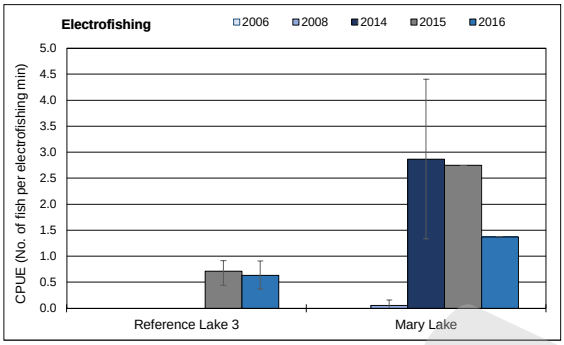
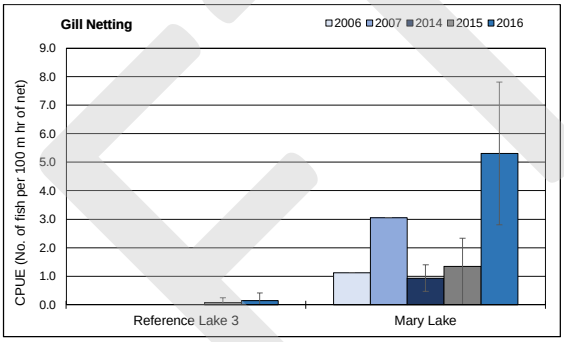
Mary Lake System: Mary Lake

- **Arctic charr abundance at Mary Lake was consistently higher than at the reference lake, and similar to baseline conditions.**

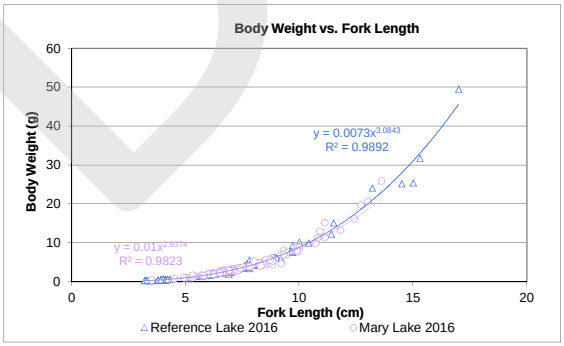


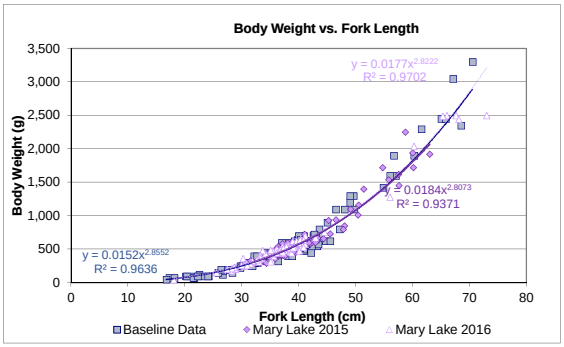


57

Mary Lake System: Mary Lake

- **No ecologically meaningful difference in Arctic charr condition indicated between Mary Lake and the reference lake (nearshore population) in 2015-2016, nor between Mary Lake 2015-2016 and the baseline period (littoral/profundal population).**





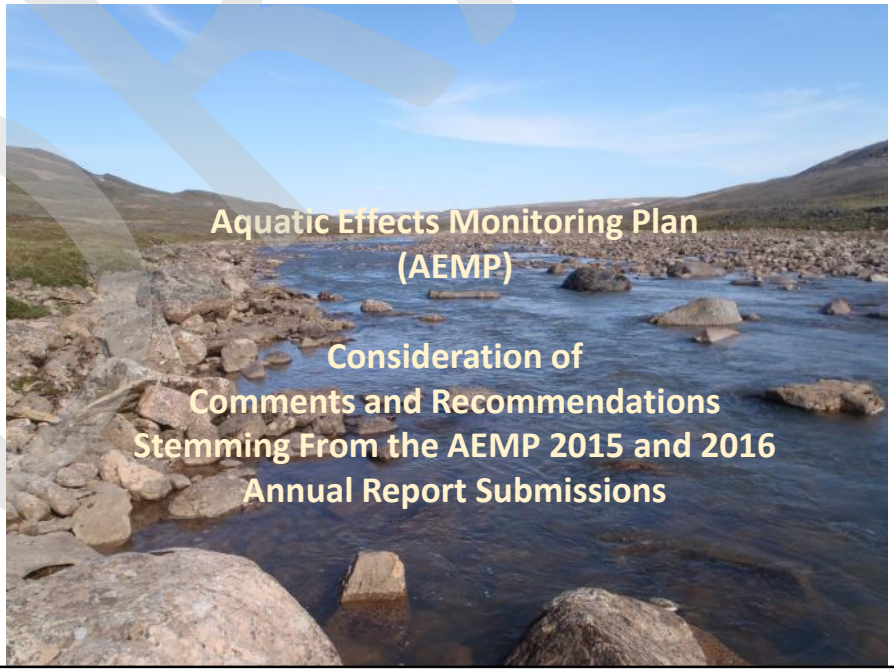
Mary Lake System: Overall Conclusions

- **Water quality of the Mary River system with elevated metal concentrations, but appears to be related to naturally high turbidity.**
- **Sediment quality of Mary Lake comparable to reference and/or baseline conditions.**
- **No adverse, mine-related effects apparent to biota (phytoplankton, benthic invertebrate and Arctic charr) of Mary River or Mary Lake based on comparisons to reference and/or baseline conditions.**

Aquatic Effects Monitoring Plan (AEMP)

1

Introduction | AEMP | EEM Phase 1 | Additional Topics | Conclusion



2

Aquatic Effects Monitoring Plan (AEMP)

- Requirement under Baffinland`s Type A Water Licence No. 2AM-MRY1325 issued by the Nunavut Water Board (NWB).
- Structured to serve as an overarching plan that conceptually provides the opportunity to integrate the results of individual but related aquatic monitoring programs.
- Includes 2 long-term and 3 targeted component studies:
  - CREMP (long-term)
  - Environmental Effects Monitoring (long-term);
  - Lake Sedimentation Monitoring (targeted);
  - Dustfall Monitoring (targeted); and,
  - Stream Diversion Monitoring (targeted).

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Aquatic Effects Monitoring Plan (AEMP)

- Living document expected to be updated periodically throughout the life of the mine 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.

4

Session Overview

- **Discussion of Environment and Climate Change Canada (ECCC) Comments on AEMP Revision 2**
- **Discussion of Indigenous and Northern Affairs Canada (INAC) Comments on AEMP Revision 2**
- **Discussion of Minnow Environmental Inc. Recommendations for the Mary River Project CREMP (outlined in March 17, 2017 letter addressed to Jim Millard)**

Objective is to Resolve Outstanding Issues so that Baffinland can Move Forward with a Focused, Scientifically-Supported Approach that Attains the Intended Goals of the AEMP.

Input from all Workshop Attendees is Encouraged!

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Environment and Climate Change Canada (ECCC) AEMP Revision 2 Comments and Discussion

6

ECCC Comment 1: Figure Quality

ECCC Comment 1:
The low resolution of some of the figures provided in the document makes it difficult to read text and discern map details.

ECCC Recommendation:
The quality of the figures and maps in the Plan should be enhanced to make the details clear to the reader.

Baffinland Response:
Acknowledged. The quality of figures and maps presented in Revision 2 of the AEMP will be enhanced to ensure clearer interpretation by the reader.

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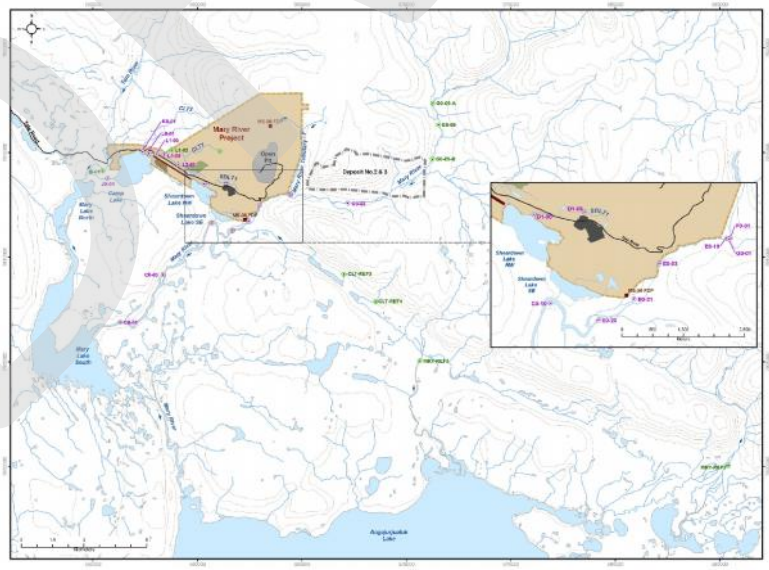
Introduction | AEMP | EEM Phase 1 | Additional Topics | Conclusion

ECCC Comment 1: Figure Quality



8

ECCC Comment 2: Final Discharge Points

ECCC Comment 2:

The document indicates that mine effluent will be discharged into the Mary River at three locations: east pond discharge, run-of-mine and crusher stockpile discharge, and the main ore stockpile discharge. However, the discharge locations are not well described nor are they shown on a map so it is difficult to determine if the locations of the discharge points into the Mary River were considered when selecting sampling locations.

ECCC Recommendation:

ECCC recommends that sampling locations in the Mary River be clearly identified and located such that impacts resulting from each individual discharge point can be identified and assessed.

ECCC Comment 2: Final Discharge Points

Baffinland Response:

The location of current and planned future discharge locations that drain into the Mary River system will be clearly illustrated on maps incorporated into the AEMP Revision 2 document. To date, effluent releases to the Mary River system include:

- **Effluent from the current waste rock sedimentation pond (MS-08) that discharges overland to an unnamed tributary to the Mary River; and,**
- **Effluent from a sedimentation pond that collects run-of-mine and crusher stockpile runoff (MS-06) that discharges directly to the Mary River. The MS-06 location also represents the outfall of treated effluent from the mine Sewage Treatment Plant.**

ECCC Comment 2: Final Discharge Points

Baffinland Response:

- **Existing CREMP locations used to monitor potential effects from the MS-08 discharge include water and phytoplankton monitoring stations FO-01, EO-10 and EO-03 and benthic invertebrate community survey area EO-01 on the Mary River.**
- **Additional EEM sampling locations include the MS-08-DS water quality station and MRNF and MRR fish sampling areas on the Mary River, and MRTF-EXP benthic sampling area on Mary River Tributary-F.**

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ECCC Comment 2: Final Discharge Points

Baffinland Response:

- **Existing CREMP locations used to monitor potential effects from the MS-06 discharge include water and phytoplankton monitoring stations EO-20 and EO-21 and benthic invertebrate community survey area EO-20 on Mary River.**

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ECCC Comment 2: Final Discharge Points

Mary River Project Current and Anticipated Discharge Descriptions

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	Phyto-plankton	Benthic Invertebrates	Fish
East Pond[a]	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
Crusher Ore Stockpile	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
Main Ore Stockpile[a]	-	Not Applicable	Not Applicable	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
West Pond[b]	MS-09	Not Applicable	Not Applicable	Camp Lake Tributary 1	CLT1 Stations	Camp Lake	CLT1 Stations	CLT1 US	Camp Lake

[a] A temporary sedimentation pond has been constructed to contain runoff from the waste rock stockpile generated during Early Revenue Phase operations.

[b] Infrastructure is not associated with the Early Revenue Phase of the Project and therefore has not been constructed to date.

[c] Infrastructure is not associated with the Early Revenue Phase of the Project and therefore has not been constructed to date.

Note: No "Run-of-Mine" Discharge Source in Current Mine Plan

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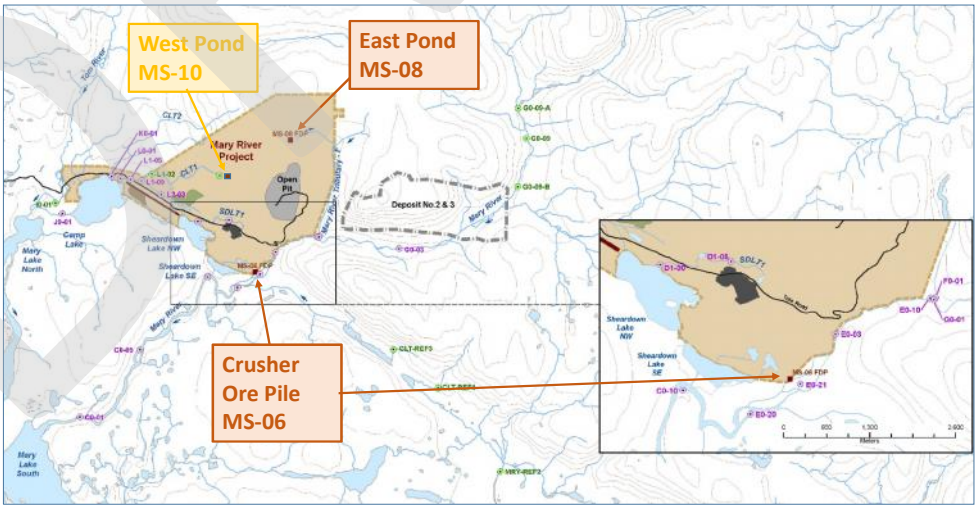
ECCC Comment 2: Final Discharge Points



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ECCC Comment 3: Reference Areas

ECCC Comment 3:

The Plan indicates that a number of reference areas including lakes, tributaries, and upstream locations, have been identified. However, the proponent does not indicate which reference areas will be used for which receiving environments.

ECCC Recommendation:

Please provide a table that specifies what type of sampling will be done at each sampling location and the corresponding reference location. The study design should identify how reference area data will be used in comparisons to exposure site data.

Introduction | AEMP | EEM Phase 1 | Additional Topics | Conclusion

ECCC Comment 3: Reference Areas

Baffinland Response: Reference Areas 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	-
		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	Not Applicable	Lotic Reference Average	Not Applicable	Not Applicable
		J0-01	555701	7913773					
		K0-01	557390	7915030					
		L0-01	557681	7914959				CLT-REF4	
		L1-02	558765	7915121					
		L1-05	558040	7914935					
		L1-08	561076	7915068					
		L1-09	558407	7914885					
		L2-03	559081	7914425					
	Camp Lake	JL0-01	557108	7914369	Reference Lake 3	Reference Lake 3	Reference Lake 3	Reference Lake 3	Reference Lake 3
		JL0-02	557615	7914750					
		JL0-07	556800	7914094					
		JL0-09	556335	7913955					
		JL0-10	557346	7914562					

ECCC Comment 3: Reference Areas

Baffinland Response: Reference Areas 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 Identier	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	-
		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 Ref. Avg.	Not Applicable	Lotic Ref. Avg.	CLT-REF4	Not Applicable
		D1-05	561397	7913558					
	Tributary 9	-	-	-	Not Applicable	Not Applicable	Not Applicable	CLT-REF4	Not Applicable
	Tributary 12	-	-	-					
	Sheardown Lake NW	DD-Hab9-Stn1	560259	7913455	Reference Lake 3	Reference Lake 3	Reference Lake 3	Reference Lake 3	Reference Lake 3
		DL0-01-1	560080	7913128					
		DL0-01-2	560353	7912924					
		DL0-01-4	560695	7913043					
		DL0-01-5	559798	7913356					
		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					
		DL0-02-7	560952	7912054					
		DL0-02-8	561301	7911846					

ECCC Comment 3: Reference Areas

Baffinland Response: Reference Areas 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 Identier	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	-
		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 and Mary Lake System	Mary River	G0-09-A	571264	7917344	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable
		G0-09	571546	7916317					
		G0-09-B	571248	7914682					
		G0-03	567204	7912587	Mary River G0-09 Average		Mary River G0-09 Average	Mary River G0-09 Average	
		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					
		C0-051	558352	7909170					
		C0-01	556305	7906894					
	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					
	Mary Lake (South Basin)	BL0-03	552680	7906651	Reference Lake 3	Reference Lake 3	Reference Lake 3	Reference Lake 3	Reference Lake 3
		BL0-04	553817	7904886					
		BL0-05	554632	7906031					
		BL0-06	555924	7903760					
		BL0-05-A	554530	7906478					
		BL0-05-B	555034	7905692					
		BL0-09	554715	7904479					

ECCC Comment 3: Reference Areas

Baffinland Response:

Reference data will be used to provide a basis for both relative and statistical comparisons to the mine-exposed station/area information as dictated by station replication. A description of how the reference data will be used in comparisons to the mine-exposed area data will included in Revision 2 of the AEMP.

ECCC Comment 4: Changes to Number of Lake Stations

ECCC Comment 4:

Minnow has recommended reducing the number of water quality monitoring stations to three in each of Camp, Sheardown NW, and Sheardown SE Lakes, and to four in Mary Lake. This reduction is based on assessment of baseline data which suggested that the lakes are well mixed making additional sampling stations redundant. ECCC notes that many of these sampling locations were added to the program based on a power analysis completed in 2014 by Knight Piesold Consulting.

ECCC Comment 4: Changes to Number of Lake Stations

ECCC Recommendation:

ECCC requests additional rationale for the removal of sampling stations given that the power analysis completed in 2014 identified the need for additional sampling locations in Mary Lake and Sheardown Lake. ECCC recommends that the number of sampling locations be maintained until sufficient data is collected to ensure that these water bodies are well mixed and are not being impacted by the Project.

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ECCC Comment 4: Changes to Number of Lake Stations

Baffinland Response (2014 Power Analysis Findings):

- **The 2014 power analysis only indicated the number of samples required to detect a difference from baseline water quality at an effects level of halfway between the mean baseline and AEMP benchmark concentration within a certain level of probability (80%) *for a given station*, and *not the number of stations* required**
- **The 2014 power analysis grouped seasonal baseline data together (winter, summer, fall), and therefore the resulting number of samples indicated were applicable to samples collected throughout the year, not to one particular season**

ECCC Comment 4: Changes to Number of Lake Stations

Baffinland Response (2014 Power Analysis Findings):

Table B.7 Results of Aluminum Power Analysis - Lakes

Station	Total Sample Size	Sample Size Detected	Median (mg/L)	Standard Deviation (mg/L)	Log Mean (mg/L)	Log Standard Deviation (mg/L)	ROS Log Mean (mg/L)	Benchmark Value (mg/L)	Log (Benchmark Value (mg/L)	N Required	N Required (half benchmark)[1]
Camp Lake											
JL0-02-S	8	8	0.0053	0.01	-5.23	1.00	-5.23	0.1	-2.30	2.93	5
JL0-02-D	9	8	0.0098	0.01	-4.79	0.48	-4.91	0.1	-2.30	2.49	5
JL0-09-S	7	7	0.0048	0.00	-5.28	0.78	-5.28	0.1	-2.30	2.98	5
JL0-09-D	7	7	0.0072	0.01	-5.04	0.85	-5.04	0.1	-2.30	2.73	5
Sheardown Lake NW											
DL0-01-1-S	13	13	0.0093	0.01	-4.80	0.82	-4.8	0.18	-1.72	3.08	5
DL0-01-1-D	13	13	0.012	0.01	-4.47	0.78	-4.47	0.18	-1.72	2.76	5[2]
DL0-01-5-S	11	11	0.0089	0.01	-5.03	0.83	-5.03	0.18	-1.72	3.31	5
DL0-01-5-D	11	10	0.015	0.12	-4.20	1.42	-4.22	0.18	-1.72	2.48	5[2]
Sheardown Lake SE											
DL0-02-3-S	10	0	0.024	0.07	-3.80	1.36	-4.23	0.18	-1.72	2.17	50
DL0-02-3-D	10	0	0.031	0.07	-3.20	1.36	-3.40	0.18	-1.72	1.57	50[2]
Mary Lake											
BL0-01-S	9	9	0.030	0.05	-3.08	1.30	-3.08	0.14	-1.99	1.09	50
BL0-01-D	10	10	0.048	0.06	-3.71	1.53	-3.71	0.14	-1.99	1.72	50[2]
BL0-05-S	11	11	0.057	0.04	-3.21	1.00	-3.21	0.14	-1.99	1.22	50
BL0-05-D	11	11	0.061	0.04	-3.11	0.87	-3.11	0.14	-1.99	1.12	50[2]

5 Samples for the Station, not 5 Stations for the Lake

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ECCC Comment 4: Changes to Number of Lake Stations

Baffinland Response (2014 Power Analysis Findings):

- **Minnow feels a rationale for the recommendations provided in the 2014 power analysis was not provided, leading to confusion around the basis, and justification, for the recommendations.**
- **For example, the addition of stations does not "ensure sufficient power to detect changes". Were additional stations recommended so that for each sampling event an evaluation relative to baseline conditions was possible (not justified given seasonality not taken into account for the baseline analysis)? Three yearly samples were recommended from each station, but no indication of why or how these to be used. How was the data from the addition of reference areas applicable to the power analysis?**

ECCC Comment 4: Changes to Number of Lake Stations

Baffinland Response (2014 Power Analysis Findings):

- The methods used for the 2014 power analysis were appropriate, though the information from the power analysis is not appropriate for determining the number of stations required.
- Parameters considered for the 2014 power analysis have since been shown not to not all be "most affected parameters during mine operation". For example, 'elevated' aluminum concentrations appear to be largely natural, and sodium/uranium not considered.
- As correctly identified in the 2014 power analysis, once data collected from mine operational period, linear regression models will be appropriate for testing differences between baseline and mine operational periods, and considering reference area data.

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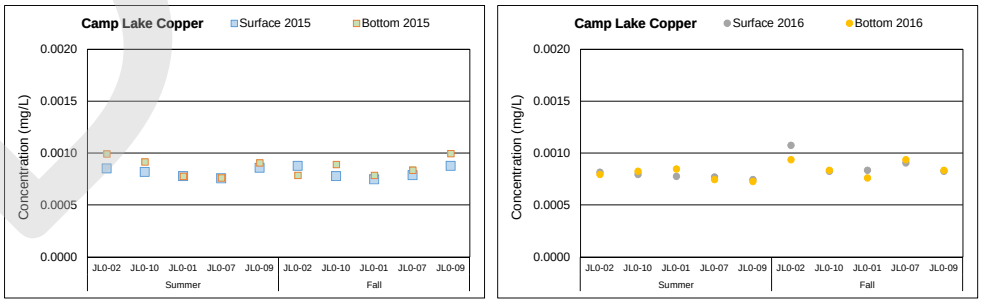
ECCC Comment 4: Changes to Number of Lake Stations

Baffinland Response (Within-Lake Spatial Variability):

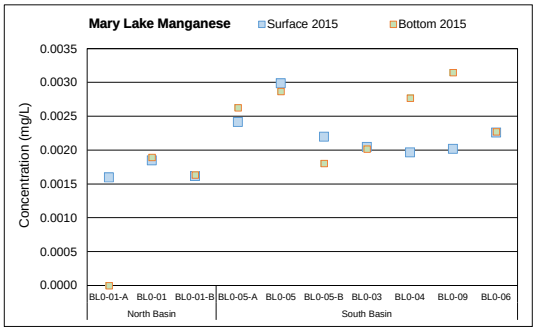
- The 2015, 2016 and 2017 data indicated very little variability in lateral chemistry within mine lakes, perhaps with exception of Mary Lake (influence of two large inputs, Mary and Tom Rivers).

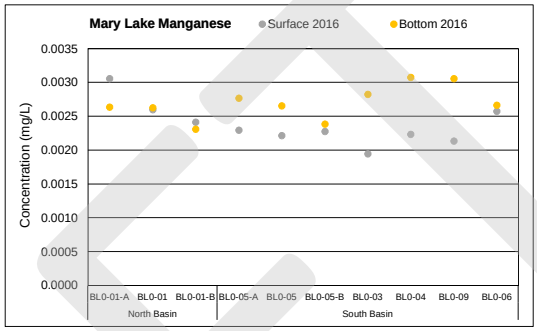


- Consistent with expectations based on typical mixing patterns within relatively small lakes with simple morphology.

ECCC Comment 4: Changes to Number of Lake Stations

Baffinland Response (Within-Lake Spatial Variability): Summer Data





- **Baseline information showed the same results, as do comparison of 'bottom' water chemistry data.**

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ECCC Comment 4: Changes to Number of Lake Stations

Baffinland Response (Within-Lake Spatial Variability):

- **Data indicate minor vertical variability in chemistry, stemming from relative homogeneity in thermal and DO properties during sampling (discussed further in response to INAC Comment 2).**
- **Plotting of water quality data sufficient to show temporal changes, with same result shown regardless whether 1 or 5 stations used.**
- **Linear regression can be used to statistically quantify 'trends' and test against predictions.**

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ECCC Comment 4: Changes to Number of Lake Stations

Baffinland Response (Within-Lake Spatial Variability):

- **Power analysis conducted using baseline and mine-operational data (2015 & 2016) indicated that, for 'mine-parameters', six samples over the course of one year sufficient to detect difference between data sets at conservative α of 0.1 and probability of 0.9 (90%).**

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ECCC Comment 4: Changes to Number of Lake Stations

Baffinland Response (Within-Lake Spatial Variability):

- **The lack of within-lake spatial variability and supporting power analysis underpin the sampling of three stations at Camp, Sheardown NW, Sheardown SE and Reference lakes.**
- **Because of the influence of two relatively large flow sources to Mary Lake, one station proposed for the North Basin (which receives flow from the Camp Lake system via the Tom River), and three stations proposed for the South Basin (which receives flow from the Sheardown Lakes and Mary River systems).**

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ECCC Comment 4: Changes to Number of Lake Stations

Baffinland Response (Proposed Stations):

Lake	Station ID	Depth (m)	Description
Reference Lake 3	REF03-01	15.1	East end of southeast basin
	REF03-02	30.4	Centre of southeast basin
	REF03-03	37.5	Centre of northwest basin
Camp Lake	JLO-02	12.3	Littoral station near primary lake inlet (CLT1, CLT2)
	JLO-07	32.7	Deep basin, near centre of lake
	JLO-09	14.3	Near lake outlet
Sheardown Lake NW	DD-Hab9-Stn1	10.3	Near inlet from SDLT1
	DLO-01-2	17.5	Deep location, near centre of northwest basin
	DLO-01-7	11.4	Near lake outlet
Sheardown Lake SE	DLO-02-6	7.1	Near inlet from Sheardown Lake NW
	DLO-02-3	13.7	Deep location, near centre of southeast basin
	DLO-02-4	8.05	Near inlet from SDLT9
Mary Lake	BLO-1A	14.65	Deepest location at the north basin
	BLO-5	21	Near inlet from Mary River
	BLO-9	30	Deepest location at the south basin
	BLO-6	6.8	Near lake outlet

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ECCC Comment 5: Changes to Number of Stream Stations

ECCC Comment 5:

Minnow has recommended that the AEMP discontinue water quality monitoring at stations L1-09 (Camp Lake Tributary), D1-05 (Sheardown Lake Tributary 1) and G0-09A, G0-09B, and C0-01 on the Mary River. The reason for discontinuation of sampling at these locations is redundancy (L1-09 and C0-01), with the rationale that a single reference sampling location in the Mary River is adequate (G0-09A and G0-09B), and that an upstream sampling location is not necessary (D1-05). ECCC notes that many of these sampling locations were added to the program based on a power analysis completed in 2014 by Knight Piesold Consulting.

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ECCC Comment 5: Changes to Number of Stream Stations

ECCC Recommendation:

ECCC requests additional rationale for the removal of sampling stations given that the power analysis completed in 2014 identified the need for additional sampling locations in these areas. ECCC recommends that stream water quality sampling locations be maintained until sufficient data is acquired to determine if there are potential impacts to these waterbodies. In addition, the removal of the upstream reference sampling locations may be inappropriate as an accurate understanding of the reference (upstream) conditions is essential to determine if impacts are occurring in the receiving environment.

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ECCC Comment 5: Changes to Number of Stream Stations

Baffinland Response (2014 Power Analysis Findings):

- **Recommendations from the 2014 review of baseline stream data only suggested the addition of a sampling station at Camp Lake Tributary 1, not in any of the Sheardown Lake tributaries or Mary River.**
- **Similar to the power analysis for lakes, the 2014 power analysis indicated the number of samples required to detect a difference from baseline water quality at an effects level of halfway between the mean baseline and AEMP benchmark concentration within a certain level of probability (80%) *for a given station*, and *not the number of stations* required.**
- **Hence, no station replication at a given area (i.e., stations not grouped), as is logical.**

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ECCC Comment 5: Changes to Number of Stream Stations

Baffinland Response (2014 Power Analysis Findings):

Table C.5 Results of Aluminum Power Analysis – Camp Lake Tributary Stations

Station	Total Sample Size	Sample Size Detected	Median (mg/L)	Standard Deviation (mg/L)	Log Mean (mg/L)	Log Standard Deviation (mg/L)	ROS Log Mean (mg/L)	Benchmark Value (mg/L)	Log Benchmark Value (mg/L)	Difference between log mean and log benchmark (mg/L)	N Required
L0-01	47	39	0.010	0.047	-4.3	0.91	-4.6	0.18	-1.7	2.6	5
L1-02	9	8	0.011	0.038	-4.2	1.0	-4.5	0.18	-1.7	2.5	5
L2-03	11	11	0.010	0.012	-4.5	0.67	-4.5	0.18	-1.7	2.8	~5[2]
L1-06	12	12	0.024	0.037	-3.7	0.96	-4.7	0.18	-1.7	1.9	~5-10[2]
L1-09	8	8	0.010	0.086	-4.4	1.2	-4.4	0.18	-1.7	2.6	20

5 - 20 Samples for the Station

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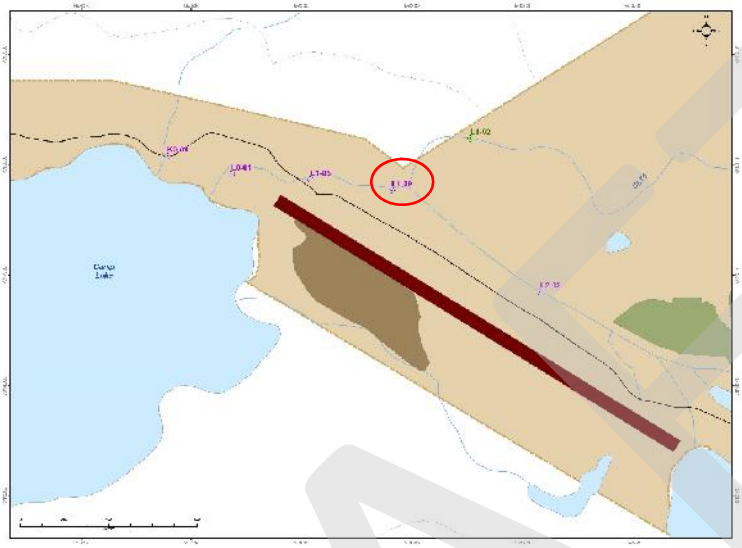
ECCC Comment 5: Changes to Number of Stream Stations

Baffinland Response (Redundancy in Mine-Exposed Stations):

- **With the suggested removal of Stations L1-09, D1-05 and CO-01, sampling locations are being maintained that will produce data to determine if there are potential impacts to these waterbodies (i.e., they don't add additional information).**

ECCC Comment 5: Changes to Number of Stream Stations

Baffinland Response (Redundancy in Mine-Exposed Stations):



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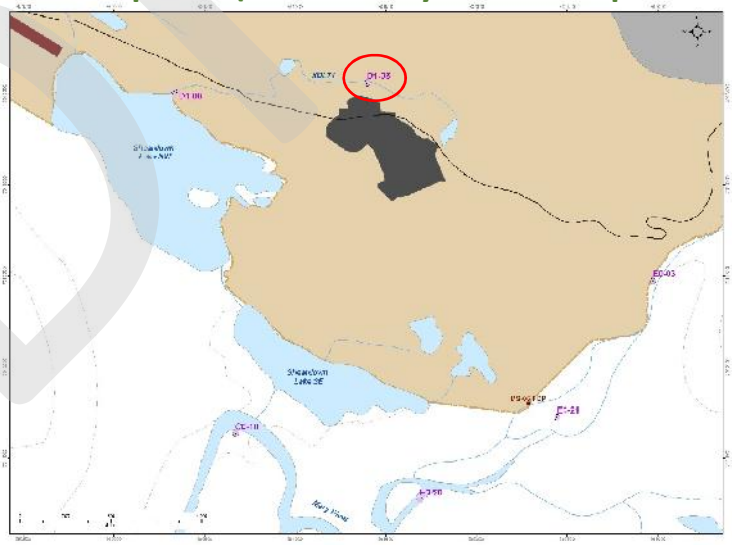
ECCC Comment 5: Changes to Number of Stream Stations

Baffinland Response (Redundancy in Mine-Exposed Stations):



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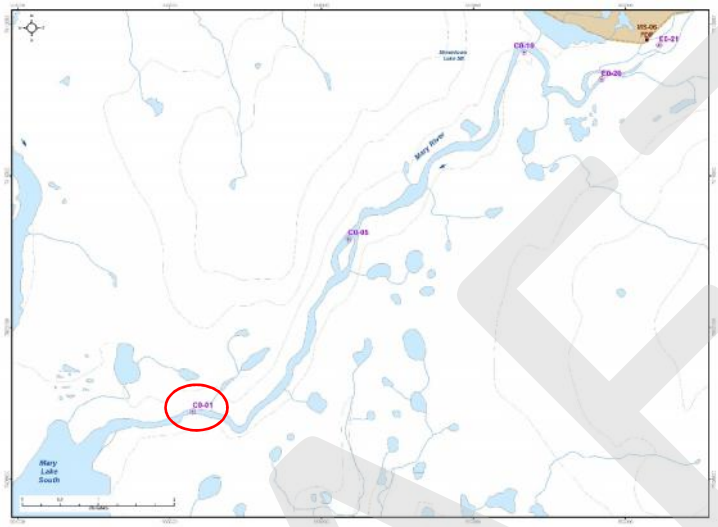
ECCC Comment 5: Changes to Number of Stream Stations

Baffinland Response (Redundancy in Mine-Exposed Stations):



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ECCC Comment 5: Changes to Number of Stream Stations

Baffinland Response (GO-09 Reference Area Stations):

- **At the GO-09 area, conservative parameters not likely associated with particulate material (e.g., dissolved parameters such as chloride, sodium), with no marked differences among GO-09 stations.**
- **At the GO-09 area, variability in non-conservative parameters likely associated with particulate material (e.g., Al, Fe, Mn).**
- **Therefore, GO-09 series stations will remain as is (allows comparison of mine-exposed data to wider range of reference data).**

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ECCC Comment 5: Changes to Number of Stream Stations

Baffinland Response (GO-09 Reference Area Stations):

Parameters	Units	Spring Sampling Event			Summer Sampling Event			Fall Sampling Event		
		G0-09-A 29-Jun-2015	G0-09 29-Jun-2015	G0-09-B 29-Jun-2015	G0-09-A 19-Jul-2015	G0-09 19-Jul-2015	G0-09-B 19-Jul-2015	G0-09-A 13-Aug-2015	G0-09 13-Aug-2015	G0-09-B 13-Aug-2015
Conductivity (lab)	umho/cm	21.4	25.6	23.9	104	72.3	72.2	138	147	140
Hardness (as $CaCO_3$)	mg/L	<10	13	11	49	33.5	33	62	65	66
Total Suspended Solids (TSS)	mg/L	46.4	13.6	12.8	<2.0	2.2	2.8	5.6	3.2	4.4
Turbidity	NTU	16.6	8.08	8.75	2.05	10.05	9.67	16.5	13.8	17.7
Nitrate	mg/L	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.021	<0.020	<0.020
Total Organic Carbon	mg/L	1.1	1.5	1.1	<1.0	<1.0	<1.0	1.1	1.3	1.3
Total Phosphorus	mg/L	0.0862	0.0214	0.021	0.0056	0.00895	0.0134	0.0122	0.0079	0.0115
Chloride (Cl)	mg/L	<0.50	<0.50	<0.50	1.54	1.07	1.09	6.48	5.38	5.21
Sulphate (SO_4)	mg/L	0.33	<0.30	0.31	1.0	0.8	0.9	3.77	3.34	3.23
Aluminum (Al)	mg/L	***0.374***	0.159	***0.213***	0.0815	0.135	0.119	***0.695***	***0.425***	*1.01*
Cadmium (Cd)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Cobalt (Co)	mg/L	0.00031	0.00011	0.00016	<0.00010	<0.00010	<0.00010	0.00024	0.00017	0.00032
Copper (Cu)	mg/L	0.00119	0.00061	0.00078	0.0008	0.0008	0.0009	0.0014	0.0013	0.0019
Iron (Fe)	mg/L	***0.512***	0.155	0.256	0.046	0.114	0.100	*0.559*	***0.367***	***0.75***
Lead (Pb)	mg/L	0.000602	0.000278	0.000303	0.00006	0.00018	0.00016	0.00044	0.00033	0.00052
Manganese (Mn)	mg/L	0.0137	0.0055	0.00683	0.00065	0.00147	0.00132	0.0068	0.0046	0.0065
Molybdenum (Mo)	mg/L	<0.000050	<0.000050	<0.000050	0.00016	0.00015	0.00015	0.00041	0.00034	0.00044
Nickel (Ni)	mg/L	0.00068	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00083	0.0006	0.00111
Potassium (K)	mg/L	0.44	0.34	0.39	0.86	0.78	0.76	1.4	1.27	1.5
Sodium (Na)	mg/L	0.334	0.217	0.328	1.610	1.130	1.120	3.38	3.24	3.24
Strontium (Sr)	mg/L	0.00265	0.00208	0.00243	0.009	0.008	0.008	0.0166	0.0158	0.0166
Titanium (Ti)	mg/L	0.028	<0.010	0.016	<0.010	<0.010	<0.010	0.0326	0.022	0.0449
Uranium (U)	mg/L	0.000356	0.000135	0.00021	0.0011	0.0010	0.0009	0.00437	0.00408	0.00388
Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

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ECCC Comment 6: Stream Sediment Sampling

ECCC Comment 6:

Based on recommendations from Minnow, all sediment quality monitoring in streams and lakes has been removed from the sediment monitoring program. According to the rationale provided this is due to the limited depositional habitat and minimal accumulation of fine sediments.

ECCC Recommendation:

ECCC recommends maintaining periodic sediment quality monitoring in rivers and streams that are directly receiving discharge. At a minimum this should tie in with the frequency required under MMER EEM (every 3 years).

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ECCC Comment 6: Stream Sediment Sampling

Baffinland Response:

- **Sediment quality monitoring in lakes *was not* recommended for removal from the sediment monitoring program. Some modifications to the lake sediment monitoring were suggested (discussed later), but sediment sampling always considered an integral component of CREMP lake sampling.**

- **Stream sediment chemistry sampling was proposed for the CREMP to "support the lake sediment chemistry data analysis".**
- **During baseline sampling, only 3 stations of the proposed 23 were sampled. On average, 95% of material represented by coarse sand.**
- **In other words, streams are not depositional.**

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ECCC Comment 6: Stream Sediment Sampling

Baffinland Response:

- **Minnow questions the relevance of stream sediment quality sampling for the following reasons:**
  - **Laboratory analysis methods use strong acid digest, and thus results not representative of biologically available amounts of material (i.e., digested sand grains);**
  - **Proportion of depositional habitat very low (less than 1% at most sampling areas);**
  - **Benthic invertebrates not 'exposed' to the same substrate sampled for sediments. Thus, comparisons to SQG irrelevant.**
  - **No translation to understanding effects on fish.**
  - **Lake sediment sampling is conducted in the CREMP.**

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ECCC Comment 6: Stream Sediment Sampling

Baffinland Response:

- Despite Minnow reservations, Baffinland sampled sediments at all stream benthic invertebrate community stations in 2017.
- Proposed assessment of data includes:
  - Presentation of sediment Total Organic Carbon (TOC) and metal concentration data, and comparisons between mine-exposed and reference areas.
  - ***No*** comparison to SQG or AEMP benchmarks.
- Consideration of including stream sediment sampling at rivers and stream stations that directly receive discharge on a three-year basis as suggested by ECCC following analysis of 2017 data.

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ECCC Comment 7: Reduced Sample Size for Fish

ECCC Comment 7:

Minnow has recommended that the fish sampling program be modified to reduce the non-lethal adult Arctic charr sample size to 50 per study lake instead of 100.

ECCC Recommendation:

A sample size of 100 fish is required under the Environmental Effects Monitoring of the Metal Mining Effluent Regulations. Fish sampling for the EEM and AEMP programs should be harmonized to reduce any duplication of effort without reducing the sample size.

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ECCC Comment 7: Reduced Sample Size for Fish

Baffinland Response:

- **Power analysis from the 2015 and 2016 studies supports that 50 fish are more than enough to determine impacts on fish condition based on a critical effect size of 10% (power = 0.9; α = 0.1).**

Mine Lake	Data Set	Minimum Sample Size (Increase[b] / Decrease[c])							
		i=5%	i=10%	i=20%	i=25%	i=30%	i=40%	i=50%	i=100%
		d=4%	d=9%	d=17%	d=20	d=23%	d=29%	d=33%	d=50%
Camp Lake	2015	46	13	4	3	3	2	2	1
	2016	103	28	8	6	5	3	3	2
Sheardown Lake NW	2015	48	13	5	3	3	2	2	1
	2016	100	27	8	6	5	3	3	2
Sheardown Lake SE	2015	52	14	5	4	3	2	2	1
	2016	73	20	6	5	4	3	2	2
Mary Lake	2015	79	21	7	5	4	3	2	2
	2016	120	32	10	7	5	4	3	2

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ECCC Comment 7: Reduced Sample Size for Fish

Baffinland Response:

- **Reduction in number of fish sampled will not affect ability of the study to meet objectives of the program.**
- **Primary goal of recommendation is to reduce incidental mortalities during CREMP sampling, which as shown through monitoring results thus far, likely have a greater impact on the population than any mine influences.**
- **Power analysis results used as justification for determination of suitable sample sizes for EEM, and by ECCC for the CREMP water analysis.**
- **EEM and CREMP study areas do not overlap – harmonization not applicable.**

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ECCC Comment 8: Sheardown Lake Sediment Benchmarks

ECCC Comment 8:

Interim AEMP benchmarks are presented for Sheardown Lake SE (SDSE) based on either the sediment quality guideline, 97.5% of the baseline data or 3x the MDL in Table 5.3. However, there are some suggested benchmarks that need further clarification.

ECCC Recommendation:

Please provide further rationale for the suggested cadmium benchmark of 1.5 mg/kg for SDSE. Arsenic, chromium, copper, iron, manganese, nickel, phosphorus - the Plan states that the benchmarks for these metals are based on 97.5% of the baseline but the numbers do not correspond to numbers listed in table for SDNW 97.5% baseline.

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ECCC Comment 8: Sheardown Lake Sediment Benchmarks

Baffinland Response (Sediment Cadmium at Sheardown Lake SE):

- **In the case of sediment cadmium concentrations at Sheardown Lake SE, only 2 of 74 samples showed concentrations above laboratory Method Detection Limits (MDL) of 0.5 mg/kg.**
- **The higher of the SQG, baseline 97.5%tile, or 3x MDL was criteria for the AEMP benchmark for cadmium at Sheardown Lake SE.**
- **In this case, 3x MDL was used as the benchmark (3 x 0.5 = 1.5 mg/kg).**
- **Baffinland will consider review of this AEMP benchmark.**
- **Notably, sediment cadmium concentrations at Sheardown Lake SE in 2016 were below 0.6 mg/kg (interim CCME SQG).**

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ECCC Comment 8: Sheardown Lake Sediment Benchmarks

Baffinland Response (Discrepancy in Sheardown Lake NW Benchmarks):

- AEMP benchmarks presented for Sheardown Lake NW taken from the initial sediment quality AEMP benchmarks (2014), whereas the 97.5%tile data presented include data from an additional year (2014) of sediment sampling.
- Potential influences on sediment quality due to mine construction, different sampling approaches over time, and lack of long-term station baseline data confounded development of AEMP benchmarks using the 2014 data.
- Better clarity will be provided in future AEMP revisions.

ECCC Comment 9: BMI Bray-Curtis Index

ECCC Comment 9:

A number of Benthic Macro-Invertebrate (BMI) metrics are listed for inclusion in the CREMP, including: abundance, composition, Shannon's Evenness, Simpson's Diversity Index and Richness. ECCC had previously commented that the Bray Curtis index be added as indicator to which the proponent had agreed to, however it is not included on the list.

ECCC Recommendation:

The Bray Curtis index should be added as an indicator for benthic macroinvertebrates.

ECCC Comment 9: BMI Bray-Curtis Index

Baffinland Response:

- **Revision 2 of the AEMP will include Bray-Curtis Index on the list of BMI community metrics to be assessed.**
- **Notably, although not included on the list, Bray-Curtis Index was included in the analysis of BMI communities in the 2015 and 2016 CREMP monitoring reports.**

Indigenous and Northern Affairs Canada (INAC) AEMP Revision 1 Comments and Discussion

INAC 2015 Comment 1: Changes to Number of Lake Stations

INAC Comment 1:

Reducing the number of sampling stations at this stage may be premature. INAC notes that though the mine was in operation in 2015, it was not at the fully planned Early Revenue Phase operating capacity. The third crusher was not operating until the end of 2015 so its impact would not have been measureable in the 2015 data.

Additionally, though the data indicates the lakes are well mixed, to our knowledge, the lake replenishment rates have not been discussed and therefore the impacts of a future point source are uncertain. It would be relevant to keep the initially determined number of water quality monitoring stations to help detect possible future point sources.

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INAC 2015 Comment 1: Changes to Number of Lake Stations

INAC Recommendation:

INAC recommends that the number of water quality monitoring stations for Camp, Sheardown NW, Sheardown SE and Mary Lakes be maintained.

Baffinland Response:

- **Data collected in 2016 confirmed water quality results from 2015.**
- **The rationale for the changes in number of lake stations is the same as that presented for ECCC Comment 5.**
- **Lake replenishment rates will be presented in the 2017 CREMP report (lakes vertically well mixed).**
- **Lake mixing further discussed in response to INAC Comment 2.**

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INAC 2015 Comment 2: Water Quality Top-Bottom Sampling

INAC Comment 2:

The revised plan proposes to "collect a single water quality sample at mid-depth instead of collecting two samples, surface and bottom, at each lake water quality monitoring station" (Minnow recommendation #9). The justification given is that "water chemistry data collected during the 2015 CREMP, as well as during baseline studies, has generally shown only minor (i.e., <2-fold higher) differences in water chemistry and chlorophyll a concentrations between the surface and bottom at each station."

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INAC 2015 Comment 2: Water Quality Top-Bottom Sampling

INAC Comment 2 (continued):

A note in the Minnow recommendation is made that if the lakes are determined to be thermally stratified, two samples (top & bottom) would be taken. This does not appear in the main text of the AEMP R2 but is found in Appendix A of Appendix B. The Final Environmental Impact Statement discussion indicated that the lakes were thermally stratified in summer 2011 and not in fall 2011. Therefore, though not permanent, lake stratification does occur.

INAC 2015 Comment 2: Water Quality Top-Bottom Sampling

INAC Recommendation:

INAC recommends that continuing lake water quality sampling at two depths (1 m below surface and 1 m above bottom) rather than at a single depth (mid-water column).

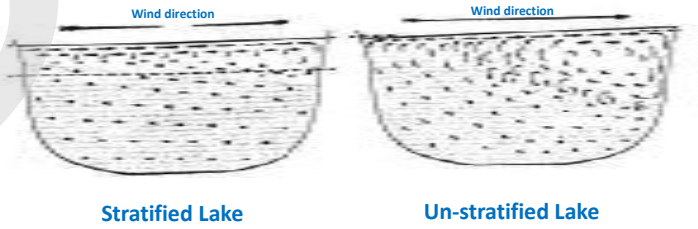
Baffinland Response:

- **The provision that a top-bottom sampling approach be used in the event of thermal stratification should have been included in the main text of the AEMP Revision 2.**

INAC 2015 Comment 2: Water Quality Top-Bottom Sampling

Baffinland Response:

- **In absence of thermal stratification, under typical limnological conditions, we don't expect water chemistry to differ substantially from top to bottom (Figure from Wetzel, 2001).**



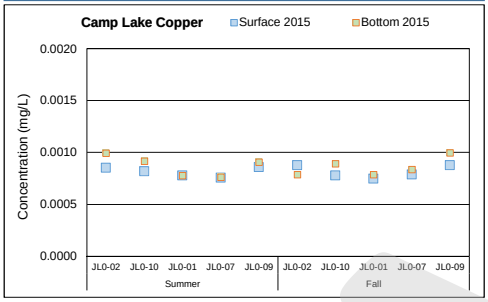
Stratified Lake | Un-stratified Lake

INAC 2015 Comment 2: Water Quality Top-Bottom Sampling

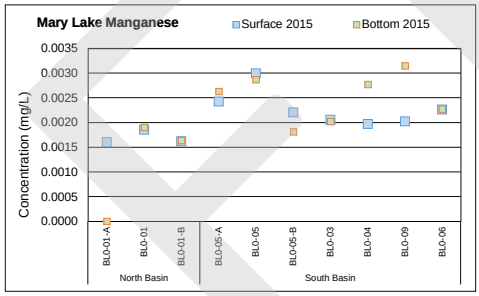
Baffinland Response:

- **Absence in thermal stratification reflected as minor differences in chemistry between top and bottom.**

Not Stratified in Summer and Fall 2015



Not Stratified in Summer 2015



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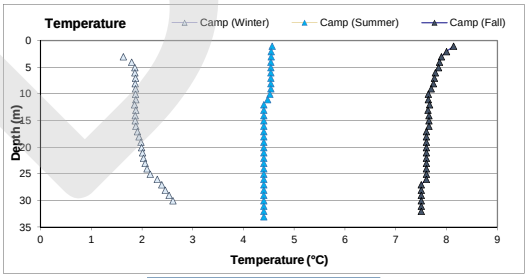
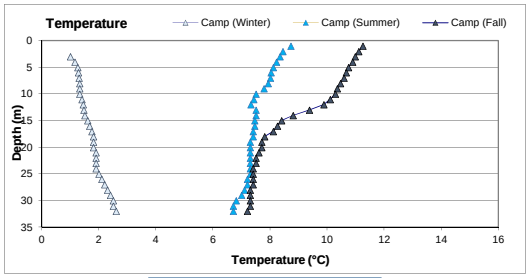
INAC 2015 Comment 2: Water Quality Top-Bottom Sampling

Baffinland Response:

- **Thermal stratification of Mary River Project lakes appears to occur uncommonly, but was evident 2011 and in profiles conducted in 2016 for Camp, Sheardown NW and Mary lakes (i.e., deep lakes). – insert figures from 2015 and 2016**



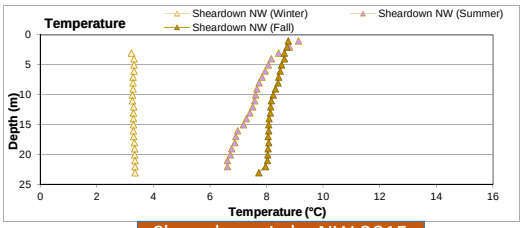
Camp Lake 2015



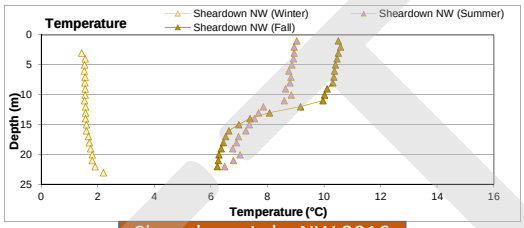
Camp Lake 2016

INAC 2015 Comment 2: Water Quality Top-Bottom Sampling

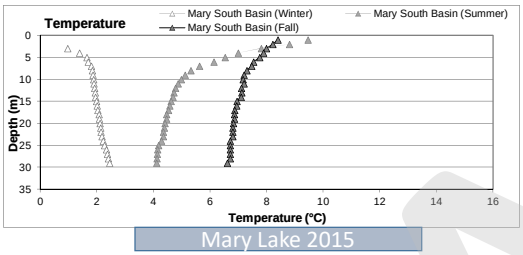
Baffinland Response:



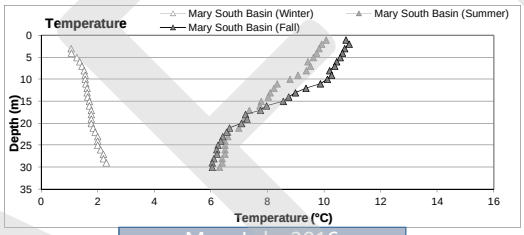
Sheardown Lake NW 2015



Sheardown Lake NW 2016



Mary Lake 2015



Mary Lake 2016

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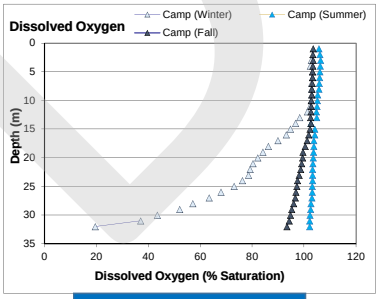
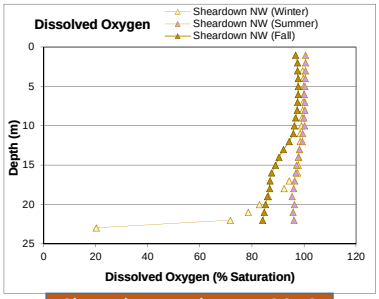
INAC 2015 Comment 2: Water Quality Top-Bottom Sampling

Baffinland Response:

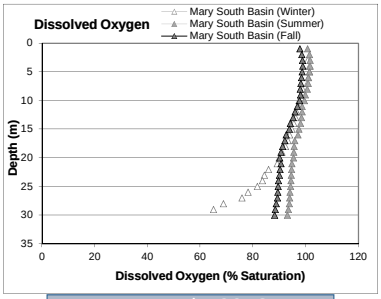
- **However, dissolved oxygen levels were consistently fully or highly saturated (80% - 100%) through the water column even in cases of thermal stratification.**



Camp Lake 2016



Sheardown Lake NW 2016

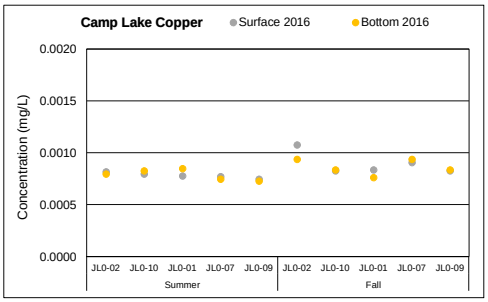


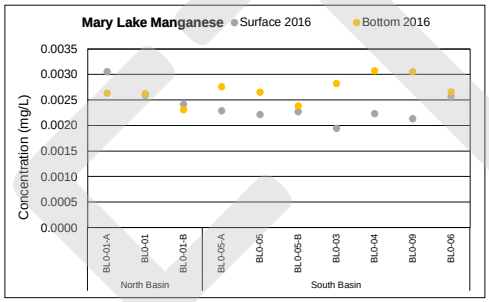
Mary Lake 2016

INAC 2015 Comment 2: Water Quality Top-Bottom Sampling

Baffinland Response:

- **Absence in substantial changes in dissolved oxygen with depth also results in minor differences in chemistry between top and bottom.**





- **Indicates we don't expect to see much difference between top and bottom water chemistry in area lakes.**

INAC 2015 Comment 2: Water Quality Top-Bottom Sampling

Baffinland Response:

- **Current stations have high variability in depth.**

- **Thermocline developed at ~10 m depth in mine lakes, and therefore 'bottom' at some stations was in the epilimnion (upper layer) during stratification.**

Lake	Station	Depth
Reference Lake 3	REF3-01	14.1
	REF3-02	20.7
	REF3-03	30.3
Camp Lake	JL0-02	12.4
	JL0-10	9.3
	JL0-01	16.5
	JL0-07	32.7
	JL0-09	14.9
Sheardown Lake NW	DD-HAB9-STN-1	9.7
	DL0-01-5	24.2
	DL0-01-1	20.8
	DL0-01-4	6.1
	DL0-01-2	18.6
	DL0-01-07	12.3
Sheardown Lake SE	DL0-02-06	6.8
	DL0-02-07	3.9
	DL0-02-04	8.9
	DL0-02-08	13.2
	DL0-02-03	14.4
Mary Lake	BL0-01A	14.9
	BL0-01	9.2
	BL0-01B	4.7
	BL0-05A	11.5
	BL0-05	20.6
	BL0-05B	7.6
	BL0-03	19.5
	BL0-04	21.1
	BL0-09	30.2
	BL0-06	9.7

INAC 2015 Comment 2: Water Quality Top-Bottom Sampling

Baffinland Response:

- **Top-bottom measures were averaged during baseline data assessment due to similar findings of very little difference in chemistry between sampling depths (essentially like taking a mid-column water chemistry sample).**

- **The proposed approach of mid-column water chemistry sampling in absence of stratification, and dual top-bottom sampling in the even of stratification, will not affect ability of the study to meet objectives of the program nor the ability to track changes in water chemistry over time.**

INAC 2015 Comment 3: Stream Sediment Quality Monitoring

INAC Comment 3:

The revised plan proposes to discontinue stream sediment quality monitoring (Minnow recommendation # 10) because the streams and rivers in the study area "contain very limited depositional habitat suitable for the collection of fine sediments". Two streams in the area are expected to experience flow reductions: Camp Lake Tributary 2 (CLT-2), during the full scale project, and Sheardown Lake Tributary 1 (SDLT-1), due to diversions associated with West Pond and the Open Pit. It is not clear if these flow reductions would be such that suitable depositional habitat may be created.

INAC 2015 Comment 3: Stream Sediment Quality Monitoring

INAC Recommendation:

Discuss whether depositional habitats may be created by flow reductions on streams CLT-2 and SDLT-1, and if so, confirm these would be sampled.

Baffinland Response:

- **To date, mine operations have not impacted (reduced) flow in Camp Lake Tributary 2 or Sheardown Lake Tributary 1 (i.e., no diversions or other alteration of watershed characteristics)**
- **Once future mine operations affect flow characteristics of these watersheds, field observations will be conducted to determine whether flow reductions have resulted in the creation of depositional habitat.**

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INAC 2015 Comment 4: AEMP Sediment Quality Benchmarks

INAC Comment 4:

Sediment quality benchmarks developed for Sheardown Lake NW are interim due to confounding factors in the collected data. Further study was recommended for 2015. It is not clear whether the data presented in the 2015 annual report meets this recommendation and the information has not yet been integrated, or if there is still work to do.

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INAC 2015 Comment 4: AEMP Sediment Quality Benchmarks

INAC Comment 4 (continued):

Minnow recommendation 14 is to consider updating the AEMP sediment quality benchmarks because "on average, arsenic, copper and iron concentrations were elevated above respective AEMP sediment quality benchmarks within Reference Lake 3 littoral and/or profundal station sediment during the 2015 CREMP". Given that to date, sediment quality benchmarks have been developed on a lake by lake basis, using data from Reference Lake 3 to modify existing benchmarks in mine site lakes appears as a change in methodology. The Department notes that it did not find this recommendation in the AEMP document.

INAC 2015 Comment 4: AEMP Sediment Quality Benchmarks

INAC Recommendation:

1) Provide an update on work done to remove the interim status of the Sheardown NW quality benchmarks: and
2) Clarify if and how they would modify previously developed sediment quality benchmarks for mine site lakes

Baffinland Response:

- **Baffinland collects sediment quality samples at Sheardown Lake NW and at Reference Lake 3 as outlined in the current revision of the AEMP (Rev. 1) in continuation of the characterization of sediment chemistry at Sheardown Lake NW.**

INAC 2015 Comment 4: AEMP Sediment Quality Benchmarks

Baffinland Response:

- **Because baseline data collection no longer can be applied to Sheardown Lake NW, only data from reference lakes can be used to update the AEMP Sediment Quality Benchmarks.**
- **Sediment sampling at Reference Lake 3 has showed naturally elevated concentrations of arsenic, copper, iron and manganese compared to AEMP benchmarks.**
- **Suggests that AEMP benchmarks for these metals may be overly conservative should they be used for inferring biological responses.**

INAC 2015 Comment 5: Water Sample Field Filtration

INAC Comment 5:

Field sampling protocols for water sampling are presented in Appendix B which includes several appendices itself. The protocol for filtering water samples for dissolved metal analyses does not appear consistent between the appendices.

INAC Recommendation:

The water sample filtration protocol for dissolved metal analyses should be consistent, and that if samples are filtered at the laboratory instead of in the field, it should be clearly indicated in the notes. Ideally, filtration should always occur in the same place to ensure results are comparable as possible.

INAC 2015 Comment 5: Water Sample Field Filtration

Baffinland Response:

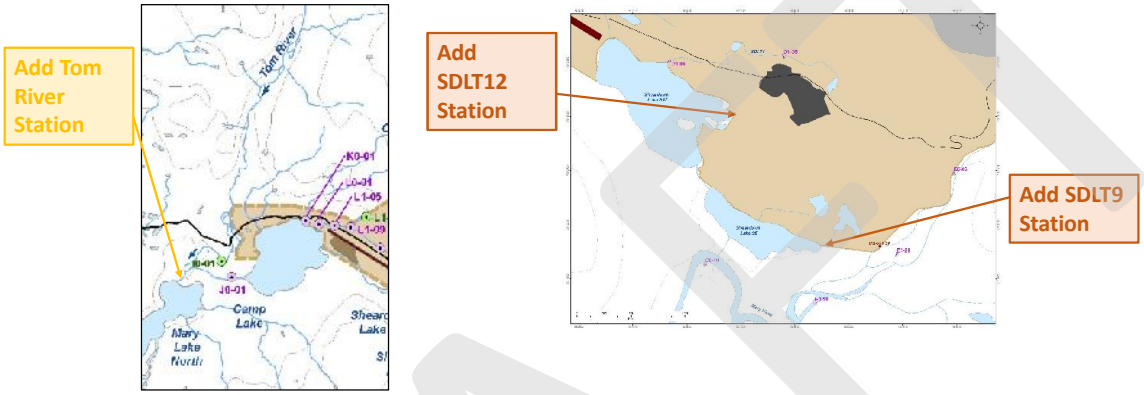
- **We agree.**
- **Methods presented regarding the collection of dissolved metals samples will also be made consistent among the various Baffinland AEMP documents and within the AEMP Revision 2 document.**

Discussion of Other Recommendations (Minnow letter to Jim Millard, March 17, 2016)

Minnow Recommendations 2 and 3: Additional Stream Water Samples

Minnow Recommendations 2 and 3:

- **Addition of water quality monitoring stations to lower Tom River, Sheardown Lake Tributary 9 and Sheardown Lake Tributary 12.**



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Minnow Recommendation 8: Single Lake Profile

Minnow Recommendation 8:

- **Conduct water quality profile only at a single station (deepest basin) rather than at every water quality monitoring station for the lake sampling. Suggested locations include:**
  - **Camp Lake Station JLO-07**
  - **Sheardown Lake NW Station DLO-01-2**
  - **Sheardown Lake SE Station DLO-02-3**
  - **Mary Lake (North Basin) Station BLO-1A**
  - **Mary Lake (South Basin) Station BLO-9**
  - **Reference Lake 3 (northwest basin) Station REF03-3**

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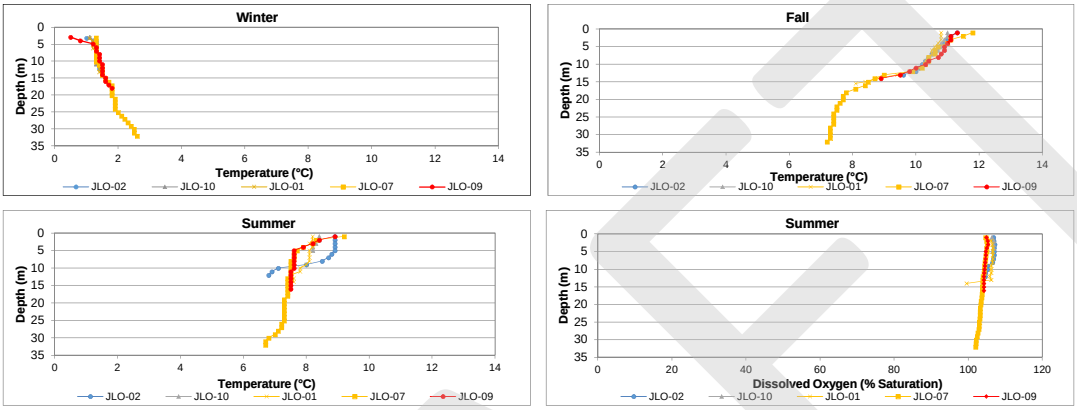
Minnow Recommendation 8: Single Lake Profile

Rationale:

- **Minor spatial variation in profile features within lakes.**



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Minnow Recommendation 11: Addition of CLT1 Benthic Area

Minnow Recommendation 11:

- **Add a benthic area (5 stations) to the upper main stem of Camp Lake Tributary 1, near water quality station L2-03.**

Rationale:

- **Water quality data from Station L2-03 indicated elevated nitrate and metal concentrations compared to all other CLT1 stations.**

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Minnow Recommendation 12: Removal of SDLT1 Benthic Areas

Minnow Recommendation 12:

- **Remove benthic areas from upper Sheardown Lake NW Tributary 1 (SDLT1), maintaining the lower-most benthic area (Reach 1) for this tributary.**

Rationale:

- **One study area is sufficient for the determination of effects to the benthic invertebrate community of SDLT1.**

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Minnow Recommendation 13: Addition of Stream Reference Benthic Invertebrate Community Sampling Area

Minnow Recommendation 13:

- **Add a stream reference benthic area (5 stations). CLT-REF4 was sampled in 2016 and shown to be a suitable study area.**

Rationale:

- **A stream reference benthic area is required for comparison to Camp Lake Tributary 1 and 2, and Sheardown Lake Tributary 1, 9 and 12 mine-exposed area benthic invertebrate community data.**
- **Ideally, the use of a reference area with existing water quality data was preferred.**

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Minnow Recommendation 15: Littoral Lake Benthic Sampling

Minnow Recommendation 15:

- **Focus the lake benthic invertebrate community (benthic) sampling only on littoral habitat (8 – 10 m depth) and remove profundal sampling. Consistent with MMER, sample 5 littoral stations per lake.**

Rationale:

- **Naturally lower density, richness and proportion of certain sensitive taxa occurs in profundal (deep) areas compared to littoral (shallow) areas in lakes.**
- **Occurrence of lower richness and greater tolerance of invertebrates in the profundal areas hampers ability of study to evaluate mine-related effects.**

Minnow Recommendation 15: Littoral Lake Benthic Sampling

Rationale (continued):

- **Littoral – profundal differences observed naturally at Reference Lake 3. Average station depth of 9.3 m and 20.5 m, respectively.**

2015 Metric	Statistical Test Results: Significant Difference Between Areas?	*p*-value	Statistical Analysis[a]	Magnitude of Difference[b] (No. of SD)	Summary Statistics: Area	Mean
Density (Individuals/m^2)	***YES***	***0.025***	ζ	***-1.2***	Reference Lake littoral	1,278
					Reference Lake profundal	180
Richness (Number of Taxa)	YES	0.005	ε	-2.4	Reference Lake littoral	12.6
					Reference Lake profundal	2.8
Simpson's Evenness (E)	YES	0.009	ε	-8.9	Reference Lake littoral	0.865
					Reference Lake profundal	0.397
Bray-Curtis Index	***YES***	***0.035***	***α***	***-1.3***	Reference Lake littoral	0.382
					Reference Lake profundal	0.157
Ostracoda (%)	NO	0.177	*α*	-	Reference Lake littoral	20.9%
					Reference Lake profundal	9.7%
Chironomidae (%)	***YES***	***0.088***	***ε***	***1.1***	Reference Lake littoral	66.5%
					Reference Lake profundal	87.8%
Metal-Sensitive Chironomidae (%)	NO	0.163	*α*	-	Reference Lake littoral	11.4%
					Reference Lake profundal	2.8%

2016 Metric	Statistical Test Results: Significant Difference Between Areas?	*p*-value	Statistical Analysis[a]	Magnitude of Difference[b] (No. of SD)	Summary Statistics: Area	Mean
Density (Individuals/m^2)	***YES***	***0.015***	ε	***-1.4***	Reference littoral	2,390
					Reference profundal	452
Richness (Number of Taxa)	YES	0.000	α	-7.3	Reference littoral	12.2
					Reference profundal	4.2
Simpson's Evenness (E)	YES	0.000	ζ	-2.6	Reference littoral	0.758
					Reference profundal	0.267
Bray-Curtis Index	YES	0.000	ε	4.8	Reference littoral	0.334
					Reference profundal	0.921
Ostracoda (%)	YES	0.000	γ	-2.4	Reference littoral	46.9%
					Reference profundal	5.7%
Chironomidae (%)	YES	0.000	β	2.5	Reference littoral	45.4%
					Reference profundal	92.2%
Metal-Sensitive Chironomidae (%)	YES	0.005	δ	***-2.1***	Reference littoral	19.3%
					Reference profundal	1.7%

Recommendation 16: Harmonize Lake Sediment and Benthic Stations

Minnow Recommendation 16:

- **Lake sediment should be collected at benthic sampling locations and analyzed for particle size, TOC and total metals.**

Rationale:

- **Collection of sediment at benthic stations will allow improved interpretation of benthic data by allowing sediment physical and chemical properties to be taken into account.**

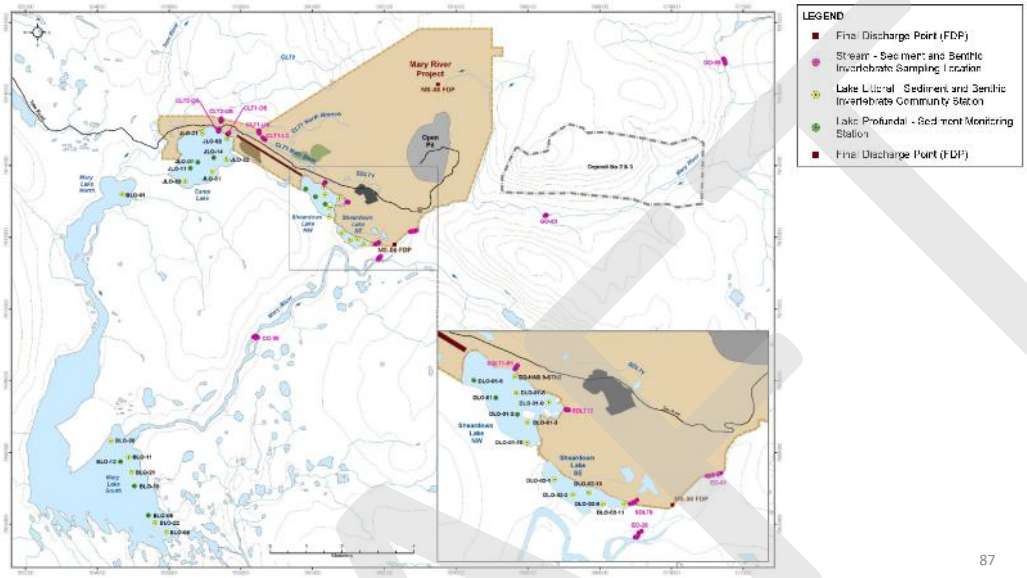
Minnow Recommendation 17: Lake Sediment Station Re-Structure

Minnow Recommendation 17:

- **Re-structure the lake sediment sampling stations to include the five littoral stations discussed in Minnow recommendations 15 and 16, as well as inclusion of three profundal sediment stations in each lake to ensure temporal continuity.**

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

Minnow Recommendation 17: Lake Sediment Station Re-Structure



Minnow Recommendation 19: Preferred Arctic charr Collection Gear

Minnow Recommendation 19:

- **Use 38 – 64 mm mesh size to capture Arctic charr from littoral/profundal habitat in lakes.**

Rationale:

- **The indicated mesh sizes were most efficient (i.e., caught the most fish), and therefore fewer incidental fish mortalities likely to result by using only these mesh sizes (e.g., quicker processing time).**

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Appendix 7

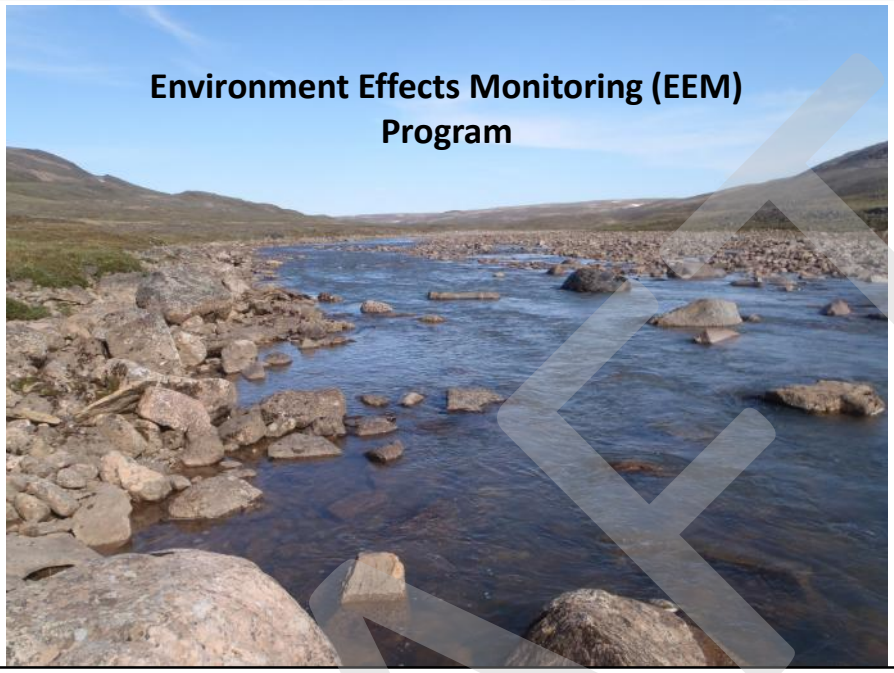
2017 Freshwater Workshop – EEM Phase 1 Study Design Workshop Slide Decks

Environmental Effects Monitoring – Phase 1 Study

Mary River Project
Environmental Effects Monitoring – Phase 1
Study Design and Reviewer Comments

- Environmental Effects Monitoring Program Overview
- EEM Study Design for the Mary River Project
- Reviewer Comments and Baffinland Responses

Environment Effects Monitoring (EEM) Program



Introduction | AEMP | EEM Phase 1 | Additional Topics | Conclusion

Environmental Effects Monitoring (EEM) Program

Under the Metal Mining Effluent Regulations of the Canada *Fisheries Act*, mines are permitted to discharge effluent if:

- **pH is within defined limits;**
- **TSS and metal concentrations meet specified limits; and,**
- **Effluent is non-acutely lethal to rainbow trout.**

EEM studies must be conducted as a condition governing the discharge of effluent under the MMER.

Environmental Effects Monitoring (EEM) Program

- The intent of the EEM program is to assess the adequacy of effluent regulations (e.g., current pH, metal and TSS limits) for protecting biota in aquatic environments.
- The evaluation of whether the effluent regulations are effective uses a science-based assessment of:
  - Benthic invertebrate communities (to assess effects on fish food base and/or habitat);
  - Fish population (to assess effects on fish health);
  - Fish tissue mercury concentrations (to assess effects on fish usage [consumption] by humans).
- The EEM program also includes effluent sublethal toxicity and water quality monitoring to support the analysis of the study components indicated above.

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Introduction | AEMP | EEM Phase 1 | Additional Topics | Conclusion

Environmental Effects Monitoring (EEM) Program

- EEM studies are designed to detect and measure changes in aquatic systems.
- Biological monitoring studies are most often conducted at a 36 month (3-year) frequency.
- The initial studies are designed to assess effects.
- If consistent effects shown in two studies, studies to investigate effects are conducted to:
  - Determine the magnitude and geographic extent of effects; and,
  - Determine the cause(s) of effects.
- Once the cause of effects is determined, studies continue to monitor potential changes in effects over time.

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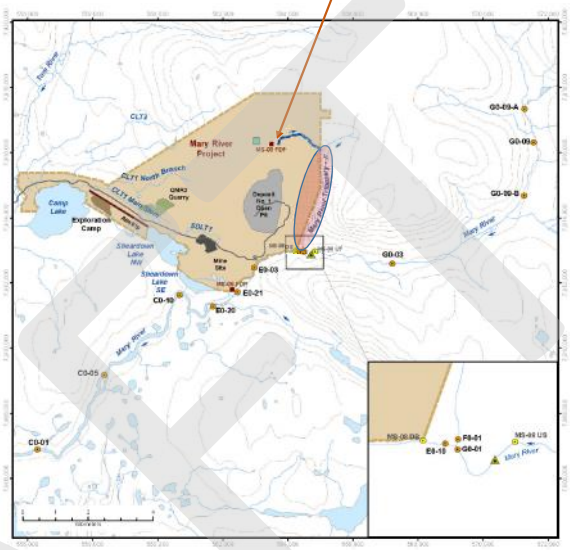
Mary River Project
Phase 1 EEM Study Design

Phase 1 EEM Study Design: Study Areas

- **Study design for the 2016 study supersedes the 2014 EEM Draft Study Design.**
    - **Two of four effluent discharges discussed in the 2014 Study Design currently do not exist**
- **Focused on the East Sedimentation Pond effluent discharge (MS-08) as effluent flow higher than the Crusher Ore Stockpile sedimentation pond discharge (MS-06).**
- **The 2016 Study Design builds upon site characterization provided in previous design and from AEMP studies, as well as methods and results of Mary River Project feasibility and other aquatic studies.**

Phase 1 EEM Study Design: Study Areas

- Mary River Tributary-F receives discharge from the MS-08 discharge and served as focus for biological sampling.

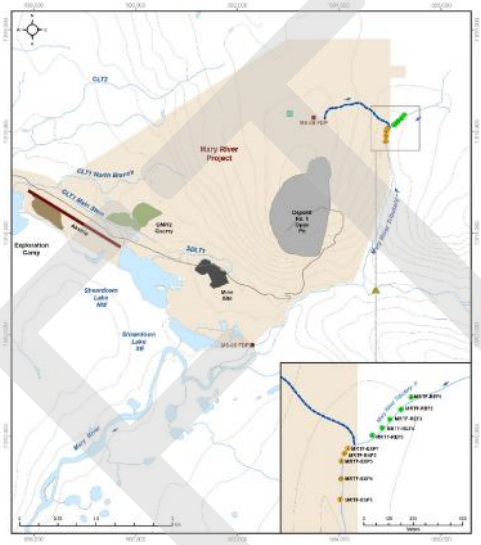


Phase 1 EEM Study Design: Study Areas

- Effluent concentrations in Mary River Tributary-F (MRTF) estimated to average 1.3%, and reach a maximum concentration of 2.5%, in 2015 at the confluence with the MS-08 discharge channel.
- No surface flow occurs in MRTF from approximately September through May due to freeze up.
- Relatively high gradient system (5.2%) exhibiting predominantly riffle-cascade morphology and wetted channel width of approximately 2.1 m and depth less than 0.2 m during August.
- Substrate predominantly large cobble and boulder, which facilitates subterranean flow.

Phase 1 EEM Study Design: Study Areas

- **Proposed benthic invertebrate community (benthic) survey study areas included an upstream (reference) and downstream (mine-exposed) area on MRTF.**



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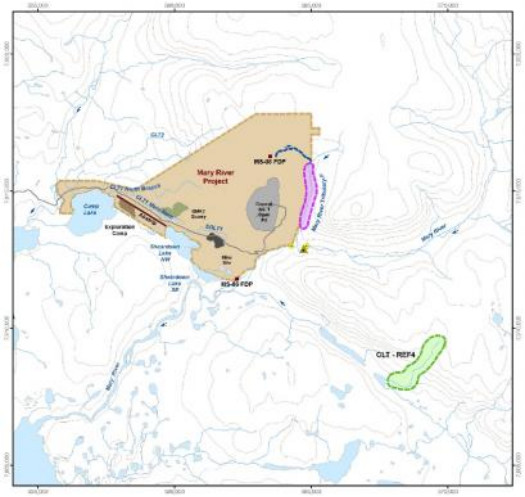
Phase 1 EEM Study Design: Study Areas

- **Proposed fish population survey study areas included an MRTF downstream (mine-exposed) area using CLT-REF4 creek as a comparable reference area.**
- **Fish migrate from lakes, and therefore any fish captured in upstream MRTF would have been exposed to mine effluent, necessitating the use of an different reference area than that used for the benthic survey.**



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Phase 1 EEM Study Design: Benthic Invertebrates

- Control-Impact design employed sampling five stations at the MRTF mine-exposed area and five stations at the MRTF reference area.
- Erosional habitat targeted for sampling using a Hess sampler outfitted with 500 um mesh
- Three grabs constituted sample at each station (0.3 m^2).
- Habitat features kept consistent among stations.
- Samples processed in lab to lowest-practical-level.
- Standard laboratory QA/QC applied.

Phase 1 EEM Study Design: Benthic Invertebrates

- Data analysis to include ANOVA comparisons of primary EEM benthic metrics (calculated at Family Level and Lowest Practical Level taxonomy) and supporting response variables.
- Application of Critical Effect Sizes.

Response	Endpoint	Critical Effect Size
Effects on Benthic Invertebrates[a]	Organism density (number of invertebrates·m^2)	± 2 SD_{REF}
	Taxonomic richness (number of taxa)	± 2 SD_{REF}
	Simpson's Evenness	± 2 SD_{REF}
	Bray-Curtis Index of dissimilarity	± 2 SD_{REF}
Supporting Response Variables[b]	Density of dominant groups (number of invertebrates·m^2)	-
	Proportion of dominant groups	-
	Density of metal-sensitive groups (number of invertebrates·m^2)	-
	Proportion of metal-sensitive groups	-
	Simpson's Diversity	-
	Shannon-Wiener Diversity	-
	Proportion of Functional Feeding Groups	-

Phase 1 EEM Study Design: Fish Population Survey

- **Control-Impact Non-Lethal design proposed targeting Arctic charr (*Salvelinus alpinus*) at mine-exposed and reference area.**
  - **Only species present in sufficient abundance;**
  - **Only non-lethal design possible as creeks freeze entirely and generally few adults migrate upstream from lakes**
  - **Individual Arctic charr do not spawn every year, resulting in high mortalities if using a lethal design.**

- **Fish were not found to be present at MRTF in historical, undocumented sampling. Suggested no fish survey in the event of absence in MRTF given effluent concentration in Mary River less than 1%.**

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Introduction | AEMP | EEM Phase 1 | Additional Topics | Conclusion

Phase 1 EEM Study Design: Fish Population Survey

- **Target sample size of 100 individual Arctic charr older than young-of-the-year (YOY).**
- **Sampling conducted using a backpack electrofisher.**
- **Non-lethal measurements of fresh body weight and length in the field.**
- **Approximately 10% of individuals sacrificed for age determination using otoliths.**

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Phase 1 EEM Study Design: Fish Population Survey

- Target sample size of 100 individual Arctic charr older than young-of-the-year (YOY).
- Sampling conducted using a backpack electrofisher.
- Non-lethal measurements of fresh body weight and length in the field.
- Approximately 10% of individuals sacrificed for age determination using otoliths.

Phase 1 EEM Study Design: Fish Population Survey

- Data analysis using standard EEM fish survey endpoints and statistical approach, as well as application of Critical Effect Sizes.

Response			Endpoint	Statistical Test[c,d,e]	Critical Effect Size
Non-Lethal Comparisons	Effects on Fish[a]	Survival	Length-frequency distribution	K-S Test	-
		Growth	Length of non-YOY (i.e., age-1+)	ANOVA	25%
			Weight of non-YOY (i.e., age-1+)	ANOVA	25%
		Reproduction	Relative abundance of YOY (% composition)	None	-
		Energy Storage	Condition (body weight against length)	ANCOVA	10%
	Supporting Response Variables[b]	Survival	Age-frequency distribution (if possible)	K-S Test	-
		Growth	Size of YOY (age 0+ fish)	ANOVA	-
			Size-at-age (body weight against age, if possible)	ANCOVA	-
		Reproduction	YOY survival	ANCOVA	-

Phase 1 EEM Study Design: Fish Usability (Tissue) Survey

- **Fish Usability (tissue) Survey not required because effluent mercury concentrations were below trigger concentration of 0.10 ug/L.**

Variable		Units	MMER Monthly Mean Limit [d]	2015 July (n = 3)	2015 August (n = 2)
Routine Monitoring [b]	Volume (m^3/day)	m^3	-	1,088	1,130
	pH	pH units	6.0 - 9.5	7.51	7.61
	TSS	mg/L	15	11.0	7.2
	Arsenic (As)	mg/L	0.5	0.0004	0.0001
	Copper (Cu)	mg/L	0.3	0.0012	0.0013
	Lead (Pb)	mg/L	0.2	0.00059	0.00019
	Nickel (Ni)	mg/L	0.5	0.012	0.023
	Zinc (Zn)	mg/L	0.5	0.0037	0.0033
	Radium-226	Bq/L	1	<0.010	0.013
Acute Toxicity	Rainbow Trout *	% Pass (N) [1]	NL	NL	NL
	Daphnia magna *	% Pass (N) [1]	NL	NL	NL
Effluent Characterization [c]	Conductivity	µS/cm	-	948	1,320
	Hardness	mg/L (as $CaCO_3$)	-	465	724
	Alkalinity	mg/L (as $CaCO_3$)	-	32	44
	Ammonia (NH_4^+)	mg/L	-	0.40	0.47
	Nitrate (NO_3)	mg/L	-	3.8	4.9
	Aluminum (Al)	mg/L	-	0.312	0.117
	Cadmium (Cd)	mg/L	-	0.00007	0.00016
	Iron (Fe)	mg/L	-	0.474	0.329
	Mercury (Hg)	mg/L	0.00010	<0.00001	<0.00001
	Molybdenum (Mo)	mg/L	-	0.0002	0.0003
	Selenium (Se)	mg/L	-	0.0014	0.0026

Phase 1 EEM Study Design: Supporting Environmental Variables

- **Supporting environmental information collected to include:**
  - **Habitat Characterization;**
  - **Water Quality Assessment during biological monitoring; and,**
  - **Routine effluent and water quality monitoring.**
- **Data to be used to support interpretation of biological data.**

Phase 1 EEM Study Design: Supporting Environmental Variables

- Habitat characterization information recorded included:
  - Channel dimensions (width, depth and velocity from at least two transects per study area);
  - Channel morphology description;
  - Substrate size (pebble count of at least 20 randomly selected in-stream substrates from at least two transects per study area);
  - Channel stability observations; and,
  - Relative in-stream cover types and proportion.

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Phase 1 EEM Study Design: Supporting Environmental Variables

- Water quality assessment at time of biological monitoring:
  - *In situ* field measurements of temperature, dissolved oxygen, pH and specific conductance; and,
  - Water chemistry sampling.
- *In situ* water quality data analysis to include statistical comparison between mine-exposed and reference study areas, as well as comparisons to Water Quality Guidelines (WQG; dissolved oxygen and pH measures only).
- Water chemistry sample collected from established EEM stations and at MRTF assessed for standard EEM parameters, with analysis including comparisons between study areas and to WQG.

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Phase 1 EEM Study Design: Supporting Environmental Variables

- Effluent quality and routine receiving environment water quality monitoring conducted at established EEM stations and analyzed for EEM parameters as per MMER requirements throughout year.
- Effluent monitoring includes effluent chemistry characterization and acute and sublethal toxicity evaluation.
- Data collected by Baffinland and submitted electronically to ECCC, but also to be summarized as part of EEM interpretive report.

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ECCC Action Item 1: Changes to EEM Study Design

ECCC Action Item 1:

Extent to which changes between original draft EEM and current EEM study design may impact NWB's ability to approve AEMP.

Baffinland Response:

- **Original EEM study design assumed full mine development, including four effluent Final Discharge Points (FDP) whereas only two active intermittent discharges occur currently.**
- **Original EEM study design suggested sampling of Mary River and Camp Lake Tributary 1 (areas currently sampled under the CREMP), whereas the current design focuses on the watercourse that currently receives majority of effluent (MS-08) from mine operations (i.e., Mary River Tributary-F).**

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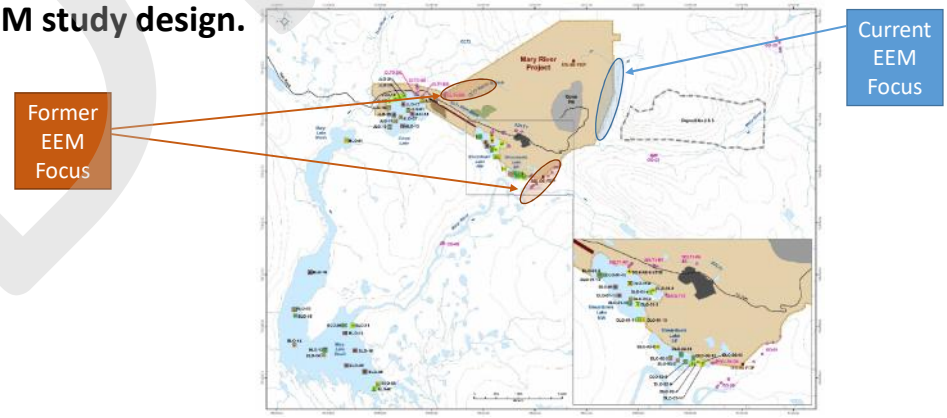
Introduction | AEMP | EEM Phase 1 | Additional Topics | Conclusion

ECCC Action Item 1: Changes to EEM Study Design

Baffinland Response (continued):

- **Thus, the current EEM study design enhances the overall spatial coverage of environmental monitoring versus the original draft EEM study design.**



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ECCC Action Item 2: Effluent Concentration Estimation

ECCC Action Item 2:

Provide further details on how the stream discharge and effluent concentrations were estimated.

Baffinland Response:

- **Mary River Tributary-F (MRTF) flow was estimated using average per unit watershed area flow data ($m^3/day/km^2$) from six nearby watercourses collected for the months of July and August, 2015.**

$$\text{Effluent Concentration} = \frac{\text{MS-08 effluent discharge } (m^3/day)}{[\text{MRTF flow } (m^3/day) + \text{MS-08 effluent discharge } (m^3/day)]}$$

ECCC Action Item 2: Effluent Concentration Estimation

Baffinland Response (continued):

- **Watershed sizes used for extrapolations varied in size from 3.6 – 250 km^2. The MRTF watershed area used was 6.8 km^2.**

H1 Phillips Creek Tributary (250 km^2)	H2 Tom River (210 km^2)	H4 Camp Lake Tributary2 (8.3 km^2)	H5 Camp Lake Tributary1 (5.3 km^2)	H6 Mary River (250 km^2)	H11 Sheardown Lake Trib1 (3.6 km^2)

- **<u>On average</u>, the MS-08 effluent was estimated to constitute 1.3 ± 0.5% of flow at MRTF, and 0.03 ± 0.02% of flow at Mary River during periods of discharge in 2015 (at confluence).**
- **<u>Under maximum effluent flow</u>, the MS-08 effluent was estimated to constitute 2.5 ± 0.9 % of flow at MRTF, and 0.07 ± 0.04 % of flow at Mary River during periods of discharge in 2015 (at confluence).**

ECCC Action Item 3: Effluent Concentration Verification

ECCC Action Item 3:

Proponent is recommended to verify effluent concentrations with in-stream conductivity measurements during effluent discharge periods in 2017.

Baffinland Response:

- **Effluent concentrations within MRTF and Mary River will be determined at the time of biological sampling in August 2017 using the approach suggested in the Metal Mining EEM Technical Guidance Document (TGD).**
- **Determination will be conducted using specific conductance measurements.**

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ECCC Action Item 4: Sampling Upstream of FDP

ECCC Action Item 4:

Proponent to provide details regarding measures implemented and monitoring that may be conducted to determine whether or not the effluent discharged from MS-08 may have any negative impact on the receiving environment, preceding the final discharge point.

Baffinland Response:

- **Monitoring of the channel that drains into MRTF will include *in situ* water quality measurements only.**
- **This portion of the MRTF system is essentially an effluent conduit (width approximately 30 cm and depth 0.05 m in August 2015).**

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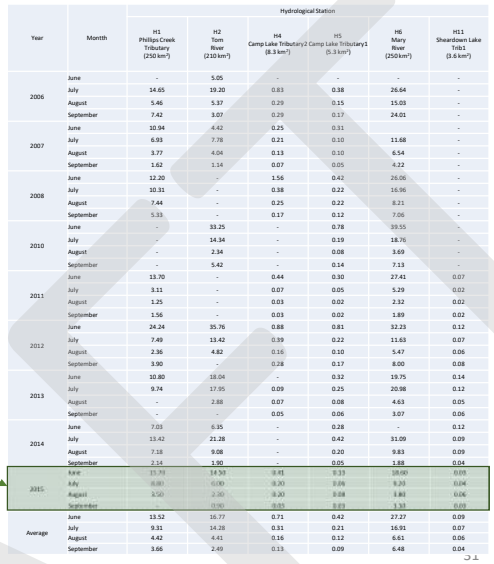
ECCC Action Item 5: 2015 Monthly Discharge Data

ECCC Action Item 5:

Table A-2 presents monthly discharge data for several stations from 2006 to 2014, but there are no 2015 data. Please provide the missing data.

Baffinland Response:

- **Table A.2 updated accordingly.**



Year	Month	Hydrological Station					
		H1 Phillips Creek Tributary (250 km²)	H2 Tom River (210 km²)	H4 Camp Lake Tributary 2 (8.3 km²)	H5 Camp Lake Tributary 1 (5.3 km²)	H6 Mary River (250 km²)	H11 Sheardown Lake Trib1 (3.6 km²)
2006	June	-	5.05	-	-	-	-
	July	14.65	19.20	0.83	0.38	26.64	-
	August	5.46	5.37	0.29	0.15	15.03	-
	September	7.42	3.07	0.29	0.17	24.01	-
2007	June	10.94	4.42	0.25	0.31		-
	July	6.93	7.78	0.21	0.10	11.68	-
	August	3.77	4.04	0.13	0.10	6.54	-
	September	1.62	1.14	0.07	0.05	4.22	-
2008	June	12.20	-	1.56	0.42	26.06	-
	July	10.31	-	0.38	0.22	16.96	-
	August	7.44	-	0.25	0.22	8.21	-
	September	5.33	-	0.17	0.12	7.06	-
2010	June	-	33.25	-	0.78	39.55	-
	July	-	14.34	-	0.19	18.76	-
	August	-	2.34	-	0.08	3.69	-
	September	-	5.42	-	0.14	7.13	-
2011	June	13.70	-	0.44	0.30	27.41	0.07
	July	3.11	-	0.07	0.05	5.29	0.02
	August	1.25	-	0.03	0.02	2.32	0.02
	September	1.56	-	0.03	0.02	1.89	0.02
2012	June	24.24	35.76	0.88	0.81	32.23	0.12
	July	7.49	13.42	0.39	0.22	11.63	0.07
	August	2.36	4.82	0.16	0.10	5.47	0.06
	September	3.90	-	0.28	0.17	8.00	0.08
2013	June	10.80	18.04	-	0.32	19.75	0.14
	July	9.74	17.95	0.09	0.25	20.98	0.12
	August	-	2.88	0.07	0.08	4.63	0.05
	September	-	-	0.05	0.06	3.07	0.05
2014	June	7.03	6.35	-	0.28	-	0.12
	July	13.42	21.28	-	0.42	31.09	0.09
	August	7.18	9.08	-	0.20	9.83	0.09
	September	2.14	1.90	-	0.05	1.88	0.04
2015	June	15.79	14.50	0.41	0.33	18.60	0.03
	July	8.81	6.90	0.20	0.16	8.23	0.04
	August	3.50	2.20	0.20	0.08	1.84	0.06
	September	-	0.90	0.05	0.03	1.33	0.03
Average	June	13.52	16.77	0.71	0.42	27.27	0.09
	July	9.31	14.28	0.31	0.21	16.91	0.07
	August	4.42	4.41	0.16	0.12	6.61	0.06
	September	3.66	2.49	0.13	0.09	6.48	0.04

ECCC Action Item 6: Stream Sediment Sampling

ECCC Action Item 6:

The study design did not describe methods for the collection of sediment samples for particle size and total organic carbon analyses, which are required if the study is conducted in an area where it is possible to sample sediment (MMER, Sched. 5, s. 16(a)(iii)). The description of the sampling areas (erosional habitat with gravel/cobble substrate) would suggest that sediment sampling will not be possible; please confirm or provide the missing information.

ECCC Action Item 6: Stream Sediment Sampling

Baffinland Response:

- **Sediment samples will not be collected concurrent with benthic invertebrate community samples given the occurrence of only erosional habitat (boulder with interspersed gravel/cobble) at MRTF.**
- **Consistent with EEM guidance for such habitat.**

Predominant habitat of MRTF is erosional, with no substantial areas in which the deposition of fine materials (e.g., silt) occurs.

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Introduction | AEMP | EEM Phase 1 | Additional Topics | Conclusion

ECCC Action Item 7: Fish Survey Requirements

ECCC Action Item 7:

An exemption to the fish population (fish) survey was proposed with the confirmed absence of fish from MRTF and due to low effluent concentration in Mary River. The MMER requires a fish survey based on an MRTF effluent concentration greater than 1% within 250 m of the final discharge point (FDP) (Sched. 5, s. 9(b)). The fish survey should be initially conducted in MRTF as proposed, and if fish are determined to be absent or in low abundance, field crews should sample progressively downstream into Mary River. Please provide information on potential reference sites for the Mary River exposure area. The proponent is recommend to identify several reference site options for MRTF and Mary River exposure areas.

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ECCC Action Item 7: Fish Survey Requirements

Baffinland Response:

- Effluent concentrations in MRTF are likely to be less than 1% for most of the open-water period, but nevertheless can be above 1% within 250 m of the effluent channel confluence.
- However, within Mary River, effluent concentrations are consistently well below 1% (e.g., maximum likely well below 0.1%).
- Effluent-exposure period for fish is less than 3 months per year, limiting the amount of time exposure occurs.
- Attributing effluent-related effects to Mary River fish is not scientifically defensible given low effluent concentration and short exposure period.
- Suggested further consultation between Baffinland and ECCC.

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Introduction | AEMP | EEM Phase 1 | Additional Topics | Conclusion

ECCC Action Item 7: Fish Survey Requirements

Fish Survey Requirements Resolution:

- Meetings were held on August 16th and 17th among Baffinland, Minnow and ECCC representatives at the Mary River Project.
- Determined that in the event of fish absence in MRTF, fish sampling will be conducted at Mary River near the confluence with MRTF, using a Mary River downstream area as a reference area.
- Due to impassable barrier, a Mary River upstream area could not serve as a reference. Because Tom River water chemistry appears to naturally differ from Mary River, no other rivers in the Local Study Area are of comparable size to Mary River, and fish permit changes were required, downstream area of Mary River deemed most appropriate area.

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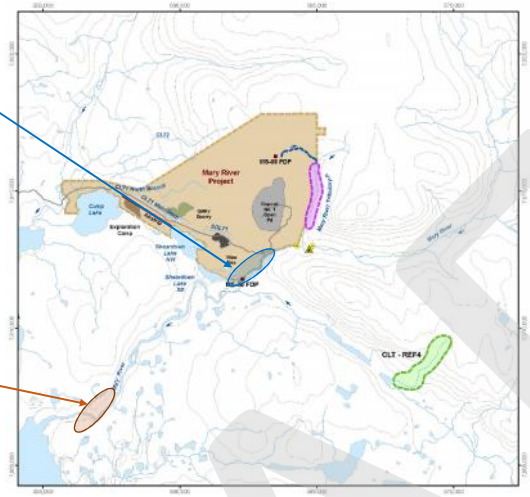
ECCC Action Item 7: Fish Survey Requirements

Fish Survey Requirements Resolution:

Proposed Mary River Effluent-Exposed Area

Proposed Mary River Downstream Reference Area



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ECCC Action Item 7: Fish Survey Requirements

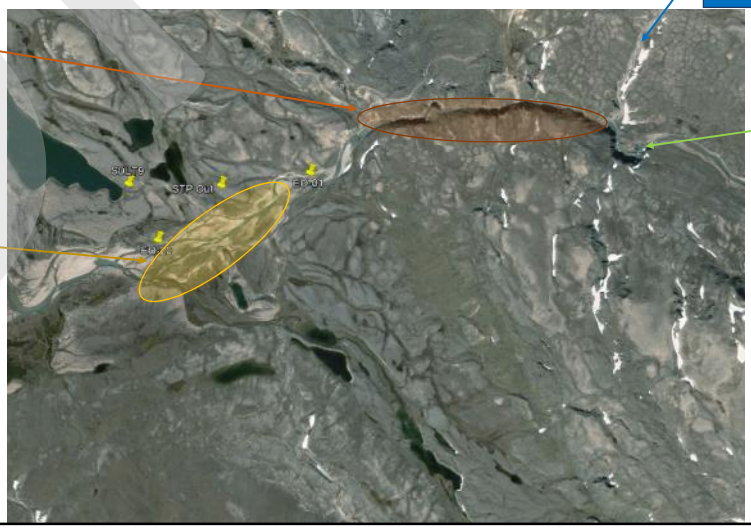
Fish Survey Requirements Resolution:

Mary River Tributary-F

Mary River "Gorge"

Mary River Barrier

"Safe" Sampling Area



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ECCC Action Item 8: Effluent Concentration Clarification

ECCC Action Item 8:

The report indicates that mine effluent represented 0.02% - 0.035% of flow in the Mary River. On p.7, the effluent percentage of flow in the Mary River was given as 0.03% and 0.065%; please clarify.

Baffinland Response:

- **On page 21, average and maximum concentrations of mine effluent in Mary River were based on average Mary River flow over the period of 2006-2015.**
- **On page 7, average and maximum concentrations of mine effluent in Mary River were based on average Mary River flow only in 2015 (July/August period).**

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ECCC Action Item 9: Calculation of Discharge Volumes

ECCC Action Item 9:

The study design indicates that stream velocity and channel dimensions will be measured, will discharge volumes be calculated?

Baffinland Response:

- **No, discharge volumes will not be calculated from the stream water velocity and channel dimension data collected for EEM.**
- **The data area collected to provide general information on habitat characteristics of each study area to assist with the interpretation of biological data.**
- **The number of monitoring points along each transect, and the in-stream transect locations, are not intended to be sufficient for accurate discharge volume calculation.**

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ECCC Action Item 10: Water Sample Preservation and Shipping

ECCC Action Item 10:

Please briefly describe field preservation and shipping protocols for water samples to ensure laboratory sample hold times are met, given the remote location of the study area.

Baffinland Response:

- **Standard Operating Procedures (SOP) developed for Baffinland water quality sampling were provided detailing the requested information.**

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Introduction | AEMP | EEM Phase 1 | Additional Topics | Conclusion

ECCC Action Item 11: Receiver Water Sampling Locations

ECCC Action Item 11:

Provide details regarding further or continued monitoring and/or analyses that may be conducted to determine the extent to which mining activities may be contributing to the differences, over time, in results observed in the water quality parameters measured at MRTF and the Mary River upstream reference station.

Baffinland Response:

- **Baffinland conducts water quality monitoring at established EEM and AEMP stations at frequencies required under each respective approved monitoring plan.**

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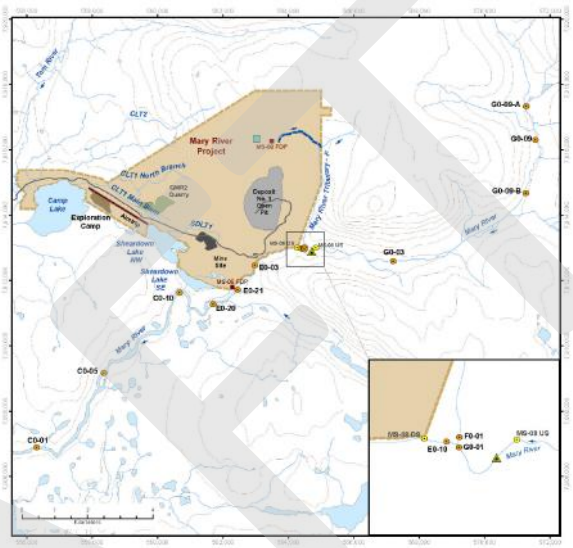
ECCC Action Item 11: Receiver Water Sampling Locations

Baffinland Response (continued):

- **The locations and frequencies of sampling appear to be sufficient for monitoring spatial differences between mine-exposed and reference areas, and temporal changes over time, in water quality of MRTF and Mary River.**



ECCC Action Item 12: Station Changes

ECCC Action Item 12:

Details regarding the exposure and reference areas to be monitored should be confirmed in the EEM Study Design in the context of BIMC's recommended discontinuation of monitoring for several stations potentially related to exposure and/or reference areas, based on the correspondence accompanying the AEMP (Rev 2).

Baffinland Response:

- **Approval for changes suggested in correspondence accompanying the AEMP (Rev 2) was not received.**
- **Therefore, no changes to stations will be implemented within the time period of the first EEM study.**

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ECCC Action Item 13: Final Discharge Point MS-06 Information

ECCC Action Item 13:

The proponent previously notified the authorization officer of the addition of a second FDP (MS-06) for the Mary River Project. The MS-06 FDP was not described in the study design. The MMER require a description of the manner in which the effluent mixes within the exposure area for each final discharge point. Please provide any available information regarding effluent mixing from MS-06, and a description of plume delineation methods to be implemented in 2017 (as requested for MS-08; see Action Item 3).

ECCC Action Item 13: Final Discharge Point MS-06 Information

Baffinland Response:

- **Discharge of effluent from the MS-06 FDP was limited to a single day (September 12) in 2016 (86 m^3 of effluent released).**
- **Because the EEM study design was required to be submitted by July 10, 2016, data pertaining to the MS-06 FDP effluent release were not provided.**
- **Effluent release from the MS-06 FDP discharge will occur rarely, and for very brief periods of time.**

ECCC Action Item 13: Final Discharge Point MS-06 Information

Baffinland Response (continued):

- To the extent possible, given potential safety concerns associated with high water velocities, water depths greater than 1 m, and large boulder substrate (safe footing issues), Baffinland will conduct a specific conductance survey at the time of effluent release to characterize mixing features.
- Because a hydrological station is established on Mary River, extrapolation of effluent concentrations in Mary River can also be conducted on a daily basis, as required.

ECCC Action Item 14: Concurrent Discharge at MS-06

ECCC Action Item 14:

The MS-06 FDP will discharge to the Mary River through a treated sewage pipeline; will mine effluent and treated sewage be discharged concurrently?

Baffinland Response:

- It is unlikely that the MS-06 FDP will discharge concurrently with the discharge of treated sewage (possibly during periods of unusually high amounts of precipitation-related runoff).
- Discharge from the MS-06 FDP will occur very rarely (a few days per year) on an intermittent basis.

ECCC Action Item 15: Location of Stream Stations

ECCC Action Item 15:

Please indicate the location of stream sampling sites listed in Table A.4. Was there a noticeable difference in water chemistry between upstream and downstream sites on MRTF?

Baffinland Response:

- **Map provided showing AEMP and EEM water sampling locations (Slide 43 herein).**
- **No difference in water chemistry has been indicated between Mary River stations located upstream and downstream of the Tributary-F confluence.**

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ECCC Other Item 22: Minimum Fish Survey Effort

ECCC Other Item 22:

The proponent is advised to plan for up to 7 days of sampling per area to meet sample size targets for the fish survey.

Baffinland Response:

- **Given the relatively small size of MRTF, the determination of whether fish are present within this tributary will likely require less than a day by an experienced electrofishing team.**
- **Following the initial sampling, ECCC will be contacted regarding effort applied and results.**
- **Suggested further discussion of this item during the ECCC site visit from August 15th – 17th, 2017.**

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ECCC Other Item 22: Minimum Fish Survey Effort

Resolution of Minimum Fish Survey Effort:

- **Meetings were held on August 16th and 17th among Baffinland, Minnow and ECCC representatives at the Mary River Project.**
- **ECCC noted that 7 days is the recommended level of effort to achieve target sample sizes, but it could take less time to determine the presence or absence of fish.**
- **ECCC recommended that an adequate level of effort be applied to achieve the fish survey objectives, and that supporting information should be provided in the EEM interpretive report justifying the level of effort used.**

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Environmental Effects Monitoring – Phase 1 Study

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Mary River Project
Environmental Effects Monitoring – Phase 1
Preliminary Information Summary

- Field Study Timing and Study Areas
- Receiving Environment Water Quality
- Benthic Invertebrate Community Survey
- Fish Population Survey

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Phase 1 EEM Preliminary Information: Field Study Timing

- **Field study completed August 24th – 28th, 2017.**
- **Effluent from the MS-08 FDP had been released just prior to field sampling (initiation at approximately 16:00 on August 23rd).**

Introduction | AEMP | EEM Phase 1 | Additional Topics | Conclusion

Phase 1 EEM Preliminary Information: Field Study Timing

Summary of Baffinland MS-08 Effluent Discharge in 2017

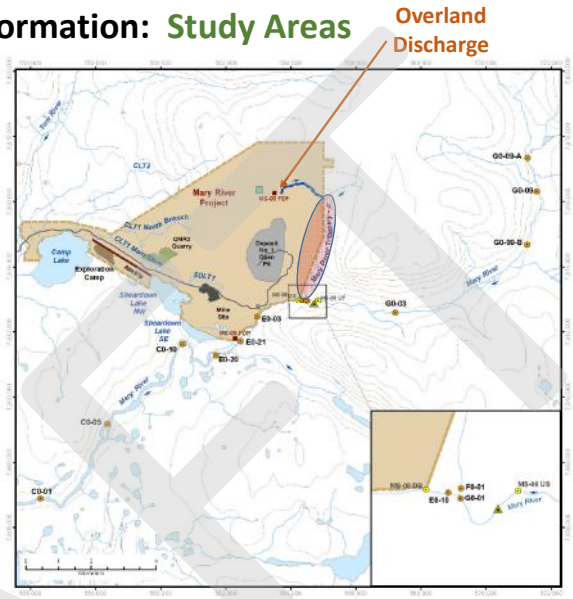
Date	Total Daily Discharge (m^3)	Cumulative Discharge (m^3)	Date	Total Daily Discharge (m^3)	Cumulative Discharge (m^3)
2-Jul-17	1,716	1,716	6-Aug-17	0	8,264
3-Jul-17	936	2,652	7-Aug-17	0	8,264
4-Jul-17	0	2,652	8-Aug-17	0	8,264
5-Jul-17	0	2,652	9-Aug-17	0	8,264
6-Jul-17	0	2,652	10-Aug-17	0	8,264
7-Jul-17	0	2,652	11-Aug-17	0	8,264
8-Jul-17	12	2,664	12-Aug-17	0	8,264
9-Jul-17	0	2,664	13-Aug-17	0	8,264
10-Jul-17	0	2,664	14-Aug-17	0	8,264
11-Jul-17	0	2,664	15-Aug-17	0	8,264
12-Jul-17	0	2,664	16-Aug-17	0	8,264
13-Jul-17	0	2,664	17-Aug-17	0	8,264
14-Jul-17	0	2,664	18-Aug-17	0	8,264
15-Jul-17	0	2,664	19-Aug-17	0	8,264
16-Jul-17	0	2,664	20-Aug-17	0	8,264
17-Jul-17	767	3,431	21-Aug-17	0	8,264
18-Jul-17	20	3,452	22-Aug-17	0	8,264
19-Jul-17	1,339	4,790	23-Aug-17	0	8,264
20-Jul-17	249	5,039	24-Aug-17	369	8,633
21-Jul-17	826	5,865	25-Aug-17	376	9,009
22-Jul-17	0	5,865	26-Aug-17	874	9,883
23-Jul-17	0	5,865	27-Aug-17	523	10,406
24-Jul-17	0	5,865	28-Aug-17	0	10,406
25-Jul-17	0	5,865	28-Aug-17	235	10,641
26-Jul-17	0	5,865	29-Aug-17	604	11,245
27-Jul-17	0	5,865	30-Aug-17	1,230	12,475
28-Jul-17	0	5,865	31-Aug-17	1,008	13,483
29-Jul-17	335	6,201	1-Sep-17	0	13,483
30-Jul-17	882	7,083	1-Sep-17	754	14,237
31-Jul-17	346	7,429	2-Sep-17	437	14,674
1-Aug-17	466	7,895	3-Sep-17	1,186	15,860
2-Aug-17	0	7,895	4-Sep-17	794	16,654
3-Aug-17	369	8,264	5-Sep-17	977	17,631
4-Aug-17	0	8,264	6-Sep-17	864	18,495
5-Aug-17	0	8,264			

EEM Field Study Implementation Dates

Phase 1 EEM Preliminary Information: Study Areas

- **Mary River Tributary-F (MRTF) receives discharge from the MS-08 discharge and served as focus for biological sampling.**

- **From MRTF confluence, flows 3.3 km to Mary River**



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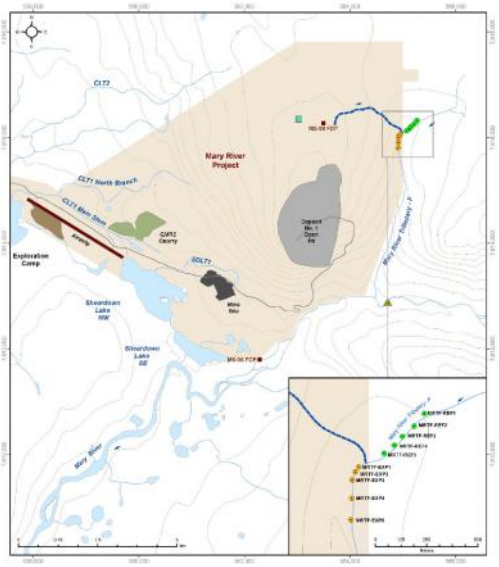
Phase 1 EEM Preliminary Information: Study Areas

- **Benthic invertebrate community sampling conducted at areas upstream (reference) and downstream (mine-exposed) of the MS-08 effluent channel on MRTF.**



Phase 1 EEM Preliminary Information: Study Areas

Habitat Features of MRTF Benthic Study Areas at Time of August 2017 Field Study

Habitat Characteristic		Mary River Tributary-F Reference			Mary River Tributary-F Effluent-Exposed		
		MRTF-REF1	MRTF-REF3	MRTF-REF5	MRTF-EXP1	MRTF-EXP3	MRTF-EXP5
Mean Width (m)	Wetted	4.2	4.1	4.7	7.7	9.6	4.4
	Bankfull	20	20.0	21.0	25.0	25.0	23.0
Mean Depth (cm)	Average	4.80	5.40	5.60	6.83	7.40	13.75
Mean Velocity (m/s)	Average	0.05	0.07	0.07	0.04	0.10	0.10
Stream Morphology	% Pool	10	20	10	40	10	5
	% Rapid	10	5	5	10	10	15
	% Riffle	45	25	85	15	60	50
	% Run	35	50	-	35	20	20
	% Gradient	4.5	5	6	7	5	7
Substrate (% areal coverage)		0% bedrock 55% boulder 40% cobble 5% pebble 0% gravel 0% sand	0% bedrock 35% boulder 50% cobble 10% pebble 5% gravel 0% sand	0% bedrock 25% boulder 65% cobble 10% pebble 0% gravel 0% sand	0% bedrock 30% boulder 60% cobble 10% pebble 0% gravel 0% sand	0% bedrock 20% boulder 65% cobble 10% pebble 5% gravel 0% sand	0% bedrock 45% boulder 45% cobble 10% pebble 0% gravel 0% sand
Aquatic Vegetation (% areal coverage)	Periphyton Description	<0.5 mm thick of attached algae/periphyton on rocks	<0.5 mm thick of attached algae/periphyton on rocks	<0.5 mm thick of attached algae/periphyton on rocks	<0.5 mm thick of attached algae/periphyton on rocks	<0.5 mm thick of attached algae/periphyton on rocks	<0.5 mm thick of attached algae/periphyton on rocks
	Macrophyte Coverage	none observed	none observed	none observed	none observed	none observed	none observed

- Average gradient of 4.8% and 6.3% at reference and effluent-exposed areas.
- Habitat features generally similar between MRTF study areas.

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Phase 1 EEM Preliminary Information: Study Areas

Example of Habitat at Benthic Invertebrate Community Study Areas

Mary River Tributary-F Reference Area

Mary River Tributary-F Effluent-Exposed Area

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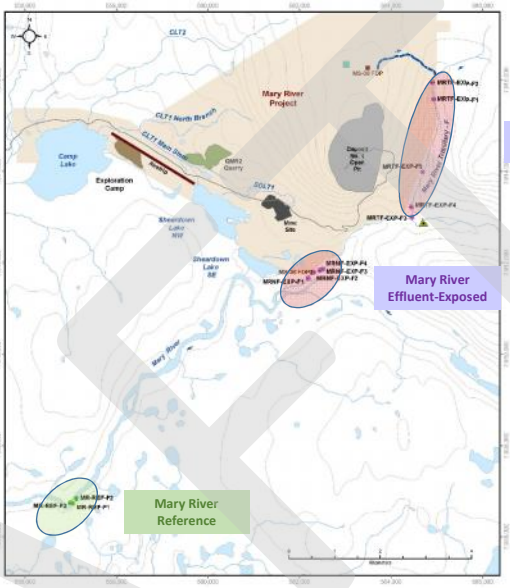
Phase 1 EEM Preliminary Information: Study Areas

- **Fish population sampling conducted within MRTF (no fish present) and at Mary River areas downstream of the MRTF confluence (mine-exposed) and just upstream of Mary Lake (reference).**
- **Mary River side-channel habitat sampled at effluent-exposed area, whereas shoreline habitat of main channel sampled at reference area.**



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Phase 1 EEM Preliminary Information: Study Areas

Example of Habitat at Fish Population Study Areas

Mary River Tributary-F
Effluent-Exposed Area : Fish Barrier

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Phase 1 EEM Preliminary Information: Receiving Water Quality

- ***In situ*** **measures collected at time of August 2017 field study were similar between MRTF benthic study areas.**

Study Area		Station	Date	Temperature (ºC)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	pH (pH units)	Specific Conductance (uS/cm)
Mary River Tributary-F	Reference	MRTF-REF1	25-Aug-16	7.10	11.94	98.7	8.19	209
		MRTF-REF2	25-Aug-16	6.90	12.20	100.4	8.18	207
		MRTF-REF3	25-Aug-16	6.60	12.12	98.9	8.17	208
		MRTF-REF4	25-Aug-16	6.00	12.34	99.3	8.16	209
		MRTF-REF5	25-Aug-16	5.70	12.52	99.0	8.16	209
	Mine-Exposed	MRTF-EXP1	25-Aug-16	5.80	12.23	97.9	8.19	212
		MRTF-EXP2	25-Aug-16	5.70	12.30	98.1	8.18	211
		MRTF-EXP3	25-Aug-16	5.75	12.28	98.0	8.18	215
		MRTF-EXP4	25-Aug-16	5.60	12.25	98.2	8.19	214
		MRTF-EXP5	25-Aug-16	5.90	12.22	97.9	8.18	211

- **Dissolved oxygen concentrations above Canadian Water Quality Guideline (CWQG) for protection of cold-water biota (i.e., 9.5 mg/L).**
- **pH within CWQG limits of 6.0 – 9.5.**

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Introduction | AEMP | EEM Phase 1 | Additional Topics | Conclusion

Phase 1 EEM Preliminary Information: Receiving Water Quality

- **Based on specific conductance measurements collected from MS-08 effluent and at MRTF study areas, estimated effluent concentration at the MRTF effluent-exposed area below the confluence with the effluent channel was 0.17%.**
- **Effluent concentration was consistent with predictions presented in study design that were calculated using effluent volume and pro-rated receiving environment stream flow (range of 0.03 – 1.3%).**
- **Effluent discharge at time of survey was approximately 20% of maximum daily volumes released in 2017 (i.e., maximum daily volume of effluent release may have resulted in effluent concentration of approximately 0.85% under the same receiving environment flows).**

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Phase 1 EEM Preliminary Information: Receiving Water Quality

- **Water quality met CWQG, with many parameters below laboratory MDL at MRTF and Mary River around time of August 2017 field study.**

	Parameters	Units	Water Quality Guideline (WQG)[1]	Mary River Tributary-F		Mary River Upstream			Mary River Downstream				
				MRTF-1	FO-01	G0-03	MS-08-US	G0-01	E0-10	MS-08-DS	E0-03	E0-21	EO-20
				24-Aug-2017	1-Sep-2017	29-Aug-2017	24-Aug-2017	1-Sep-2017	1-Sep-2017	24-Aug-2017	1-Sep-2017	1-Sep-2017	1-Sep-2017
Conventionals	Conductivity (lab)	umho/cm		196	266	132	136	151	157.5	141	164	164	163
	pH (lab)	pH	6.5 - 9.0	8.12	8.22	7.99	8.06	8.08	8.095	8.04	8.06	8.04	7.99
	Hardness (as $CaCO_3$)	mg/L	-	96	134	61	61	70	74	63	77	78	80
	Total Suspended Solids (TSS)	mg/L	-	<2.0	5.2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	9.5
	Total Dissolved Solids (TDS)	mg/L	-	106	136	61	76	74	76	43	71	79	82
	Alkalinity (as $CaCO_3$)	mg/L	-	97	107	59	58	66	69	61	73	69	69
Nutrients and Anions	Total Ammonia	mg/L	variable[2]	0.177	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Nitrate	mg/L	13	0.116	0.134	0.028	<0.020	<0.020	0.035	<0.020	0.062	0.058	0.057
	Total Organic Carbon	mg/L	-	<1.0	1	1.2	1.4	1.1	1.15	1.5	1.1	1.1	1.3
	Total Phosphorus	mg/L	0.020[3]	<0.0030	0.0067	0.006	0.0046	0.0036	0.0038	0.0053	0.0196	0.0037	0.006
	Chloride (Cl)	mg/L	120	1.26	5.37	4.07	3.86	4.61	4.65	3.87	4.68	4.7	4.17
	Sulphate (SO_4)	mg/L	218[3]	2.8	25.3	2.68	2.44	2.93	4.34	2.97	7.53	7.53	6.65
Total Metals	Aluminum (Al)	mg/L	0.100	0.0573	0.187	0.167	0.154	0.0586	0.07085	0.150	0.108	0.0704	0.0716
	Antimony (Sb)	mg/L	0.020[4]	0.00043	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)	mg/L	0.005	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Cadmium (Cd)	mg/L	0.00012	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)	mg/L	-	20.7	26.5	12.6	13.1	13.7	14.9	13.2	15.2	15.7	15.1
	Chromium (Cr)	mg/L	0.0089[4]	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)	mg/L	0.0009[4]	<0.00010	0.00017	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)	mg/L	0.002	<0.0010	0.00096	0.00088	0.001	0.00084	0.00081	<0.0010	0.00094	0.00085	0.00087
	Iron (Fe)	mg/L	0.30	<0.050	0.237	0.105	0.114	0.043	0.0525	0.091	0.098	0.053	0.044
	Lead (Pb)	mg/L	0.001	0.000051	0.000253	0.000105	0.000103	<0.000050	0.0000565	0.000089	0.000099	0.000073	<0.000050
	Magnesium (Mg)	mg/L	-	11.5	16.4	7.22	8.9	8.01	8.87	7.34	9.34	8.94	9.56
	Manganese (Mn)	mg/L	0.935[5]	0.00052	0.00675	0.0013	0.00186	0.000579	0.000985	0.00105	0.00682	0.0051	0.00328
	Mercury (Hg)	mg/L	0.000026	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)	mg/L	0.073	0.000186	0.000255	0.000229	0.00031	0.00027	0.000255	0.000315	0.000495	0.000556	0.000553
	Nickel (Ni)	mg/L	0.025	<0.00050	0.00068	<0.00050	<0.00050	<0.00050	<0.00050	0.0005	<0.00050	0.0005	0.00061
	Potassium (K)	mg/L	-	0.902	1.38	0.98	1.04	0.92	0.965	1.06	1.03	0.98	1.12
	Selenium (Se)	mg/L	0.001	<0.000050	<0.0010	<0.0010	<0.000050	<0.0010	<0.0010	<0.000050	<0.0010	<0.0010	<0.0010
	Silver (Ag)	mg/L	0.00025	<0.000050	<0.000010	<0.000010	<0.000050	<0.000010	<0.000010	<0.000050	<0.000010	<0.000010	<0.000010
	Sodium (Na)	mg/L	-	0.9	1.76	2.04	2.23	2.32	2.28	2.07	2.31	2.26	2.23
	Strontium (Sr)	mg/L	-	0.0108	0.0191	0.0123	0.0125	0.0132	0.0134	0.0133	0.0157	0.0156	0.0144
	Uranium (U)	mg/L	0.015	0.00251	0.00261	0.00222	0.00231	0.00278	0.00276	0.00237	0.00274	0.00266	0.00158
	Vanadium (V)	mg/L	0.006[4]	<0.00050	<0.0010	<0.0010	<0.00050	<0.0010	<0.0010	<0.00050	<0.0010	<0.0010	<0.0010
	Zinc (Zn)	mg/L	0.030	0.0038	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

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Introduction | AEMP | EEM Phase 1 | Additional Topics | Conclusion

Phase 1 EEM Preliminary Information: Receiving Water Quality

- **Aluminum concentrations were above CWQG at MRTF and Mary River downstream appeared related to naturally elevated Total Suspended Solids (TSS).**
- **Primary indication of MS-08 mine effluent in MRTF reflected as higher conductivity, hardness, dissolved solids and nitrate than at applicable reference areas based on August 24th and September 1st sampling events.**

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Phase 1 EEM Preliminary Information: Benthic Invertebrates

- **Benthic invertebrate community (benthic) sampling conducted as described in the study design with the exception that, because water depth at riffle habitat of MRTF was generally less than 10 cm, a Surber sampler was used instead of a Hess sampler.**

Hess Sampler

Surber Sampler

- **Consultation was conducted with ECCC prior to implementation of change of sampling apparatus.**

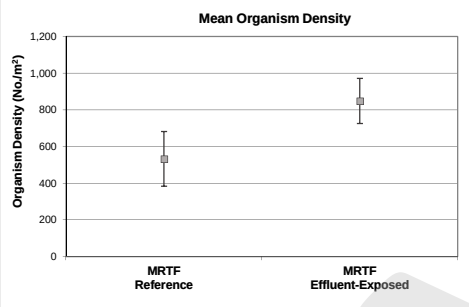
Phase 1 EEM Preliminary Information: Benthic Invertebrates

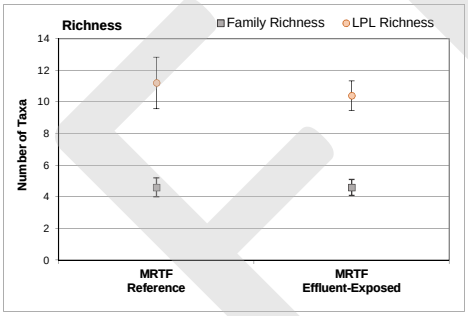
- **Replicate sample characteristics similar between the effluent-exposed and reference benthic sampling areas.**

Study Area	Station	Water Depth (cm)			Water Velocity (m/s)			Substrate Size[a] (cm)			Embeddedness		
		Replicate Grab 1	Replicate Grab 2	Replicate Grab 3	Replicate Grab 1	Replicate Grab 2	Replicate Grab 3	Replicate Grab 1	Replicate Grab 2	Replicate Grab 3	Replicate Grab 1	Replicate Grab 2	Replicate Grab 3
Mary River Tributary-F Reference	MRTF-REF1	6	7	6	0.27	0.25	0.26	6.6	6.4	6.8	0%	38%	13%
	MRTF-REF2	4	4	4	0.28	0.14	0.18	6.6	6.1	6.8	25%	13%	38%
	MRTF-REF3	3	3	3	0.19	0.14	0.15	6.7	6.1	4.9	13%	0%	13%
	MRTF-REF4	4	5	6	0.12	0.19	0.15	6.7	4.1	8.0	0%	25%	25%
	MRTF-REF5	4	4	4	0.13	0.11	0.29	6.2	5.5	5.0	25%	25%	38%
Mary River Tributary-F Effluent-Exposed	MRTF-EXP1	4	4	4	0.11	0.18	0.26	5.6	6.1	4.7	13%	25%	13%
	MRTF-EXP2	6	6	6	0.17	0.23	0.22	5.2	5.7	6.5	0%	25%	50%
	MRTF-EXP3	6	7	7	0.29	0.17	0.13	7.0	6.9	7.0	13%	13%	13%
	MRTF-EXP4	7	7	6	0.30	0.14	0.19	7.8	6.4	6.8	13%	38%	0%
	MRTF-EXP5	8	9	6	0.29	0.23	0.17	6.7	5.9	7.2	13%	25%	25%

Phase 1 EEM Preliminary Information: Benthic Invertebrates

- Initial plots of data suggest higher density of benthic invertebrates at the effluent-exposed area than at the reference area of MRTF.
- However, similar richness between the MRTF study areas.





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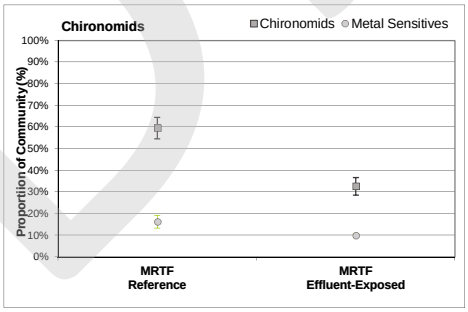
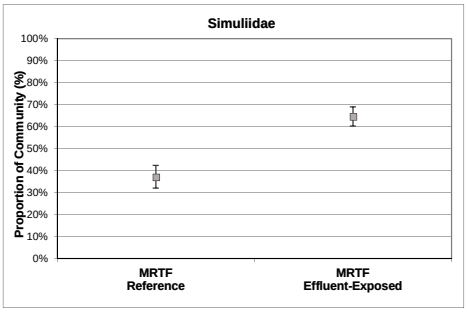
Introduction | AEMP | EEM Phase 1 | Additional Topics | Conclusion

Phase 1 EEM Preliminary Information: Benthic Invertebrates

- Initial plots of data suggest differences in the proportion of dominant groups between MRTF study areas, but similar composition.
- Similar proportion of metal-sensitive taxa between MRTF areas.





- Collectively, suggests only minor differences in benthic features between MRTF areas.

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Phase 1 EEM Preliminary Information: Fish Population

- **Electrofishing conducted on MRTF confirmed absence of Arctic charr (and other fish species) in the watercourse, including near the mouth.**
- **Hypothesized to reflect a combination of:**
  - Complete freezing over the winter;
  - High stream gradient (average of 12% in lower 750 m); and,
  - Natural in-stream barriers (i.e., step-drops ≥ 1 m).
- **Therefore, fish sampling conducted on Mary River as agreed upon with ECCC.**

Introduction | AEMP | EEM Phase 1 | Additional Topics | Conclusion

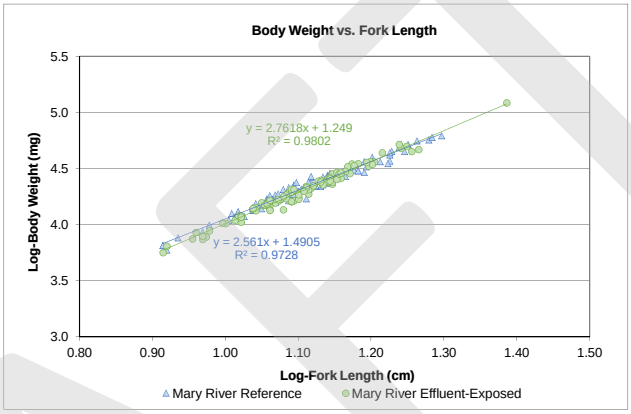
Phase 1 EEM Preliminary Information: Fish Population

- **Mary River electrofishing was successful in capturing the requisite number of Arctic charr juveniles (100) older than young-of-the-year (non-YOY) at both study areas.**

Watercourse	Station ID	Date	Location			Effort (seconds)	Fish Species				Total (all species)	
			Coordinates		Station Length (m)		Arctic Charr		Ninespine Stickleback			
			Easting	Northing			Catch	CPUE	Catch	CPUE	Total Catch	CPUE
Mary River Tributary-F	MRTF-EXP-F1	26-Aug-17	564945	7915557	167	1,254	0	0.00	0	0.00	0	0.00
	MRTF-EXP-F2	26-Aug-17	564913	7915917	193	730	0	0.00	0	0.00	0	0.00
	MRTF-EXP-F3	26-Aug-17	564470	7913003	55	355	0	0.00	0	0.00	0	0.00
	MRTF-EXP-F4	26-Aug-17	564457	7913229	125	866	0	0.00	0	0.00	0	0.00
	MRTF-EXP-F5	26-Aug-17	564702	7913980	138	952	0	0.00	0	0.00	0	0.00
					Total	**1,984**	**0**	**0.00**	**0**	**0.00**	**0**	**0.00**
Mary River Effluent-Exposed	MR-EXP-F1	27-Aug-17	562188	7911661	129	2,086	40	1.15	0	0.00	40	1.15
	MR-EXP-F2	27-Aug-17	562309	7911796	55	481	7	0.87	0	0.00	7	0.87
	MR-EXP-F3	27-Aug-17	562436	7911831	133	1,093	26	1.43	0	0.00	26	1.43
	MR-EXP-F4	27-Aug-17	562501	7911860	71	927	27	1.75	0	0.00	27	1.75
					Total	**4,587**	**100**	**1.30**	**0**	**0.00**	**100**	**1.30**
Mary River Reference	MR-REF-F1	28-Aug-17	557037	7906734	159	1,754	27	0.92	0	0.00	27	0.92
	MR-REF-F2	28-Aug-17	557118	7906835	331	2,794	22	0.47	2	0.04	24	0.52
	MR-REF-F3	28-Aug-17	556991	7906745	218	3,792	56	0.89	1	0.02	57	0.90
					Total	**8,340**	**105**	**0.76**	**3**	**0.02**	**108**	**0.78**

Phase 1 EEM Preliminary Information: Fish Population

- **Relative numbers of Arctic charr captured at the Mary River study areas slightly higher at the effluent-exposed area.**
- **Initial visual assessment of plotted data suggest similar fish condition (weight-at-length relationship) between the effluent-exposed and reference study areas of Mary River.**



Phase 1 EEM Preliminary Information: Schedule for Completion

- **EEM Interpretive Report required to be submitted to Environment and Climate Change Canada (ECCC) on or before January 10th, 2018.**
- **Data applicable to Mary River (i.e., fish population survey) may also be incorporated into the 2017 Core Receiving Environment Monitoring Program (CREMP) report due March 31st, 2018.**

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2017 Freshwater Workshop

Meeting Minutes

Date: November 8 & 9, 2017
Location: Kitikmeot Conference Room - Frobisher Inn - Iqaluit, Nunavut

This document summarizes discussions that occurred during the 2017 Freshwater Workshop chaired by Baffinland Iron Mines Corporation (Baffinland) on Nov. 8 & 9, 2017 in Iqaluit, Nunavut. For details on content presented during the workshop and associated documentation, the reader is referred to the workshop information circular[1] and presentation slides[2]. Slides referenced in this document refer to the finalized workshop presentation slides, dated November 13, 2017.

Workshop participants and represented agencies/parties are outlined in the list below:

In Person Participants

Andrew Vermeer – Baffinland
William Bowden – Baffinland
Christopher Murray – Baffinland
Paul LePage – Minnow Environmental (Baffinland consultant)
Jamie Van Gulck – Arktis Solutions (on behalf of Qikiqtani Inuit Association)
Nick Jewitt– Arktis Solutions (on behalf of QIA)
Sarah Forté – Indigenous and Northern Affairs Canada (INAC)
David Zhong – Indigenous and Northern Affairs Canada (INAC)
Bradley Pirie - Government of Nunavut, Department of Environment (GN)
Karén Kharatyan – Nunavut Water Board (NWB)

Teleconference Participants

Erik Allenn – Environment and Climate Change Canada (ECCC)
Anne Wilson – Environment and Climate Change Canada (ECCC)
Sean Joesph – Nunavut Water Board (NWB)

[1] Baffinland, 2017. 2017 Freshwater Workshop Information Circular. Issued on November 1, 2017
[2] Baffinland, 2017. 2017 Freshwater Workshop Presentation Slides (Day 1 and 2). Issued on November 13, 2017

Summary of 2017 Freshwater Workshop Action Items

Table 1 below outlines the action items agreed upon during workshop discussions.

Table 1 – Summary of 2017 Freshwater Workshop Action Items

Action Item (AI)	Action Required By
Action Item 1 Continue to discuss the Water Compensation Agreement (WCA) and further define any additional monitoring prescribed by the WCA.	Baffinland QIA
Action Item 2 Conduct a gap analysis to determine if the Project's current aquatic effects monitoring programs are sufficient for monitoring the Project's potential effects on aquatic ecosystems.	Baffinland
Action Item 3 Confirm EIS assessment boundaries for the Mine Site and compare to monitoring locations included in the CREMP.	Baffinland
Action Item 4 Include graphs showing the correlation between select metals and turbidity in the 2017 CREMP annual monitoring report.	Baffinland
Action Item 5 Modify the table on slide 81 (Day 1) to show Mary River GO-09 stations as reference/non-exposed water quality monitoring stations. **Note:** The modified table will be included in the resubmitted Revision 2 of the Aquatic Effects Monitoring Plan (AEMP).	Baffinland
Action Item 6 Develop a technical memo for ECCC and INAC to further explain the power analysis and approach (ANOVA, data selection) presented to justify the proposed reduction in number of lake water quality monitoring stations under the CREMP.	Baffinland
Action Item 7 Include a discussion on lake replenishment rates for lakes monitored under the CREMP in the 2017 CREMP monitoring report to address outstanding concerns (INAC) regarding the proposed reduction of lake water quality monitoring stations under the CREMP.	Baffinland
Action Item 8 Provide additional detail in Revision 2 of the AEMP on how stratification will be defined (based on temperature and DO) and determined in the field to ensure consistency among personnel conducting the sampling and among stations/sampling events/studies.	Baffinland
Action Item 9 Further investigate the inclusion of reference data in deriving aquatic effects benchmarks in other aquatic effects studies (i.e. mining projects).	INAC

Action Item (AI)	Action Required By
Action Item 10 Coordinate meeting with participating agencies to further discuss objectives (toxicological vs. tracking of temporal changes) and any proposed changes to the AEMP benchmarks.	Baffinland
Action Item 11 Revise the Surface Water and Aquatic Ecosystems Management Plan (BAF-PH1-830-P16-0026) to further define how the construction based TSS criteria will be applied in the Tote Road Freshet Monitoring Program.	Baffinland
Action Item 12 Provide additional clarity in Baffinland's suite of environmental management and monitoring plans in regards to monitoring conducted during construction works involving surface water management infrastructure.	Baffinland
Action Item 13 Install large sediment traps in 2018 as part of the Lake Sedimentation Monitoring Program in Sheardown Lake NW in order to determine the bulk density of sediment collected.	Baffinland
Action Item 14 Provide Baffinland with contact information for group conducting community based monitoring in Pond Inlet.	INAC
Action Item 15 Review workshop feedback and comments and propose path forward to relevant agencies and regulators for revising the AEMP document (Rev. 2).	Baffinland

Day 1 – November 8, 2017

Introduction

The following section summarizes discussions during the introduction session of the workshop. Refer to the following workshop presentation slides for details on content presented: Day 1 – Slide 2 to 9.

Comment/Question	Response	Slide Reference
Arktis Solutions – Jamie V. The Water Compensation Agreement (WCA) under the Commercial Lease prescribes conditions for freshwater monitoring that should be taken into account for Project monitoring programs.	*Baffinland* The WCA continues to be discussed between the QIA and Baffinland. Additional monitoring requirements under the WCA will need to be defined and will require further discussions between parties (**AI 1**).	Day 1 – Slide 5
INAC – Sarah F. The AEMP includes a Hydrometric Monitoring Program. How is data from this program incorporated into the Environment Effects Monitoring (EEM) Program and where can it be accessed?	*Baffinland* Hydrology data collected under the Hydrometric Monitoring Program is used to inform effluent concentrations in receiving water bodies (i.e. Mary River Trib. F and Mary River). The annual monitoring report for the Hydrometric Monitoring Program is included in the annual report submitted to QIA and the NWB.	Day 1 – Slide 8
Arktis Solutions – Jamie V. Are the targeted studies under the AEMP only for the Mine Site or do they assess aquatic effects across Project sites?	*Baffinland* The AEMP includes targeted studies that focus on the Mine Site (i.e. Lake Sedimentation Monitoring Program) as well as all Project sites (i.e. Dustfall Monitoring Program)	Day 1 – Slide 8
Arktis Solutions – Jamie V. Does the Lake Sedimentation Monitoring Program only occur at the Mine Site?	*Baffinland* Yes. The Lake Sedimentation Monitoring Program only occurs at the Mine Site at Sheardown Lake NW. The FEIS predicted that Sheardown Lake NW would receive the highest inputs of sediment through dust deposits and site runoff in comparison to other local waterbodies near the Project. As such, sedimentation rates observed in Sheardown NW are considered to be representative of a worst case scenario in regards to the Project's potential effects on lake sedimentation rates.	Day 1 – Slide 8

Comment/Question	Response	Slide Reference
Arktis Solutions – Jamie V. Does Revision 2 of the AEMP include changes to monitoring along the Tote Road and Milne Port?	*Baffinland* No. Revision 2 of the AEMP focuses on proposed changes to the Core Receiving Environment Monitoring Program (CREMP).	Day 1 – Slide 8
Arktis Solutions – Jamie V. The QIA believes there is a monitoring gap for aquatic effects at Milne Port and along the Tote Road. The AEMP does not capture all Project sites as it does the Mine Site.	*Baffinland* Noted. Baffinland will conduct a gap analysis to determine if the Project's current aquatic effects monitoring programs are sufficient for monitoring the Project's potential effects on aquatic ecosystems (**AI 2**).	Day 1 – Slide 8 & 9
Arktis Solutions The QIA requests that Baffinland include adequate adaptive management principles in the Tote Road Management Plan, requested by the QIA.	*Baffinland (include. Minnow Env.)* Agreed. As Project management and monitoring plans continue to be developed and updated, plans will be reviewed to ensure clear adaptive management measures and principles are included in the plans to proactively manage environmental impacts and reduce risks to the environment and the likeliness to exceed compliance limits.	N/A

Overview of the Core Receiving Environment Monitoring Program (CREMP) Study Design

The following section summarizes discussions regarding the CREMP study design. Refer to the following workshop presentation slides for details on content presented: Day 1 – Slides 12 to 31.

Comment/Question	Baffinland Response	Slide Reference
Arktis Solutions – Jamie V. What was the assessment boundary for the EIS aquatic effects predictions in regards to extent from the Mine Site?	*Baffinland* The assessment boundaries outlined in the EIS predictions will be confirmed by Baffinland **(AI 3).**	Day 1 – Slide 16
INAC – David Z. What is the average length of sediment cores taken to assess sediment quality in lakes?	*Baffinland* The entire core is approx. 20 cm. Only the top 2 cm are used to assess sediment quality at each monitoring station in lakes.	Day 1 – Slide 24

Overview of Key 2015 and 2016 CREMP Results

The following section summarizes discussions regarding the results reported in the 2015 and 2016 CREMP monitoring reports. Refer to the following workshop presentation slides for details on content presented: Day 1 – Slides 32 to 64.

Comment/Question	Response	Slide Reference
INAC – Sarah F. What years are used to define the construction phase?	*Baffinland* 2014.	Day 1 – Slide 33
INAC – David Z. Are total metals displayed in graphs presented? Are average metal concentrations presented?	*Baffinland* Correct. Total metals are displayed on slide 33. Any parameter concentrations presented with error bars are averages.	Day 1 – Slide 33
ECCC – Anne W. Are dissolved and total metals monitored at water quality monitoring stations?	*Baffinland* Yes. All results (dissolved and total) are presented in the appendices of the CREMP annual monitoring reports.	Day 1 – Slide 34
ECCC – Anne W. Were the elevated metal parameters in particulate form or dissolved?	*Baffinland* Results presented in the slides refer to total metal concentrations. Dissolved metal concentrations were not believed to be elevated above water quality guidelines/ benchmarks, although data would be required to be reviewed to confirm this statement.	Day 1 – Slide 34
Arktis Solutions – Jamie V. How is the natural regional variability mean calculated? Based on size of the region?	*Baffinland* Natural regional variability is captured through sampling at reference streams (three tributaries to Anjark Lake and one tributary to Mary River), Mary River locations upstream of the Project, and at Reference Lake 3. These areas were selected, in part, based on areas outside of, or with minimal influence from, modelled dustfall predictions.	Day 1 – Slide 36
Arktis Solutions – Jamie V. Does Baffinland have a good sense of natural variability in the area of the Mine Site?	*Baffinland* Baffinland has collected a significant amount of baseline data (2006 to 2013) for the CREMP and established reference streams for the CREMP in 2014 to better characterize natural variability. Upstream locations (i.e. Mary River) are also monitored to better understand natural variability in the region. From this perspective, Baffinland feels that natural variability is captured sufficiently for the purposes of the CREMP.	Day 1 – Slide 36

Comment/Question	Response	Slide Reference
Arktis Solutions – Jamie V. How is natural variability defined?	*Baffinland* Multiple factors are considered in determining natural variability. Assessing variability on a spatial (reference area information) and temporal (baseline information) basis allows Baffinland to gain a good understanding of natural variability in the region.	Day 1 – Slide 36
INAC – David Z. Does Baffinland have enough baseline data to understand natural variability?	*Baffinland* Baffinland has collected a significant amount of baseline data (2006 to 2013) for the CREMP in order to characterize natural conditions and variability. However, since no more baseline data can be collected, only the current baseline data set can be used to characterize natural variability in waterbodies located near the Project prior to commercial mine production. It should be noted that the amount of baseline data available varies among monitored water bodies.	Day 1 – Slide 36
Arktis Solutions – Jamie V. Where can agencies access the baseline data?	*Baffinland* Knight Piesold (KP) was retained by Baffinland to conduct the majority of baseline studies. Baseline analysis was conducted by KP in 2014 and can be found in the appendices of the current revision of the AEMP (Rev. 1).	Day 1 – Slide 36
Arktis Solutions – Jamie V. Does the AEMP use the baseline data collected by KP?	*Baffinland* Yes. The baseline data collected by KP is used to assist with the determination of mine-related influences to chemical and biological conditions at aquatic systems as part of the AEMP. In addition, the KP baseline data still form the basis for defining long term trends and for derivation of site-specific AEMP benchmarks (the latter of which may be revisited to consider including reference area data).	Day 1 – Slide 36

Comment/Question	Response	Slide Reference
Arktis Solutions – Jamie V. What is SEL? Why are we comparing sediment quality to probable effects limits (PEL)? Would it not be more protective (conservative) to apply lower effects limits?	*Baffinland* SEL stands for severe effects limit as defined under the Ontario provincial sediment quality guidelines document. PEL is used as a federal guideline defined under the Canadian environmental quality guidelines for sediment. Because provincial and federal sediment quality guidelines have not been developed for the same parameters, the CREMP includes comparisons to SEL and PEL. In cases where SEL and PEL exist for the same parameter, the more conservative value was used. The SEL is defined as the concentration at which 95% of the benthic community are expected to be affected. Because concentrations near or below the SEL/PEL limit can often be observed at applicable reference areas, these limits are considered to be reasonable estimates for concentrations likely to elicit influences on biota.	Day 1 – Slide 38
Arktis Solutions – Jamie V. Are lower effects limits applied for adaptive management purposes? Are adverse effects based on a weight of evidence approach?	*Baffinland* The AEMP benchmarks and adaptive management/response framework is outlined in the AEMP. Yes. Adverse effects is determined by using a weight of evidence approach.	Day 1 – Slide 39
Arktis Solutions – Jamie V. What would be an unacceptable adverse effect?	*Baffinland* At the time of assessment and consistent with EEM under the MMER, if effects are outside critical effects sizes then action by management may be warranted taking a weight-of-evidence approach into account.	Day 1 – Slide 39
Arktis Solutions – Jamie V. Is the adaptive management framework included in Revision 2 of the AEMP?	*Baffinland* Yes.	Day 1 – Slide 39

Comment/Question	Response	Slide Reference
INAC – Sarah F. Is chlorophyll-a representative of phytoplankton?	*Baffinland* Yes. Chlorophyll-a is a commonly used surrogate for phytoplankton abundance.	Day 1 – Slide 40
INAC – David Z. Do you have graphs available showing the positive correlation between concentrations of select metals and turbidity?	*Baffinland* Graphs showing the correlation are not included in the workshop presentation slides or in the CREMP documents. Graphs and/or tables showing the correlations between select metals and turbidity will be included in the 2017 CREMP annual monitoring report (**AI 4**).	Day 1 – Slide 47
INAC – David Z. Why is total iron concentration not presented?	*Baffinland* Iron concentrations were often below laboratory Method Detection Limits (MDL; 0.03 mg/L) in water quality samples, and thus presentation of data for iron were not considered additionally informative.	Day 1 – Slide 47
INAC – David Z. Is phosphorus presented as total or dissolved?	*Baffinland* Total concentrations were presented in slide 49.	Day 1 – Slide 49
ECCC – Erik A. Are mature and non-mature Arctic charr separated out during analysis of fish condition?	*Baffinland* Nearshore sample groups (via electrofishing) include Young-of-Year (YOY) and other non-mature individuals. Of those fish captured in the littoral/profundal areas (via gill netting), only about 30 percent (%) are in spawning condition. Nearshore and littoral/profundal sampling groups are treated as separate groups for the fish condition assessment. All nearshore captured fish are considered non-mature. Because sexes cannot be determined by non-lethal assessment and low numbers of mature fish are sufficiently developed at the time of sampling, no separation of mature and non-mature fish is conducted for the analysis of the littoral/profundal data sets. Standard EEM approach/guidance are used for the analysis, including identification of outliers for the statistical analysis.	Day 1 – Slide 52 & 53

Comment/Question	Response	Slide Reference
ECCC – Anne W. How is turbidity measured? Is it correlated with TSS concentrations?	*Baffinland* Third party (external) laboratory analysis was used to analyze water samples for turbidity. Field based turbidity results were not utilized. Turbidity did not correlate well with TSS, although in part, this reflected the fact that TSS was often below laboratory MDL. In turn, this suggested that particles composing the suspended material were very small and/or exhibit low density.	Day 1 – Slide 55
INAC – David Z. The elevated turbidity on slide 55 is identified as natural. How do you know the elevated turbidity in the Mary River was natural and not related to mining operations?	*Baffinland* During CREMP monitoring sessions, turbidity has been documented to be at its highest at water quality stations upstream of mining operations (reference/non-exposed stations; e.g., GO-09 and GO-03 series stations).	Day 1 – Slide 55
INAC – David Z. Could the natural high turbidity at upstream locations on the Mary River be attributed to dust deposition from mining operations?	*Baffinland* Dustfall would have minor influences on turbidity at upstream Mary River water quality stations. The most likely causes of high turbidity upstream of mining operations are precipitation events in combination with the Mary River's easily erodible river banks made up of glacial till (sand, gravel).	Day 1 – Slide 55
INAC – David Z. Have you separated the water quality data for the Mary River by monitoring season/session in the presentation slides?	*Baffinland* Fall data is primarily presented in the slides and forms the main basis for comparisons given highest concentrations of mine-related parameters have generally been documented during the fall season. However, high turbidity can occur across all seasons. Spring monitoring sessions usually have the highest turbidity due to snow melt and runoff associated with freshet. When comparing data, the evaluation of spatial/temporal effects considers the seasons separately.	Day 1 – Slide 57

Proposed Rationalizations to the CREMP included in Revision 2 of the AEMP

The following section summarizes discussions regarding the proposed rationalizations/changes to the CREMP included in Revision 2 of the AEMP. Refer to the following workshop presentation slides for details on content presented: Day 1 – Slides 67 to 134 and Day 2 – Slides 5 to 13.

ECCC Review and Comments on Revision 2 of the AEMP

ECCC Comment 1 (Refer to Day 1 – Slides 70 to 71)

No comments or questions from workshop participants.

ECCC Comment 2 (Refer to Day 1 – Slides 72 to 77)

Comment/Question	Response	Slide Reference
INAC – Sarah F. Will additional monitoring be incorporated into the AEMP to monitor potential effects from the seepage observed in 2017 originating from the toe of the Waste Rock Stockpile Sedimentation Pond?	*Baffinland* No. Baffinland is working on addressing the observed seepage originating from the toe of the Waste Rock Stockpile Sedimentation Pond. Temporary monitoring locations downstream of the observed seepage may be setup in 2018 to monitor water quality however these monitoring stations would not be included as part of the AEMP.	Day 1 – Slide 77

ECCC Comment 3 (Refer to Day 1 – Slides 78 to 82)

Comment/Question	Response	Slide Reference
INAC – Sarah F. Why are the GO-09 stations listed with the Mary River stations? Are these stations not upstream/reference locations?	*Baffinland* Baffinland will modify the table on slide 81 by identifying the GO-09 stations as reference/ non-exposed water quality monitoring stations (**AI 5**).	Day 1 – Slide 81

Comment/Question	Response	Slide Reference
INAC – David Z. If GO-09 water quality stations are classified as reference/non-exposed water quality monitoring stations, Baffinland may not be able to differentiate between turbidity caused by mine related dust deposition and turbidity from natural sources in the Mary River.	*Baffinland* G0-09 water quality stations are expected to receive minimal dustfall impacts from mine operations according to air quality predictions included in the Project's FEIS. The GO-09 area is located on the fringe of the area predicted to be influenced by mine-related dust deposition. Although GO-09 may not be definitively outside of the area influenced by mine-related dust deposition, dust deposition at this area is likely to be minimal, if at all, providing a strong basis for its inclusion as a reliable reference area.	Day 1 – Slide 81

ECCC Comment 4 (Refer to Day 1 – Slides 83 to 98)

Comment/Question	Baffinland Response	Slide Reference
INAC – David Z. Can you clarify that the number of required samples indicated by the 2014 power analysis conducted by KP is per year and not by season or sampling session?	*Baffinland* Yes. The number of samples required, as indicated by the 2014 power analysis, is on an annual basis.	Day 1 – Slide 86
INAC – David Z. Why is water quality data collected during the spring (on-ice) monitoring session for lakes not included in slide 89?	*Baffinland* Water quality data collected during the spring (on-ice) lake monitoring session was not included because there is the possibility that surface samples (1 metre below ice) may have been influenced by the sampling/augering process (sampling error). For example ice cuttings from augering the hole may have been included in the water sample, resulting in the dilution of metal concentrations. Notably, all data are provided/compared in the CREMP 2015 and 2016 monitoring reports.	Day 1 – Slides 89 & 90
ECCC – Anne W. How would the graphs on slides 89 and 90 (within-lake spatial variability) look if spring (on-ice) water quality data was included?	*Baffinland* Spring (on-ice) lake data may have sampling biases for reasons previously identified that are hard to account for and may confuse overall water quality data interpretations/ assessment.	Day 1 – Slide 90

Comment/Question	Baffinland Response	Slide Reference
ECCC – Anne W. ECCC will have to further assess the presented rationale/approach for reducing the amount of lake water quality monitoring stations. Does the presented approach consider the water chemistry differences between samples taken near the surface and the bottom of monitored lakes?	*Baffinland* KP evaluated surface and bottom water samples separately in their power analysis conducted in 2014. For presented power analysis, only surface samples are used. The presented approach focuses on parameters that are suspected to be related to mining operations and have shown change over time. For parameters that have not shown a trend or change over time, another order of magnitude in sample sizes would be required to detect changes as variability in these data are high.	Day 1 – Slide 98
ECCC – Anne W. In this approach, are the assumptions met for using parametric statistics?	*Baffinland* Data will be evaluated for normality and variance to ensure assumptions for parametric statistical tests are satisfied. In the event that these assumptions cannot be met, even with the use of data transformation, non-parametric statistics will be applied for the discussed approach.	Day 1 – Slide 98
INAC – Sarah F. Can you specify which parameters were used in the power analysis presented?	*Baffinland* For the power analysis presented, Camp Lake aluminum, copper, uranium, molybdenum and manganese concentrations were used.	Day 1 – Slide 98
INAC – David Z. Should there not be more room/contingency for error? Three (3) samples for three (3) stations per lake only allows for 2 additional samples to account for sampling or analytical errors.	*Baffinland* Noted. The presented approach/power analysis has an increased probability of 90% compared to the 2014 power analysis which only had an 80% probability. Because only 6-7 annual samples were determined to be sufficient for the proposed approach, a 'safety' margin of 2-3 samples currently exists under the more stringent probability of 90%. In addition, based on the minimal amount of sampling/analytical errors that have occurred during the CREMP monitoring sessions to date, Baffinland believes the reduction of lake water quality stations is justified.	Day 1 – Slide 98

Comment/Question	Baffinland Response	Slide Reference
INAC – David Z. Spatial variability in water chemistry of monitored lakes may need to be better understood. Baffinland only has 3 years of data which may not allow for an adequate understanding of natural variability.	*Baffinland* Baffinland believes it has a sufficient amount data to justify the reduction of water quality stations in monitored lakes under the CREMP. Lakes monitored in the CREMP are generally well mixed and have shown limited variability in water chemistry throughout each year. To date Baffinland has produced a full data set each year for every lake monitored in the CREMP on top of the data collected during the baseline studies. Four (4) water quality monitoring locations are proposed for Mary Lake to account for the fact that the two main inlets to the lake have distinctly differing chemistry, resulting in higher variability in the lake's chemistry.	Day 1 – Slide 98
Arktis Solutions – Jamie V. Based on the last 3 years of lake water quality data collected under the CREMP, how many samples came back with analytical error or information that may have compromised the data quality? Analysis of these variables against the 2 sample safety factor may be useful to support the argument that additional 2 samples is protective and an adequate safety margin.	*Baffinland* Baffinland would have to confirm sampling and/or analytical errors for the CREMP dataset. Data quality analysis is provided as Appendix A of each CREMP annual monitoring report. The high quality of data collected to date is demonstrated by the fact that no outliers and/or data points were suspected of being compromised due to sampling or analytical error and removed in conducting the presented power analysis.	Day 1 – Slide 98
Arktis Solutions – Nick J. Some of the slides presented in this section were not included in the information circular? Will these new slides be provided to workshop participants after the workshop?	*Baffinland* Some additional slides were added to this section of the presentation to better communicate the new power analysis and approach. All slides will be provided to workshop participants following the workshop.	Day 1 – Slide 98
INAC – Sarah F. INAC will have to further review the presented approach to better understand how the reduced amount of lake water quality stations will account for seasonality in lake water chemistry.	*Baffinland* Noted.	Day 1- Slide 98

Comment/Question	Baffinland Response	Slide Reference
Arktis Solutions – Jamie V. It may be required to compare CREMP monitoring locations to the assessment boundaries of the region and how that relates back to the Water Compensation Agreement (WCA). Original sampling locations for CREMP may not have taken into account the WCA.	*Baffinland* Noted. Baffinland looks forward to discussing the WCA with the QIA in further detail. The assessment boundaries outlined in the EIS predictions will be confirmed by Baffinland **(AI 1 & 3).**	Day 1- Slide 98
ECCC – Anne W. *INAC – Sarah F.* A technical memo outlining Minnow's approach (ANOVA) for reducing the number of lake water quality monitoring stations would be helpful to better understand the rationale.	*Baffinland* Noted. Baffinland will put together a technical memo to further explain the power analysis and approach (ANOVA, data selection) presented. (**AI 6**)	Day 1- Slide 98

ECCC Comment 5 (Refer to Day 1 – Slides 99 to 108)

Comment/Question	Baffinland Response	Slide Reference
INAC – Sarah F. What is the distance between stream water quality monitoring stations L1-09 and L1-05?	*Baffinland* Approx. 300 to 400 metres.	Day 1 – Slide 104
ECCC – Anne W. Removing L1-09 may limit the CREMP's ability to discern water quality impacts from dustfall.	*Baffinland* Stream water quality monitoring stations L1-05 and L1-09 are in the same general area and would experience similar levels of dustfall. In removing L1-09, upstream monitoring stations L1-01 and L1-02 would still be in place to monitor any effects on water quality.	Day 1 – Slide 104
INAC – David Z. From a cost/benefit perspective, are there significant savings to warrant the discontinuation of L1-09 given the importance of this tributary to Camp Lake and the potential effects of dust deposition?	*Baffinland* Water chemistry is consistent between L1-09 and L1-05 with no confluences (no dilution) present between stations. Baffinland is of the opinion that there is limited benefit in continuing L1-09 as L1-05 is expected to receive similar amounts of dustfall and is able to characterize water quality in that region of the tributary.	Day 1 – Slide 104

Comment/Question	Baffinland Response	Slide Reference
Arktis Solutions – Jamie V. Arktis would recommend keeping L1-09 if it would allow for a better understanding of the effects of dustfall on the tributary.	*Baffinland* Baffinland believes station L1-09 does not provide any additional information that L1-05 doesn't already provide.	Day 1 – Slide 104
ECCC – Erik A. Are there any differences between D1-05 and D1-00 in regards to water quality?	*Baffinland* There is some variation in water quality between stations however no clear trend.	Day 1 – Slide 105
Arktis Solutions – Jamie V. There may be a benefit in assessing water quality stations D1-05 and D1-00 to determine if data collected at these stations could be used to support other monitoring programs.	*Baffinland* Baffinland is of the opinion that having both stations is redundant and that D1-05 doesn't provide any additional information.	Day 1 – Slide 105
ECCC – Anne W. Would removing water quality monitoring station C0-01 on the Mary River affect the CREMP's ability of conducting a gradient assessment given C0-01 is downstream of effluent discharge locations (treated sewage, MMER)?	*Baffinland* Because there are no main confluences (sources of dilution) between C0-05 and C0-01, it would be expected that there would be no change in water quality between stations. There are six (6) water quality stations on the Mary River downstream of the MS-08 final discharge point, removing one station shouldn't impede the CREMP's ability to determine any gradients present on the Mary River.	Day 1 – Slide 106
Arktis Solutions – Nick J. Are there water quality monitoring stations downstream of C0-01?	*Baffinland* Yes. There are multiple water quality monitoring stations in the south basin of Mary Lake, downstream of C0-01.	Day 1 – Slide 106

ECCC Comment 6 (Refer to Day 1 – Slides 109 to 112)

Comment/Question	Baffinland Response	Slide Reference
ECCC – Anne W. ECCC sees validity with the proposed approach and rationale. What were the particle size distributions for the stream sediment quality samples collected during 2017?	*Baffinland* No grain size analysis completed to date. On a qualitative basis, the majority of samples were medium to coarse sand.	Day 1 – Slide 112
ECCC – Anne W. ECCC would like to see the analytical data for sediment quality samples collected in 2017 prior to supporting the reduction or	*Baffinland* Noted. Data will be provided in the 2017 CREMP monitoring report.	Day 1 – Slide 112

Comment/Question	Baffinland Response	Slide Reference
elimination of sediment quality samples in lotic environments.		

ECCC Comment 7 (Refer to Day 1 – Slides 113 to 115)

Comment/Question	Baffinland Response	Slide Reference
ECCC – Erik A. The rationale for the 100 fish requirement for fish surveys under MMER is to obtain adequate resolution for characterizing length frequency distribution, fish condition and the proportion of Young-of-Year (YOY) in the population.	*Baffinland* Baffinland is proposing to reduce the required sample size to 50 fish for the non-lethal fish survey for adult Arctic charr, using gill nets, in monitored lakes under the CREMP. This is supported by power analysis conducted for all four lake systems in each of the 2015 and 2016 studies that indicated that 20 – 30 fish were typically sufficient to determine differences in condition of ±10% with α and β set equally at 0.1 relative to baseline data sets. As such, the proposed change in sample size will not change the CREMP's ability to assess fish condition in monitored lakes. Incidental mortalities that occur during non-lethal lake survey (gill nets) are analyzed to determine age and sex, however given the resulting small sample size from the reference area, no additional statistical analysis of these data are conducted. Baffinland has reduced the length of time gill nets are set in an attempt to reduce the amount of incidental mortalities.	
ECCC – Erik A. ECCC agrees with the rational for the reduction in sample size for the non-lethal fish survey for adult Arctic charr in lakes monitored under the CREMP given that only one endpoint (fish condition) is being monitored.	*Baffinland* Noted.	

ECCC Comment 8 (Refer to Day 1 – Slides 116 to 118)

No comments or questions from workshop participants.

ECCC Comment 9 (Refer to Day 1 – Slides 119 to 120)

No comments or questions from workshop participants.

INAC Comments and Baffinland Responses

INAC Comment 1 (Refer to Day 1 – Slides 122 to 123)

Comment/Question	Response	Slide Reference
INAC - Sarah F. INAC would want to see an assessment of lake replenishment rates before supporting the proposed reduction in lake water quality stations under the CREMP.	*Baffinland* Understood. Baffinland will provide replenishment rates for lakes monitored under the CREMP in the 2017 CREMP monitoring report. The replenishment rates will be determined using existing lake bathymetry measures and data from hydrometric stations (**AI 7**).	Day 1 – Slide 123

INAC Comment 2 (Refer to Day 1 – Slides 124 to 134)

Comment/Question	Response	Slide Reference
INAC – David Z. Is in-situ pH measured as part of the water column profiles conducted at lakes monitored under the CREMP? If so, is there usually a pH gradient present in monitored lakes?	*Baffinland* Yes, in-situ pH is measured in the water column profiles. pH gradients observed in monitored lakes are minor and usually consists of a pH change between water column top and bottom of 0.5 to 1 pH units.	Day 1 – Slide 129
INAC – Sarah F. Baffinland states that the formal definition of stratification is 1° C change per metre of water column (Wetzel, 2001). Will there be a more conservative approach for defining stratification and determining the need for top and bottom sampling in lakes under the CREMP given the weak gradients observed in 2011 and 2016? Will this definition be included in sampling protocols and be simple enough that field personnel could easily make determinations on the type of samples necessary (mid-column or top and bottom)?	*Baffinland* Baffinland will provide additional detail in Revision 2 of the AEMP on how stratification will be defined (based on temperature and DO) and ultimately determined in the field to ensure consistency among personnel conducting the sampling and among stations/sampling events/studies (**AI 8**).	Day 1 – Slide 134

Day 2 – November 9, 2017

INAC Comments and Baffinland Responses cont'd

INAC Comment 3 (Refer to Day 2 - Slides 6 to 7)

No comments or questions from workshop participants.

INAC Comment 4 (Refer to Day 2 – Slides 8 to 11)

Comment/Question	Response	Slide Reference
INAC – Sarah F. There are biological differences (lake productivity) between Reference Lake 3 and the monitored lakes near the Mary River Mine Site. Based on that fact, is Reference Lake 3 a representative reference lake and should consideration be given to identifying other reference lakes?	*Baffinland* Reference Lake 3 sediment and water quality data are relevant for comparisons with monitored lakes near the Mary River Mine Site. Baffinland conducted a number of reconnaissance surveys during the baseline period to identify a suitable reference lake and of these, due to a number of variables that included abiotic (physical), chemical and biological features, determined that Reference Lake 3 was the best reference area available from the suite of surveyed waterbodies.	Day 2 – Slide 11
Baffinland Would INAC be open to incorporating Reference Lake 3 data into the data set used to determine AEMP benchmarks for sediment quality?	*INAC – Sarah F.* INAC would have to further investigate this approach (inclusion of reference data in dataset used to derive benchmarks) to determine if the approach has been used in monitoring programs for other mining projects before supporting the use of reference lake information for deriving new benchmarks applicable to the Mary River Project (**AI 9**).	Day 2 – Slide 11
Baffinland Would workshop participants be supportive of basing AEMP water quality benchmarks for metals using dissolved metals (bioavailable fraction) concentrations instead of the current approach (total metals)?	*ECCC – Anne W.* ECCC strongly suggests that the current approach (total metals) be maintained due to the fact that metals bioavailability can vary with changes in water chemistry and the fact that existing water quality benchmarks are typically applicable to total metal concentrations.	Day 2 – Slide 11

Comment/Question	Response	Slide Reference
Arktis Solutions – Jamie V. Arktis is aware of other projects that incorporate background (reference) data into action level benchmarks and is in favor of functional benchmarks that would require management action/response.	*Baffinland* Noted.	Day 2 – Slide 11
INAC – Sarah F. Current sediment and water quality benchmarks for the CREMP are lake specific. Is Baffinland proposing that a single benchmark for all monitored lakes be developed in contrast to the current approach?	*Baffinland* If Reference Lake 3 data was used in deriving sediment quality benchmarks, benchmarks could be derived on lake to lake basis or Project wide. Baffinland welcomes further discussion on this topic as it believes additional clarity on the overall objectives of the AEMP benchmarks (toxicological vs. determination of temporal chemistry changes) needs to be determined.	Day 2 – Slide 11
INAC – Sarah F. *Arktis Solutions – Jamie V.* We agree that further discussions are necessary on functional CREMP water and sediment quality benchmarks.	*Baffinland* Noted. Baffinland will review current AEMP benchmarks and contact represented agencies to advance discussions on the topic at a later date (**AI 10**).	Day 2 – Slide 11

INAC Comment 5 (Refer to Day 2 – Slides 12 to 13)

No comments from workshop participants.

Remaining Minnow Recommendations for CREMP

The following section summarizes the workshop discussions on the proposed changes to the CREMP that ECCC and/or INAC did not provide comments on in their review of Revision 2 of the AEMP, submitted to the NWB on April 11, 2016. Proposed recommendations are identified as outlined in Minnow's Letter to Baffinland.[3]

Minnow Recommendation 2 & 3 (Refer to Day 2 – Slide 15)

No comments or questions from workshop participants.

[3] Minnow Environmental, 2016. Mary River Project CREMP Recommendations for Future Monitoring. Submitted to Baffinland on March 17, 2016.

Minnow Recommendation 8 (Refer to Day 2 – Slides 16 to 17)

Comment/Question	Response	Slide Reference
ECCC – Anne W. Would a single sample be taken at these lake water quality stations or would water samples be collected at the top and bottom of the water column?	*Baffinland* If stratification is observed at these stations (definition of stratification to be further refined), then water samples would be collected near the top and bottom at these lakes stations. If stratification was not detected, a single water sample would be collected at mid-depth.	Day 2 – Slide 17
INAC – David Z. What parameters would be used to determine stratification?	*Baffinland* Temperature would be the main parameter used to determine the presence of stratification in lakes. However, dissolved oxygen concentrations would also be examined to support the analysis of top and bottom water quality sampling in lakes.	Day 2 – Slide 17
Minnow – Paul L. If stratification is determined to exist at a monitored lake, top and bottom water quality samples would be taken at all of the lake's monitoring stations with depths below the determined epilimnion. For the lake's monitoring stations that are not deeper than the determined epilimnion (shallow stations), a single water quality sample would be collected at mid-depth.	-	Day 2 – Slide 17
INAC – David Z. *INAC – Sarah F.* Would in-situ water chemistry data be collected at the sampling depth for all lake water quality samples?	*Baffinland* Yes. In-situ water quality data, using a multimeter, will be recorded at the depth at which the water quality sample is collected.	Day 2 – Slide 17

Minnow Recommendation 11 (Refer to Day 2 – Slide 18)

No comments and questions from workshop participants.

Minnow Recommendation 12 (Refer to Day 2 – Slide 19)

No comments and questions from workshop participants.

Minnow Recommendation 13 (Refer to Day 2 – Slide 20)

No comments and questions from workshop participants.

Minnow Recommendation 15 (Refer to Day 2 – Slides 21 to 22)

Comment/Question	Response	Slide Reference
INAC – David Z. INAC agrees with the presented rationale for the revised littoral benthic invertebrate sampling. However, because there are differences in benthic communities between profundal and littoral areas, shouldn't at least one profundal monitoring station be maintained to monitor current differences in benthic communities? The selected profundal station that is maintained could also be used to monitor long term trends and effects.	*Baffinland* Acknowledged. However, maintaining one station in the profundal area of lakes would not be sufficient to determine statistical differences between profundal and littoral benthic communities in lakes. Due to the increased density and richness of benthic communities in littoral areas, as well as the presence of more sensitive taxa, it is expected that mine related effects would be observed in the benthic communities of littoral areas before effects would be observed in profundal benthic communities.	Day 2 – Slide 22
INAC – Sarah F. Would the removal of the profundal benthic community monitoring stations reduce the overall number of benthic samples per lake? Would the profundal sampling stations removed be replaced by new littoral stations?	*Baffinland* Yes, the total number of lake stations would be reduced by removal of the profundal stations (from 50 to 26 in total). However, due to natural influences of depth on benthic invertebrate communities, samples collected from the profundal area are not useful for evaluating mine-related influences and thus do not add information. Therefore the removal of profundal stations does not limit the interpretation of mine-related influences nor the objectives of the AEMP. The proposed littoral sampling design (five stations per lake) is based on the approach used for EEM studies under the MMER, and thus has a solid scientific backing.	Day 2 – Slide 22

Minnow Recommendation 16 (Refer to Day 2 – Slide 23)

Comment/Question	Response	Slide Reference
INAC – David Z. Are lake water quality monitoring stations harmonized with the sediment and benthic community monitoring stations?	*Baffinland* Lake water quality stations under the existing CREMP are in slightly different locations than the sediment quality and benthic community	Day 2 – Slide 23

Comment/Question	Response	Slide Reference
If not, is it possible to harmonize a single water quality station for each lake with the sediment and benthic community stations?	Baffinland would have to confirm exact locations however there is already some harmonization that currently exists within the current CREMP. To support the interpretation of sediment quality and benthic community data, in-situ water quality data will continue to be collected near the water-sediment interface at each sediment and benthic community monitoring station. Note that such a design is not necessary given low within-lake spatial variability in water chemistry among stations (i.e., lakes are typically well mixed)	
INAC – David Z. Are benthic and sediment quality samples taken within days of each other?	*Baffinland* In general, yes. Ideally, benthic community and sediment quality samples are collected on the same day.	

Minnow Recommendation 17 (Refer to Day 2 – Slides 24 & 25)

Comment/Question	Response	Slide Reference
ECCC – Anne W. Will the current approach of selecting the Mary Lake profundal sediment quality stations closest to the mouth of the Mary River reduce some of the variability between profundal sediment quality stations?	In general, there is naturally high variability in lake sediment quality and therefore the presented approach would not be expected to reduce the observed variability in profundal sediment quality.	Day 2 – Slide 25
ECCC – Anne W. By restructuring and reducing the number of profundal sediment quality monitoring stations, will the revised CREMP lose the ability to determine and characterize potential effects?	No. Baffinland believes the proposed restructured sediment quality monitoring program will be able to effectively assess potential effects from mine operations.	Day 2 – Slide 25

Minnow Recommendation 19 (Refer to Day 2 – Slide 26)

No comments or questions from workshop participants.

Environmental Effects Monitoring (EEM) Phase I Study Design

The following session summarizes workshop discussions regarding the current EEM Phase 1 Study Design and action items outlined in ECCC's review of the proposed monitoring program in 2016. Refer to the following workshop presentation slides for details on content presented: Day 2 – Slides 30 to 77.

Comment/Question	Response	Slide Reference
Arktis Solutions – Nick J. Why wasn't this study design submitted to QIA for review? All environmental monitoring programs are to be submitted to the QIA for review under the Commercial Lease.	*Baffinland* Understood. Baffinland employees attending the workshop cannot comment on why it wasn't submitted to the QIA as they were not involved with the plan's submission to regulators and stakeholders. The draft version of the study design was included in Revision 1 of the AEMP.	Day 2 – Slide 34

ECCC Action Item 1 to 6 (Refer to Day 2 Slides 51 to 59)

No comments or questions from workshop participants.

ECCC Action item 7 (Refer to Day 2 – Slides 60 to 64)

Comment/Question	Response	Slide Reference
ECCC – Erik A. Is it possible to conduct the EEM exposure area fish survey at the confluence of the Mary River and Mary River Tributary F?	Conducting the fish survey at the confluence presents safety concerns for personnel conducting in-stream work related to relatively deep and fast moving water and large boulder substrate at that location. These conditions make walking along/within the river treacherous, especially considering that personnel conducting fish sampling are required to carry sampling equipment (e.g., backpack electrofisher, pails). Given the cool to cold-water conditions and remote access to this sampling location at the site (foot access only down steep gradient; haul road clearance required) and the area in general (high Arctic with closest hospital services likely 6 - 8 hours away at best), risks to personnel safety associated with sampling of this area are considered very high.	Day 2 – Slide 64

ECCC Action Items 8 to 13 (Refer to Day 2 – Slides 65 to 73)

No comments or questions from workshop participants.

ECCC Action item 14 (Refer to Day 2 – Slide 74)

Comment/Question	Response	Slide Reference
ECCC – Erik A. Are there separate pipelines to discharge treated sewage effluent and effluent from the Crusher Pad Sedimentation Pond (MS-06) to the Mary River?	No. Both effluent types are discharged through the same pipeline.	Day 2 – Slide 74

ECCC Action Item 15 (Refer to Day 2 - Slide 75)

No comments or questions from workshop participants.

ECCC Other Item 22 (Refer to Day 2 – Slide 76)

No comments or questions from workshop participants.

Environmental Effects Monitoring (EEM) - Preliminary Results for 2017 Field Program

The following session summarizes workshop discussions regarding the preliminary data collected during the 2017 field program for the EEM required by the MMER. Refer to the following workshop presentation slides for details on content presented: Day 2 – Slides 78 to 98.

Comment/Question	Response	Slide Reference
INAC – Sarah F. Where is the MS-06 effluent discharge location relative to the exposure area for the EEM program?	*Baffinland* The exposure area for the EEM fish survey is conducted near the MS-06 effluent discharge location (refer to map on slide 85). Effluent from the Crusher Pad Sedimentation Pond (MS-06) is intermittently discharged on an infrequent basis during the summer months in small volumes. Existing Mary River water quality monitoring stations under the CREMP can be utilized to monitor water quality downstream of MS-06 discharges.	Day 2 – Slide 85
ECCC – Erik A. ECCC appreciates the EEM program overview. Also, ECCC has a new electronic reporting system for the submission of EEM interpretive reports called EEMER.	*Baffinland* Noted.	Day 2 – Slide 99

Comment/Question	Response	Slide Reference
ECCC – Erik A. Are effluent discharges from MMER regulated facilities at the Project anticipated be significantly greater in future years? Will the west sedimentation pond (MS-10) be discharged in future years to other receiving water bodies (besides the Mary River)?	*Baffinland* Volumes of effluent discharged under MMER may increase in future years. Volumes discharged under MMER are primarily dependent on annual precipitation at the Mary River Mine Site. There are no current plans to construct the west sedimentation pond for the Waste Rock Stockpile Facility.	Day 2 – Slide 99

Additional Freshwater Topics

The following section summarizes workshop discussions regarding the following additional freshwater monitoring topics discussed during the workshop.

- Sedimentation Monitoring Programs
    - Freshet Specific Monitoring
        - Tote Road
        - Mine Site
    - Lake Sedimentation Monitoring Program (component study of AEMP)
- Waste Rock Stockpile Facility
    - Summary of key 2017 events
    - Corrective actions taken to date
    - Current status of investigation
- Tote Road Freshwater Monitoring Programs
- Community Based Monitoring and Traditional Knowledge
- Future Freshwater Monitoring Discussion Forums

Refer to the workshop presentation slides for details on content presented.

Sedimentation Monitoring Programs (Refer to Day 2 – Slides 101 to 112)

Comment/Question	Response	Slide Reference
Arktis Solutions – Jamie V. Baffinland plans to expand the existing Crusher Pad Sedimentation Pond. What water quality criteria for TSS would be used to monitor runoff coming from the construction area associated with the expansion?	*Baffinland* Baffinland plans on using the construction water quality criteria as outlined in the Type A Water Licence (Part D, Item 15).	N/A

Comment/Question	Response	Slide Reference
INAC – Sarah F. Were the water quality results for the Freshet Monitoring Program at the Mine Site included in the 2016 QIA/NWB Annual Report for Operations?	*Baffinland* Yes. The results were included in the biweekly reports and completion report, required under the Fisheries Act Direction. The biweekly reports and completion report were included in Appendix D of the 2016 QIA/NWB Annual Report for Operations.	Day 2 – Slide 102
Arktis Solutions – Jamie V. Is the INAC Inspector notified when exceedances of the water licence criteria (water quality) occur?	*Baffinland* Yes. Exceedances are reported in the monthly monitoring reports required by Baffinland's Type A Water Licence. Spill reports are also submitted to the NT/NU Spill Line depending on the severity of the exceedance/event. INAC, the NWB, and the QIA are cc'd on all spill reports submitted by Baffinland.	N/A
Arktis Solutions – Jamie V. It is recommended that the QIA be notified if exceedances of the water licence criteria occur.	*Baffinland* Noted. Baffinland follows the reporting requirements outlined in Baffinland's water licences issued by the NWB.	N/A
Arktis Solutions – Nick J. For the Tote Road Freshet Monitoring Program, how are suspected exceedances of TSS determined by visual inspection?	*Baffinland* Suspected TSS exceedances by visual inspections are dependent on past experience and professional judgement. The use of in field turbidity meters is being considered (suggested by ECCC and INAC during workshop discussions).	Day 2 – Slide 107
Arktis Solutions – Nick J. If TSS is confirmed to be above the appropriate TSS criteria at a location, is follow up sampling conducted?	*Baffinland* Yes. If TSS exceeds criteria at a location, follow up samples are taken every five (5) days until TSS levels fall below the appropriate TSS criteria.	Day 2 – Slide 107
Arktis Solutions – Nick J. Does general construction activities, outside of freshet, trigger additional sampling?	*Baffinland* In-water construction works (i.e. culvert replacement) triggers additional sampling downstream of the construction site. Construction works associated with surface water management infrastructure is usually planned in the winter to mitigate risks associated with sedimentation.	Day 2 – Slide 107

Comment/Question	Response	Slide Reference
Arktis Solutions – Jamie V. The term "construction" and when the construction TSS criteria would be applied in the Tote Road Freshet Monitoring Program needs to be better defined.	*Baffinland* Noted. Baffinland will revise the Project's Surface Water and Aquatic Ecosystems Management Plan (BAF-PH1-830-P16-0026) to further define how the construction based TSS criteria will be applied in the Tote Road Freshet Monitoring Program (**AI 11**).	Day 2 – Slide 107
Arktis Solutions – Jamie V. Why is the water licence criteria for surface water runoff during construction not used in the Tote Road Freshet Monitoring Program?	*Baffinland* Baffinland has taken a more conservative approach and uses 30 mg/L for monitoring TSS at Tote Road water bodies that may be affected by construction activities.	Day 2 – Slide 107
Minnow – Paul LePage (Baffinland) It may be useful to discuss how much of a TSS change between upstream and downstream samples at a Tote Road culvert location would trigger the need for mitigative actions to be taken.	*Baffinland* Noted. Baffinland will take this suggestion into consideration.	Day 2 – Slide 107
Arktis Solutions – Jamie V. Arktis is aware of other projects where the upstream/downstream approach is applied to determine and trigger mitigation or corrective actions for water quality concerns. Arktis suggests that Baffinland request a change be made to the water licence TSS criteria for surface water runoff during freshet if water quality monitoring data continues to show the presence of naturally elevated TSS levels that are above the water licence TSS criteria.	*Baffinland* Noted. Baffinland will take this suggestion into consideration.	Day 2 – Slide 107
Arktis Solutions – Jamie V. Are there post-construction, performance monitoring programs for culverts modified or replaced during frozen conditions (winter months)?	*Baffinland* Currently, there is not a formalized monitoring program. Baffinland will consider formulating a post-construction monitoring program to assess the performance of changes to Project surface water management infrastructure.	N/A

Comment/Question	Response	Slide Reference
Arktis Solutions – Jamie V. Arktis would be interested in gaining a better understanding of the monitoring conducted for construction works that involve changes to surface water management infrastructure implemented during open water and frozen conditions.	*Baffinland* Noted. Baffinland will revise its suite of management plans to clarify current monitoring practices (**AI 12**).	N/A
ECCC – Anne W. Does Baffinland put in place sedimentation mitigation measures for sedimentation events that are deemed natural?	*Baffinland* Baffinland does not respond to natural sedimentation events.	Day 2 – Slide 108
Arktis Solutions – Nick J. Does Baffinland plan on developing a roads management plan/guide? Is there any timeline for the development of this plan/guide?	*Baffinland* Baffinland is currently updating its Roads Management Plan (BAF-PH1-830-P16-0023). The revised plan will be submitted to the relevant agencies once finalized internally by Baffinland.	N/A
Arktis Solutions – Jamie V. If year over year water quality monitoring results at specific culverts along the Tote Road demonstrate ongoing sedimentation concerns, what are the required actions?	*Baffinland* Baffinland continues to assess and address concerns associated with the surface water management infrastructure along the Tote Road. In the event that reoccurring sedimentation concerns are observed at a specific area of the Tote Road, Baffinland would assess the area and determine the appropriate corrective actions. Typical corrective actions for sedimentation concerns include; culvert replacements, road embankment reinforcement and regrading surface water drainage infrastructure.	Day 2 – Slide 108

Waste Rock Stockpile Facility (Refer to Day 2 – Slides 113 to 129)

Comment/Question	Response	Slide Reference
NWB – Karen K. What is the capacity of the current Waste Rock Stockpile Facility's sedimentation pond and for how long can it contain the Facility's surface water runoff?	*Baffinland* The pond's capacity is 9,200 m^3. The pond is discharged intermittently throughout the summer, starting in late June. The pond's design capacity is based on a design storm event (maximum flow) derived from regional meteorological data and the time required to settle sediments from inflowing runoff.	Day 2 – Slide 115
Arktis Solutions – Nick J. QIA would like to note Baffinland has yet to respond to their information request regarding the Waste Rock Stock Facility. QIA is also concerned that their ongoing investigation was not mentioned in the workshop presentation slides.	*Baffinland* Baffinland asks that QIA resubmit the information request and Baffinland will provide a response. **Note:** Baffinland provided a response to QIA on December 1, 2017.	N/A
INAC – David Z. How long did it take to observe the rhodamine dye down gradient of the Waste Rock Stockpile Facility's sedimentation pond?	*Baffinland* The duration between the application of rhodamine dye in the pond and the detection of the dye downstream of the Facility would need to be confirmed.	Day 2 – Slide 118
INAC – Sarah F. Was the rhodamine dye added to the sedimentation pond following the repair of the liner key-in?	*Baffinland* Yes.	Day 2 – Slide 118
INAC – David Z. The sedimentation pond is only designed for sedimentation and not containment. To manage the design storm event, the water volume in the pond has to be below approx. thirty (30) percent of the pond's capacity.	*Baffinland* The pond associated with the Waste Rock Facility is a sedimentation pond and requires to be actively discharged throughout the summer months to ensure there is enough capacity for the design storm event.	N/A

Comment/Question	Response	Slide Reference
INAC – David Z. INAC is concerned about the source of the acid rock drainage (ARD). Predictions for the first five (5) years of operations indicated no potential acid generating (PAG) rock would be encountered. Has Baffinland encountered PAG rock in the last three (3) years? Does Baffinland know how much PAG rock has been produced and where they are in the waste rock pile?	*Baffinland* Yes. PAG has been encountered during the first three (3) years of ERP operations. As outlined in the Phase 1 Waste Rock Management Plan, PAG was predicted to be encountered in the first five (5) years of operations. However, predictions for the waste rock stockpile expected minimal ARD in the first five (5) years of operations. Baffinland participants of the workshop would have to confirm with the Mine Operations the amount of PAG generated to date and its placement at the Waste Rock Facility.	N/A
Arktis Solutions – Nick J. Has Baffinland conducted testing to determine if the PAG rock is properly segregated?	*Baffinland* Baffinland representatives in attendance cannot comment on waste rock segregation practices. Baffinland would have to confirm the status of monitoring and testing undertaken to date with the Project's Mine Operations department.	N/A
Arktis Solutions – Jamie V. QIA will be looking for a quick response from Baffinland in regards to QIA's outstanding information request regarding the Waste Rock Stockpile Facility. In this way, QIA will be able to begin its investigation and provide input into corrective actions required to address concerns.	*Baffinland* Noted. Baffinland will ensure Baffinland responds promptly to QIA's information request regarding the Waste Rock Stockpile Facility. **Note:** Baffinland provided a response to QIA on December 1, 2017.	N/A
INAC – Sarah F. Does the emergency ditches down gradient of the sedimentation pond have a grade to direct water towards the emergency sumps?	*Baffinland* The intent of the emergency ditches was to direct water to the sumps. The grade of the ditches would need to be confirmed.	Day 2 – Slide 119
INAC – Sarah F. How will water collected in the emergency sumps be managed?	*Baffinland* Water collected in the sumps would be pumped back into the sedimentation pond and treated to meet water licence and MMER discharge criteria.	Day 2 – Slide 123

Comment/Question	Response	Slide Reference
Arktis Solutions – Jamie V. The assumptions of current security calculations do not take into account the management of ARD. QIA will be looking to further discuss with Baffinland how ARD will be accounted for in the 2018/2019 Annual Security Review.	*Baffinland* Noted.	Day 2 – Slide 129
INAC – David Z. Kinetic tests for ARD can be conducted either in the lab or in the field. Given that lab tests have failed to predict the onset of ARD and field-based tests have been considered in Baffinland's 2014 waste rock management plan, Baffinland should consider the implementation of the field based waste rock kinetic tests.	*Baffinland* Noted. Baffinland will take this suggestion into consideration. Baffinland is currently reviewing the current monitoring programs associated with the Waste Rock Stockpile Facility.	Day 2 – Slide 129
INAC – Sarah F. INAC would like to better understand timelines for deliverables and plans going forward to address outstanding concerns with the Waste Rock Stockpile Facility.	*Baffinland* Baffinland continues to respond to action items outlined in INAC's Inspector's Direction issued to Baffinland on Sept. 5, 2017. Baffinland's Mine Operations department is currently reviewing current waste rock management and monitoring practices and the appropriate corrective actions to address current concerns. The timeline for deliverables and additional actions is unknown at this time.	Day 2 – Slide 129
INAC – David Z. Does Baffinland's Mine Operations department implement the waste rock management plans?	*Baffinland* Yes.	Day 2 – Slide 129
Arktis Solutions – Jamie V. Has ECCC issued a formal directive or order to Baffinland?	*Baffinland* ECCC has notified Baffinland that it has initiated an investigation under the Fisheries Act and the MMER however no formal directive or order from ECCC has been issued to Baffinland at this time.	Day 2 – Slide 129

Lake Sedimentation Monitoring Program (Refer to Day 2 – Slides 109 to 112)

Comment/Question	Response	Slide Reference
INAC – David Z. Is there enough material collected by the sediment traps to conduct chemical and mineralogical analysis?	*Baffinland* No. Current quantities of sediment collected by the sediment traps only allow for bulk dry weight analysis. Baffinland plans on installing larger sediment traps in 2018 that will collect enough sediment to allow for bulk density analysis (**AI 13**).	Day 2 – Slide 110
Arktis Solutions – Jamie V. Analyzing the sediment for volatile and non-volatile fractions may assist in determining the source of the material collected by the sediment traps (biological matter vs. dustfall/sediment).	*Baffinland* Noted.	Day 2 – Slide 112
INAC – David Z. How deep are the sediment traps set in the water column?	*Baffinland* The mouths of the sediment traps are approx. 1 to 1.5 metres above the bottom of the lake.	Day 2 – Slide 111
INAC – David Z. Is each sediment trap made of one or several cups/columns? What data was used to create the error bars shown on slide 111?	*Baffinland* Each sediment trap is made up of three (3) cups/columns. There are five (5) traps (duplicates) deployed in each of the three (3) monitored areas. Error bars are derived from the five (5) duplicates for each monitored area.	Day 2 – Slide 111

Tote Road Freshwater Monitoring (Refer to Day 2 – Slides 130 to 131)

Comment/Question	Response	Slide Reference
INAC – Sarah F. How does Baffinland plan to collect data for high flow volumes at hydrology stations under the Hydrometric Monitoring Program? The majority of data points (flow measurements) on the current rating curves are for low flow volumes.	*Baffinland* Flow measurements are currently conducted using an in-stream flowmeter. Safety concerns associated with in-stream flow measurements during high flows has prevented Baffinland from collecting high flow measurements in the past. Baffinland is currently assessing alternate methods for measuring high flows at hydrology stations.	Day 2 – Slide 130

Comment/Question	Response	Slide Reference
INAC – Sarah F. How does Baffinland define and monitor for low flow years at dust suppression water take locations along the Tote Road, as outlined in Baffinland's Type A Water Licence?	*Baffinland* Baffinland is currently working with its consultant to set up staff gauges at dust suppression water take locations along the Tote Road to address this condition of the Type A Water Licence.	
INAC – Sarah F. Have the results for the Dustfall Monitoring Program been compared to predictions presented in the Project's EIS?	*Baffinland* Yes. Monitoring results for the Dustfall Monitoring Program are reported annually in the NIRB annual report and compared to EIS predictions.	
Arktis Solutions - Nick J. When was the last time the Dustfall Monitoring Program was updated?	*Baffinland* The last update to the program occurred in 2014 and involved the addition of eight (8) dustfall monitoring stations.	
ECCC – Anne W. There seems to some information missing in 2016 Annual NIRB Report in regards to dustfall monitoring results.	*Baffinland* Dustfall monitoring results are included in the Annual Terrestrial Environment Monitoring Report. The 2016 Terrestrial Environment Monitoring Report is provided on Baffinland's Document Portal (http://www.baffinland.com/news-reports/sharedocuments/?cat=5&subcat=15&archive=1&lang=en).	
Arktis Solutions – Nick J. Does Baffinland plan on further developing a monitoring program that assesses the potential impacts of dust on water bodies along the Tote Road?	*Baffinland* Baffinland will conduct a gap analysis to determine if the Project's current aquatic effects monitoring programs are sufficient for monitoring the Project's potential effects on aquatic ecosystems. Any additional monitoring programs for the Project will be based on the gap analysis (**AI 2**)	
Arktis Solutions - Jamie V. QIA has concerns regarding the deposition of dust on snowpack near the Tote Road its potential effects on nearby water bodies.	*Baffinland* Noted.	

Note: Discussions between QIA and Baffinland regarding the requirements for environmental monitoring along the Tote Road were taken offline following Day 2 of the 2017 Freshwater Workshop.

Community Based Monitoring and Future Freshwater Monitoring Discussions
(Refer to Day 2 – Slides 132 to 133)

Comment/Question	Response	Slide Reference
INAC – Sarah F. How is community based monitoring being incorporated into Project's monitoring programs? INAC is interested in how Baffinland plans on implementing community based freshwater monitoring for the Project.	*Baffinland* Baffinland has not formalized its plans for community based monitoring but plans to explore this topic further in future traditional knowledge workshops focusing on freshwater resources.	
INAC – Sarah F. There is a group in Pond Inlet that has implemented community based monitoring.	*Baffinland* Would INAC be able to provide information for the community based monitoring group in Pond Inlet? *INAC – Sarah F.* Yes. INAC will provide information to Baffinland on the group in Pond Inlet. (**AI 14**)	
Arktis Solutions – Jamie V. It should be noted that an amendment to Baffinland's Type A Water Licence would require a review of the Water Compensation Agreement (WCA).	*Baffinland* Noted.	

Closing Comments

Comment
Arktis Solutions – Nick J. QIA requests that workshop content (information circular, presentation slides) for future workshops be provided to participants earlier in order to allow participants to be more familiar with content to be presented.
INAC – Sarah F. INAC thought the workshop was useful and productive however INAC does not see the need to setup a freshwater working group. INAC believes that the current approach of holding workshops as required is the best path forward.
NWB – Karen K. NWB appreciates being involved in these workshops and freshwater monitoring discussions. It should be noted that the NWB relies on the technical expertise provided by INAC and ECCC for revisions to monitoring programs.
Arktis Solutions – Jamie V. QIA though the workshop was very useful. QIA thinks that setting up a three (3) year review period for major monitoring plans (i.e. CREMP) would be beneficial and would allow for the discussion of results and further changes/adaptations to the programs.
ECCC – Anne W.

Comment
ECCC thought the workshop was very useful and would be supportive of taking part in a freshwater working group.
ECCC – Erik A. ECCC thought the workshop was very useful as it allowed participants to gain a better understanding of current freshwater monitoring programs.
Baffinland Baffinland thought the workshop was very productive and would like to thank all participants for attending the workshop.