of the trend analysis (i.e., trend analysis indicates an upward trend) and evaluation of potential pathways of effect (i.e., causes of observed changes) to determine if management/mitigation is required; and
- Identify next steps based on the above analyses. Next steps may include those identified for the high action level response

A quantitative trigger for the **high action level response** has not been identified as the need for additional study and/or mitigation will depend on the ultimate effects of the observed increases in the indicator parameter(s) of concern on the applicable receiver system. Also, the benchmark may need to be revised in consideration of ongoing monitoring results. The precise relationships among water quality, sediment quality and lower trophic level changes and collective effects on fish can be difficult to predict and therefore actions undertaken under a moderate action level response will attempt to explore these relationships to advise on overall effects to the affected ecosystem. Results would be discussed with regulatory agencies and the next steps would be identified. Additional actions that may be implemented in a subsequent phase (i.e., high action level response) could include:

- Implementation of increased monitoring to further assess the potential for effects and/or define magnitude and spatial extent if warranted
- Implementation of mitigation measures or other management actions that may be identified under the moderate action level response (see the mitigation toolkit in Section 5.3)

Management actions will be implemented as identified in the low and moderate action responses for each aquatic component based on assessment of whether the change is mine-related and the action level determined relative to the benchmark(s). In the instance of detecting change among multiple stressors, action will be implemented according to a weight of evidence evaluation.

Mitigation measures will be evaluated and implemented on a case-by-case basis, with consideration of an issue-specific assessment of the situation and corresponding action level. Moderate Action Responses may include mitigation measures that are easily implemented at low-cost and in a short timeframe. Such mitigation measures may already be identified as contingency or adaptive management measures within various management plans for the Project. A moderate action response may include development of a High Action Response, which will be implemented if the trend over time is a continued (i.e., sustained) change relative to an AEMP benchmark (increase in the magnitude of the effect). The duration of a sustained moderate action response that may escalate to a high action response if a cause has not been previously identified through triggered management action is at least three full years (i.e., year-one to identify the potential effect and determine whether cause is mine-related, with two follow-up years to confirm cause is not mine-related and/or whether degree of adverse change has increased). High Action Responses will be reviewed by key regulatory agencies prior to implementation unless an immediate response is required (e.g., spill event).

As indicated above, management actions and mitigation measures will be evaluated and implemented on a case-by-case basis and dependent upon the degree of change/effect identified. In the event of a specific incident known to or that is likely to result in an adverse response to the aquatic environment, response times for management action/ mitigation will be determined with appropriate regulatory authorities using an appropriate level of action. Should a chronic Project-related influence on aquatic environment be identified as part of the annual CREMP analyses, management responses and mitigation measures for moderate and high action responses will be proposed for the following year and/or years dependent upon response determined to adequately address the effect/cause and upon consultation/notification with appropriate stakeholders.

The low, moderate, and high-risk conditions and associated responses are outlined in the Trigger Action Response Plans (TARPs) presented in Table 5.1.

5.2 REPORTING

Reporting of AEMP component studies is conducted based on an annual reporting cycle. Best efforts will be employed to integrate the results of individually monitored but related aquatic monitoring programs under the AEMP into each respective AEMP report (i.e., individual CREMP, Lake Sedimentation, Dustfall Monitoring, and Initial Stream Diversion programs, where applicable). The key constraint to within-year integration of results among program reports is the limited availability of time between sample collection, analysis, data evaluation, and report preparation within the annual reporting cycle. In the event that adequate time is not available to integrate results of various aquatic programs within an individual report for the reporting year, the most recent reported data for applicable programs will be considered for integration within each individual report. In addition, for each of the individual studies conducted under the AEMP, yearly-generated reports will include comparisons to impact predictions made in the Final Environmental Impact Statement to confirm the accuracy of these predictions and to aid in the ongoing assessment of environmental conditions and trends at the Project. Under the MDMER, Baffinland submits an annual report to ECCC through MERS. The EEM biological studies are reported on three-year cycles as required under the MDMER.

AEMP component study monitoring results for the CREMP and Lake Sedimentation Study are appended to the QIA/NWB Annual Report for Operations on an annual basis. A monitoring results summary is also presented in the effects evaluation section of the NIRB Annual Report.

Monitoring results from the Dustfall Monitoring Program will be reported in the Terrestrial Environment Annual Monitoring Report, appended to the NIRB Annual Report, as required by Project Certificate No. 005.

The AEMP Annual Report will provide a compilation, assessment and interpretation of findings across monitoring programs, and present an evaluation of effects and actions taken (or that will be taken) to address influences to the aquatic receiving environment that may be Project-related. Revisions to study designs or management response actions will be summarized and discussed for each key issue.

The AEMP will be updated periodically, as required. Updates to the AEMP will be filed with the QIA/NWB Annual Reports in accordance with Schedule B, Section g, Item (ii) of the Amended Type A Water Licence. Updates to the AEMP may consist of modifications to study designs, or termination of shorter-term targeted studies accompanied by adequate rationale.

5.3 TRIGGER ACTION RESPONSE PLAN (TARP)

The preliminary Moderate and High Action Pre-Defined Responses to be implemented in the event of an exceedance of a moderate risk or high risk threshold are outlined in Table 5.3. These responses should not be considered exhaustive and may be supplemented pending the results of adaptive management investigations and subsequent QIA approval.

TABLE 5.2 TRIGGER ACTION RESPONSE (TARP) TABLE

Monitoring Plan	Objective	Performance Indicators	Activity Being Monitored	Threshold/ Pre-defined Response(s)					
				Low Risk	Moderate Risk	High Risk	Low Risk	Moderate Risk	High Risk
MDMER Effluent Monitoring	Detect short-term and long-term effects of the Project's activities on the aquatic environment resulting from the Project Evaluate the accuracy of impact predictions Assess the effectiveness of planned mitigation measures Identify additional mitigation measures to avert or reduce unforeseen environmental effects	Deleterious substances (As, Cu, Pb, Ni, Zn, TSS, Ra-226) and pH	Mine effluent discharges	Addressed in the Fresh Water Supply, Sewage and Wastewater Management Plan					
		Acute Lethality Testing: Rainbow trout, Daphnia magna		Addressed in the Fresh Water Supply, Sewage and Wastewater Management Plan					
MDMER Effluent and Water Quality Monitoring Studies		Effluent characterization: hardness, alkalinity, EC, temperature, Al, Cd, Fe, Hg, Mo, Se, NO_3-N, Cl, Cr, Co, SO_4, Tl, U, P, Mn, NH_3-N		Addressed in the Fresh Water Supply, Sewage and Wastewater Management Plan Note there are Hg and Se discharge limits in effluent characterization that trigger a fish tissue study, if exceeded[1].					
		Sublethal toxicity testing (fish and/or invertebrate and/or macrophyte and/or algal species)		Addressed in the Fresh Water Supply, Sewage and Wastewater Management Plan					
		Water Quality Monitoring at exposure and reference areas: temperature, dissolved oxygen, pH, hardness, alkalinity, EC, salinity (marine only), deleterious substances and effluent characterization parameters		Receiving water quality subject to the AEMP benchmarks established for the CREMP (see below)					
MDMER Biological Monitoring Studies		Critical Effects Sizes for Arctic char health: Total body weight at age: ± 25% of reference mean Liver weight at total body weight: ± 25% of reference mean Total body weight at length (condition): ± 10% of reference mean Age: ± 25% of reference mean		**Threshold:** Fish health endpoint at effluent-exposed area significantly different from reference area (ρ <0.1) but within Critical Effect Size(s), or significantly different from reference area at a magnitude outside of Critical Effect Size(s) in one and/or non-consecutive studies.	**Threshold:** Fish health endpoint at effluent-exposed area significantly different from (ρ <0.1), and at a magnitude outside of Critical Effect Size(s), compared to reference area, for two consecutive assessments.	**Threshold:** To be determined based on outcome of moderate pre-defined response.	**Response:** Env't Dept: Continue with scheduled monitoring as prescribed in the regulations to confirm difference; determine if there are contributing factors in effluent (review deleterious substances monitoring of effluent and acute lethality testing results).	**Response:** Env't Dept: Conduct investigation of cause of the consistent differences between effluent-exposed area and reference area consistent with the MDMER; develop high risk response threshold and evaluate and implement most appropriate action(s) from the AEMP Action Level Toolkit. Responsible Dept(s): Implement plan to address potential mine-related inputs and sources.	**Response:** Env't Dept: Conduct further investigation to confirm cause is consistent with results of investigation conducted under the moderate risk response action; evaluate and implement most appropriate action(s) from the AEMP Action Level Toolkit. Responsible Dept(s): Implement plan to address potential mine-related inputs and sources.
		Critical Effects Sizes for benthic invertebrate community: Density: ± 2 SD of reference mean Simpson's Evenness Index: ± 2 SD of reference mean Taxa Richness: ± 2 SD of reference mean		**Threshold:** Benthic endpoint at effluent-exposed area significantly different from reference area (ρ <0.1) but at a magnitude within Critical Effect Size(s), or significantly different from reference area at a magnitude outside of Critical Effect Size(s) in one and/or non-consecutive studies.	**Threshold:** Benthic endpoint at effluent-exposed area significantly different from (ρ <0.1), and at a magnitude outside of Critical Effects Size(s), compared to reference area, for two consecutive assessments.	**Threshold:** To be determined based on outcome of moderate pre-defined response.			
MDMER Biological Monitoring Studies	Detect short-term and long-term effects of the Project's activities	Fish Tissue Study[1] Mercury (Hg) in muscle tissue: low risk threshold is MDMER effect	Mine effluent discharges	**Threshold:** Total Hg in fish tissue exceeds MDMER threshold for an effect on fish tissue from Hg (0.2 µg/g wet weight) in fish	**Threshold:** Total Hg in fish tissue exceeds MDMER threshold for an effect on fish tissue from Hg (0.5 µg/g wet weight) in fish tissue at an	**Threshold:** To be determined based on	**Response:** Env't Dept: Conduct follow-up monitoring	**Response:** Env't Dept: Conduct follow-up monitoring and trend	**Response:** Env't Dept: Conduct further investigation to confirm cause is

Monitoring Plan	Objective	Performance Indicators	Activity Being Monitored	Threshold/ Pre-defined Response(s)					
				Low Risk	Moderate Risk	High Risk	Low Risk	Moderate Risk	High Risk
	on the aquatic environment resulting from the Project Evaluate the accuracy of impact predictions Assess the effectiveness of planned mitigation measures Identify additional mitigation measures to avert or reduce unforeseen environmental effects	concentration (0.5 µg/g wet weight); moderate risk threshold is low risk threshold and consistent effects in one or more other study components which links results to the Project		tissue at an exposure area and is a statistically significant increase (ρ <0.1) over the reference area.	exposure area and is a statistically significant increase (ρ <0.1) over the reference area.	outcome of moderate pre-defined response.	and trend analysis to determine if Hg in fish tissue is increasing with time. Review the results of other component studies. Determine if there are other project-related Hg sources other than mine effluent. Responsible Dept(s): Implement a review of mine-related processes to determine if sources can be mitigated	analysis to determine if Hg in fish tissue is increasing with time. Determine if there are other project-related Hg sources other than mine effluent. Evaluate and implement most appropriate action(s) from the AEMP Action Level Toolkit. Responsible Dept(s): Develop and implement action(s) to reduce Hg emissions.	consistent with results of investigation conducted under the moderate risk response action; evaluate and implement most appropriate action(s) from the AEMP Action Level Toolkit. Responsible Dept(s): Implement plan to address potential mine-related inputs and sources.
		Fish Tissue Study[1] Selenium (Se) in muscle and/or whole-body tissues: low risk threshold is 100% increase relative to reference; moderate risk threshold is United States Environmental Protection Agency chronic effects criterion of 11.3 µg/g dry weight (USEPA, 2016)		**Threshold:** Total Se in fish tissue from an exposure area exceeds the Critical Effects Size (100% increase relative to reference).	**Threshold:** A low risk condition for two consecutive assessments with Se concentrations in fish tissue exceeding the USEPA (2016) chronic effects criterion (11.3 µg/g dry weight).	**Threshold:** To be determined based on outcome of moderate pre-defined response.	**Response:** Env't Dept: Conduct follow-up monitoring and trend analysis to determine if Se in fish tissue is increasing with time. Review the results of other component studies. Determine if there are other project-related Se sources other than mine effluent. Responsible Dept(s): Implement a review of mine-related processes to determine if sources can be mitigated.	**Response:** Env't Dept: Conduct follow-up monitoring and trend analysis to determine if Se in fish tissue is increasing with time. Determine if there are other project-related Se sources other than mine effluent. Evaluate and implement most appropriate action(s) from the AEMP Action Level Toolkit. Responsible Dept(s): Develop and implement action(s) to reduce Se emissions.	**Response:** Env't Dept: Conduct further investigation to confirm cause is consistent with results of investigation conducted under the moderate risk response action; evaluate and implement most appropriate action(s) from the AEMP Action Level Toolkit. Responsible Dept(s): Implement plan to address potential mine-related inputs and sources.
Lake Sedimentation Monitoring	Detect short-term and long-term effects of the Project's activities on the aquatic environment resulting from the Project Evaluate the accuracy of impact predictions Assess the effectiveness of planned	Sedimentation (i.e., amount of sediment accumulation) in Sheardown Lake	Dustfall, erosion and sedimentation	**Threshold:** Sediment accumulation during the ice-cover / Arctic char egg incubation period exceeds thickness of 0.15 mm[4]	**Threshold:** Annual sediment accumulation during the ice-cover / Arctic char egg incubation period exceeds 0.54 mm[5]	**Threshold:** Annual sediment accumulation during the ice-cover / Arctic char egg incubation period exceeds 1 mm[6]	**Response:** Env't Dept: Detailed review of existing sediment and erosion control measures and implementation of additional control measures. Assess trends to determine if sediment levels are increasing in the project area. Responsible Dept(s): Implement precautionary mitigation to avoid	**Response:** Env't Dept: Conduct a review annual and historical data, and assess effects based on a multiple lines of evidence study with the other component studies of the AEMP; establish proposed high action response. Responsible Dept(s): Implement plan to address mine-related inputs and sources during the next open water season[3].	**Response:** Env't Dept: To be determined if the moderate risk threshold is exceeded; may include further study such as in-situ or laboratory study on egg mortality, and adjustments to mine operations to stop or reverse the observed effect. Responsible Dept(s): Implement plan to address potential mine-related inputs and sources.

Monitoring Plan	Objective	Performance Indicators	Activity Being Monitored	Threshold/ Pre-defined Response(s)					
				Low Risk	Moderate Risk	High Risk	Low Risk	Moderate Risk	High Risk
	mitigation measures Identify additional mitigation measures to avert or reduce unforeseen environmental effects						potential threshold exceedance during the next open water season[3].		
Core Receiving Environment Monitoring Program (CREMP)	Detect short-term and long-term effects of the Project's activities on the aquatic environment resulting from the Project. Evaluate the accuracy of impact predictions. Assess the effectiveness of planned mitigation measures. Identify additional mitigation measures to avert or reduce unforeseen environmental effects.	Water and Sediment Quality AEMP benchmarks	Dustfall, erosion and sedimentation	**Threshold:** Mine-related changes above AEMP benchmarks or above concentration(s) observed during baseline and at an applicable reference area.	**Threshold:** Mine-related changes that results in one or more parameters exceeding the AEMP benchmarks and concentration(s) observed during baseline and at an applicable reference area.	**Threshold:** Establish if moderate risk condition status is reached.	**Response:** Env't Dept: Conduct temporal trend analysis; confirm site specific relevance of threshold; determine next steps as part of annual reporting. Responsible Dept(s): Implement precautionary mitigation to avoid potential threshold exceedance as per outcome of the above investigation[6].	**Response:** Env't Dept: Weight of evidence evaluation / risk assessment; evaluate need for and specifics of increased monitoring as required to further assess mine contribution; evaluate and implement most appropriate action(s) from the AEMP Action Toolkit if trend analysis suggests continued increase; develop high risk response threshold as part of annual reporting. Responsible Dept(s): Implement plan to address mine-related inputs and sources during the next open water season[3].	**Response:** Env't Dept: Conduct further investigation to confirm cause is consistent with results of investigation conducted under the moderate risk response action; evaluate and implement most appropriate action(s) from the AEMP Action Level Toolkit. Responsible Dept(s): Implement plan to address potential mine-related inputs and sources.
		Chlorophyll a		**Threshold:** Mine related changes above benchmark of 3.7 µg/L chlorophyll-*a*	**Threshold:** Mine related changes above benchmark of 3.7 µg/L chlorophyll-*a* multiple locations over multiple seasons	**Threshold:** Establish if moderate risk condition status is reached.	**Response:** Env't Dept: Conduct temporal trend analysis; confirm site specific relevance of threshold; determine next steps as part of annual reporting. Responsible Dept(s): Implement precautionary mitigation to avoid potential threshold as per outcome of the above investigation[3].	**Response:** Env't Dept: Weight of evidence evaluation / risk assessment; evaluate need for and specifics of increased monitoring; evaluate and implement most appropriate action(s) from the AEMP Action Toolkit if trend analysis suggests continued increase; evaluate benchmark and condition of BMI community to assess ecological effects; develop high risk response threshold and action(s) as part of annual reporting. Responsible Dept(s): Implement plan to address	**Response:** Env't Dept: Conduct further investigation to confirm cause is consistent with results of investigation conducted under the moderate risk response action; evaluate and implement most appropriate action(s) from the AEMP Action Level Toolkit. Responsible Dept(s): Implement plan to address potential mine-related inputs and sources

Monitoring Plan	Objective	Performance Indicators	Activity Being Monitored	Threshold/ Pre-defined Response(s)					
				Low Risk	**Moderate Risk**	**High Risk**	**Low Risk**	**Moderate Risk**	**High Risk**
								mine-related inputs and sources during the next open water season[3].	
		Benthic Invertebrates Critical Effects Sizes: Density: ± 2 SD of baseline or reference mean Simpson's Evenness Index: ± 2 SD of baseline or reference mean Taxa Richness: ± 2 SD of baseline or reference mean		**Threshold:** Benthic endpoint at mine-exposed area significantly different from reference area (ρ <0.1) but at a magnitude within Critical Effect Size(s), or significantly different from reference area at a magnitude outside of Critical Effect Size(s) in one and/or non-consecutive studies[7].	**Threshold:** Benthic endpoint at mine-exposed area significantly different from (ρ <0.1), and at a magnitude outside of Critical Effects Size(s), compared to reference area, for two consecutive assessments[7].	**Threshold:** Establish if moderate risk condition status is reached.	**Response:** Env't Dept: Conduct temporal trend analysis; confirm site specific relevance of threshold; determine next steps and implement timeline as part of annual reporting. Responsible Dept(s): Implement next steps and/or precautionary mitigation to avoid potential threshold exceedance during the next open water season[3].	**Response:** Env't Dept: Weight of evidence evaluation / risk assessment; evaluate need for and specifics of increased monitoring as required to further assess mine contribution; evaluate and implement most appropriate action(s) from the AEMP Action Toolkit if trend analysis suggests continued increase; develop high risk response threshold and action(s) as part of annual reporting. Responsible Dept(s): Implement plan to address mine-related inputs and sources during the next open water season[3].	**Response:** Env't Dept: Conduct further investigation to confirm cause is consistent with results of investigation conducted under the moderate risk response action; evaluate and implement most appropriate action(s) from the AEMP Action Level Toolkit. Responsible Dept(s): Implement plan to address potential mine-related inputs and sources.
Core Receiving Environment Monitoring Program (CREMP)		Critical Effects Sizes for Arctic char health: Total body weight at age: ± 25% of baseline or reference mean Total body weight at length (condition): -10% of baseline reference mean Relative abundance of YOY (% composition of YOY) OR relative age-class strength: ± 25% of baseline or reference mean Age: ± 25% of reference mean	Dustfall, erosion and sedimentation	**Threshold:** Fish health endpoint at mine-exposed area significantly different from reference area (ρ <0.1) but within Critical Effect Size(s), or significantly different from reference area at a magnitude outside of Critical Effect Size(s) in one and/or non-consecutive studies.	**Threshold:** Fish health endpoint at mine-exposed area significantly different from (ρ <0.1), and at a magnitude outside of Critical Effect Size(s), compared to reference area, for two consecutive assessments.	**Threshold:** Establish if moderate risk condition status is reached.			
Fish Passage Monitoring	Safeguard fish habitat and fish passage	Fish presence/absence	Water crossings	Addressed in the Surface Water and Aquatic Ecosystem Management Plan					

NOTES:

1. A Hg fish tissue study is required if the annual mean concentration of Hg in effluent >0.10 µg/L, unless (i) the results of the previous two biological monitoring studies indicate no effect on fish tissue from mercury, or (ii) the method detection limit used in respect of mercury for the analysis of at least two of four effluent samples in a calendar year is equal to or greater than 0.10 µg/L. A Se fish tissue study is required if the annual mean concentration of Se in effluent is >5 µg/L and/or the grab sample Se concentration is >10 µg/L. t
2. Two consecutive assessments refer to two sampling events based on frequency of sampling for each program (annually for CREMP and within 36 months of the previous MDMER biological study).
3. Subject to feasibility and regulatory approval as identified during the evaluation of next steps.
4. Upper range of natural sedimentation rate of 50 mg/cm^2/year, converted to a sediment thickness using the measured dry bulk density of sediment in Sheardown Lake.
5. Predicted sediment accumulation in FEIS Volume 7, Section 3.4.2.3.
6. FEIS threshold carried forward into the lake sedimentation program.
7. For performance indicators related to fish health and benthic invertebrate communities, MDMER critical effect sizes (CES) have been adopted as the basis for defining risks and guiding responses. These CES have bounds in both the positive (higher) and negative (lower) direction of a reference area mean, and therefore differences between two study areas can have a magnitude within these bounds or fall outside of these bounds. Because use of the terminology "exceeds the CES threshold" normally has a connotation in the positive direction, such terminology does not adequately account for large differences in the negative direction. Similarly, describing a difference as "lower than the CES threshold" can be construed as meeting a criterion when in fact it could be a large negative difference that does not meet the criterion. For these cases, use of the terminology "within" and "outside" of a CES more adequately reflects whether a difference meets or does not meet a criterion.

TABLE 5.3 FRESHWATER ENVIRONMENT - MODERATE AND HIGH ACTION PRE-DEFINED RESPONSES

Mitigation	Key Stressor	Potential Responses
Avoid/reduce	Dust emissions	• Redesign engineering controls. • Spray (or respray piles) with approved dust suppressant. • Research for alternate dust suppression products. • Evaluate surface watering and sprinkler system options via mister trucks or trailers. • Where applicable, install or redesign conveyor shrouding for fugitive dust. • Conduct review of new technology and solutions available on the market for dust control. • Develop site-specific risk-based guidelines. • Complete risk assessment
	Erosion and sedimentation	• Stabilize eroding surfaces with rip rap or other measures. • Install sediment control infrastructure (i.e., check dams). • Explore redesign of water conveyance structures and culverts. • Construct diversion ditches or berms. • Direct non-contact water away from site infrastructure. • Conduct review of new technology and solution available on the market for erosion and sedimentation control. • Explore options for temporary vegetation of disturbed land (progressive reclamation).
	Water management	• Assess potential use and effectiveness of batch water treatment with reagents, and/or flocculants. • Construct water management structures (i.e., additional settlement ponds, dams etc.). • Install stream specific water treatment plant. • Implement alternate water treatment technologies (i.e., permeable reactive barriers).
Compensation	Any/all stressors	• Compensation under WCA.

6.0 REVIEW OF PLAN EFFECTIVENESS

An important element of Baffinland's management system is reviewing the continued suitability, adequacy and effectiveness of each management plan. This will occur through an annual review process as well as scheduled updates.

6.1 ANNUAL REVIEW OF COMPLIANCE AND UNANTICIPATED EFFECTS

Baffinland conducts internal inspections and audits throughout the year. Throughout the year, immediate corrective actions are taken as appropriate to address instances of non-compliance, as well as unanticipated effects that may be observed. Follow-up corrective actions may also be required. As described above (Section 5.2), before the end of each calendar year, water quality and sediment quality data will be evaluated relative to applicable AEMP benchmarks as a basis for determining occurrence of a potential mine-related effect and determining appropriate follow-up actions. The annual review of unanticipated effects will incorporate a comparison of results to predictions from the FEIS and its addendums to inform on the Project's performance relative to these original predictions and to aid in the ongoing assessment of environmental conditions and trends at the Project. These immediate and follow-up corrective actions will be documented in the Annual Report.

One follow-up corrective action may be to revise mitigation measures or monitoring programs described in the applicable management plans. During the annual reporting cycle, Baffinland will review instances of non-compliance as well as unanticipated effects and determine if a review of plan effectiveness is appropriate. This process is articulated on Figure 6.1. The results of this annual review will be reported in the annual report. Management plan updates that result from this process will also be filed with the annual report.

This process may occur annually whether repeat non-compliance and/or unanticipated effects are identified or not (Figure 6.1).

6.2 SCHEDULED UPDATES

In addition to the annual review cycle described above, scheduled Plan reviews will occur according to the schedule presented in Table 6.1.

TABLE 6.1 PLAN REVIEW SCHEDULE

Review Event	Description	Responsibility
Every 3 years during operation	Mandatory management review	General Manager or designate Superintendent Operations or designate Superintendent Technical Services or designate Superintendent Environment or designate

Plan updates will be recorded in the Document Revision Record located at the front of the Plan.

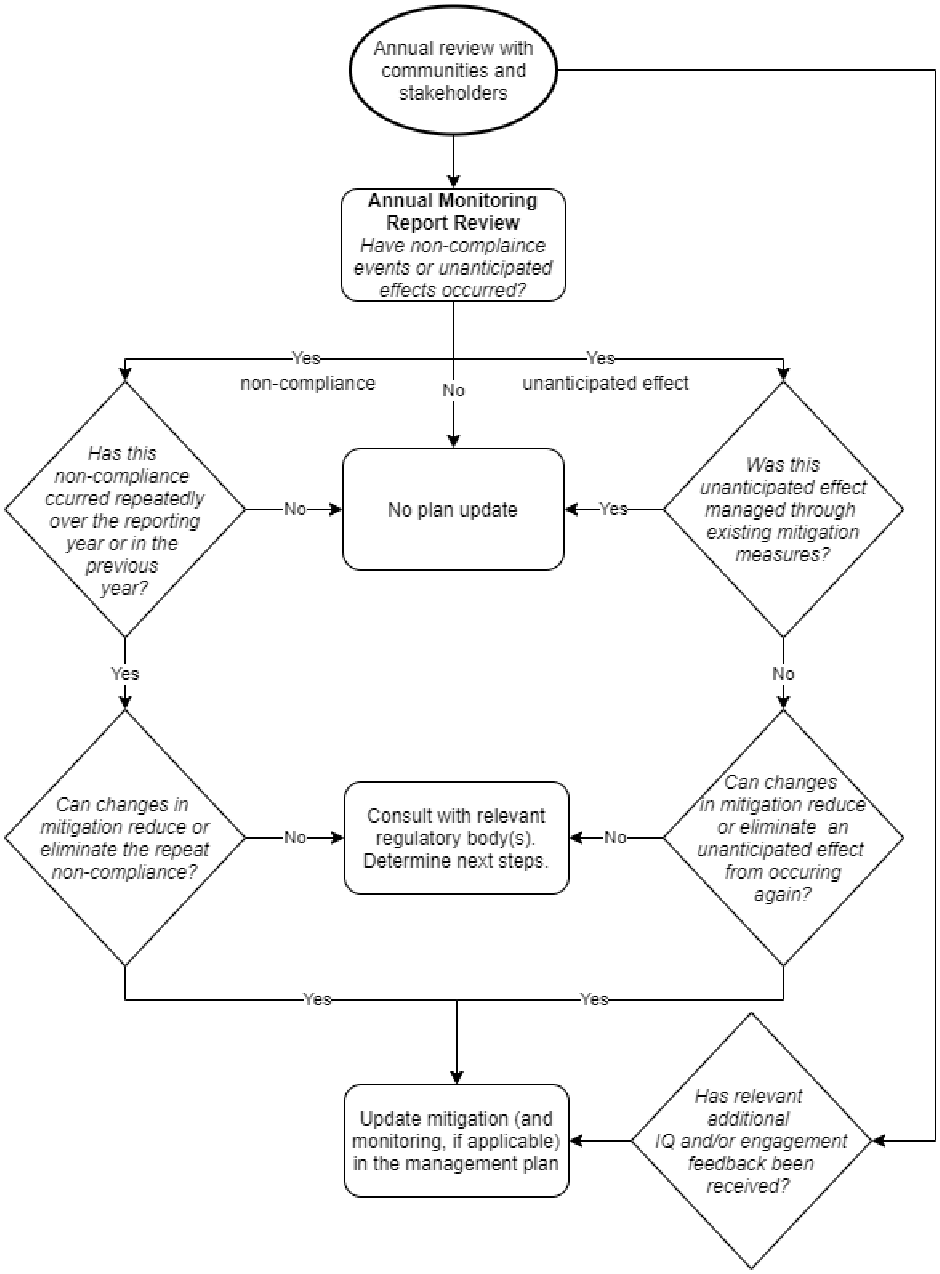

FIGURE 6.1 ANNUAL REVIEW OF PLAN EFFECTIVENESS

7.0 REFERENCES

Alberta Environment (AENV). (updated 2013). *Lake water trophic status*. http://environment.alberta.ca/01715.html. Accessed February 22, 2014.

Azimuth Consulting Group Inc (Azimuth). 2010. *Aquatic Effects Management Program: Meadowbank Gold Project, Version 1*. Project No. AE-10-01. Prepared for Agnico-Eagle Mines Ltd., Baker Lake, Nunavut. May 2010.

Baffinland Iron Mines Corporation (Baffinland). 2012. *Final Environmental Impact Statement*. February 2012.

Baffinland. 2013a. *Addendum to the Final Environmental Impact Statement*. June 2013.

Baffinland. 2013b. *Aquatic Effects Monitoring Program Framework*. February 2013.

Baffinland. 2013c. *Updated Aquatic Effects Monitoring Program Framework*. December 2013.

Baffinland. 2014. *Terrestrial Environment Management and Monitoring Plan*, Version 3.0. January 2014.

British Columbia Ministry of the Environment, undated. Water Quality Guidelines (Criteria) Reports. Available at: http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html. Accessed April 2014.

Carlson R.E. 1977. A trophic state index for lakes. *Limnol. Oceanogr*. 22: 361-369.

Canadian Council of Ministers of the Environment (CCME). 1999. *Canadian environmental quality guidelines*. Canadian Council of Ministers of the Environment, Winnipeg, MB. Updated to 2014. Available at: http://st-ts.ccme.ca/.

CCME. 2007. *Canadian sediment quality guidelines for the protection of aquatic life: Summary tables and fact sheets. Update 2002*. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

Department of Fisheries and Oceans Canada (DFO). 1995. *Freshwater Intake End-of-Pipe Fish Screen Guideline*. Ottawa: Ministry of Supply and Services Canada. Catalogue No. Fs 23-270 / 1995E.

Environment Canada. 2003. *Revised Technical Guidance on How to Conduct Effluent Plume Delineation Studies.* National EEM Office, National Water Research Institute and Environment Canada. March 2003.

Environment Canada. 2004. *Canadian guidance framework for the management of phosphorus in freshwater systems. Ecosystem Health: Science-based Solutions Report No. 1-8*. National Guidelines and Standards Office, Water Policy and Coordination Directorate, Environment Canada. 114 p.

Environment Canada. 2012. *Metal Mining Technical Guidance for Environmental Effects Monitoring*. National Environmental Effects Monitoring Office.

Fisheries Act. R.S.C. (1985). c. F-14, June 29, 2012.

Galvez-Cloutier R. and M. Sanchez. 2007. Trophic status evaluation for 154 lakes in Quebec, Canada: monitoring and recommendations. *Wat. Qual. Res. J. Can*. 42: 252-268.

Golder Associates. 2014. *Diavik Diamond Mines aquatic effects monitoring program study design Version 3.4.* Prepared for Diavik Diamond Mines Inc. by Golder Associates Ltd., Calgary, AB, January 2014. 318 p.

Indian and Northern Affairs Canada (INAC). 2009. *Guidelines for Designing and Implementing Aquatic Effects Monitoring Programs for Development Projects in the Northwest Territories*. Yellowknife. June 2009. Volumes 1-6.

Knight Piésold Ltd., 2007. *Mary River Project – Bulk Sampling Program – Fish Habitat No Net Loss and Monitoring Plan*. Ref. No. NB102-181/10-4, Rev. 0, dated August 30, 2007.

Knight Piésold Ltd. 2014a. *Baffinland Iron Mines Corporation – Mary River Project – Water and Sediment Quality Review and CREMP Study Design*. Ref. No. NB102-181/33-1, Rev. 2, dated June 25, 2014.

Knight Piésold Ltd. 2014b. *Baffinland Iron Mines Corporation – Mary River Project – Water and Sediment Quality Sampling Protocol*. Ref. No. NB102-181/33-2, Rev.0, dated March 28, 2014.

Knight Piésold Ltd. 2014c. *Initial Stream Diversion Barrier Study - Rev. 0 - Mary River Project - Aquatic Effects Monitoring Program*. Memo Ref. No. NB14-00160, dated June 25, 2014.

MacDonald, D.D., Clark, M.J.R., Whitfield, P.H., and Wong, M.P. 2009. Designing monitoring programs for water quality based on experience in Canada I. Theory and framework. *Trends in Analytical Chemistry* 28(2):204-213.

Minister of Justice (MOJ). 2012. Consolidation Metal Mining Effluent Regulations. SOR/2002-222. Current to September 12, 2012.

Minister of Justice (MOJ). 2020. Metal and Diamond Mining Effluent Regulations. SOR/2002-222. Current to July 15, 2020.

North/South Consultants Inc (NSC). 2014a. *Mary River Project - Core Receiving Environment Monitoring Program: Freshwater Biota.* June.

North/South Consultants Inc (NSC). 2014b. *Mary River Project* - Candidate Reference Lakes: Preliminary Survey 2013. June.

North/South Consultants Inc (NSC). 2014c. *Mary River Project - Aquatic Effects Monitoring Program: Lake Sedimentation Monitoring Program*. June.

Nürnberg, G.K. 1996. Trophic state of clear and colored, soft- and hardwater lakes with special consideration of nutrients, anoxia, phytoplankton and fish. Lake and Reservoir Management. 8: 17-30.

Nunavut Impact Review Board (NIRB), 2020. *In the matter of an application by Baffinland Iron Mines Corporation for development of the Mary River Project Proposal in the Qikiqtani Region of Nunavut: NIRB Project Certificate No. 005*. June 18, 2020.

Nunavut Impact Review Board (NIRB), 2014. *Nunavut Impact Review Board - Public Hearing Report - Mary River Project: Early Revenue Phase Proposal - Baffinland Iron Mines Corporation - NIRB File No. 08MN053*. March 2014.

Nunavut Water Board (NWB). 2015. *Water Licence No: 2AM-MRY1325 – Amendment No. 1*. July 31, 2015.

Ontario Ministry of the Environment (OMOE). 2011. *Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act*. PIBS # 7382e01, dated April 15, 2011.

Organization for Economic Cooperation and Development (OECD). 1982. *Eutrophication of waters - Monitoring, Assessment and Control - Final Report*. OECD cooperative programme on monitoring of inland waters (eutrophication control), Environment Directorate. OECD, Paris. 154 p.

Qikiqtani Inuit Association (QIA), 2013. *Commercial Lease No. Q13C301, Commercial Lease for Inuit Owned Lands Between: Qikiqtani Inuit Association (as Landlord) and Baffinland Iron Mines Corporation (as Tenant)*. September 6.

Qikiqtani Inuit Association (QIA), 2020a. Comment on Adaptive Management in Baffinland's Aquatic Environment Monitoring Plan (AEMP) 7 September 2020 draft Rev. 2 with focus on Table 5.1. Prepared by Bruce Stewart, September 7.

Qikiqtani Inuit Association (QIA), 2020b. Comment on Trigger Action Response Plan in Baffinland's Aquatic Environment Monitoring Plan (AEMP) draft Rev. 2 with focus on Table 5.1. Prepared by Bruce Stewart, November 20.

Ryding., S.O. and W. Rast. 1989. *The Control of Eutrophication of Lakes and Reservoirs.* Vol. 1. UNESCO, Paris and the Parthenon Publishing, United Kingdom. 314 p.

Swedish Environmental Protection Agency. 2000. *Environmental quality criteria. Lakes and watercourses*. Swedish EPA Report 5050. 102 p.

University of Florida, Florida Lakewatch. 2002. *Trophic state: a waterbody's ability to support plants, fish and wildlife*. Gainesville, FL, USA.

United States Environmental Protection Agency (USEPA). 2009. National lake assessment: A collaborative survey of the nation's lakes. EPA 841-R-09-001. USEPA, Office of Water and Office of Research and Development, Washington, D.C.104 p.

United States Environmental Protection Agency (USEPA). 2014. *National Recommended Water Quality Criteria: Aquatic Life Criteria Table*. Office of Water, Office of Science and Technology, USEPA, Washington, DC. Available at: http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm#altable. Last modified May 22, 2014.

United States Environmental Protection Agency (USEPA). 2016. *Aquatic Life Ambient Water Quality Criterion for Selenium - Freshwater*. EPA 822-R-16-006.

Wetzel, R. 1983. *Limnology 2nd Ed: Lake and River Ecosystem*. Academic Press, San Diego, C

Wright, D. G. & Hopky, G. E. 1998. *Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters*. Canadian Technical Report of Fisheries Aquatic Sciences 2107.

Appendix A

Corporate Policies

Baffinland's Sustainable Development Policy identifies Baffinland's commitment internally and to the public to operate in a manner that is environmentally responsible, safe, fiscally responsible and respectful of the cultural values and legal rights of Inuit.

Baffinland's Health, Safety and Environment Policy is the company's commitment to achieve a safe, health and environmentally responsible workplace.

These policies and others are available at: https://baffinland.com/media-centre/document-portal/

Appendix B
Concordance Tables

Tables B.1, B.2 and B.3 show the terms and conditions of the Project's Type A Water Licence (2AM-MRY1325 - Amendment No. 1), the Project Certificate No. 005 and the location within the Aquatic Effects Monitoring Plan that the information can be found.

TABLE B.1 CONCORDANCE TABLE WITH TYPE A WATER LICENCE TERMS AND CONDITIONS

Part	Item	Condition	Section
I	1	The Board has approved with the issuance of the Licence, for the Construction Phase of the Project, the plan entitled *Aquatic Effects Monitoring Program (AEMP) Framework*, dated February 2013, applicable during the Construction Phase of the Project.	Superseded by final plan under Item 2
	2	The Licensee shall submit to the Board, for approval in writing, at least sixty (60) days following approval of this Amendment, a revised version of the Plan entitled Aquatic Effects Management Plan (BAF-PH1-830-P16-0039, Rev 0), June 27, 2014, that addresses the relevant comments received from intervening parties during the review period for the Plan. The Plan under this condition, once approved, will supersede the Plan referenced in Part I, Item 1.	This plan

TABLE B.2 CONCORDANCE TABLE WITH PROJECT CERTIFICATE TERMS AND CONDITIONS

No.	Condition	Section
21	The Proponent shall ensure that the scope of the Aquatic Effects Monitoring Plan (AEMP) includes, at a minimum:	
	a. monitoring of non-point sources of discharge, selection of appropriate reference sites, measures to ensure the collection of adequate baseline data and the mechanisms proposed to monitor and treat runoff, and sample sediments; and	2.3, 3.7, 5.1
	b. measures for dustfall monitoring designed as follows: i. To establish a pre-trucking baseline and collect data during Project operation for comparison; ii. To facilitate comparison with existing guidelines and potentially with thresholds to be established using studies of Arctic char egg survival and/or other studies recommended by the Terrestrial Environment Working Group (TEWG); and, iii. To assess the seasonal deposition (rates, quantities) and chemical composition of dust entering aquatic systems along representative distance transects at right angles to the Tote Road and radiating outward from Milne Port and the Mine Site.	3.5 (reference to dustfall monitoring); 4.3.1 and Appendix F (related lake sedimentation monitoring program); Air Quality and Noise Abatement Management Plan (dustfall monitoring program)

TABLE B.3 CONCORDANCE TABLE WITH COMMERCIAL LEASE WITH THE QIA

Sch.	Condition	Section
G	Identifies the AEMP as a key monitoring program	This plan