Knight Piésold CONSULTING

MEMORANDUM

Date:	August 22, 2019	**File No.:**	NB102-00181/53-A.01
		Cont. No.:	NB19-00602
To:	Mr. Lou Kamermans		
Copy To:	Mr. Steve Borcsok		
From:	Amber Blackwell, P.Geo.		
Re:	**Proposed North Railway Aquatic Monitoring Programs – Mary River Project – Phase 2 Proposal**		

1.0 INTRODUCTION

During the technical review of Baffinland's application to amend its Type A Water Licence (Knight Piésold, 2019a) for the Phase 2 Proposal, Baffinland received a number of technical review comments (TRCs) focused on monitoring of the aquatic environment along the North Railway, during and following construction (Qikiqtani Inuit Association [QIA], 2019a; Environment and Climate Change Canada [ECCC], 2019; Fisheries and Oceans Canada [DFO], 2019).

Table 1 summarizes the specific TRCs relating to monitoring of the Phase 2 Proposal (mainly the North Railway) during construction, post-construction, and during operations.

Table 1 Summary of Comments Relating to Railway Monitoring

TRC #	Summary of Technical Review Comment	Location
ECCC 3.2	Lack of detail regarding construction monitoring	Memo
QIA 4.2	Add water quality monitoring locations that align with Inuit water use	Response
QIA 5.1	Flow diversion monitoring and adaptive management plan	Section 5
QIA 6.1	Lack of monitoring and mitigation measures for construction and operation of the North Railway	Response
QIA 8.1	SWAEMP needs to specify the frequency of monitoring and how this will inform maintenance activities	Section 3
QIA 9.1	SWAEMP includes recommendations or forward-referenced commitments to monitor without the requisite details	Sections 3-6
QIA 13.1	Provide figures showing the location of field monitoring associated with construction, operation and closure of the North Railway	Response
QIA 16.1 & 16.2	Present monitoring triggers that will be used to mitigate against exceedances of water quality criteria/thresholds	Section 3
QIA 17.1	Confirm when the assessment and detailed design will be completed and available regarding the high-risk stream diversions	Assessment June 18, 2019; designed design ongoing and will be filed 60-day prior to construction

TRC #	Summary of Technical Review Comment	Location
QIA 18.1	Confirm when the monitoring program will be completed and available regarding the embedded culvert installations at fish bearing crossings	Section 4
QIA 19.2	Provide the specific erosional events and/or sedimentation triggers that would action medial measures	Section 3 – this is related to observations of erosion noted during rail inspections.
QIA 23.1	Provide what monitoring program will occur and what adaptive management strategies will be in place regarding the moderate risk stream diversion	Section 5
QIA 23.2	Provide the monitoring values and trigger mitigation measures that will be adopted for this monitoring program	
QIA 23.3	Provide details regarding when the monitoring and adaptive management will *not* be required during and post construction	
QIA 24.1	Provide an amendment to the Water Licence that is devoted to the North Railway	Response
QIA 24.2	Provide requirements for construction reporting regarding the North Railway within this amendment	Response
QIA 24.3	QIA is willing to work through the NWB Water Licence amendment to include the North Railway with Baffinland	Response
DFO 3.2.5	Clarify the intent of the mitigation measures specific to the bridges along the rail corridor to be adopted if fish passage is affected	Response
DFO 3.3.4	Provide additional rational/assessment supporting the assertion that water withdrawal from non-fish bearing streams will not negatively affect fish-bearing waterbodies downstream	Section 6

Most of the above TRCs can be summarized as follows:

- Monitoring of water quality in watercourses downgradient of active construction were not described in detail with respect to monitoring frequency; triggers and timing of corrective actions; the nature of corrective actions; adaptive management; and reporting of monitoring data.
- Recommendations for future elements of construction monitoring were presented without providing details on those elements, including:
  - Post-construction monitoring at stream diversions
  - Post-construction monitoring of culverts at high risk of interrupting fish passage
  - Monitoring of water withdrawals at one location (BG32) to confirm fish are not being adversely affected
- DFO recommended that fish habitat be assessed at existing and proposed water withdrawal stations, and that a detailed water withdrawal plan be submitted with an application for an authorization under the *Fisheries Act* or an earlier Request for Review.

2.0 INCORPORATING INUIT QAUJIMAJATUQANGIT AND ADAPTIVE MANAGEMENT

As an outcome of the Nunavut Impact Review Board (NIRB) technical meetings in April and June 2019, Baffinland has started to develop a framework for integrating Inuit Qaujimajatuqangit (IQ) into Baffinland's operations including its management plans (IQ Integration Framework) and a separate Adaptive Management (AM) Framework. Work on both these frameworks is ongoing.

The AM Framework will assist Baffinland in standardizing how AM is integrated across its environmental management system in order to provide increased consistency, and to facilitate the review and updating of these plans. A preliminary AM checklist has been developed (Table 2) to outline the expected components of AM in each management/monitoring plan. The specifics will be adapted to each plan and monitoring program.

Table 2 Adaptive Management Components and Mechanisms

Component	Proposed Adaptive Management Mechanisms
Plan Updates	Identify the triggering events and frequency of non-triggered updates to the management plan
Monitoring	Establish monitoring program to identify threshold exceedance
	Articulate the process for review of monitoring data
	Establish data reporting mechanism (e.g. NIRB annual report)
Mechanisms for IQ integration/influence	Identify mechanisms for IQ integration/influence
	Identify opportunities for IQ holders to review results and provide input into AM responses/mitigation
Triggers and Thresholds	Establish compliance thresholds that should not be exceeded
	Identify early warning triggers for action so that thresholds are not exceeded
	Define how decisions to take action will be made in the absence of clear triggers or thresholds
Action Levels and Responses	Identify levels of action to be undertaken if early warning triggers and thresholds are exceeded
	Identify means of documenting response actions taken
	Identify how unanticipated effects or issues will be actioned and resolved
Notification, Reporting and Follow-up	Identify notification and reporting mechanisms for threshold exceedances
	Identify follow-up procedures including issues resolution

3.0 WATER QUALITY MONITORING

Construction activities have the potential to affect the local and downstream water quality, particularly downstream of water crossing installations, quarrying and soil spoils disposal sites. As indicated in the Surface Water and Aquatic Ecosystems Management Plan (SWAEMP; Baffinland, 2019a):

> *Monitoring will occur at active work areas along the North Railway during construction, as prescribed in a future Fisheries Authorization for crossings. This is expected to include turbidity monitoring downstream of active work areas, including crossing locations as well as downstream of quarries and soil spoils disposal areas (mainly former borrow pits and quarries).*

Fish-bearing streams will be monitored for fish passage in accordance with the future Fisheries Authorization.

A brief description of the installation of crossings (culverts, arch culverts and bridges) is followed by a more detailed description of this monitoring program. This monitoring program will support a future application for a *Fisheries Act* Authorization.

3.1 DESCRIPTION OF WATER CROSSING INSTALLATIONS

3.1.1 CULVERT INSTALLATIONS

Corrugated steel pipe (CSP) culverts will be installed during the open water period but following freshet (July to October) or during winter when the streambed is frozen or dry. This will help to minimize the risk of environmental impacts, such as sedimentation and erosion, fish passage or fish disturbance, as well as provide a safer environment for construction work (i.e. lower flow, less moving water). Each CSP culvert installation will take an average of 24 hours to complete.

Arch culverts are proposed at several locations to address fish passage and other concerns. Arch culverts are installed by embedding the culvert and retaining substrate, which mimics the natural streambed, thus providing fish with adequate conditions for passage. These installations will include additional footings and shoreline work, and thus will require additional time to construct. Baffinland's contractor will be required to develop a Culvert Installation Plan that complies with the environmental protection measures outlined in section 2.9 of the Environmental Protection Plan for sediment and erosion control. Baffinland will review the proposed sediment and erosion control measures and ensure that they meet Baffinland's standards. The Culvert Installation Plan will be submitted as part of the application for an authorization under the *Fisheries Act*.

3.1.2 BRIDGE CONSTRUCTION

Bridges will be installed at four crossings. Each of the bridges consist of abutments, piers (steel piles) installed into the stream bed, and a bridge superstructure. Each bridge will be constructed under frozen conditions between February and May. To install the steel piles, it will be necessary to establish a temporary rock fill pad within the streambed, so that piling equipment can access the pier locations. The rock fill pad will be removed prior to freshet. As with culverts, Baffinland's contractor will be required to develop a Bridge Construction Plan that complies with the environmental protection measures outlined in section 2.9 of the Environmental Protection Plan for sediment and erosion control. The Bridge Construction Plan will be submitted as part of the application for an authorization under the *Fisheries Act*.

3.2 WATER QUALITY MONITORING DURING CONSTRUCTION

In 2018, Baffinland developed *Environmental Guidelines for Project Water Crossing Repairs, Modifications and/or Installations* in consultation with the QIA. These guidelines are found in Appendix C of the Roads Management Plan (Baffinland, 2019b), and apply to all repairs, modifications, and installations of a water crossing (e.g. culvert, bridge) along the Tote Road. The guidelines provide monitoring protocols applicable pre-, during and post-construction, during both open water and frozen conditions. Sampling locations in relation to a water crossing; monitoring parameters, methods and frequency. Prescribed water quality thresholds are identified along with corresponding response levels used to inform mitigation and management actions.

These guidelines will apply to all water crossings along the North Railway, Tote Road, and access roads associated with the Phase 2 Proposal. A copy of the guidelines is included in Appendix A of this memo.

3.3 WATER QUALITY MONITORING DURING OPERATIONS

Baffinland developed an operation phase *Tote Road Monitoring Program (TRMP)* in consultation with the QIA that is designed to monitor water quality downstream of representative water crossings along the Tote Road. This monitoring program is in Appendix D of the Roads Management Plan (Baffinland, 2019b). It identifies sampling locations; monitoring parameters, sampling methods and frequency and prescribed water quality thresholds along with corresponding response levels used to inform mitigation and management actions. TRMP monitoring locations are presented in Figure 1.

Baffinland proposes to modify the TRMP, in consultation with the QIA to incorporate monitoring of the North Railway. This includes consideration of potential waterbodies that align with Inuit water use (QIA 4.2), as identified in IQ collection initiatives since the Project was first approved, including the QIA's Tusaqtavut Study for Pond Inlet (QIA, 2019b). Monitoring stations can be modified or added in the future to account for new IQ that becomes available from Baffinland's monitoring programs or other sources

A copy of the Tote Road Monitoring Program is included in Appendix B of this memo.

4.0 FISH PASSAGE MONITORING

The Phase 2 Proposal will involve construction work in streams or other waterbodies including culvert and bridge installations, stream and pond encroachments and infilling, and stream diversions as part of the North Railway, access roads and realignments of the Tote Road. Bridges will be used to cross the four largest rivers, and plate arch culverts will be installed at 11 crossings previously identified as being a high risk for unencumbered fish passage. An estimated 412 corrugated steel pipe (CSP) culverts will be installed in watercourses and to manage runoff. Culverts can present a potential obstacle to upstream migration of fish as a result of increased water velocity, decreased water depth, culvert length, and height of the culvert outlet related to the natural channel.

KP (2019b) conducted a desktop assessment of the hydrologic and hydraulic characteristics within CSP culverts located in streams with known or potential Arctic char populations (for the purpose of the assessment all sites with the potential to have Arctic char populations were assumed to be fish-bearing). Culvert diameters in the fish-bearing watercourses will range from 600 mm to 1800 mm and will be installed at slopes between 1% and 5%. Each crossing will have between one and five pipes, and culvert length will vary from 12 m to 95 m. At least one culvert at each fish-bearing crossing will be embedded with bed material at 20% of the diameter. All CSP culverts are assumed to be installed at the elevation of the downstream beds; therefore, fish passage related to vertical drops was not assessed.

Average velocity and maximum water depth were calculated for each of the embedded CSP culverts based on mean monthly July and August flows, culvert diameter, and culvert slope. The risk to fish passage was rated as Low, Moderate, or High in 93 of the culverts to be installed in fish-bearing watercourses, based on the calculated average culvert velocity and velocity thresholds for two sizes of Arctic char (88 mm and 256 mm) in July and August. A total of 29 of the culverts were rated as presenting a high risk to fish passage (see Figure 2).

Site-specific assessments at these high-risk sites will be conducted prior to construction to collect baseline information on water depth, velocities and discharge, channel morphology and fish use. Measures to mitigate fish passage issues will be proposed (e.g., baffles installed in CSP culverts; additional culvert

pipes, or alternative crossing structures such as arch culverts) and fish passage risk will be re-assessed with these additional mitigation measures. This information will be presented in the application for an authorization under the *Fisheries Act*.

Following installation, an annual inspection of the 29 culverts previously assessed as high risk to fish passage along the North Rail will be conducted each year by a Professional Fisheries Biologist. The focus of the annual inspection will be to determine fish passage success by surveying the presence of fish and document habitat quality upstream and downstream of the culverts, following the protocol established for the Tote Road monitoring program. The proposed duration of the program is 5 years following completion of installation of all of the crossings in fish-bearing watersheds.

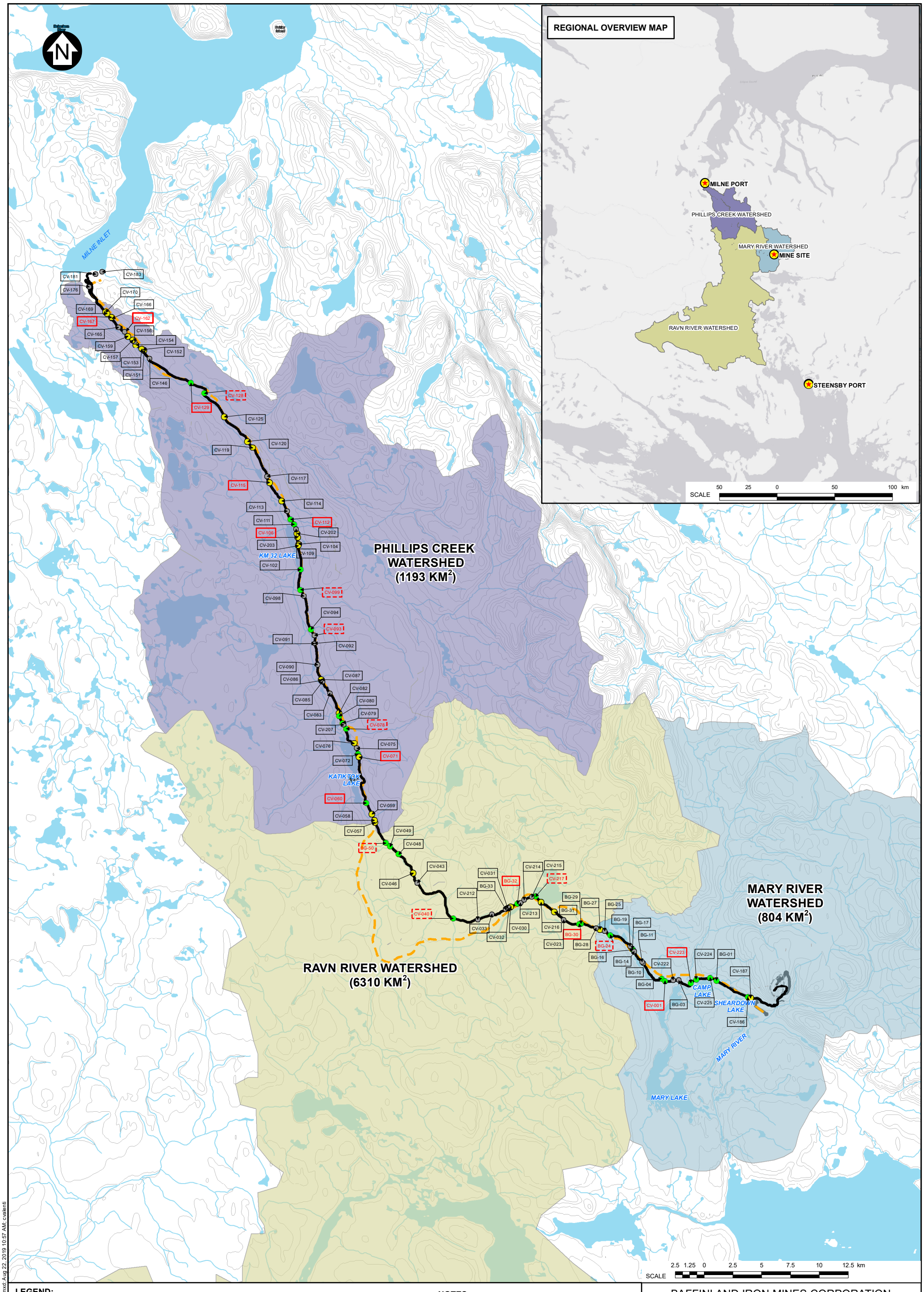
5.0 STREAM DIVERSIONS MONITORING

The upstream portions of 10 non-fish-bearing streams that will be intersected by railway construction will be diverted to adjacent streams on the upstream side of the railway (Figure 3). This will result in increased flows to the receiving streams and conversely may result in decreased flows to previous receiving streams. KP undertook an assessment of the planned diversions in support of the FEIS Addendum for the Phase 2 Proposal (KP, 2017 in Baffinland, 2018). Subsequent railway design changes reduced the number and location of stream diversions, and an updated assessment was presented by KP (2019b).

5.1 ASSESSMENT METHODOLOGY

This assessment focused on the effect of increased flow in the receiving stream, with potential effects including:

- *Exceedance of channel capacity and flooding.* If flow increases are modest, flooding may be infrequent. Where flow increases are larger, the channel banks may be overtopped each year during freshet (nival runoff) or during rainfall driven runoff events. Given the lack of vegetation and shallow frozen soils, rainfall runoff is rapid, causing sudden pronounced and relatively large increases in flow. If the channel is within a well-defined valley, the flooded extent may be modest, but in flat terrain flooding may be extensive or follow low terrain (e.g. ice wedges) into other drainages.
- *Changes in permafrost and frozen soil*. Flooding and higher water levels may affect permafrost and frozen soil conditions proximal to the channel, causing subsidence or slope instability.



LEGEND:

- WATER
- MILNE INLET TOTE ROAD
- POTENTIAL DEVELOPMENT AREA
- PROPOSED NORTH RAIL ALIGNMENT
- WATER CROSSING MONITORED BY TOTE ROAD MONITORING PROGRAM
- HADD FISH BEARING WATER CROSSING MONITORED BY TOTE ROAD MONITORING PROGRAM

FISH BEARING STATUS

- NO
- MARGINAL
- IMPORTANT

NOTES:

1. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: UTM NAD83 ZONE 17N.
2. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
3. CONTOUR INTERVAL IS 40 METRES.
4. CATCHMENT BASED ON JULY 2006 INSPECTIONS.
5. FISH BEARING STATUS BASED ON: BAFFINLAND IRON MINES CORP., FISH HABITAT MONITORING 2017 ANNUAL REPORT, TABLE 2, DECEMBER 2017.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
0	22AUG'19	ISSUED WITH MEMO	AV	AS/CJV	AV

BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

TOTE ROAD MONITORING PROGRAM

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P/A NO.	REF NO.
NB102-181/53	NB19-00602

FIGURE 1 REV 0

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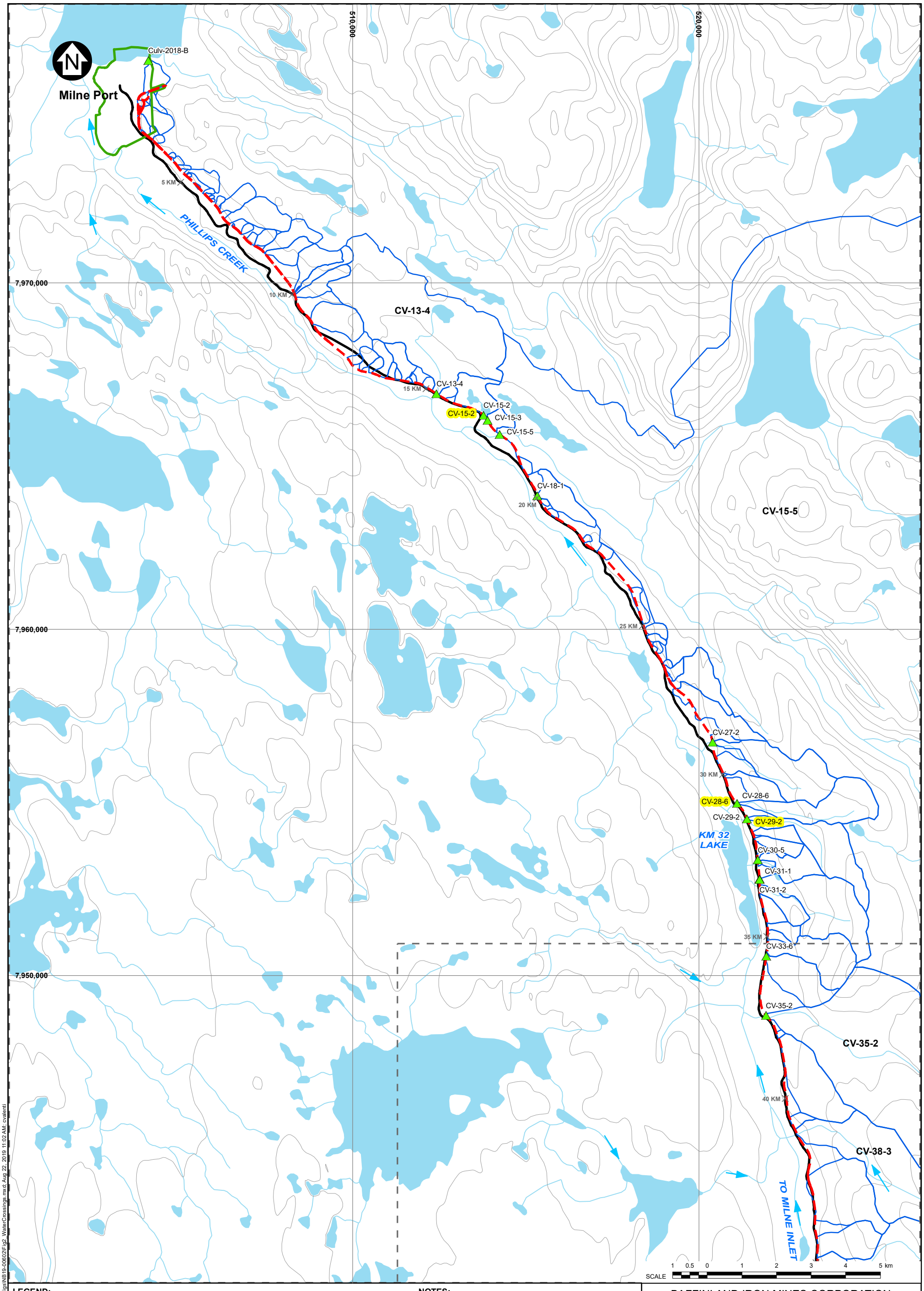

LEGEND:

GENERAL
- POTENTIAL DEVELOPMENT AREA (MINE, PORT)
- RIVER/STREAM
- LAKE
- FLOW DIRECTION
- CONTOUR
- CATCMENT BOUNDARY
- PROPOSED NORTH RAILWAY
- MILNE INLET TOTE ROAD
- ACTIVE HYDROMETRIC STATION
- CV-29-2 CULVERT AT HIGH RISK OF RESTRICTING FISH PASSAGE SITES

FISH BEARING STATUS
- POTENTIAL
- YES

NOTES:

1. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N.
2. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
3. CONTOUR INTERVAL IS 40 METRES.
4. SITES HIGHLITED IN YELLOW ARE HIGH RISK FISH PASSAGE SITES.

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MARY RIVER PROJECT

NORTH RAILWAY SHOWING HIGH RISK FISH PASSAGE WATER CROSSINGS (SHEET 1 OF 3)

Knight Piésold CONSULTING

P/A NO. NB102-181/53

REF NO. NB19-00602

FIGURE 2

REV 0

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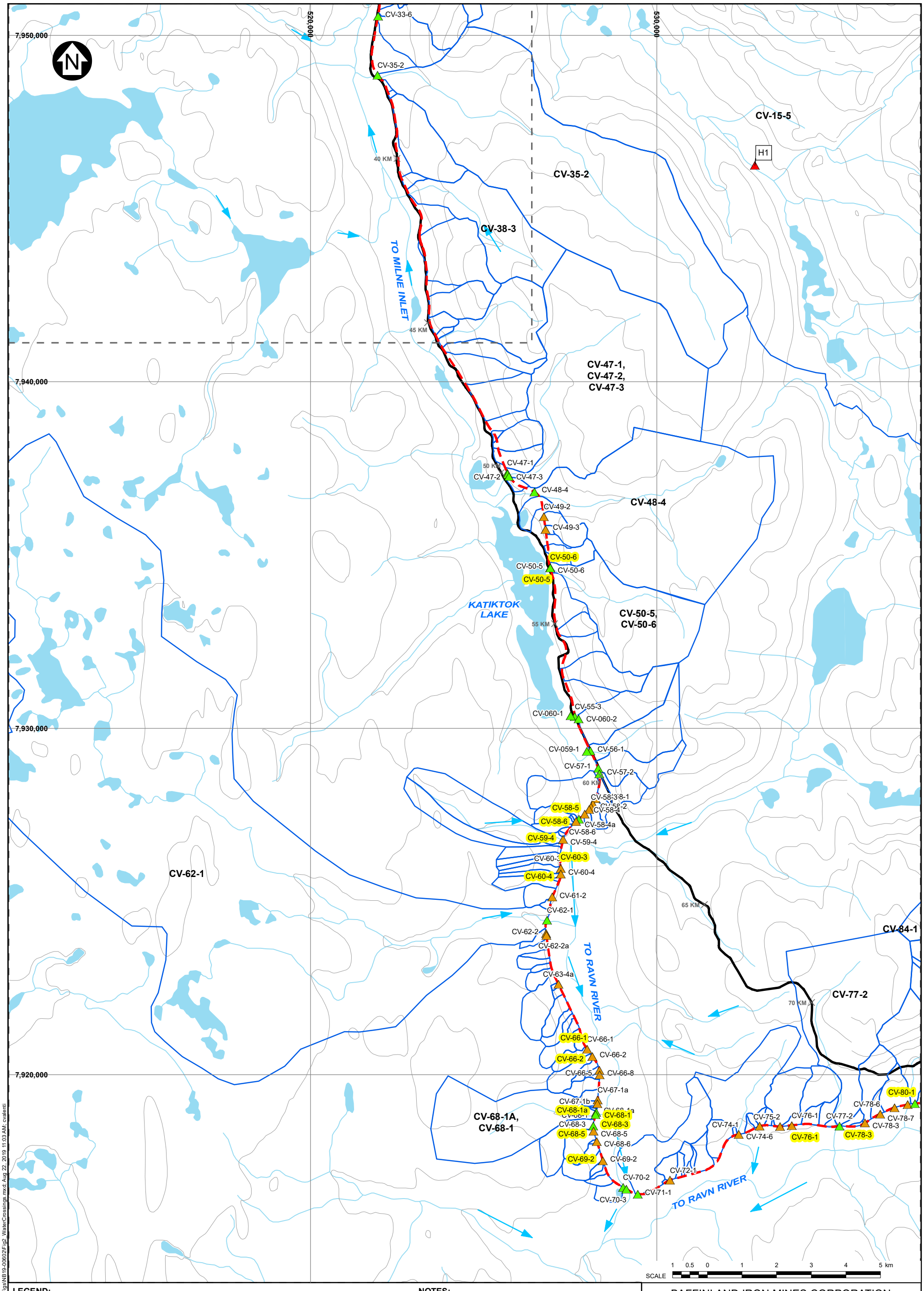

LEGEND:

- POTENTIAL DEVELOPMENT AREA (MINE, PORT)

GENERAL

- RIVER/STREAM
- LAKE
- FLOW DIRECTION
- CONTOUR
- CATCMENT BOUNDARY
- PROPOSED NORTH RAILWAY
- MILNE INLET TOTE ROAD
- ACTIVE HYDROMETRIC STATION
- CV-29-2 CULVERT AT HIGH RISK OF RESTRICTING FISH PASSAGE SITES

FISH BEARING STATUS

- POTENTIAL
- YES

NOTES:

1. COORDINATE GRID IS IN METRES.
   COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N.
2. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
3. CONTOUR INTERVAL IS 40 METRES.
4. SITES HIGHLITED IN YELLOW ARE HIGH RISK FISH PASSAGE SITES.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
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BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

NORTH RAILWAY SHOWING HIGH RISK FISH PASSAGE WATER CROSSINGS (SHEET 2 OF 3)

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-181/53	NB19-00602

FIGURE 2 REV 0

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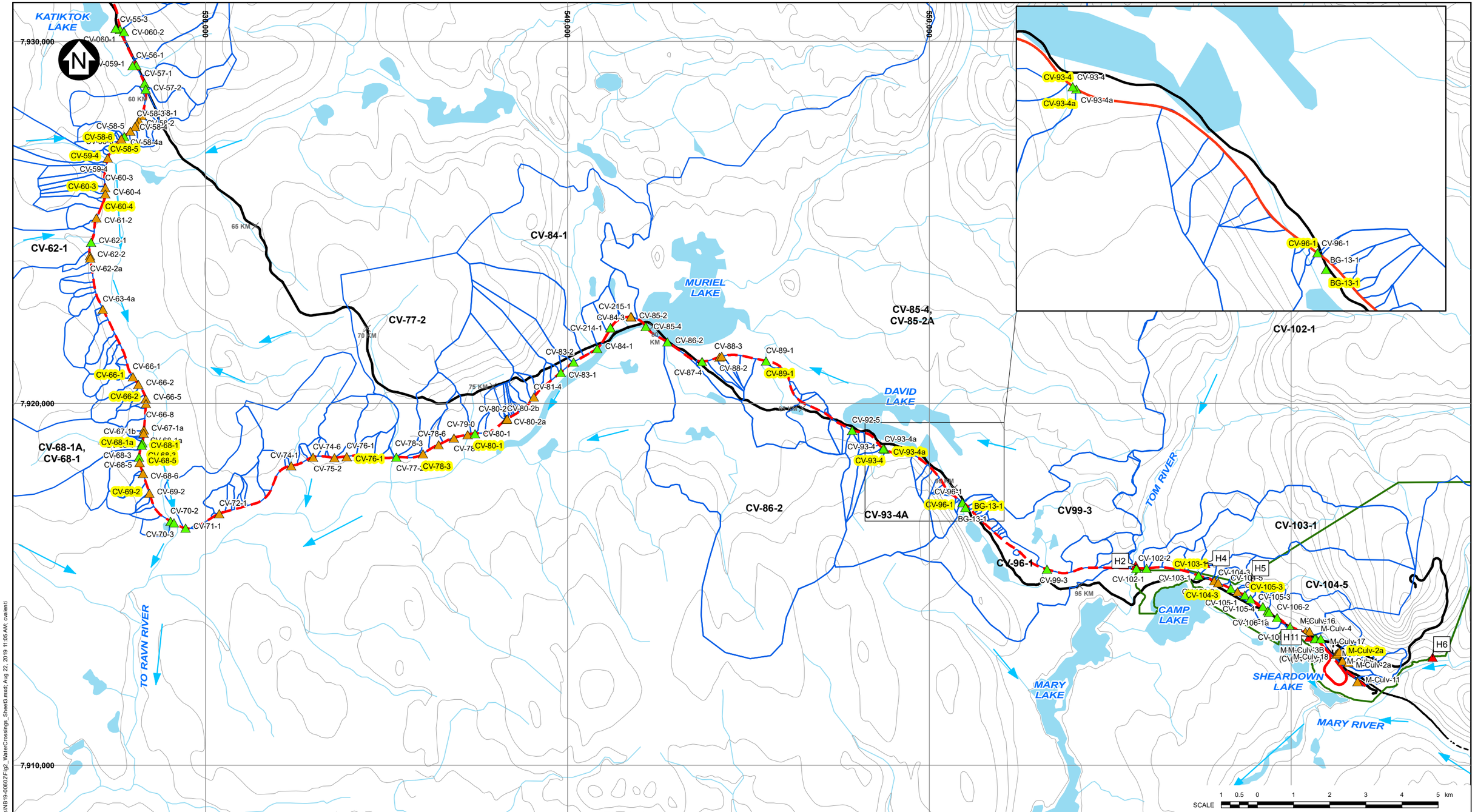

LEGEND:

GENERAL

- RIVER/STREAM
- LAKE
- FLOW DIRECTION
- CONTOUR
- PROJECT DEVELOPMENT AREA
- CATCMENT BOUNDARY
- PROPOSED NORTH RAILWAY
- MILNE INLET TOTE ROAD
- ACTIVE HYDROMETRIC STATION
- CV-29-2 CULVERT AT HIGH RISK OF RESTRICTING FISH PASSAGE SITES

FISH BEARING STATUS

- POTENTIAL
- YES

NOTES:

1. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N.
2. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009). ALL RIGHTS RESERVED.
3. CONTOUR INTERVAL IS 40 METRES.
4. SITES HIGHLITED IN YELLOW ARE HIGH RISK FISH PASSAGE SITES.

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MARY RIVER PROJECT

NORTH RAILWAY SHOWING HIGH RISK FISH PASSAGE WATER CROSSINGS (SHEET 3 OF 3)

Knight Piésold CONSULTING

P/A NO. NB102-181/53 | REF NO. NB19-00602

FIGURE 2 | REV 0

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- *Fluvial geomorphic change*. Increased flows may cause channel bed scour or bank erosion. Additionally, overbank flows may erode surficial soils. These eroded materials would be deposited downstream where the watercourse meets the diverted channel, larger river or lake.

The magnitude of flow change must be sufficient and the channel morphology sensitive to flow changes, in order to realize these potential effects.

Each of the 10 diversion locations, where flow is diverted from one stream to another, were assessed based on available desktop information, and were screened with consideration of the following:

- *Change in flow.* If the predicted increase in flow in the receiving stream is less 10% (i.e. less than 10% change in contributing catchment area), it is unlikely that measurable changes in channel morphology or flood conditions would be detected. These diversions were rated as low risk.
- *Channel morphology.* For catchments less than 0.5 km^2, mean annual discharge and 2-year peak flow were estimated to be less than 5 l/s and 0.4 m^3/s respectively. In these locations, the channels are small and channel morphology is dominated by ice, frozen soil and non-fluvial processes. If the combined catchment area (baseline plus diverted catchments) is less than 0.5 km^2, it is unlikely that measurable changes in channel morphology or flood conditions would be detected. These diversions were rated as low risk.

Where diversions cause a greater than 10% increase in flow and the combined catchment area (baseline plus diverted catchments) is greater than 0.5 km^2, it is considered that there is potential to cause more frequent overbank flooding, and potential changes in permafrost, frozen soil conditions and fluvial morphology.

Catchment area mean annual discharge (MAD) and 2-year peak flow (Q2) and length of stream channel with affected flows were estimated for each diverted and receiving stream.

5.2 RESULTS

The stream diversions are listed in Table 2 and are shown on Figure 3.

Of the 10 diversions, 9 are considered low risk. Crossings CV-68-1 and CV-68-1a are branches of the same stream, and channel alterations will occur maintaining both branches (i.e., no transfer of flow from one branch to another). Additionally, one of the diversions (CV-105-4 to downstream pond) is a channel realignment with flows reporting to the same receiving water body (a pond adjacent to CV-105-3).

One diversion (CV-47-1c into CV-47-1b) is considered medium risk. The stream at crossing CV47-1b will receive increased flows, but the channel meets the CV47-1c channel approximately 100 m downstream of the crossing, at which point flows become unchanged from baseline.

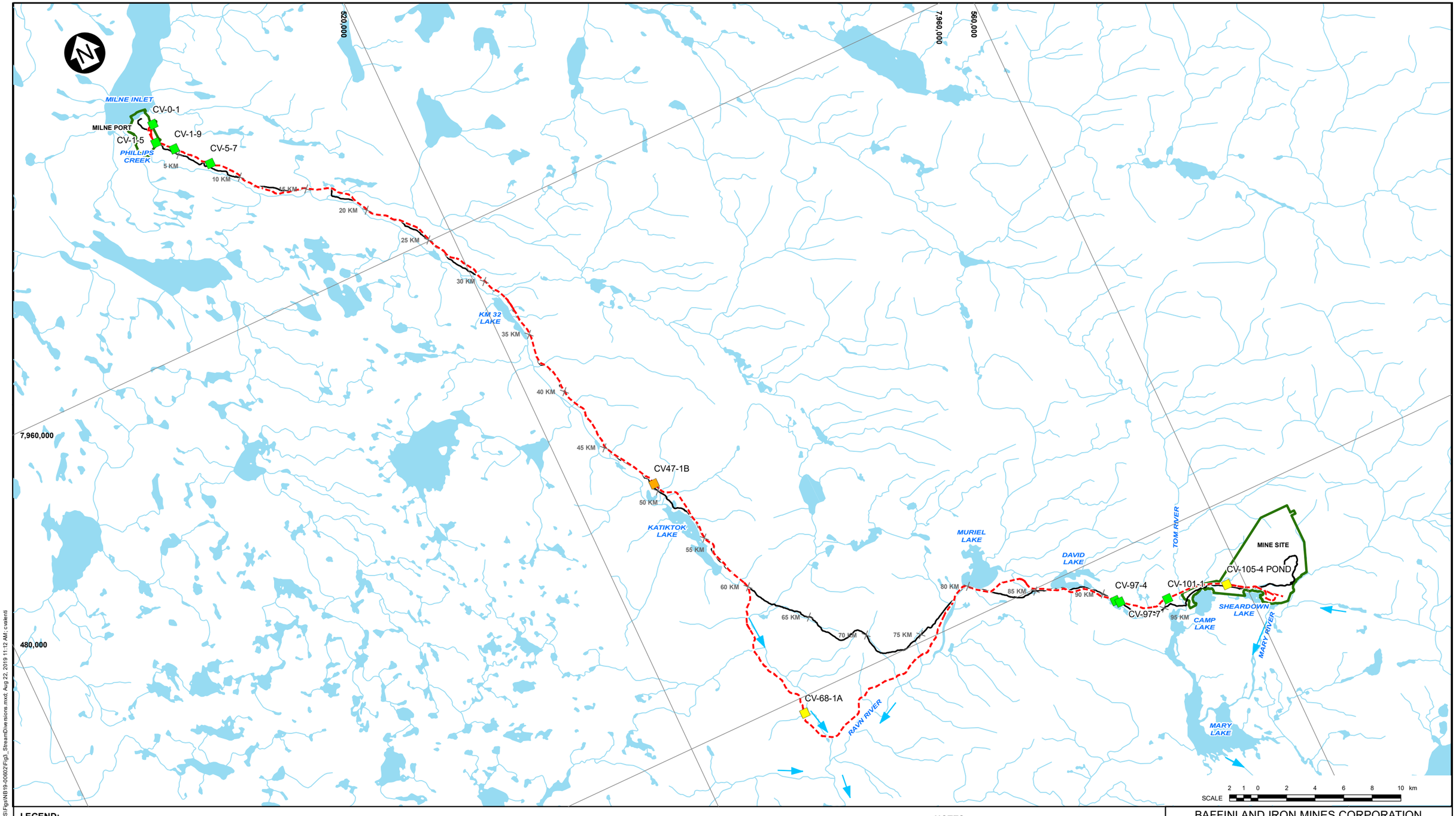
5.3 MONITORING PROGRAM

The nine low-risk stream diversions will be visually monitored monthly during the first complete open water season (and the preceding partial open water season, if applicable) to identify evidence of:

- Flooding if the capacity of the channel is being exceeded
- Subsidence or slope instability
- Channel bed scour or bank erosion
- Deposition of previously eroded materials

Table 3 Summary of Stream Diversion Effects Screening

Diverted Stream	Receiving Stream	Description	Easting	Northing	Fish-bearing at Crossing?	Risk of Geomorphic Change
Milne Port						
CV-0-2		Cut	504234	7975572	No	
	CV-0-1	Daylight + culvert	504289	7975593	No	Low
CV-1-6		Cut	504292	7974064	No	
	CV-1-5	Culvert	503938	7974336	No	Low
North Railway						
CV-1-7		Cut	504662	7973667	No	
	CV-1-9	Daylight + culvert	504926	7973382	No	Low
CV-5-5		Cut	506643	7971540	No	
	CV-5-7	Daylight + culvert	506775	7971413	No	Low
CV-47-1c		Cut	525543	7937715	No	
	CV47-1b	Culvert	525454	7937939	Yes	Medium
CV-68-1		Stream Crossing, infilling and diversion	528236	7918847	Yes	
	CV-68-1a	Stream Crossing, infilling and diversion	528254	7918912	Yes	Low
CV-97-5		Cut	551410	7916785	No	
	CV-97-4	Culvert	551291	7916898	No	Low
CV-97-6		Cut	551457	7916754	No	
	CV-97-7	Culvert	551550	7916660	No	Low
CV-101-1b		Cut	554883	7915453	No	
	CV-101-1	Culvert	554672	7915456	No	Low
Mine Site						
CV-105-4		Stream Crossing, infilling and diversion	559222	7914359	Yes	
	Pond	Pond	558852	7914615	Yes	Low



LEGEND:

- LOW RISK STREAM DIVERSION, NO FISH
- LOW RISK STREAM DIVERSION, FISH BEARING
- MEDIUM RISK STREAM DIVERSION, FISH BEARING
- FLOW DIRECTION
- RIVER/STREAM
- POTENTIAL DEVELOPMENT AREA (MINE, PORT)
- LAKE
- PROPOSED NORTH RAILWAY

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
0	22AUG'19	ISSUED WITH MEMO	RAC	AS	RAC

NOTES:

1. BASE MAP: HER MAJESTY THE QUEEN IN RIGHTS OF CANADA, DEPARTMENT OF NATURAL RESOURCES, (2004).
2. COORDINATE GRID IS UTM (NAD83) ZONE 17 AND IS IN METRES.
3. FIGURE CREATED BY KNIGHT PIESOLD LIMITED.

BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

PROPOSED NORTH RAILWAY STREAM DIVERSIONS

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-181/53	NB19-00602

FIGURE 3 REV 0

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An inspection form developed to record appropriate information will be completed, and photographs will be taken from a consistent vantage point. If subsidence or erosion is evident, an incident form will be completed and turbidity and/or TSS monitoring and any resultant actions and reporting will be carried out in accordance with the water quality monitoring program described in Section 3 (Appendix A).

Inspection forms and photos will be included with a summary discussion in the annual report to the QIA and NWB for operations for the full and partial year(s) monitored.

The medium risk stream diversion at CV-47-1b will be subject to a pre-construction site assessment and possible design mitigation to address any concerns that may be identified regarding potential flooding, subsidence, channel bed scour or bank erosion. The assessment is likely to include: the establishment of transects, survey (level and rod), and take. Post-construction monitoring of this site will be conducted as described above for the low-risk stream diversions, with implementation of the sediment and erosion monitoring program and associated response framework implemented as described in Section 3 (Appendix A).

Some parameters, such as TSS, have accurate action levels that will trigger the action response framework (Appendix A and B). Others, such as flooding and/or changes to stream morphology, are subjective and will require an exercise of professional judgement regarding action response, as there are no definitive action level triggers.

6.0 WATER WITHDRAWALS

Fifteen (15) water sources are approved under the Type A Water Licence (Figure 4 and Table C.1 in Appendix C); minor adjustments to the maximum daily water withdrawal volume are proposed (KP, 2019b). Baffinland is proposing to add 13 water sources to support additional dust suppression efforts for Phase 2 (Figure 4 and Table C-2 in Appendix C).

Section 10.2.3 of the draft Surface Water and Aquatic Ecosystem Management Plan (SWAEMP; Baffinland, 2019) proposed the following monitoring:

> *A survey of the water withdrawal site BG32 is recommended in the first year following Project approval in late summer/fall when water withdrawals occur and during a low flow event to ensure there is no stranding of Arctic Char. In the event that stranding is observed, a fish salvage would be undertaken to relocate stranded fish to a local waterbody.*

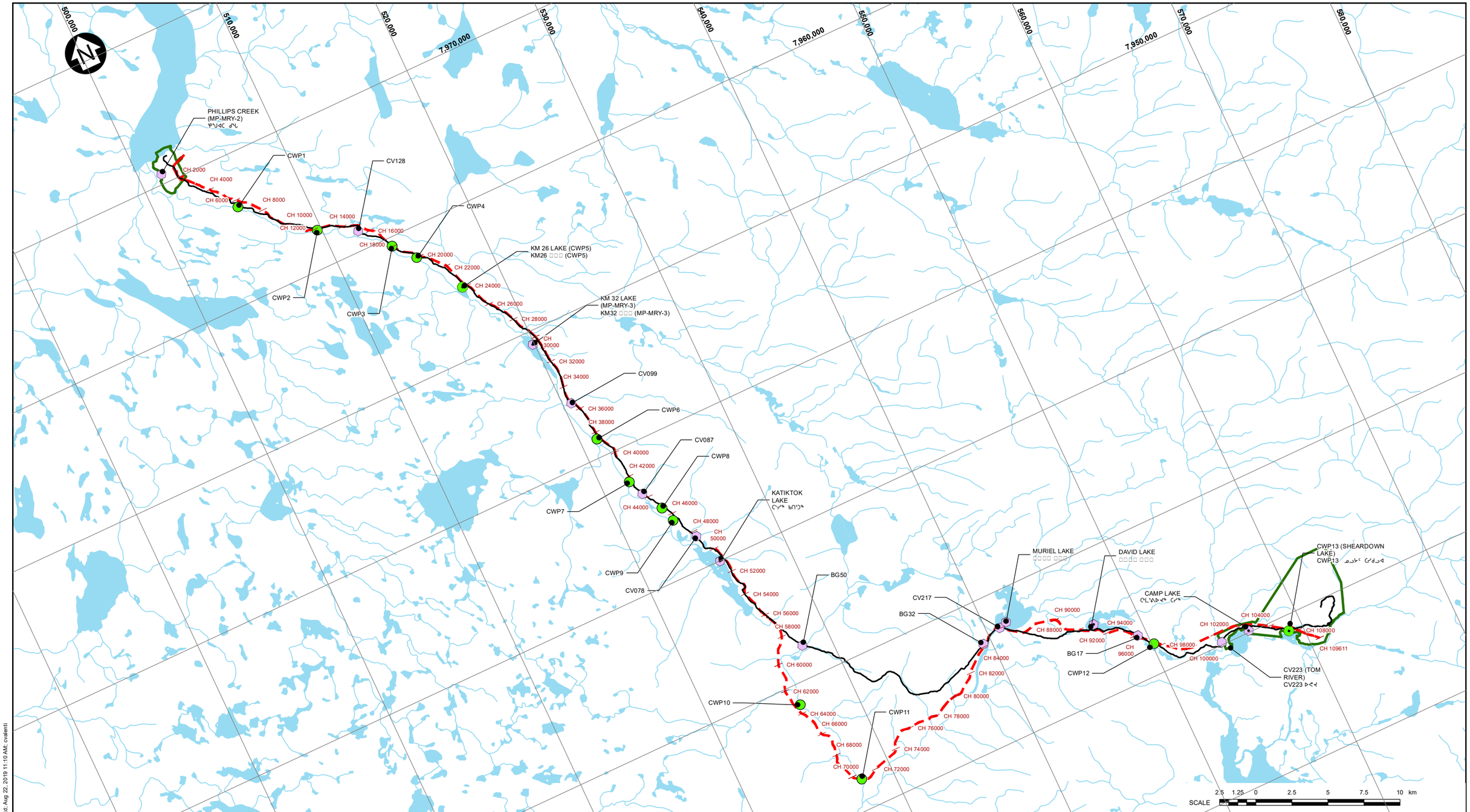
Further to this, Baffinland has agreed to Fisheries and Oceans Canada's (DFO's) request in TRC 3.3.3 to develop a detailed water withdrawal plan supported by site-specific habitat assessments. The detailed water withdrawal plan will include:

- Relevant fish habitat information
- Potential impacts that may arise for each water withdrawal location
- Proposed water withdrawal instructions applicable to each water withdrawal site

This information will be presented on 1-page for each water withdrawal site complete with photos.

Baffinland will submit its detailed water withdrawal plan as part of a Request for Review and/or application for an Authorization under the *Fisheries Act* to be submitted in 2020. Fisheries surveys are currently underway at the existing and proposed water withdrawal locations.

The SWAEMP will be updated incorporating the detailed water withdrawal plan.



LEGEND:

- NORTH RAILWAY CHAINAGE (m)
- APPROVED WATER SOURCES, LAKE
- APPROVED WATER SOURCES, STREAM
- CONSTRUCTION WATER SOURCE, LAKE
- CONSTRUCTION WATER SOURCE, STREAM
- MILNE INLET TOTE ROAD
- PROPOSED NORTH RAILWAY
- PROJECT DEVELOPMENT AREA
- MILNE PORT- REVISED PDA FOR PHASE 2 PROPOSAL MILNE
- RIVER/STREAM/DRAINAGE
- WATER

NOTES:

1. COORDINATE GRID IS IN KILOMETRES.
   COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N.
2. BASE MAP/IMAGERY: © ESRI AND DATA (ONLINE) SERVICE LAYERS (2017). REDLANDS, CA: ENVIRONMENTAL SYSTEM RESEARCH INSTITUTE. ALL RIGHTS RESERVED.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
0	22AUG'19	ISSUED WITH MEMO	RAC	AS	RAC

BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

EXISTING AND PROPOSED WATER TAKE LOCATIONS

Knight Piésold CONSULTING

P/A NO. NB102-181/53

REF NO. NB18-00602

FIGURE 4

REV 0

SAVED: I:\1\102\00181\53A\GIS\Figs\B29R0.mxd: Aug 22, 2019 11:10 AM: cvalenti

7.0 REFERENCES

Baffinland Iron Mines Corporation (Baffinland), 2018. *Addendum to the Final Environmental Impact Statement - Mary River Project - Phase 2 Proposal - NIRB File No. 08MN053.* Revised, September 2018.

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Knight Piésold Ltd. (KP), 2019a. *Mary River Project - Phase 2 Proposal - Updated Application for Amendment No. 2 of Type A Water Licence 2AM-MRY1325*. Ref. No. NB102-181/53-3, Rev. 0, May 2, 2019.

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Qikiqtani Inuit Association (QIA), 2019b. *Tusaqtavut for Phase 2 Applications of the Mary River Project: Pond Inlet*. Submission to the Nunavut Impact Review Board for the Mary River Project.

8.0 CLOSING

We trust this meets with your present requirements. Please do not hesitate to contact the undersigned with any questions.

Yours truly,
Knight Piésold Ltd.

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Reviewed:
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Specialist Environmental Scientist | Associate

Approval that this document adheres to the Knight Piésold Quality System:

Attachments:

Appendix A	Environmental Guidelines for Project Water Crossing Repairs, Modifications, and/or Installations
Appendix B	Tote Road Monitoring Program
Appendix C	Water Withdrawal Sites

/ab

APPENDIX A

Environmental Guidelines for Project Water Crossing Repairs, Modifications, and/or Installations

(Pages A-1 to A-15)

Appendix C
Environmental Guidelines for Project Water Crossing Repairs, Modifications and/or Installations