C.1 Water Quality Monitoring Requirements and Guidelines

Prior to, during and following construction work that involves the repair, modification and/or installation of a water crossing (e.g. culvert, bridge), water quality monitoring will be conducted upstream and downstream of the affected water crossing(s). The following subsections discuss the monitored parameters, monitoring methods, sampling/monitoring locations and frequency for each phase of monitoring (pre, during and post).

1. Monitored Parameters

Monitored parameters and the method at which each parameter will be monitored are listed below.

i. Discrete Water Samples
   a. Total Suspended Solids (TSS; mg/L)
   b. Total Dissolved Solids (TDS; mg/L)
   c. pH (pH units)

ii. Field Monitoring (*in-situ*)
   a. Turbidity (NTU)
   b. pH (pH units)
   c. Specific Conductivity (µS/cm)
   d. Water Temperature (°C)
   e. Dissolved oxygen (mg/L, %)
   f. Presence/Absence of Sheen (visual inspection)

2. Methods and Equipment

Field monitored parameters will measured using a calibrated, multi-parameter water quality probe (e.g. YSI). A visual inspection will be conducted to determine the presence or absence of sheen.

Discrete water samples will be collected in accordance with the protocols outlined in Baffinland's Surface Water Sampling Program – Quality Assurance and Quality Control Plan (BAF-PH1-830-P16-0001; QA/QC Plan).

3. Monitoring Locations

Concurrent water sampling and field monitoring will be conducted at locations 100 metres downstream and 50 metres upstream of each water crossing being repaired, modified and/or installed. Field monitoring will also occur at a location 50 metres downstream of the affected water crossing. Deviations from these distances due to safety and/or accessibility concerns will be documented on the *Water Crossing Monitoring Form.*

Monitoring events will start at the monitoring location furthest downstream of the affected water crossing and progress in an upstream direction to prevent monitoring results from being affected by sediment re-suspended during sampling activities (e.g. stream bed disturbance).

4. Water Sampling and Monitoring Frequency

The following subsections discuss the frequency at which water quality monitoring will be conducted at water crossings that are repaired, modified and/or installed. Water quality is monitored prior to, during and following construction. Post-construction monitoring described below has been designed to assess the performance of the water crossing during an open water season and ensure water quality impacts, if any, are acceptable based on applicable water quality action levels.

Table C-1 – Summary of Water Quality Monitoring Frequency

Monitoring Method	Monitoring Phase		
	Pre-Construction	**During Construction**	**Post Construction**
Water Sampling	One (1) sampling event at locations 100 m downstream and 50 m upstream of the affected water crossing.	Every eight (8) hours at locations 100 m downstream and 50 m upstream of the affected water crossing. Adaptive water sampling events will also be conducted when downstream flows are suspected of encroaching on TSS and turbidity action levels.	One sampling event in June, July and August at locations 100 m downstream and 50 m upstream of the affected water crossing. Sampling events will occur at least 10 days apart.[2]
Field Monitoring	One (1) monitoring event (alongside water sampling event) at locations 100 m and 50 m downstream and 50 m upstream of the affected water crossing.	Every four (4) hours at locations 100 m and 50 m downstream and 50 m upstream of the affected water crossing.[1] Field monitoring will also be conducted alongside adaptive water sampling events outlined above.	Field monitoring will be conducted concurrently with the water sampling events listed above.[2]

Notes:

[1]Field monitoring should be conducted concurrently with water samples collected every eight (8) hours to allow for TSS/turbidity curve development.

[2]Additional monitoring may be required if applicable water quality action levels are exceeded. Refer to action response framework for post-construction performance monitoring presented in Section 7, ii.

i. Pre-Construction Monitoring

Concurrent water sampling and field monitoring will be conducted at least once at locations 100 metres downstream and 50 metres upstream of the water crossing to be repaired, modified and/or installed. During the same monitoring event, field monitoring will also be conducted at a location 50 metres downstream of the affected water crossing.

ii. During Construction Monitoring

Water samples will be collected at locations 100 metres downstream and 50 metres upstream of the affected water crossing every eight (8) hours. Field monitoring will occur at locations 100 metres and 50 metres downstream and 50 metres upstream of the affected water crossing every four (4) hours. Additional adaptive monitoring events will be conducted if downstream flows are suspected of encroaching on TSS and turbidity action levels, outlined in Section 5 below.

The during construction action response framework, provided below in Section 7, i, will be used for assessing during construction monitoring results and the performance of construction mitigation measures (i.e. silt fences) implemented.

iii. Post-Construction Monitoring

Post-construction water quality monitoring, at a minimum, will consist of three (3) concurrent water sampling and field monitoring events conducted during the open water season following the completion of construction at a water crossing. Water quality will be monitored during high flows (June), medium flows (July) and low flows (August) at locations 100 metres downstream and 50 metres upstream of the water crossing. Water sampling and field monitoring events will occur at least 10 days apart.

For example, a water crossing repaired, modified and/or installed during frozen conditions would be monitored at least once during June, July and August of the following open water season. In contrast, a water crossing repaired, modified and/or installed during July, would be monitored at least once during the following month (August) and once again during June and July of the following year. This approach will ensure that a modified water crossing's performance is assessed and determined to be adequate for varying flow conditions, representative of flow conditions during a typical open water season.

As shown in the post construction action response framework in Section 7, ii, below, additional monitoring events may be required if elevated TSS and/or turbidity are observed during sampling/monitoring events.

5. Water Quality Action Levels

Environmental concerns associated with construction work and the performance of water crossings focus on the potential effects of elevated suspended solids (sedimentation) on aquatic receiving environments. As such, turbidity and TSS monitoring conducted prior to, during and following construction on water crossings will be used to inform mitigation and management actions. Table C-1 outlines the interim water quality action levels that will be used to assess monitoring results during the first year of implementation. Action levels outlined below will be reassessed following the first year of implementation.

Table C-1 – Interim Water Quality Action Levels

Parameter	Monitoring Phase		
	Pre-Construction	During Construction	Post Construction
Turbidity (NTU)	None. TSS will be the parameter used to assess the pre-construction water quality conditions near water crossings.	An increase of 25 NTU from background levels (DFO, 1999)[1], or an appropriate action level derived from site-specific TSS/turbidity datasets. The turbidity monitoring action level will be used to inform mitigation and management actions in the field, as outlined in the action response framework detailed in Section 7, i, below.	None. TSS will be the parameter used to assess the post-construction water quality conditions near water crossings.
TSS (mg/L)	A maximum increase of 50 mg/L from background levels (upstream) when background levels are between 25 and 250 mg/L. A maximum increase of 20% of background levels when background levels are greater than 250 mg/L.[2]	A maximum increase of 100 mg/L from background levels (upstream).[3]	A maximum increase of 50 mg/L from background levels (upstream) when background levels are between 25 and 250 mg/L. A maximum increase of 20% of background levels when background levels are greater than 250 mg/L.[2]

Notes:

[1] An increase of 25 NTUs approximates to an increase of 100 mg/L TSS (adapted from DFO, 1999)[1]

[2] Based on low risk to aquatic organisms, expressed as an increase over background levels (adapted from DFO, 1999)

[1] Department of Fisheries and Oceans Canada (DFO), 1999. The Effects of Sediment on Fish and their Habitat. ISSN 1480-4883.

[3] During construction TSS action level used in Aquatic Effects Monitoring Plan & Surveillance Network Program: Construction of the Inuvik to Tuktoyaktuk Highway (Government of NWT, 2014)

Water quality sampling, in comparison to the Type 'A' Water Licence criteria, will continue to be reported in the NWB/QIA Annual Report for Operations.

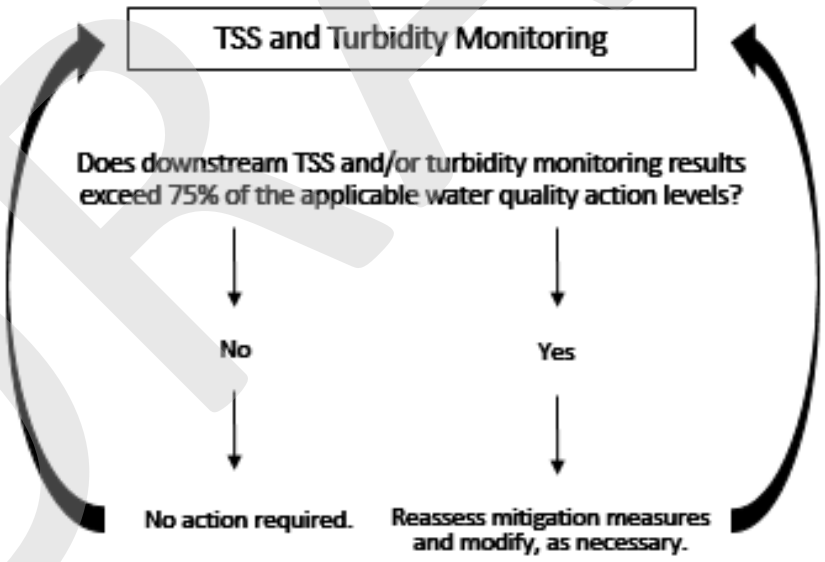
6. Data Management

All data collected during monitoring activities will be documented using the *Water Crossing Monitoring Form.* A *Water Crossing Monitoring Form* will be completed for each water crossing that is repaired, modified and/or installed. All documentation, including photos, will be saved on the onsite Environmental server.

7. Action Response Framework

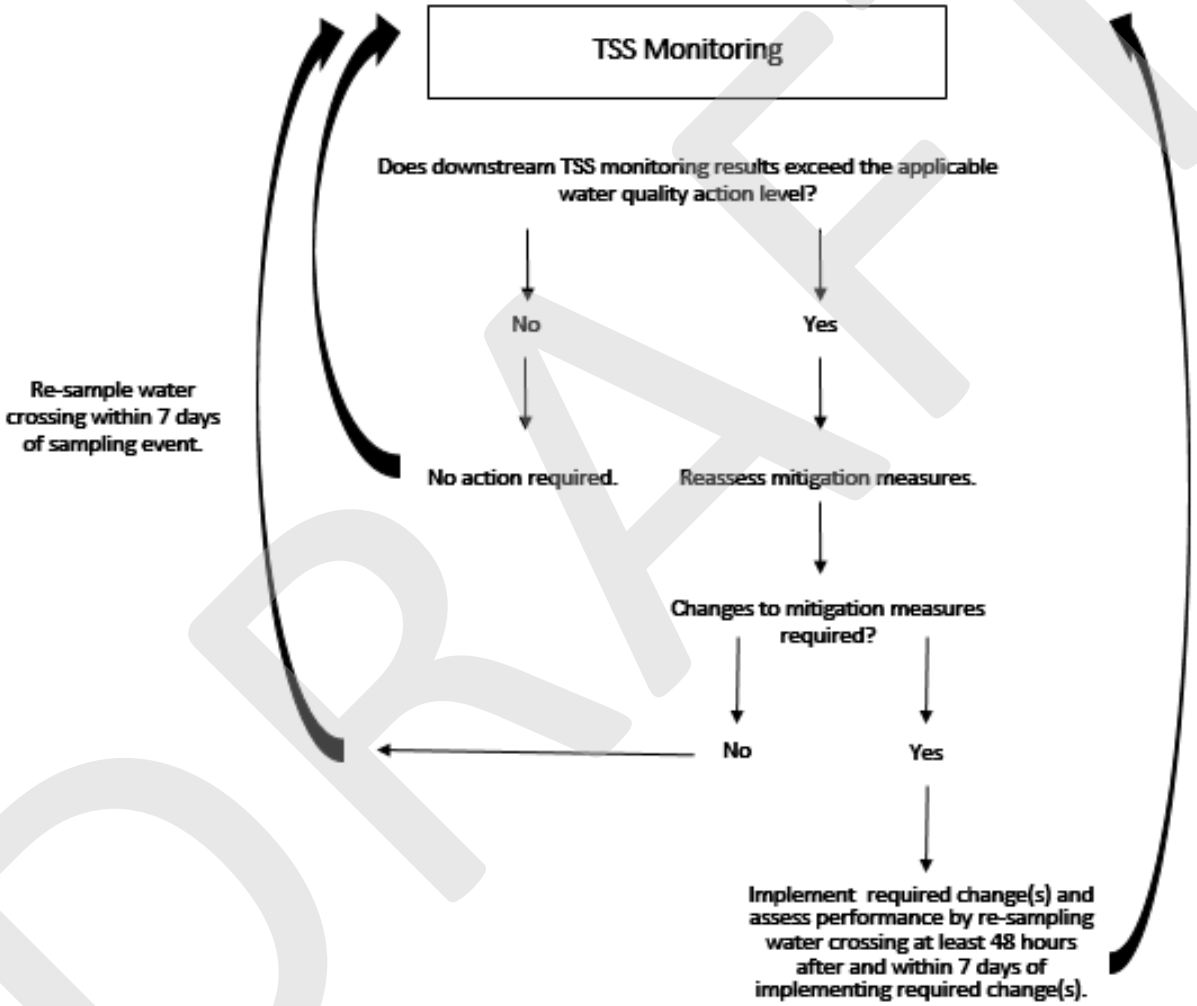
i. During Construction

The following action response framework will be used to assess the performance of the mitigation measures used during construction activities on water crossings, during periods of flow.



ii. Post- Construction

The following action response framework will be used to assess the performance of the water crossings in regards to water quality impacts following construction activities.



8. Data Reporting Requirements and Interpretation

Data collected during the monitoring program will, at a minimum, be presented in the Annual Report prescribed by the Project's Commercial Lease with the QIA and the Type 'A' Water Licence, issued by the NWB. In the Annual Report, Baffinland will present the data, compare the data against the interim water quality actions levels presented in Table C-1 and the Type 'A' Water Licence criteria and outline Baffinland's interpretation of the data and plans for any additional monitoring.

C.2 Construction and Monitoring Guidelines during Frozen Conditions

2. General

All materials and equipment used for site preparation and construction shall be operated and stored in such a manner that prevents deleterious substances from entering nearby water bodies. Specifically:

a. Any excavated and stockpiled materials shall be stored and stabilized in a designated area that is at least 31 metres from the ordinary High Water Mark of nearby water bodies.
b. Any part of a vehicle and/or equipment entering the water shall be free of fluid leaks and externally cleaned/degreased;
c. Vehicle and equipment washing, re-fuelling, and/or maintenance shall be conducted in a location that is at least 31 metres from the ordinary High Water Mark of nearby water bodies.
d. Vehicles and equipment involved with construction activities shall be operated in a way that minimizes the disturbance to the banks of the watercourse/waterbody. If disturbance occurs, the banks shall be restored.
e. Fuel and any other materials associated with the servicing of machinery shall be stored at least 31 metres from the ordinary High Water Mark of nearby water bodies.

3. Typical Scope of Work for Culvert Repair/Installation

The basic construction scope of work expected at a culvert includes the following activities:

a. Excavate to desired elevation to install new or extend existing culvert(s).
b. Install new culverts, or new culvert lengths/extensions.
c. Back fill with compaction to finished grade.
d. Place rip-rap at culvert inlet and outlet ends, as required.
e. Clean up loose material around the culvert(s) prior to freshet to mitigate water quality impacts from construction.

4. Monitoring Activities

a. Take pre, during and post photographs of the affected water crossing, as outlined in the *Water Crossing Monitoring Form.*
b. Complete post-construction water quality monitoring during next open water season and record results and observations on the *Water Crossing Monitoring Form*, as outlined in Section C.1.
c. Include affected water crossing in the next biannual geotechnical inspection, prescribed by the Type 'A' Water Licence.
d. If fish bearing, include affected water crossing in the annual inspection of the Project's fish bearing water crossings, conducted by a Professional Fisheries Biologist.
e. Record all relevant information on *Water Crossing Monitoring Form*.

C.3 Construction and Monitoring Guidelines during Periods of Flow

1. General

All materials and equipment used for site preparation and construction shall be operated and stored in such a manner that prevents deleterious substances from entering nearby water bodies. Specifically:

a. Any excavated and stockpiled materials shall be stored and stabilized in a designated area that is at least 31 metres from the ordinary High Water Mark of nearby water bodies.
b. Any part of a vehicle and/or equipment entering the water shall be free of fluid leaks and externally cleaned/degreased;
c. Vehicle and equipment washing, re-fuelling, and/or maintenance shall be conducted in a location that is at least 31 metres from the ordinary High Water Mark of nearby water bodies.
d. Vehicles and equipment involved with construction activities shall be operated in a way that minimizes the disturbance to the banks of the watercourse/waterbody. If disturbance occurs, the banks shall be restored.
e. Fuel and any other materials associated with the servicing of machinery shall be stored at least 31 metres from the ordinary High Water Mark of nearby water bodies.

2. Typical Scope of Work for Culvert Repair/Installation

The basic construction scope of work expected at a culvert includes the following activities:

a. Excavate to desired elevation to install new or extend existing culvert(s).
b. Install new culverts, or new culvert lengths/extensions.
c. Back fill with compaction to finished grade.
d. Place rip-rap at culvert inlet and outlet ends, as required.
e. Clean up loose material around the culvert(s) to mitigate water quality impacts from construction.

3. Pre-Construction Activities

Where there are construction activities occurring during periods of flow, the following steps will be taken prior to construction.

a. Complete a fish assessment prior to construction. Record information on the *Water Crossing Monitoring Form*.
b. If the stream survey yields the presence of fish, a salvage fishery will be conducted if any in-stream work is anticipated. If fish are present for any in-stream work, a barrier net will be placed downstream of the construction site to prevent additional fish potentially from accessing the construction site. Any fish present upstream of the barrier will be captured (using a backpack electrofisher) and transferred to fish-bearing habitat downstream of the barrier.

c. Take pre-construction photographs of the affected water crossing as outlined in the Water Crossing Monitoring Form.
d. Complete pre-construction water quality monitoring and record results and observations on the *Water Crossing Monitoring Form,* as outlined in Section C.1.
e. Install sediment control measures. Ensure sediment control measures are functioning properly prior to the start of construction. Record information on the *Water Crossing Monitoring Form*.
f. Record all relevant information on *Water Crossing Monitoring Form*.

4. During-Construction Activities

a. Complete construction activities.
b. Take during construction photographs of the affected water crossing as outlined in the *Water Crossing Monitoring Form*.
c. Complete during construction water quality monitoring and record results and observations on the *Water Crossing Monitoring Form*, as outlined in Section C.1.
d. Record all relevant information on *Water Crossing Monitoring Form*.

5. Post-Construction Activities and Performance Monitoring

a. Take post-construction photographs of the affected water crossing as outlined in the *Water Crossing Monitoring Form*.
b. Complete post-construction water quality monitoring and record results and observations on *Water Crossing Monitoring Form*, as outlined in Section C.1.
c. Include affected water crossing in the next biannual geotechnical inspection, prescribed by the Type 'A' Water Licence.
d. If fishing bearing, include affected water crossing in the annual inspection of the Project's fish bearing water crossings, conducted by a Professional Fisheries Biologist.
e. Record all relevant information on the *Water Crossing Monitoring Form*.

WATER CROSSING MONITORING FORM

Baffinland

WATER CROSSING MONITORING FORM
PART 1 - GENERAL INFORMATION

WATER CROSSING ID:									
Construction Duration:			**Start (YY/MM/DD XX:XX HRS):**		**Finish (YY/MM/DD XX:XX HRS):**				
During Frozen Conditions?	Yes / No								
During Periods of Flow?	Yes / No								
IF CONSTRUCTION OCCURS DURING PERIODS OF FLOW, COMPLETE ENTIRE FORM (PART 1 & PART 2A, B & C) (PRE, DURING AND POST CONSTRUCTION WATER QUALITY MONITORING)									
IF CONSTRUCTION OCCURS DURING FROZEN CONDITIONS, COMPLETE PART 1 & PART 2C OF THIS FORM (POST CONSTRUCTION WATER QUALITY MONITORING)									
CROSSING MODIFICATION / REPAIR DETAILS									
Change in existing design?	**Yes / No**		**If Yes, details of change:**						
Final Design (e.g. number of culverts, length, etc.):									
Applicable Approvals									
TRAN									
DFO Approvals									
Notes:									
LOCATION									
Datum:	**Zone:**								
Easting (m):	**Northing (m):**		**Elevation (from mapping):**						
Notes:									
FISH ASSESSMENT PRIOR TO CONSTRUCTION									
Date (YY/MM/DD):									
Fish Present?	Yes / No		**If Yes, distance from crossing:**					US / DS	
Spawning Arctic charr present at crossing?			Yes / No		If Yes, contact a biologist				
Spawning site present 20 m upstream or downstream of crossing?			Yes / No						
Notes:									
SEDIMENT AND EROSION CONTROL MEASURES									
Measures Installed:					Date installed:				
					Date removed:				
Measures taken to stabilize disturbed areas:									
Notes:									
PHOTOS									
View across water crossing, view from upstream, view from downstream and view of sediment controls employed.									
	Photo #	**Date (YY/MM/DD)**	**Direction**	**Vantage Point**		**Photo #**	**Date (YY/MM/DD)**	**Direction**	**Vantage Point**
Before					**After**				
Across					Across				
From US					From US				
From DS					From DS				
During					**Sed. Cont.**				
Across					Across				
From US					From US				
From DS					From DS				
Notes:									

Baffinland

WATER CROSSING MONITORING FORM
PART 2A - PRE-CONSTRUCTION WATER QUALITY MONITORING

WATER CROSSING ID: **Pg. (X/X):**

Location (e.g. 100 m downstream)	Date (YY/MM/DD)	Time (XX:XX HRS)	Field Monitoring						Water Sample Collected (Yes / No)	Lab Water Sample ID	Notes
			Turbidity (NTU)	pH (pH Units)	Sp. Cond. (µS/cm)	Water Temp. (°C)	DO (mg/L)	DO (% Sat.)			

Monitoring Frequency:

Water Sampling - At least one (1) sampling event at locations 100 m downstream and 50 m upstream of the affected water crossing, prior to construction.

Field Monitoring - At least one (1) monitoring event (alongside water sampling event listed above) at locations 100 m and 50 m downstream and 50 m upstream of the affected water crossing, prior to construction.

Baffinland

WATER CROSSING MONITORING FORM
PART 2B - DURING CONSTRUCTION WATER QUALITY MONITORING

WATER CROSSING ID:											Pg. (X/X):
Location (e.g. 100 m downstream)	Date (YY/MM/DD)	Time (XX:XX HRS)	Field Monitoring						Water Sample Collected (Yes / No)	Lab Water Sample ID	Notes
			Turbidity (NTU)	pH (pH Units)	Sp. Cond. (µS/cm)	Water Temp. (°C)	DO (mg/L)	DO (% Sat.)			

Monitoring Frequency:

Water Sampling - Every eight (8) hours at locations 100 m downstream and 50 m upstream of the affected water crossing, during construction.

Field Monitoring - Every four (4) hours at locations 100 m and 50 m downstream and 50 m upstream of the affected water crossing, during construction.

Note: Field monitoring and water sampling shall be conducted concurrently where frequency and locations overlap.

Adaptive water sampling events will also be conducted when downstream flows are suspected of encroaching on TSS and turbidity criteria limits.

Baffinland

WATER CROSSING MONITORING FORM
PART 2C - POST CONSTRUCTION WATER QUALITY MONITORING

WATER CROSSING ID:												Pg. (X/X):
Location (e.g. 100 m downstream)	Date (YY/MM/DD)	Time (XX:XX HRS)	Field Monitoring						Water Sample Collected (Yes / No)	Lab Water Sample ID	Notes
			Turbidity (NTU)	pH (pH Units)	Sp. Cond. (µS/cm)	Water Temp. (°C)	DO (mg/L)	DO (% Sat.)			

Monitoring Frequency:

Water Sampling - Three sampling events: once in June, July and August at locations 100 m downstream and 50 m upstream of the affected water crossing. Sampling events will occur at least 10 days apart.

Field Monitoring - Field monitoring will be conducted concurrently with water sampling events listed above.

APPENDIX B

Tote Road Monitoring Program

(Pages B-1 to B-10)

Appendix D
Tote Road Monitoring Program

1. Purpose and Scope

The Tote Road Monitoring Program (TRMP) has been developed to monitor the water quality of surface water flows at select water crossing (culverts, bridges) along the Milne Inlet Tote Road (Tote Road), with a primary focus on monitoring total suspended solids (TSS) concentrations upstream and downstream of Tote Road water crossings.

Monitoring data collected under the TRMP will be used to:

a) Inform Project operations of potential water quality impacts from Project activities at water crossings along the Tote Road.
b) Guide and prioritize Tote Road maintenance work, corrective actions and improvements projects for surface water management infrastructure;
c) Adjust mitigation measures and management strategies for Project activities along the Tote Road; and,
d) Expand the Project's understanding of natural water quality conditions along the Tote Road (upstream) and the natural factors that contribute to changes in surface water quality.

2. Monitored Parameters

Water quality monitoring conducted to date along the Tote Road have identified TSS as a parameter of concern. Observations indicate that sources of TSS can be both Project-related, such as construction activities, and natural, such as bank erosion and streambed scouring during high flow periods.

In addition to TSS, the TRMP will monitor for additional parameters, including metals, nutrients, oil & grease, and routine chemistry, such as dissolved anions, turbidity and total dissolved solids (TDS).

Tables D-1 and D-2 outline the field and analytical parameters that will be monitored under the TRMP.

Table D-1 – Tote Road Monitoring Program – Field Parameters

Parameter Type	Method	Units	Parameter Group
Turbidity	1	NTU	Group 1
pH	1	pH units	
Specific Conductivity	1	µS/cm	
Water Temperature	1	°C	
Dissolved Oxygen	1	mg/L, %	
Oil & Grease Sheen	2	Presence/Absence	

Notes:

[1]Method 1 – *In-situ* testing using a multi-parameter water quality probe (i.e. YSI)
Method 2 – Visual inspection during water sampling event.

Table D-2 – Tote Road Monitoring Program - Analytical Parameters

Parameter Type	Method[1]	Units	Parameter Group
pH	3	pH units	Group 2
Total Suspended Solids (TSS)	3	mg/L	
Total Dissolved Solids (TSS)	3	mg/L	
Conductivity	3	µS/cm	
Oil & Grease	3	mg/L	Group 3
Hardness	3	mg/L as $CaCO_3$	Group 4
Alkalinity	3	mg/L as $CaCO_3$	
Chloride (Cl^-)	3	mg/L	
Ammonia	3	mg/L N	
Total Phosphorus	3	mg/L N	
Nitrate (NO_3^-)	3	mg/L N	
Nitrite (NO2)	3	mg/L N	
Dissolved Organic Carbon (DOC)	3	mg/L N	
Total Organic Carbon (TOC)	3	mg/L N	
Total and Dissolved Metals	3	mg/L	

Notes:

[1]Method 3 – analytical testing of water samples by an accredited third party laboratory

3. Monitoring Methods and Equipment

Field monitored parameters will measured using a calibrated, multi-parameter water quality probe (e.g. YSI). A visual inspection will be conducted to determine the presence or absence of sheen.

Discrete water samples will be collected, transported and analyzed in accordance with the protocols outlined in Baffinland's Surface Water Sampling Program – Quality Assurance and Quality Control Plan (BAF-PH1-830-P16-0001; QA/QC Plan).

4. Monitoring Locations

Water crossings monitored under the TRMP have been selected to give a geographically representative sample set of water crossings for each given watershed intersected by the Tote Road (Phillips Creek, Ravn River, Mary River), presented in Figure D-1. In selecting the Tote Road water crossings within each watershed, the following factors were considered:

a) Key depositional habitats downstream of the Tote Road (e.g. fish habitat);
b) Areas historically prone to sedimentation events;
c) Historical borrow source locations; and,
d) Existing monitoring locations and programs.

Using the factors and criteria listed above, the following 20 Tote Road water crossings, presented in Table D-3, were identified as monitoring locations.

Table D-3 – Water Crossings Monitored under TRMP

Water Crossing	Watershed	Approximate Tote Road Chainage
CV167	Phillips Creek	6
CV162	Phillips Creek	8
CV128*	Phillips Creek	17
CV129	Phillips Creek	17
CV115	Phillips Creek	27
CV112	Phillips Creek	31
CV106	Phillips Creek	33
CV099*	Phillips Creek	37
CV093*	Phillips Creek	41
CV078*	Phillips Creek	51
CV071	Phillips Creek	54
CV060	Phillips Creek	58
BG50*	Ravn River	62
CV040*	Ravn River	72
BG32	Ravn River	78
CV217*	Ravn River	80
BG30	Ravn River	84
BG24*	Mary River	87
CV001	Mary River	94
CV223	Mary River	97

Notes:

Water crossing with an asterisk (*) are HADD fish bearing water crossings.

5. Monitoring Frequency

During each year, water quality monitoring under the TRMP will commence with the start of flows and end with the freeze-up of flows. Water quality monitoring will be divided into two seasons: Freshet and Summer. Freshet will be begin with the start of flows and end July 15. Summer will begin July 16 and end with the freeze-up of flows in September. Selected water crossings will be sampled weekly (4 events per month) during Freshet and monthly during the Summer.

Tables D-4 and D-5 outline the frequency of sampling events for the primary parameters (Groups 1 & 2) and additional parameters (Group 4), respectively. As shown in Tables D-4 and D-5, primary parameters will be monitored weekly during Freshet and monthly during Summer while the additional parameters will only be sampled once per season at HADD fish-bearing water crossings. Water samples will be collected for oil & grease (Group 3) during sampling events in which visible sheen is observed.

Table D-4 – Monitoring Frequency for Primary Parameters (Groups 1 & 2)[1]

Month	May				June				July			August				September			
All Water Crossings	F	F	F	F	F	F	F	F	F	F		S			S			S	

Notes:

F – Indicates Freshet water sampling event
S – Indicates Summer water sampling event
[1]Water samples for Group 3 (oil & grease) will be collected where visible sheen is observed.

Table D-5 – Monitoring Frequency for Additional Parameters (Group 4)[1]

Month	May	June	July	August	September
HADD Fish-Bearing Water Crossings[2]		F		S	

Notes:

F – Indicates Freshet water sampling event
S – Indicates Summer water sampling event
[1]Water samples for Group 3 (oil & grease) will be collected where visible sheen is observed.
[2]HADD fish-bearing water crossings are identified in Table D-3.

During each water sampling event, water samples will be collected at a location approximately 100 metres downstream and 50 metres upstream of each monitored water crossing, as access allows. Field monitoring (*in-situ*) parameters will be measured at the same locations. Deviations from these established distances due to safety and/or accessibility concerns will be documented on the *TRMP – Sampling Event Monitoring Form.*

Water sampling events will start at the monitoring location furthest downstream of the monitored water crossing and progress in an upstream direction to prevent monitoring results from being affected by sediment re-suspended during sampling activities (e.g. stream bed disturbance).

It should be noted that additional monitoring may be required if the TSS water quality action levels, presented in Section 6 below, are exceeded. Additional sampling requirements and responses to documented TSS exceedances under the TRMP are outlined in the action-response framework presented in Section 6.

6. TSS Water Quality Criteria and Response-Action Framework

The Tote Road Monitoring Program will utilize a response-action framework to identify, mitigate and monitor for Project related changes in TSS concentrations, if present. The response framework is outlined in the Figure D-2.

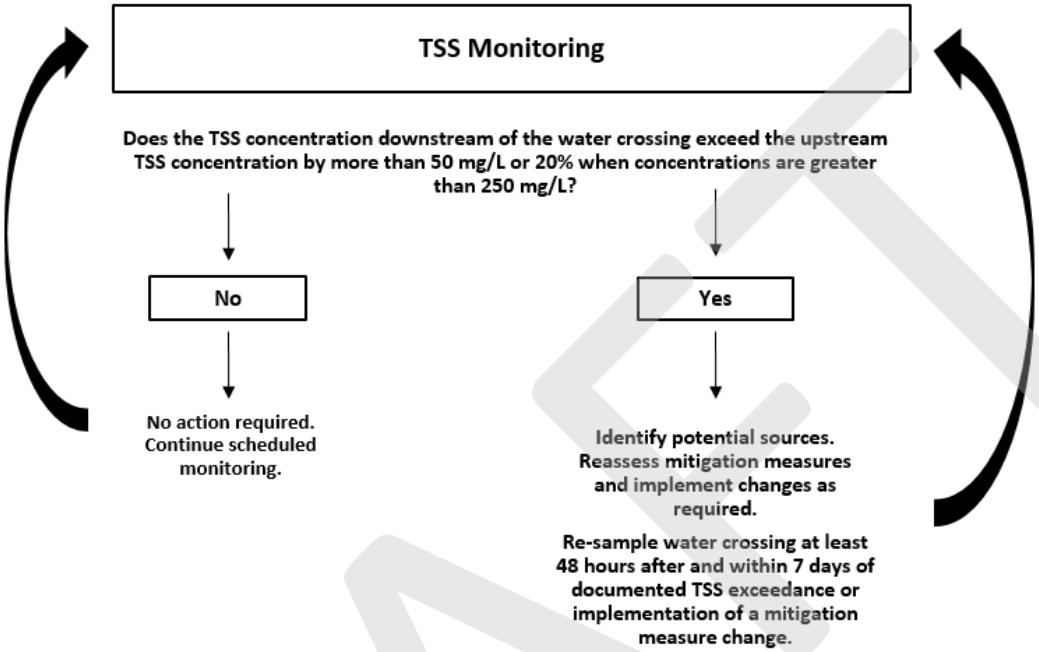


Figure D-2 – TSS Response-Action Framework

To evaluate the potential for a Project related change to concentrations of TSS within the Tote Road LSA, water samples will be collected at designated locations approximately 100 m downstream and 50 m upstream of the crossing, as access allows, at the frequency outlined in Section 3.3.1.4. Following receipt of analytical results, TSS concentrations at the upstream and downstream location will be compared. When upstream concentrations are less than 250 mg/L, a potential Project related change is defined as a greater than 50 mg/L increase in the downstream concentration. Where concentrations are greater than 250 mg/L in the upstream sample, a potential Project related change is defined as a greater than 20% increase in the downstream sample.

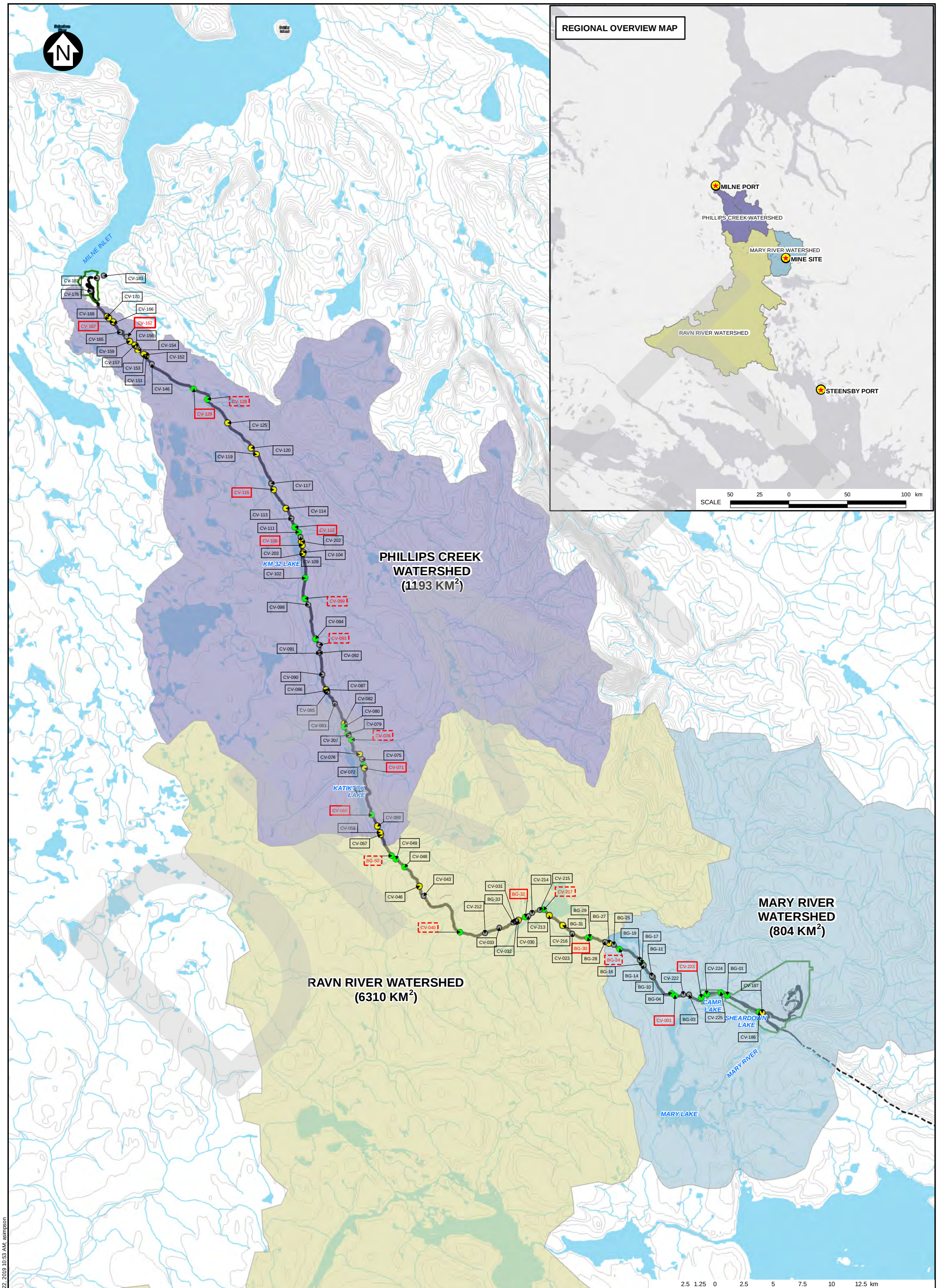
If the results of a sampling event identify a potential Project related change, Baffinland will implement new mitigation measures and/or assess the effectiveness of existing mitigation measures. During the assessment, the water crossing will be evaluated to determine the potential sources of the observed sedimentation event(s) and TSS concentration increases, including natural phenomenon. The water crossing will then be re-sampled at least two (2) days, but not later than seven (7) days, following receipt of sampling results to confirm that mitigation and/or corrective actions have reduced TSS concentrations below the appropriate action level.

7. Data Management

All data collected during monitoring activities will be documented using the *TRMP – Sampling Event Monitoring Form.* During each sampling event, a *TRMP – Sampling Event Monitoring Form* will be completed. All documentation, including photos, will be saved on the onsite Environmental server.

8. Data Reporting Requirements and Interpretation

Data collected during the TRMP will be presented in the Annual Report prescribed by the Project's Commercial Lease with the QIA and the Type 'A' Water Licence, issued by the NWB. In the Annual Report, Baffinland will present the data, compare the data against the applicable water quality criteria and outline Baffinland's interpretation of the data and plans for any additional monitoring in the upcoming field season.



LEGEND:

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

FISH BEARING STATUS

- NO
- MARGINAL
- IMPORTANT

NOTES:

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

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
0	22MAR19	ISSUED WITH TRANSMITTAL	AV	AS	AV

BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

TOTE ROAD MONITORING PROGRAM

Baffinland

P/A NO.	REF NO.
NB102-181/54	NB19-00240

FIGURE D-1 REV 0

SAVED: I:\1\02\00181\54\A\GIS\Figs\B07 R0.mxd: Mar 22, 2019 10:53 AM; asimpson

TRMP – Sampling Event Monitoring Form

Baffinland

TOTE ROAD MONITORING PROGRAM - SAMPLING EVENT MONITORING FORM

Water Crossing ID	Monitoring Location Description (e.g. 100 m downstream)	Coordinates of Monitoring Location (UTM; NAD83)[1]			Date (YY/MM/DD)	Time (XX:XX HRS)	Field Monitoring							Water Samples Collected (Yes / No)	Reason for Sampling (e.g. Scheduled Sampling Event, Follow-up, etc.)	Mitigation Measures Implemented (Yes / No)	Photos IDs	Notes (General Observations, Weather, Deviations from Protocol, etc.)
		Zone	Easting	Northing			Turbidity (NTU)	pH (pH Units)	Sp. Cond. (µS/cm)	Water Temp. (°C)	DO (mg/L)	DO (% Sat.)	Sheen Observed (Yes / No)					

Notes:
[1]Coordinates will be recorded for sampling events that deviate from the prescribed distances upstream (50 m) and downstream (100 m) of water crossings.

APPENDIX C

Water Withdrawal Sites

(Pages C-1 to C-2)

APPENDIX C
WATER WITHDRAWAL SITES

Table C.1 Proposed Water Takes at Previously Approved Water Sources

Water Take Station	Coordinates		Additional Water Take Requested for Dust Suppression	Currently Authorized Water Take[3]	Phase 2 Proposal Maximum Water Take
	Northing (m)	Easting (m)	(m^3/day)	(m^3/day)	(m^3/day)
MP-MRY-2 (Phillips Creek)	7,975,254	502,829	-	579.5[4]	No change
CV128	7,965,895	513,545	-	579.5	No change
MP-MRY-3 (KM32 Lake)	7,953,660	521,189	-	364[1] / 367.5[5]	No change
CV099[2]	7,948,820	521,811	-	110	No change
CV087[2]	7,941,040	523,704	-	90	No change
CV078[2]	7,936,787	525,852	15	75	**90**
Katiktok Lake	7,934,552	526,600	-	318	No change
BG50	7,926,846	529,334	60	150	**215**
BG32[2]	7,921,622	540,706	60	120	**180**
CV217	7,922,158	542,219	-	130	No change
Muriel Lake	7,921,987	542,508	-	212	No change
David Lake	7,919,396	547,885	-	132	No change
BG17[2]	7,917,643	550,703	-	75	No change
CV223 (Tom River)	7,914,691	555,818	-	135	No change
Camp Lake	7,914,684	557,793	-	743.5[6] / 441.4[7]	**743.5** (both constr/ oper)

NOTES:

1. WATER TAKING FOR DUST SUPPRESSION IS ONLY AUTHORIZED DURING SUMMER MONTHS.
2. RETAIN PREVIOUS RESTRICTION THAT WATER TAKING IS ONLY PERMITTED DURING JUNE AND JULY DURING LOW FLOW (< MEAN FLOW) YEARS.
3. AUTHORIZED WATER USE WAS RETRIEVED FROM THE NUNAVUT WATER BOARD WATER LICENCE NO. 2AM-MRY1325, AMENDMENT NO. 1 (NWB, 2015).
4. PHILLIPS CREEK APPROVED WATER TAKE - SUMMER ONLY = 579.5 M^3/DAY (212 M^3/DAY FOR DUST SUPPRESSION + 367.5 M^3/DAY FOR INDUSTRIAL/DOMESTIC USE).
5. KM32 LAKE APPROVED WATER TAKE = 364 M^3/DAY (SUMMER - DUST SUPPRESSION) OR 367.5 M^3/DAY (WINTER - DOMESTIC USE).
6. CAMP LAKE APPROVED WATER TAKE - CONSTRUCTION = 743.5 M^3/DAY (86 M^3/DAY FOR DUST SUPPRESSION + 657.5M^3/DAY FOR MINE SITE INDUSTRIAL/DOMESTIC USE.
7. CAMP LAKE APPROVED WATER TAKE - OPERATIONS = 441.4 M^3/DAY (86 M^3/DAY FOR DUST SUPPRESSION + 355.4 M^3/DAY FOR MINE SITE INDUSTRIAL/DOMESTIC USE).

Table C.2 Proposed Water Takes at New Water Sources

Water Take Station	Coordinates		Phase 2 Proposal Maximum Water Take (m3/day)	Restrictions
	Northing (m)	Easting (m)		
CWP1[1]	7,970,914	506,663	140	None
CWP2[1]	7,967,146	510,978	110	
CWP3[1]	7,963,947	515,215	55	
CWP4[1]	7,962,497	516,439	75	
CWP5 (KM26 Lake)[1]	7,958,592	518,839	120	
CWP6[1]	7,945,826	522,434	80	
CWP7[1]	7,942,153	523,218	60	
CWP8[1]	7,939,580	524,497	35	
CWP9[1]	7,938,445	524,839	45	
CWP10	7,923,139	527,413	55	
CWP11	7,916,686	529,119	100	
CWP12	7,916,606	551,452	80	June - July only during low flow (less than mean flow) years
CWP13 (Sheardown Lake)	7,913,489	560,288	10	None

NOTES:
1. LOCATED ON PHILLIPS CREEK.

ATTACHMENT 6: FWSSWMP PART 5 FILE

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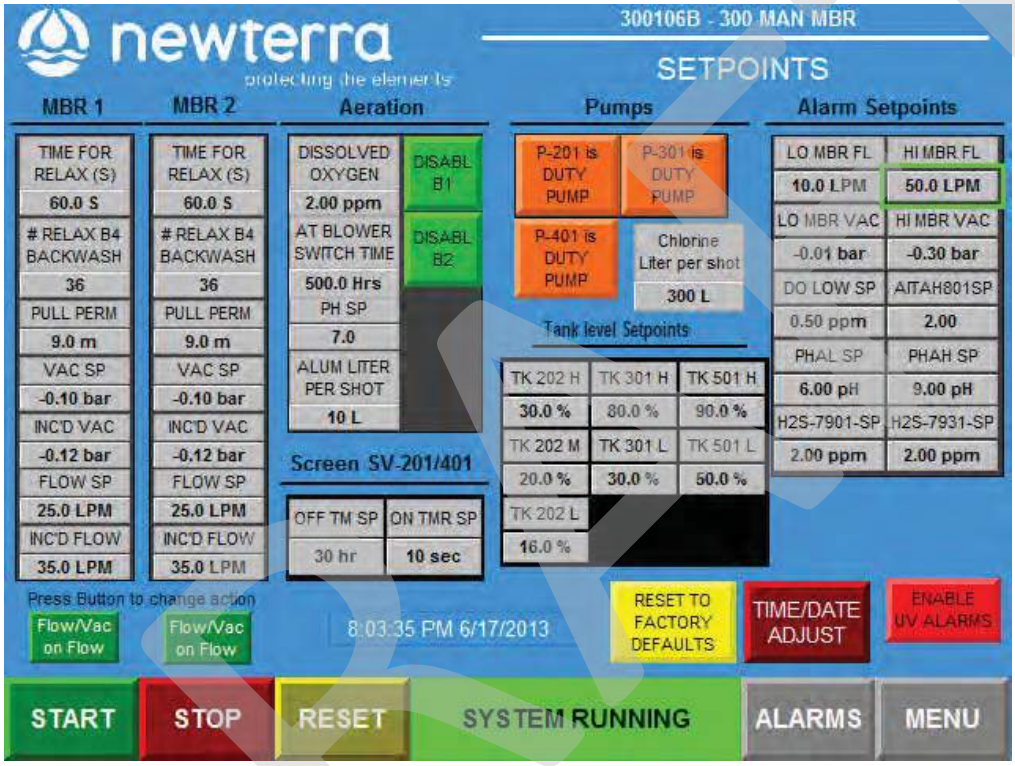
5.2.3 Process Setpoints Screen

The **Setpoints Screen** is accessed from the main menu by pressing the **"SETPOINTS"** button. This screen allows optimization of the system operation. Once the system is correctly set up, these values **should not be changed**.



See the table on the following page for the description of setpoints.

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newterra MBR Operational Setpoints Description

Process Location	Setpoint	Value	Description
Inlet Screen Module (SCR-201)	OFF TMR SP	30 hr	Setpoint for the amount of time when solenoid valve (SV-201) used for potable water delivery for screen cleaning is closed (OFF)
	ON TMR SP	10 sec	Setpoint for the amount of time when solenoid valve (SV-201) used for potable water delivery for screen cleaning is open (ON)
The second Screen Module (SCR-401)	OFF TMR SP	30 hr	Setpoint for the amount of time when solenoid valve (SV-401) used for potable water delivery for screen cleaning is close (OFF)
	ON TMR SP	10 sec	Setpoint for the amount of time when solenoid valve (SV-401) used for potable water delivery for screen cleaning is open (ON)
Membranes	TIME FOR RELAX (S)	60 sec	Setpoint for the amount of time the membrane relaxes between pulls, in seconds (shown for MBR 1 & MBR 2)
	# RELAX B4 BACKWASH	36	Setpoint for the number of relaxes before a backwash is triggered.
	PULL PERM MBR 1	9 min	Setpoint for the amount of time (in minutes) the system pulls permeate from TNK-601 before relaxing
	PULL PERM MBR 2	9 min	Setpoint for the amount of time (in minutes) the system pulls permeate from TNK-602 before relaxing
	VAC 1 SP	-0.10 bar	Setpoint for the vacuum in TNK-601 (in bar) the system will put on the membrane under normal operating conditions
	VAC 2 SP	-0.10 bar	Setpoint for the vacuum in TNK-602 (in BAR) the system will put on the membrane under normal operating conditions
	INC'D 1 VAC	-0.12 bar	Setpoint for the vacuum in TNK-601 (in bar) the system will put on the membrane when the system is experiencing a high flow (typically controlled by a high level in the EQ tank)
	INC'D 2 VAC	-0.12 bar	Setpoint for the vacuum in TNK-602 (in bar) the system will put on the membrane when the system is experiencing a high flow (typically controlled by a high level in the EQ tank)

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Process Location	Setpoint	Value	Description
Membranes	FLOW 1 SP	25.0 LPM	Normal flow setpoint for permeate flow rate (in LPM) in TNK-601. Under normal operation the system will default to this setpoint
	FLOW 2 SP	25.0 LPM	Normal flow setpoint for permeate flow rate (in LPM) in TNK-602. Under normal operation the system will default to this setpoint
	INC'D 1 FLOW	35.0 LPM	Increased Flow setpoint for permeate flow rate (in LPM) in TNK-601. If LSH-301 is activated the system will use the Increased Flow setpoint.
	INC'D 2 FLOW	35.0 LPM	Increased Flow setpoint for permeate flow rate (in LPM) in TNK-602. If LSH-301 is activated the system will use the Increased Flow setpoint.
Aeration Tank	DISSOLVED 0XYGEN	2.00 ppm	Setpoint for the amount of dissolved oxygen in ppm in the aeration tank
	AT BLOWER SWITCH TIME	500.0 Hrs	Setpoint for switching between aeration tank blowers under normal operation. The switch time is usually 500hrs.
	pH SP	7.0	Setpoint for the pH level in the aeration tank
	ALUM LITER PER SHOT	10 L	Setpoint for the amount of alum (L) added in the aeration tank
Tank Level Setpoint	TK 202 H	30.0 %	Setpoint for the high level (in %) for the screen tank (TNK-202)
	TK 202 M	20.0 %	Setpoint for the medium level (in %) for the screen tank (TNK-202)
	TK 202 L	16.0 %	Setpoint for the low level (in %) for the screen tank (TNK-202)
	TK 301 H	80.0 %	Setpoint for the high level (in %) for the equalization tank (TNK-301)
	TK 301 L	30.0 %	Setpoint for the low level (in %) for the equalization tank (TNK-301)
	TK 501 H	90.0 %	Setpoint for the high level (in %) for the aeration tank (TNK-501)
	TK 501 L	50.0 %	Setpoint for the low level (in %) for the aeration tank (TNK-501)

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newterra MBR Alarm Setpoints Description

Alarm Setpoints	LO MBR FL	10.0 LPM	If the discharge flow is below this setpoint for more than 5 minutes, an alarm will be initiated.
	HI MBR FL	50.0 LPM	If the discharge flow is higher this setpoint for more than 5 minutes, an alarm will be initiated.
	LO MBR VAC	-0.01 bar	If the vacuum on the membrane is below this setpoint for more than 60 seconds, an alarm will be initiated.
	HI MBR VAC	-0.30 bar	If the vacuum on the membrane is higher this setpoint for more than 60 seconds, an alarm will be initiated.
	DO LOW SP	0.50 ppm	If the dissolved oxygen in the aeration tank is below this setpoint for more than 15 minutes, an alarm will be initiated.
	AITAH801SP	2.0 ppm	If the % solids in the aeration tank is above this setpoint an alarm will be initiated.
	PHAL SP	6.00 pH	If the pH in the aeration tank is below this setpoint for more than 15 minutes, an alarm will be initiated.
	PHAH SP	9.00 pH	If the pH in the aeration tank is higher this setpoint for more than 15 minutes, an alarm will be initiated.
	H_2S-7901-SP	2.00 ppm	If the concentration of detected H_2S reaches this setpoint for more than 5 minutes, an alarm will be initiated.
	H_2S-7931-SP	2.00 ppm	If the concentration of detected H_2S reaches this setpoint for more than 5 minutes, an alarm will be initiated.

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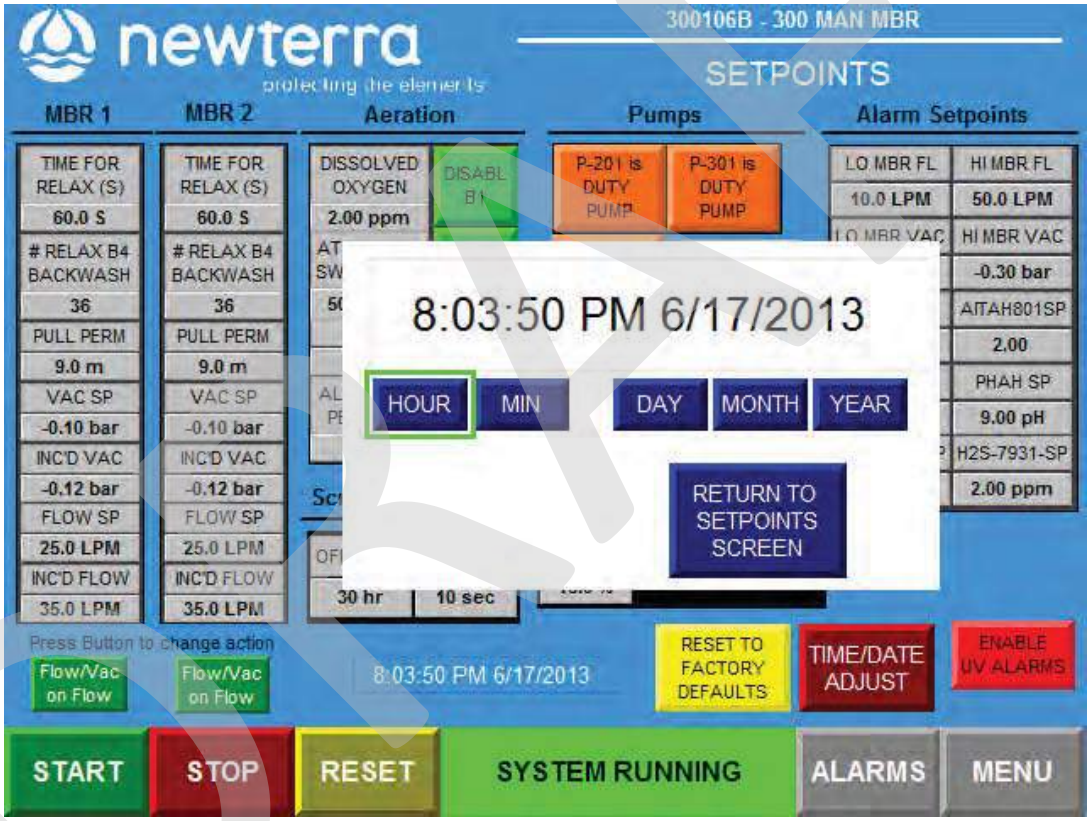
The following screen shows **setpoints** modification procedure. **Setpoints** should only be modified under the direction of **newterra** engineers to prevent damaging the membranes.

RESET TO FACTORY DEFAULT (yellow button) - Pressing this button will reset all process and alarm setpoints to the default values at the factory.



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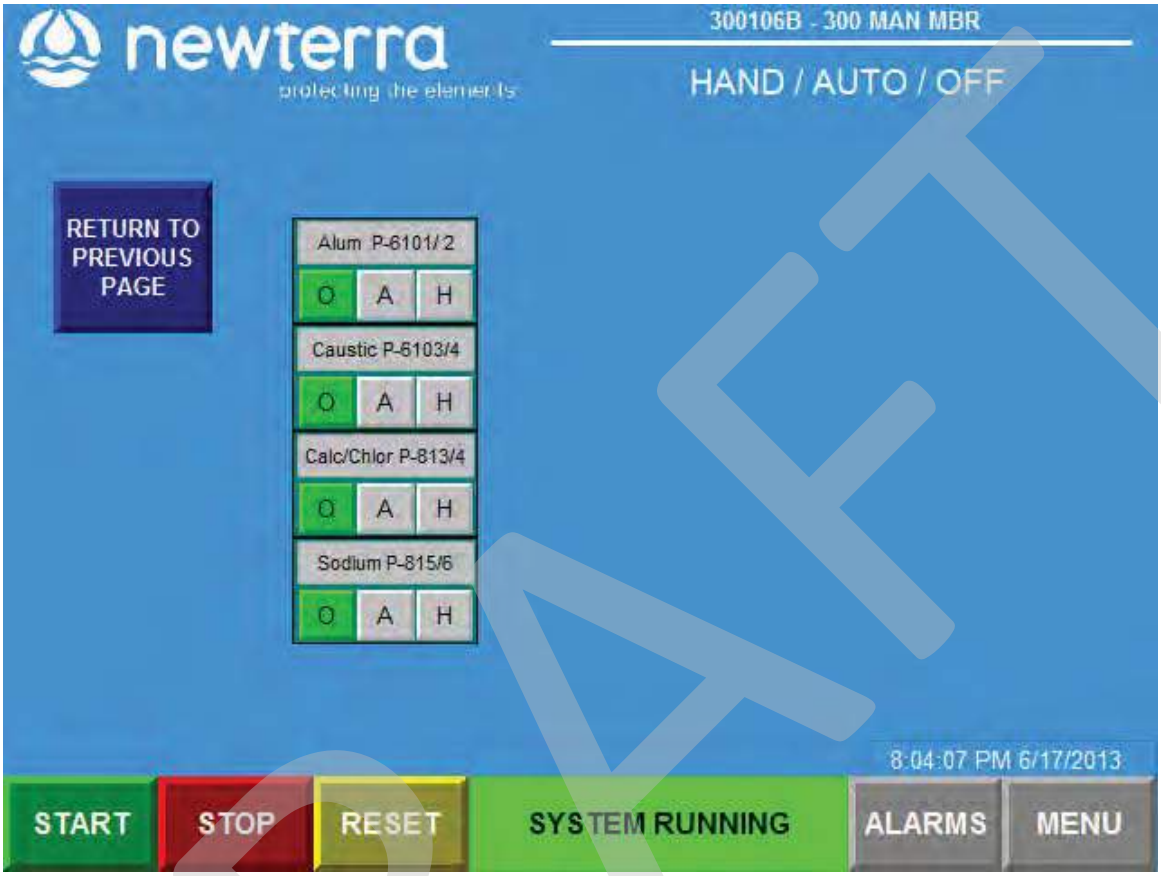
5.2.4 System HAO's (HAND /AUTOs/ OFF)

The **Hand / AUTO / OFF** screen is accessed from the main menu by pressing the "**HAO**" button.

- Each PLC controlled motor or valve in the system has **a Hand/Auto/Off (HAO)** Switch to control its operation. This screen displays all the system HAO's
- For normal operation, all switches should be in the **AUTO (A)** position
- The **HAND (H)** position of a switch is used for testing and troubleshooting of the system. As a safety precaution to prevent damage to equipment, the equipment will operate for two minutes in hand mode and will then return to the **OFF (O)** position



5.2.5 Motor Info Control Screen

The following screen shows the status of the VFD's and their PID control values.

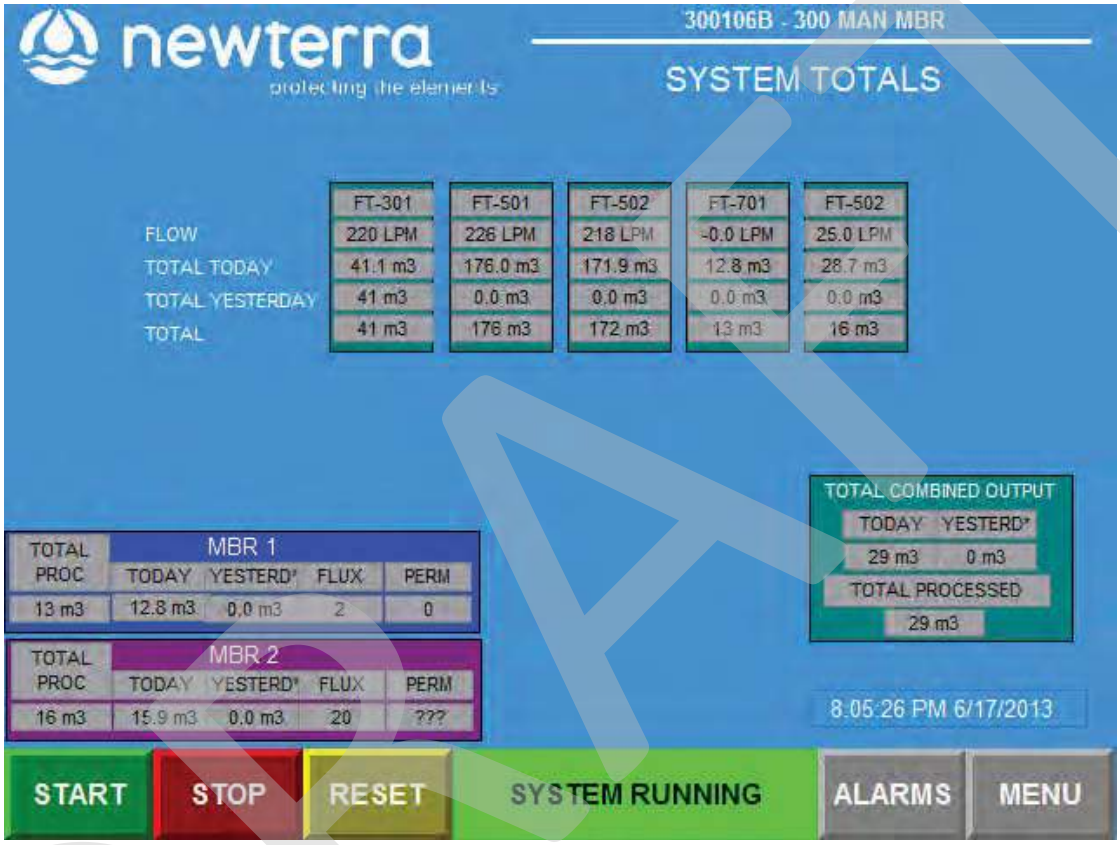
5.2.6 Moto Hours Control Screen

Motor Hours screen is accessed from the main menu by pressing the “Motor Hours” This screen shows the total number of hours that each motor can run.

- When the SERVICED button is pressed, it resets the hours since service to zero (0)
- When the REPLACED button of a motor is pressed, it resets the total hours to zero (0).

5.2.7 System Totals

The **System Totals** Screen is accessed from the main menu by pressing the **"TOTALS"** button



This screen is used to show:

- The total amount of water processed through the process train, and also current (today) amount and amount of water processed yesterday
- Flux (**J**) for membrane unit expressed in **LMH (L/m²·h)**
- Permeability **(K)** for membrane unit expressed in **LMH/bar**

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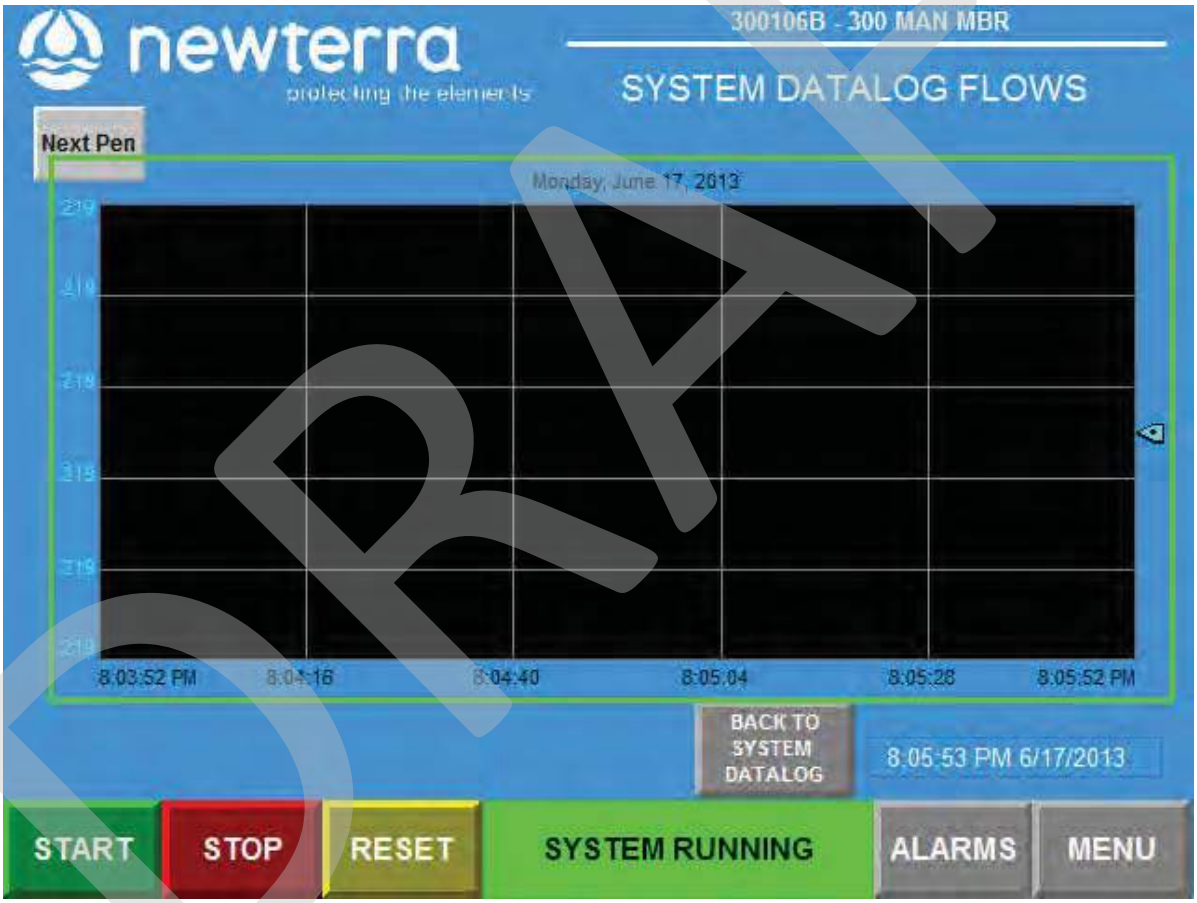
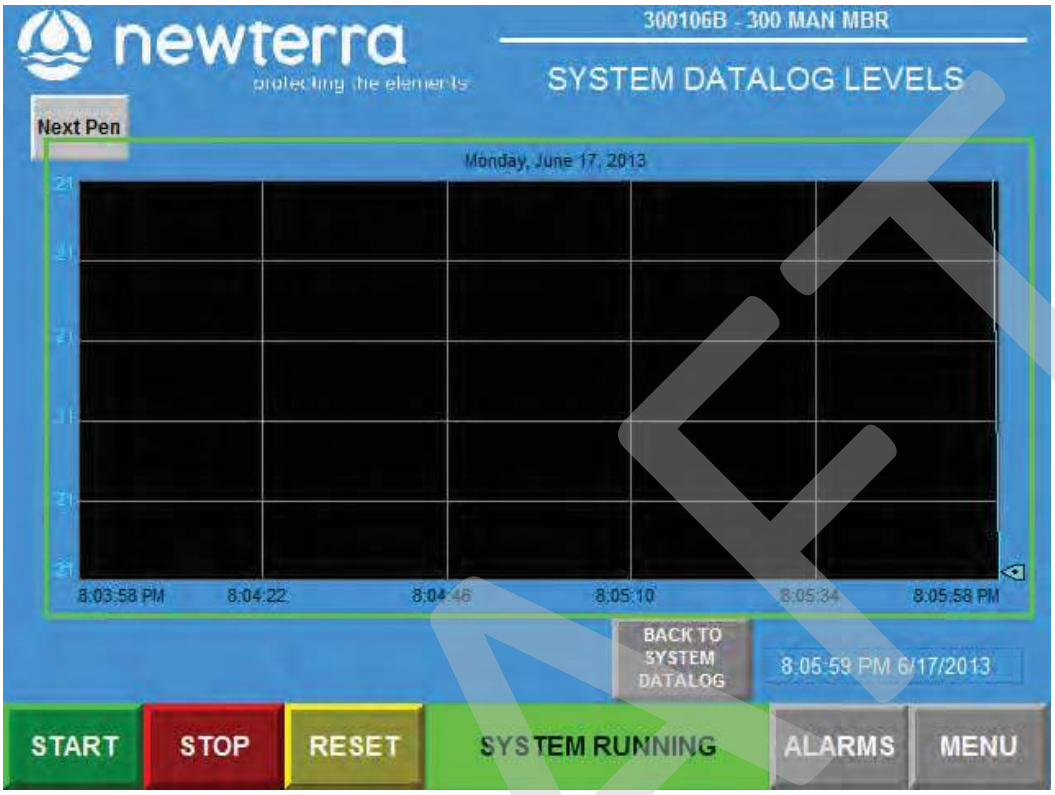
5.2.8 System Data Log Screens

- The following screens show how system is setup with extensive dada log to keep a history of the performance.
- It shows real time data log of critical process operating parameters
- This information is saved on a USB stick that is located on the front of the control panel
- The LOG INTERVAL setting determines how often data points are stored. The factory default setting is 600 seconds





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6.0 PLANT START-UP, OPERATING GUIDELINES AND MONITORING

6.1 Plant Start-Up

Mechanical & Electrical Start-up Procedure:

- If the system is being started for the first time, work your way through the **newterra Pre-Commissioning Test Checklist** presented in **Appendix C** of this O&M Manual.
- If the kill switch on the panel (red mushroom shaped button) is pulled out, then push it in to confirm that the MBR system is off.
- Push the reset button on the operator interface to reset all alarms.
- Make sure there are no obstructions over any moving parts, for example a jacket laying on a belt drive.
- Put all HAND/OFF/AUTO switches to AUTO **(A)** mode.
- Pull the kill Button (red button on panel) out to start the process.
- Push the start button on the Operator Interface.

Process Start-up:

Seeding

The procedure for determining the amount of seed sludge required for process start-up, and methods for seeding the system are as follows:

1. Calculate the volume of seed sludge required to ensure that there is a minimum of 3,000 mg/L MLSS in the membrane tank. The volume of seed sludge required can be calculated with the following formula.

$$V_s = \frac{3000 \times V_t}{MLSS_s}$$

V_s: Total volume of seed sludge for MBR system (m^3)
V_t: Total volume of process tanks in MBR system (m^3)
$MLSS_s$: MLSS concentration of seed sludge from a similar treatment system (mg/L)

2. Arrange for delivery of fresh seed sludge from an activated sludge system employing a suspended growth type process. If it is possible, obtain seed sludge from a facility treating a similar wastewater and operated with similar processes (nitrification etc).

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3. Drain the water used for clean water testing from the reactor, if the returned activated sludge (MLSS<10,000 mg/L) is used. Do not drain the water after clean water testing, if the dewatered sludge is used.

4. **Screen all seed sludge with the 2 mm basket screen** before the sludge is transferred to the aeration or membrane tanks **to remove gross solids and rags and hair**.

5. Remove grit from the screen if required.

6. Once the tanks are fully seeded in aeration tank and membrane tank is turned on, the system can start to work. Do not waste sludge, as membrane filtration continues, until the MLSS in the aerobic or membrane tank becomes concentrated to the targeted concentration. The system will be started at a reduced design flow/loading initially per **newterra** start-up schedule.

7. Foaming may occur during start-up, which is normal. However, after a period of time (1 week), the foam should disappear. Foaming can be addressed by water spraying, food based defoamer **(silicone based defoamer is strictly prohibited**) addition, or aeration minimization in the membrane tank.

8. If a defoamer is required, contact **newterra ltd**. for recommendation of an acceptable antifoaming agent and dosing quantities.

9. Process start-up and adaptation periods can last for two or three weeks.

10. If fresh activated seed sludge is not available, **newterra** can supply dry cultures bacteria (a consortia group of different kinds of bacteria) for start-up. Please consult newterra ltd; quantities of dry bacteria and procedure of seeding will be confirmed by newterra technical representative during commissioning / start-up period.

ATTENTION	No untreated wastewater should enter the membrane tank. Make sure wastewater is completely biologically treated before it gets to the membrane tank

ATTENTION	It is advisable to start the MBR system with a minimum MLSS concentration of 3,000 mg/L to minimize foaming. The seed sludge should come from a plant which has a screen of 2 mm. It is critical to screen the seed sludge with 2 mm perforated screen prior to seeding for membrane protection.

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6.2 System Operating Guidelines and Monitoring

6.2.1 Operating Guidelines

The operators are expected to run the MBR system at all times in accordance with the maintenance, operational procedures and details specified in this manual. The following two tables provide operating parameters that can be easily maintained, and define the range of operating values.

There may be situations where the system needs to operate outside of the conditions covered in this manual. If these conditions develop, please consult newterra ltd. to discuss operation and methods to optimize performance.

Generally, the following points can be used to operate the MBR system properly:

1. The MBR system is designed to treat wastewater with specified influent characteristics.
2. Never operate the MBR tank below the minimum membrane submerged level. It is necessary to maintain a minimum of 250 mm liquid level above the membrane modules to ensure they are wet at all times and to allow for proper filtration.
3. Always supply the required amount of air for scouring to the membrane module.
4. Always filter wastewater at or below design flow rate.
5. Periodically, relax the membranes by ending filtration while allowing the membrane aeration scour to operate continuously and initiate backwash operation during membrane relaxation (default relaxation mode preset in PLC - permeation continues for 9 min and stops for 45 sec, and backwash the membrane).
6. Always operate the MBR in accordance with the parameters listed in the following tables.
7. Clean the membranes in-place with a dilute chemical in accordance with **Section 7** of the O&M Manual.

Membrane Filtration Operational Conditions

Parameter	Recommended Value	Notes
Diffuser Relaxation	10 minutes/day	Effluent filtration must be turned off, blower shuts down for 10 mins/day
Relax Time	1 min/10 min	Filtration must be off and blower are operating continuously
Backwahing	48 cycles	Built-in backwash mode during relaxation mode
In-situ Chemically Enhanced Backwash (CEB)	200 ppm as NaOCl	Requires 3 L to fully backwash one MCXL cassette. Frequency of CEB may vary. Refer to Membrane Cleaning Section 7.3 for cleaning procedure.

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Avg Flux Rate	15 LMH (9 gpd)	Average flux rate with permeation 9 minutes out of 10 minutes
TMP	< 0.2 bar (2.9 psi)	Membranes to be cleaned once the TMP exceeds 0.2 bar (2.9 psi)

MBR – Recommended Biological Operational Conditions

Parameter	Recommended	Range	Notes
MLSS (mg/L)	10,000	8,000 – 15,000	Never operate the membranes if MLSS < 3,000 mg/l. Sludge wasting should be undertaken as required to maintain target MLSS
Temperature (°C)	15 - 35	10 – 35	Avoid sudden changes in temperature. Minimum operating temperature is 15 °C
pH (s.u.)	6.8 - 8.5	6.0 – 9.0	Membrane module can handle a change in pH, however it is recommended to keep pH between 6.8 - 8.5
Aeration Tank, DO (mg/L)	≥ 2.0	1.0 – 8.0	This can be maintained by adjusting the volume of air supplied to the aeration tank
Viscosity (mPa-s)	Not applicable	0 – 300	–
Membrane Tank to Aeration Tank Recirculation	400%	200 – 600%	–
F:M (kg BOD/kg MLSS/d)	0.1	0.03 – 0.2	F:M = [Flow (m^3/d) x BOD conc (mg/l)] / [Process volume (m^3) x MLSS conc (mg/l)]
F:M (kg COD/kg MLSS/d)	0.15	0.05 – 0.3	F:M = [Flow (m^3/d) x BOD conc (mg/l)] / [Process volume (m^3) x MLSS conc (mg/l)]
SRT	> 15	12 – 50	

Process Troubleshooting Guide is presented in **Appendix M** of this O&M Manual.

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6.2.2 Sampling

To ensure accurate system monitoring and the validity of laboratory test data, samples must be collected as outlined below. These are only recommended guidelines. It is imperative that scheduled testing protocols are performed in compliance with local regulatory agency requirements. Composite samples of the MBR systems may need to be sent out to a certified laboratory for testing, based on the local regulatory requirements

Monitoring and Testing Requirements

Parameter***	Influent	Aeration Tank	Membrane Tank	MBR Effluent
Flow rate	D (PLC)			D (PLC)
Fat, Oil and Grease (FOG)	AR			AR
Alkalinity	AR			
Biological Oxygen Demand (BOD)	W			W
Total Suspended Solids (TSS)	W			W
Total Kjeldahl Nitrogen / Total Nitrogen (TKN / TN)	M			AR
Ammonia Nitrogen(NH_4-N)				AR
Nitrate Nitrogen (NO_3-N)				AR
Total Phosphorus (TP)	W			W
Mixed Liquor Suspended Solids (MLSS)			W	
Mixed Liquor Volatile Suspended Solids (MLVSS)			AR*	
Temperature		D (PLC)		
pH	AR	D (PLC)		W
Dissolved Oxygen (DO)		D (PLC)		
Filterability			TW	
Turbidity				AR**
Fecal Coliform / *E-Coli*				W

Legend: D = daily; W = weekly; TW = three times weekly; M = monthly; AR = as required.

* If MLVSS /MLSS ratio of a minimum of 0.7 is detected, MLVSS testing can be done periodically, on an "as required" basis.

**The effluent should be routinely checked for any signs of problem. Normally, the effluent is reasonably clear, colourless, and odourless. If the effluent becomes turbid, testing should be carried out required.

*** Explanation and definition of abbreviations, acronyms and terms used in the manual are presented in **Appendix G – Glossary & Terms and Appendix H – Biological Treatment & Monitoring Parameters.**

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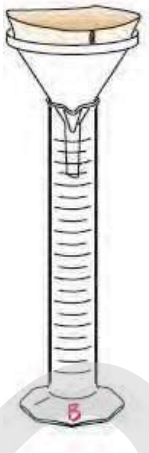
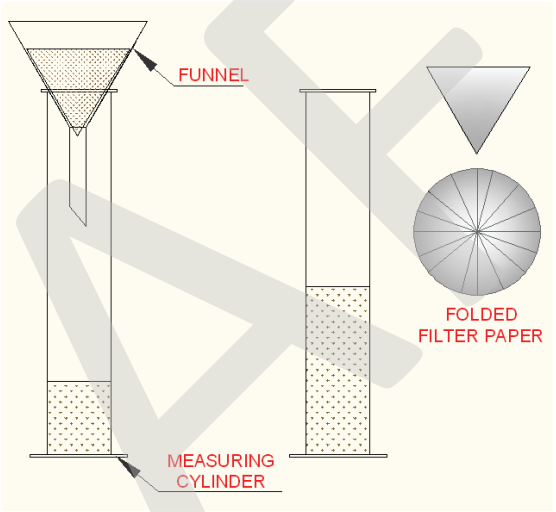
Filterability Test

The objective of the filterability test is to evaluate the condition of the working biomass. This is assessed by measuring the volume of filtrate passing through the filter paper. If filtrate is greater than 10 mL/10 min, then biomass filterability is acceptable; however, if it is less than 10 mL/10 min, modifications to the plant operating condition are required to prevent premature membrane fouling.

Laboratory Glassware and Filter Paper





Apparatus:

Filterability Kit is distributed by **newterra ltd (Part # 24146).**

Filterability Kit includes:

- Filter paper distributed;
- Funnel (75 mm diameter recommended);
- 2 - 50 mL graduated cylinder;

Stop watch

Measurement Procedure:

1. Pleat filter paper by folding in half, quarters etc.
2. Line the funnel with pleated filter paper and place the funnel in the graduated cylinder.
3. Collect 50 mL of activated sludge sample in a beaker and stir.
4. Pour the 50 mL sample into the funnel.
5. Start timer when the first drop of water filtered through the filter paper.
6. After 10 minutes of filtration, record the level of filtrate in the graduated cylinder.

Filterability (FT)	Action	State of urgency
> 10 ml	Excellent, no action req'	
5 - 10 ml	Tweak process operation	
< 5 ml	Process adjustment req	**Contact newterra ltd.**

6.2.3 Record Keeping

An essential component of quality control in any facility is sound record keeping. A log book covering the entire treatment system performance should be maintained, updated, and readily accessible to all operators. The log book should be used to record observations, set point alterations, and unusual conditions.

For each wet chemistry parameter analysis, a separate work-sheet has to be prepared. Work-sheet data for at least the previous year should be kept for possible consultation.

The second step in quality control is to train all operators to follow an established procedure for each test. Identical samples should be periodically tested for any parameter by different operators, and the variability among results should be compared. Consistent variability in results may lead to the technique improvement of operators.

Duplicate analysis of a sample should also regularly be done. And, split samples should regularly be sent to an outside accredited laboratory and analysis results should be compared with those done in-house.

In addition to summary sheets, it is highly recommended that data should be entered into prepared Excel spread-sheets. Spread-sheets greatly aid in the data presentation and manipulation, and would be of immeasurable value when report writing is required.

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6.2.4 Process Trending

Other than pre-planned process changes or major upsets, process modifications should be based on trends shown in the process data. A trend is nothing more than an indication of real change in a process parameter over time. A trend chart is simply a graph of data being trended.

As the graph changes, upward or downward trends are detectable. Smoothing trends by graphing the 3-, 7-, or 30-day average of the data allows the trend to be shown more clearly. Because the individual data point may be questionable, the actual value of data point are less important compared with the trend regarding the process monitoring.

Trend graphs are a part of the Excel data spread-sheet; the operator can trend and analyse many parameters in just a few minutes in order to assess process performance.
When a trend is identified, its indication to the process can be evaluated, and corrective action may be carried out, if needed. Statistically, the more data points there are in a trend chart, the more reliable the trend.

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7.0 SYSTEM MAINTENANCE

CAUTION: Shut off all electrical power before working on the mechanical or electrical equipment.

The system should be routinely checked for any signs of operational problems. Such problems could include, but are not necessarily limited to, abnormally high peak flows, unpleasant odour, and diffuser clogging, and so on.

7.1 Plant Visual Checks

Noise	During normal operation, there is a uniform humming sound at the plant. In case of an unusual noise, it could be an indication that the blower needs maintenance or repairs.
Smell	The MicroClear™ MBR is an aerobic system. During normal operation, the system has an earthy smell similar to that of a well-maintained compost pile. If other odours are noticed, the aeration process may not be operating or the system has been overloaded. Check the DO manually and the blower to verify proper operation.
Sight	Normally, the effluent is reasonably clear, colourless, and odourless. If the effluent becomes turbid, there is a pin hole in the membrane or a leakage in the piping. Take the unit out of operation and investigate. **Check uniformity of membrane air distribution periodically to ensure air scoring is effective across all membrane plates.**

7.1.1 Air Scouring Patterns in Membrane Tanks

Membrane air scouring check is essential procedure for **newterra** MBR WWTP. Air scour has to be observed for uniformity of bubbling action all across the membrane module/cassette on regular basis.

A visual inspection of the aeration patterns should be performed with the liquid level 2-3" (5 – 7.5 cm) above the permeate pipe.

Proper air scouring in membrane tank

Uneven aeration in membrane tank

It is easy to observe aeration patterns through clear window in membrane tank. Operator should note any unusual patterns of air distribution. The visual inspection also should be performed before any membrane cassette removal from membrane tank. Operator has to check for:

- damage of air diffusers - if this occurs, empty the tank and fix the diffuser;
- air leakages - if this occurs, tighten up the fittings.

If there is insufficient air scouring, localized dewatering (**clogging, sludging, caking and plugging**) may occur and may in turn lead to membrane fouling.

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7.2 Schedule for Routine Operation and Maintenance Checkups (if Applicable)

Location	Item	Day	Week	Month	Quarter	Year	Comments
HEADWORKS	**Inspect and maintain grease trap in the kitchen of the work/mining camp**		X	X*			*Kitchen grease trap(s) should be checked weekly and cleaned monthly to ensure proper performance.
	Inspect lift station with sump pumps		X				
	Remove grease from lift stations and top of PC tank		X				
PROCESS	**Perform visual check**	X					Refer to Plant Visual Checks
	Check for proper wasting to sludge system		X				
	Record permeate flow rate	X					
	Record DO in the aeration tank	X					
	Record pH in the aeration tank	X					
	Record vacuum pressure at the membranes	X					Normal range: 0.07 – 0.15 bar (28" -61" WC)
Note: When the vacuum at the membranes reaches 0.2 bar/2.9 psig/80" WC), stop the permeation and perform recovery cleaning (please see procedure separately)							
MECHANICAL & PROCESS	**Inspect membranes and permeate withdrawal system**		X				1 hour
	Clean and calibrate the DO sensor			X			1 hour
	Inspect and maintain valves & fittings for leaks		X				
	Clean manually Fine Screen and direct solids to primary settling/sludge holding tank		X				may require daily cleaning during start-up (subject to PI502 reading)
	Membrane in-situ cleaning				X		2-4 hours
	Remove membrane module for mechanical cleaning and inspection					X	Drain membrane tank. Roll out membrane cassette. Remove membranes and inspect. (1 -2 days)
	Visual inspection of air bubbles in the equalization, aeration and membrane tanks		X				Replace diffusers if big uneven bubbles/high turbulence is found.

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Location	Item	Day	Week	Month	Quarter	Year	Comments
MECHANICAL & PROCESS	**Remove, inspect and maintain diffusers in equalization, aeration and membrane tanks**					X	This involves a complete draining of tanks (1-2 days)
	Pump out solids collected in the primary settling/sludge holding tank for offsite disposal				X		
	Check and record UV instrumentation: % Transmissivity vs required minimum; Remaining Lamp Life; Total Days of Operation		X				
	Inspect and maintain pump bearings			X			
	Check blower operation (if vibrating)		X				
	Check time clock setting		X				
	De-ragger (foam suppression unit)						may require daily cleaning during start-up
	Inspect functionality of baseboard heater				X		
	Check ventilation systems for container					X	
ELECTRICAL	**Check electrical leads**				X		
	Inspect and maintain breakers, fuses, resets and anodes			X			
	Check motor mounting bolts			X			
	Clean dust away from electric motor			X			
	Check PLC and control panel functionality		X				

All connections (hoses, hose clamps, camlocks) have to be checked periodically (on a monthly basis) to make sure all of them are in good conditions.

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7.2.1 De-ragger operation and maintenance cleaning

Please refer to the drawing presented in **Appendix A** of this O&M Manual.

De-ragger is part of the anti-foaming system which is provided in the system for foam suppression in the aeration tank. The main purpose of a de-ragger in this system is to avoid the spray nozzles clogging by catching fibres and other impurities found in the recirculation water pumped through the system.

De-ragger is simple equipment consisting of a PVC clear pipe, a nylon bristle brush installed in the pipe, and a fernco coupling for quick disconnection. During the water spraying process the brush (with a sliding fit in the pipe) catches fibres and other impurities
.
When the de-ragger is filled with impurities, perform maintenance as follows:

- Turn off P-503 operation.
- Close 2' PVC isolation valve and open 1' PVC drain valve and drain the content to a 20-L pail.
- Disconnect fernco coupling.
- Remove brush and rinse with clean water.
- Close the drain valve and reassemble the fernco coupling.
- Make sure all connections are tight.
- Open isolation valve.
- Turn on P-503 operation.

7.2.2 Polymer Make-up Instructions

Please refer to the P&I Diagram presented in **Appendix A** of this O&M Manual.

1. Fill polymer make up tank (conical bottom mixing tank) with 100L clean water
2. Open air mixer speed valve by turning valve one and a half revolutions (1 ½) to allow mixer to run at high speed
3. Slowly add 1 cup (~250ml) of Powdered CC4509 polymer into vortex beside mixer shaft (keep bag sealed when not in use)
4. Run mixer on high speed for 5 min
5. Reduce mixer speed to low by turning value back to half (1/2) a revolution open, continue mixing for 45 min
6. Polymer is now ready to use

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7.3 Membrane Cleaning

7.3.1 Membrane In-situ Chemically Enhanced Backflush (CEB)

Chemical cleaning is only to be carried out by qualified and trained personnel! Chemicals can lead to serious injuries. Always wear personal protective equipment (PPE) when handling chemicals! Obey the chemical safety handling procedure as listed in the Material Safety Data Sheets.

It is recommended that in-situ CEB be carried out before the TMP exceeds 0.2 bar (or permeability drops rapidly to 50 LMH/bar) This is typically done once every couple weeks/months depending on biomass characteristics and system operating condition.

On certain occasions, membrane module/cassette may need to be physically inspected for membrane integrity if membrane permeability performance is not recovered after the cleaning (i.e., suspect of membrane deterioration); please refer to subsection **7.3.3**.

The maximum backwash pressure of MicroClear™ MCXL filter is 0.1 bar or equivalent to a 100 cm water line. Only use gravity force to perform the backflush.

Note: Membrane have a maximum active chlorine tolerance of 100,000 ppm.h.

For better cleaning performance, it is recommended:

- Potable water (permeate is acceptable if potable water is unavailable)
- Water temperature is above 20 ^{0}C (better cleaning efficiency if water temperature ranges from 20 to 30 ^{0}C)

Procedure

Note: Only clean (backwash) one membrane tank at time.

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***Step 1: Cleaning with sodium hypochlorite (NaOCl)* - 3L cleaning solution required per MCXL cassette for in-situ CEB. The CEB is performed manually.**

1) Press the disable membrane button on the screen.

2) Open valve (SV-801) and allow water to fill up the backwash tank (T-801) to LSH-801 level.

3) Close valve (SV-801).

4) Add concentrated NaOCl into the backwash tank to a concentration of 500 mg/L (acceptable range of 200 to 1,000 mg/L).

Volume of concentrated NaOCl required can be calculated with the following formula,

$$V_x = \frac{V_m \times 0.05}{C_s}$$

V_m: Volume of the solution (Gallon, or Litre), equal to 3 L multiplying the number of MCXL cassettes;
C_s: Concentrated NaOCl concentration (%)
V_x: Volume of concentrated NaOCl required (Gallon, or Litre)

5) Open valve (MV-701 or MV-702) and inject chemical solution by pump (P-801) into membrane tank (TNK-601 or TNK-602) until reach LSL-801 level in backwash tank. (T-801).

6) Soak the membranes in NaOCl solution for 1-2 h. Adjust air scour in interval, if necessary, to control potential foaming.

7) Resume normal operation by turning off the disable membrane button. Check permeability. Normal permeability after cleaning: 150 to 300 LMH/bar.

8) Repeat the cleaning procedures if the normal permeability value is not attained.

Step 2: Cleaning with Citric Acid – only required in case of inorganic fouling caused by the high hardness.

Rinse membrane filter thoroughly with potable water to completely remove NaOCl solution before treatment with citric acid. Mixing NaOCl with citric acid releases toxic chlorine gas!

1) Repeat the above steps with 0.2% citric acid solution (a max of 2%)

7.3.2 Membrane Recovery Cleaning

The membrane recovery cleaning is to be done once a year at a minimum. On certain occasions, membrane cassette may need to be inspected for membrane integrity (suspect of membrane deterioration, membrane permeability performance does not recover after the cleaning, etc.).

Disable operation of the dedicated membrane tank that needs to be cleaned by pressing the disable membrane button on the screen.

For better cleaning performance, it is recommended:

- Potable water is used
- Water temperature is above 20 ^{0}C (better cleaning efficiency if water temperature ranges from 20 to 30 ^{0}C)

Procedure

Step 1: Cleaning with Sodium Hypochlorite (NaOCl)

1. Drain all mixed liquor from the membrane tank to the sump/recycle back to the process tanks.

2. Clean (wash down) the membrane tank with potable water and drain the dirty liquid to the sump/recycle back to headwork.

3. Turn off air scour, fill the membrane tank with potable water until the membranes are completely covered, and add NaOCl into the membrane tank to a concentration of 500 mg/L as free chlorine (max. 1,000 mg/L). Turn on air scour for 5 min to mix the solution and turn it off during membrane soak.

   Volume of NaOCl required can be calculated with the following formula:

$$V_x = \frac{V_m \times 0.05}{C_s}$$

V_m: Volume of membrane tank (Gallon, or Litre)
C_s: NaOCl concentration (%)
V_x: Volume of NaOCl required (Gallon, or Litre)

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4. Keep the membranes soaked for a min 12 hours in the NaOCl solution (longer soak time required if severe fouling is evident). Air scour can be on intermittently during soak time (5 min every 4 hrs).

5. Drain spent NaOCl solution to the sump/recycle to headwork.

6. Rinse membrane filter thoroughly with potable water and drain the entire tank. Rinse waters are drained to the sump/recycle back to the headwork.

Step 2: Cleaning with Citric Acid – only required in case of inorganic fouling caused by the high hardness

Rinse membrane filter thoroughly with potable water to completely remove NaOCl solution before treatment with citric acid. Mixing NaOCl with citric acid releases toxic chlorine gas!

1. Fill the membrane tank with potable water, turn on scouring air, and add citric acid to pH 2.0. Turn off air scour when the pH of 2.0 is reached.
2. Keep the membranes soaked in the citric acid solution for 2 hours (longer soak time required if severe fouling is evident).
3. Drain spent citric acid solution, rinse membranes thoroughly with potable water and drain all the rinse waters. Spent citric acid solution and rinse waters are drained to the sump/recycle back to headwork.

Step 3: ***Resume normal operation***

Step 4: Checking Permeability on Clean Water

Normal permeability after cleaning: 150 to 300 LMH/bar.

Repeat the cleaning procedures If normal permeability is not achieved.

Note: Membrane maintenance (CEB) and recovery cleaning has to be recorded according to Membrane Cleaning Log Sheet presented in Appendix K of the manual.

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7.3.3 Membrane Physical Check

***WARNING:** A membrane cassette that has been in operation weighs more than dry membrane cassette before installation.*
Failure to comply with the instructions provided in this manual can cause equipment & property damage or severe personal injury, and will render the warranty null and void.

To remove membrane module from membrane tank

This procedure is required if the membranes are being inspected as part of routine maintenance for physical check or being replaced.

Once membrane inspection or replacement has begun, it must be completed promptly. It is important that the membrane DO NOT DRY OUT OR FREEZE during this procedure.

1. Lifting the membrane cassette out of a tank or emptying a tank should take at least 5 min. For each single filter layer.

MicroClear™ Membrane Module	Filter Layers	Acceptable time for membrane filter lifting out of the membrane tank or empting the tank
MB2- series	2	10 min
MB3- series	3	15 min
MB4- series	4	20 min (module must be separated in to 2 parts)
MB5- series	5	25 min (module must be separated in to 2 parts)

Note: Non observance will lead to damage of the filters because of exceeding the maximum backwash pressure.

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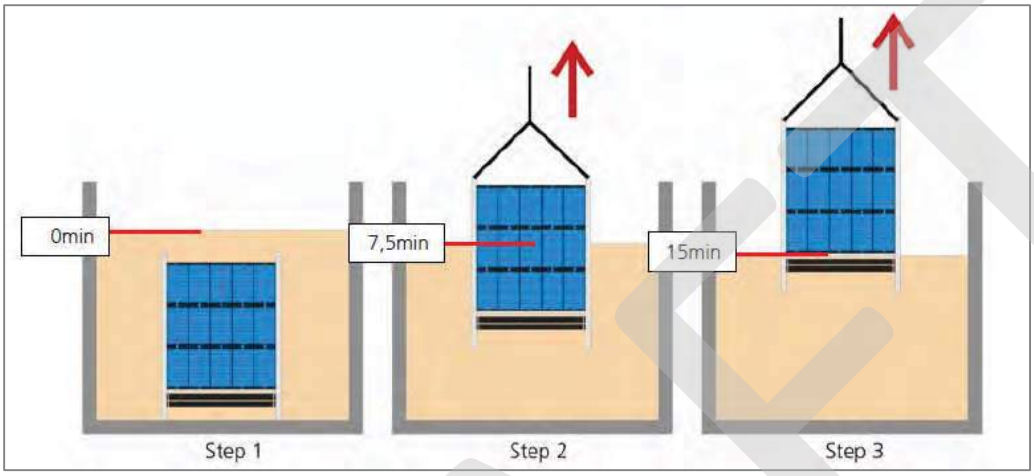

Schematic of MicroClear™ membrane module lifting / emptying of the membrane tank

Membrane module replacement

If membranes require changing verify membrane modules are secure within the membrane tanks after re-installing the modules – i.e. verify wheel chocks are in the correct location and that there is no lateral movement (less than an inch) of the membrane modules on the wheel tracks in the tank.

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8.0 SHUT DOWN

8.1 Temporary Shut Down

A temporary shutdown for a few days requires continuous aeration of the biomass to keep the DO level at least 2 mg/L and continues biomass recycle between the bioreactors.

8.2 Permanent Shut Down / Winterizing

Permanent shut-down is required if system operation stops at least for 2 weeks without inflow. Permanent Shut Down includes the following procedure:

- Perform membrane cleaning before permanent shut down / winterizing.
- Drain all tanks.
- Remove membranes and winterize
    - For short term storage (up to 6 months): soak membranes in 10 ppm NaOCl solution, and membranes are not allowed to dry out), never expose the membrane unit to frost, dust, rain, or direct sunlight.
    - For long term storage: soak membranes in preservation solution - 20 % glycerin solution (by weight).The glycerin will pass through the membrane via diffusion and provides pore protection from freezing and from drying out.
- Disassemble all PVC ball valves and drain any water inside (open and close to ensure trapped water escapes).
    - Leave all valves ½ open during reinstallation
- Open all drain valves and leave open.
- Clean and reinstall all sprayer nozzles.
- Find all check valves and make sure water is not being held by valve (Wet/Dry Vac works well here).
- Drain / remove all pumps from tanks, ensure no water is left inside the pump.
- Use RV biodegradable Antifreeze to
    - Refill any check valve
    - Dump in 2 (qty) 4-L bottles in each tank
- Remove pH and DO probes (if unit is equipped) and store with membranes in a heated area ensure probes are kept wet.
- Remove power from system.

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Double check and ensure that there is no water left in any pipes, fittings etc. If it is not possible to remove the water fill with antifreeze.

Glycerine Solution Solution Components and Solution Make-Up

1. Chemicals:
Technical Glycerin (86.5%)
Distilled water

2. Solution make-up procedure:

Dissolve technical glycerin (86.5%) in water and homogenize according the following table.

Preservation Solution 20 % Glycerin	Technical Glycerin [86,5%]	Distilled Water
[kg]	[kg]	[kg]
1	0.23	0.75
10	2.3	7.5
100	23	75
1000	230	750

The preservation solution has a density of 1,045 g/cm^3. The concentration of preservation solution can be tested and corrected with a density meter.

Membrane preservation procedure

- Allow the membrane unit to soak in preservation solution for a few hours.
- Remove the membrane unit and allow excess glycerin to drain.
- Shrink wrap the unit with a thick (1.5 mm) plastic bag and seal membrane unit using a hand sealer or tape.

For long term storage preserved unit should be stored in a cool (4^{0}C - 20^{0}C), dry area, away from direct sunlight and protected from accidental damage.

Re-commissioning the unit is straight forward. Once unit is lowered into MBR Tank, first start the aeration, then the permeate pump. In order to let all the traces of glycerin in the permeate to dissipate, make the arrangement for the permeate to recycle back to the aeration tank for the first half hour.

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9.0 SERVICE & SUPPORT

Commissioning and Start-up

newterra MicroClear™ MBR System's **commissioning & start-up** is the last step of the **newterra** project execution process. Experienced engineers and technicians are available to assist clients in these procedures including system initial set up and primary start-up and providing all performance tests according to the pre-commissioning checklist.

Initial on-site training program is an important part of the commissioning service as well. During on-site training, **newterra** technical representative will cover process monitoring, system operation, maintenance, and troubleshooting activities related to the **newterra** ™MBR System. Customized training packages are available. Contact **newterra** for more information.

Post commissioning Services

A comprehensive range of post commissioning services is available from within **newterra** beyond system design and installation. Specific services are included:

- Technical support (including after-hours emergency telephone support).
- Spare parts order and delivery.
- Training program.
- Plant optimization and upgrades.
- Telemetry control and monitoring.
- Assistance in preparing system performance reports (process data monitoring & analysis).
- Preventive maintenance cleaning (including membrane cleaning).
- System audits for reviewing the performance of all MBR subsystems and the efficiency.

1. **Technical support** is available to assist in troubleshooting of **newterra** MBR system during normal working hours 8:30 am to 5:00 pm (Eastern Time Zone for **newterra** ltd.). Telephone service is available via **1.800.420.4056**.

Emergency **24/7 telephone technical support –** This will be activated upon subscribing to **newterra's** 24/7 technical support service.

If problem cannot be resolved through telephone or e-mail supports, **newterra** engineers are available for site visit.

Appendix E
Steensby and Rail Camps Freshwater Supply, Sewage and Wastewater – Plans for Future Work

There will be no construction and development of Steensby and the Rail camps in the near future. Updates to these sections of the Plan will be done when required and will be included in a future Annual Report to NWB as required by Part B, Item 4 of existing Type A Water Licence (2AM-MRY1325 Amendment No. 1). Block Flow Diagrams for Steensby and Railway Camps will be updated when required.

E.1 Freshwater

E.1.1 Freshwater System Process Description

E.1.1.1 Steensby Port Site

Currently, there are no construction activities planned for Steensby Inlet. During the future construction phase the on-site population will be approximately 600 people. Half the camp personnel will be accommodated on a barge which will be equipped with potable water treatment systems. The potable system onboard the barge will be a reverse osmosis based system. The full configuration will include coagulation, filtration by media filter, reverse osmosis and chemical disinfection. The remaining personnel will be accommodated by a land based potable water treatment system. This system will continue to operate during the operation phase while the barge based system will only be used during the construction phase.

The existing fresh water equipment will not be used and a new fresh water distribution system will be installed. The fresh water demand for construction and operation are shown on the drawing Steensby Site - Water Supply Balance Block Flow Diagram in Appendix C.

For the land based system, a heated and insulated pump house will be built at Lake ST347 with duty/standby pumps to deliver fresh water to a fresh water tank (located in close proximity to the new potable water treatment plant). Water from this tank will be used to provide fire water as well as meet the fresh water requirements of the site. A stand pipe within the tank will ensure that fire water is always available in the tank. Some fresh water requirements such as road dust suppression, stockpile dust suppression, concrete and explosives manufacturing will be provided directly from nearby lakes using a vacuum truck.

The land based potable water treatment scheme will consist of coagulation followed by media filtration and disinfection by ultraviolet radiation. The water will then undergo a secondary disinfection by sodium hypochlorite injection to ensure residual chlorine content at the point of use. The applicable guidelines specify minimum required levels of chlorine residual free chlorine. The barge based potable water treatment scheme will include the same equipment as well as a membrane based system to desalinate the seawater source.

E.1.1.2 Mid-Rail Site

Currently, there are no construction activities planned for the Mid-Rail Site. During the future construction phase, the on-site population will be approximately 200 people. A new potable water treatment system and fresh water distribution system will be put in place to support the construction phase operations. The fresh water demand for construction and operation are shown on the drawing Mid-Rail - Water Supply Balance Block Flow Diagram in Appendix C.

A heated and insulated pump house will be built at an adjacent Unnamed Lake with duty/standby pumps to deliver fresh water to a fresh water tank during summer. During the winter, water will be trucked from Ravn Camp Lake to the fresh water tank. This tank will be located in close proximity to the new potable water treatment plant. Water from this tank will be used to provide fire water as well as meet the fresh water requirements of the site. A stand pipe within the tank will ensure that fire water is always available in the tank. Some fresh water requirements such as road dust suppression and tunnel drilling will be provided directly from nearby lakes by vacuum truck.

The potable water treatment scheme will consist of coagulation followed by media filtration and disinfection by ultraviolet radiation. The water will then undergo a secondary disinfection by sodium hypochlorite injection to ensure residual chlorine content at the point of use. The applicable guidelines specify minimum required levels of chlorine residual free chlorine.

E.1.1.3 Ravn River Site

Currently, there are no construction activities planned for the Mid-Rail Site. During the future construction phase, the on-site population will be approximately 400 people. A new potable water treatment system and fresh water distribution system will be put in place to support the construction phase operations. The fresh water demand for construction and operation are shown on the drawing Ravn River - Water Supply Balance Block Flow Diagram in Appendix C.

A heated and insulated pump house will be built at Ravn Camp Lake with duty/standby pumps to deliver fresh water to a fresh water tank (to be located in close proximity to the new potable water treatment plant). Water from this tank will be used to provide fire water as well as meet the fresh water requirements of the site. A stand pipe within the tank will ensure that fire water is always available in the tank. Some fresh water requirements such as road dust suppression and tunnel drilling will be provided directly from nearby lakes by vacuum truck.

The potable water treatment scheme will consist of coagulation followed by media filtration and disinfection by ultraviolet radiation. The water will then undergo a secondary disinfection by sodium hypochlorite injection to ensure residual chlorine content at the point of use. The applicable guidelines specify minimum required levels of chlorine residual free chlorine.

E.1.1.4 Cockburn Tunnels Camp Site (Cockburn North Camp)

Currently, there are no construction activities planned for the Cockburn Tunnels Camp Site. During the future construction phase, the on-site population will be approximately 100 people. A new potable water treatment system and fresh water distribution system will be put in place to support the construction phase operations. The fresh water demand for construction and operation are shown on the drawing Cockburn Lake Tunnels Camp - Water Supply Balance Block Flow Diagram in Appendix C.

A heated and insulated pump house will be built at Cockburn Lake with duty/standby pumps to deliver fresh water to a fresh water tank (located in close proximity to the new potable water treatment plant). Water from this tank will be used to provide fire water as well as meet the fresh water requirements of the site. A stand pipe within the tank will ensure that fire water is always available in the tank. Some fresh water requirements such as road dust suppression and tunnel drilling will be provided directly from nearby lakes by vacuum truck.

The potable water treatment scheme will consist of coagulation followed by media filtration and disinfection by ultraviolet radiation. The water will then undergo a secondary disinfection by sodium hypochlorite injection to ensure residual chlorine content at the point of use. The applicable guidelines specify minimum required levels of chlorine residual free chlorine.

E.1.1.5 Cockburn South Camp Site

Currently, there are no construction activities planned for the Cockburn South Camp Site. During the future construction phase, the on-site population will be approximately 400 people. A new potable water treatment system and fresh water distribution system will be put in place to support the construction phase operations. The fresh water demand for construction and operation are shown on the drawing Cockburn South - Water Supply Balance Block Flow Diagram in Appendix C.

A heated and insulated pump house will be built at Cockburn Lake with duty/standby pumps to deliver fresh water to a fresh water tank (located in close proximity to the new potable water treatment plant). Water from this tank will be used to provide fire water as well as meet the fresh water requirements of the site. A stand pipe within the tank will ensure that fire water is always available in the tank. Some fresh water requirements such as road dust suppression and tunnel drilling will be provided directly from nearby lakes by truck.

The potable water treatment scheme will consist of coagulation followed by media filtration and disinfection by ultraviolet radiation. The water will then undergo a secondary disinfection by sodium hypochlorite injection to ensure residual chlorine content at the point of use. The applicable guidelines specify minimum required levels of chlorine residual free chlorine.

E.2 Sewage Treatment

E.2.1 Sewage Treatment Process Description

E.2.1.1 Steensby Site

During the construction and operation phase the camp population will increase to approximately 600 people. There is no planned construction at Steensby Site in the immediate future.

During construction start-up, sewage generated by the workforce will be treated in an existing sewage treatment plant that is on-site but not yet installed. During the construction phase, 300 people will be accommodated by a temporary sewage treatment system in place for the construction period. In addition, the temporary sewage treatment plant will be designed to process raw or partially treated sewage from the Cockburn Lake rail camps which will be conveyed to the Steensby temporary sewage treatment facility by truck. The remaining workforce will be accommodated by a permanent sewage treatment system which will remain in service during the operation phase.

These sewage treatment plants will be housed in a temperature controlled areas and as such their performance will not be negatively impacted by arctic conditions.

Effluent from the sewage treatment plants will be stored in effluent tanks. The effluent tanks will have a hydraulic retention time of two days (at minimum) based upon nominal flows. It is intended that the effluent tank will be at a low level during operation such that if sampling indicates that the effluent quality does not meet the applicable criteria further discharge can be prevented for a period in excess of a day to allow this effluent to be mixed, retreated, and retested. In addition this retention volume will allow for a minimal amount of recirculation through the STP using any spare STP capacity. This will improve the quality of the final effluent in the tank. The volume is sufficient to allow for periodic sampling and testing of the treated effluent before discharge or reuse. The new permanent sewage treatment facility will be RBC based technology or superior. Treated effluent will be discharged to the ocean.

The equalization tank that feeds the temporary sewage treatment plant will be sized to accommodate the sewage from the Cockburn Lake and Cockburn South rail camps. The rail camp sewage will be added during periods of low sewage generation at Steensby in order to reduce excessive surge volumes building up in the tank.

The sludge generated will be dewatered using a mechanical dewatering device such as belt filter or filter press and then incinerated. Sludge cake will be stored in an animal proof secure area. Odour generation will be limited because the sludge will be aerobically digested, dewatered and incinerated regularly such that the sewage cake is not stored for significant periods. Odour control carbon vents will be installed where deemed necessary. The incinerator design will consider the solids content of the sludge from the dewatering device.

The equalization tank that feeds the new sewage treatment plant will be sized to accommodate the sewage from the Cockburn Lake and Cockburn South rail camps. The rail camp sewage will be added during periods of low sewage generation at Steensby in order to reduce excessive surge volumes building up in the tank.

The sludge generated will be dewatered using a mechanical dewatering device such as belt filter or filter press and then incinerated. Sludge cake will be stored in an animal proof secure area. Odour generation will be limited because the sludge will be aerobically digested, dewatered and incinerated regularly such that the sewage cake is not stored for significant periods. Odour control carbon vents will be installed where deemed necessary.

E.2.1.2 Mid-Rail and Ravn River Sites

Sewage waste generated at the Ravn River and Mid-Rail camps and Sewage generated at the Cockburn North and Cockburn South camps can only be transported and treated at either the Mine Site Sewage Treatment Facility or the Steensby Port Sewage Treatment Facility, unless otherwise approved by the Board in writing.

Sewage generated at these sites will mainly be conveyed to the Mary River permanent sewage treatment facility by truck. During the first year when there will only be access to the camp via an ice road, sewage can only be trucked from January to April. During the remaining months the sewage will be stored. There would be an opportunity to partially or fully treat sewage prior to storage. Sewage storage facilities may be aerated to prevent the waste from becoming septic (generating odours and noxious gases). Sludge will form and settle in the facility depending on how long the sewage resides there. This sludge will be withdrawn and delivered separately to the dewatering system at the Mine Site. Given the quantity of waste to be moved or stored every effort will be made to reduce this volume by using low flow showers and toilets and potentially segregating gray water to be treated and reused as urinal flush water. Other potential waste minimization techniques will also be reviewed. These will be evaluated during the detailed design. In addition, the surrounding water bodies will be modelled and sampled to potentially support having sewage treatment and waste discharge near the camp sites. An additional amendment to the Type A Water Licence would be required to support this option.

The equalization tank at Mary River will be sized to provide sufficient residence time for freshly added sewage from the Mid-Rail or Ravn River to mix with sewage generated at the Mine Site. Given that sewage generation follows diurnal patterns the sewage from the remote sites will be added during the low generation periods at the Mine Site.

E.2.1.3 Cockburn Tunnels (Cockburn North) and Cockburn South Sites

Sewage generated at these sites will be conveyed to the Steensby permanent sewage treatment facility by truck. Raw to partially treated sewage will be conveyed to Steensby Inlet by means of established roads

along the rail alignment or by ice road. Depending on the volume of sewage to be stored at site, the sewage storage facilities will be sized accordingly. At the north camp there will only be access to the camp via an ice road and as such sewage can only be trucked from January to April. During the remaining months the sewage will be stored. Sewage storage facilities will be aerated to prevent the waste from becoming septic (generating odours and noxious gases). There will be the opportunity to partially or fully treat sewage prior to storage. Sludge will form and settle in the facility depending on how long the sewage resides there. This sludge will be withdrawn and delivered separately to the dewatering system at the Steensby site. Given the quantity of waste to be moved every effort will be made to reduce this volume by using low flow showers and toilets and potentially segregating gray water to be treated and reused as urinal flush water. Other potential waste minimization techniques will also be reviewed. These will be evaluated during the detailed design. In addition, the surrounding water bodies will be modelled and sampled to potentially support having sewage treatment and waste discharge near the camp sites. An additional amendment to the Type A Water Licence would be required to support this option.

The equalization tank at Steensby will be sized to provide sufficient residence time for freshly added sewage from the Cockburn Tunnels (Cockburn North) and Cockburn South camps to mix with sewage generated at the Steensby site. Given that sewage generation follows diurnal patterns the sewage from the remote sites will be added during the low generation periods at the Steensby site.

E.2.1.4 Design Considerations from 'Lessons Learned'

Previous studies have recommended the use of Polishing Waste Stabilization Ponds (i.e. Mary River Project Appendix 10D-3 Wastewater Management Plan SD-EMMP-003, March 31, 2010) followed by a secondary waste polishing system. The existing infrastructure at the Mine Site and Milne Port include these ponds in part to allow for secondary treatment of the sewage treatment plant (STP) effluent which was not meeting the phosphorus discharge limit. However, based upon practical experience at the site with the STP it was projected that a secondary polishing system will not be required in the future.

The new systems will be installed with temporary storage ponds for off-spec water but will not require secondary polishing for the following reasons:

- The proposed new STPs will be based on membrane technology. This technology produces better quality effluent, is less susceptible to the impact of varying loads and has shorter start-up periods.
- The STP trains will be better able to handle upsets by using the available spare capacity to operate the equipment at more conservative flow rates.
- The existing equipment (at the Mine Site) was designed to meet a phosphorus discharge criterion of 0.5 mg/L. The new STPs shall be designed to meet a much lower phosphorus discharge criteria of <0.1 mg/L.

Sewage Treatment equipment vendors will be assessed based upon their experience producing equipment for arctic environments.

E.2.2 Oily Water/Wastewater Treatment Process Description

The process descriptions for both oily water/wastewater treatment systems for Steensby are described in the section that follows.

E.2.2.1 Steensby Site

Future Construction and Operation Phase

Oily water may be generated from the following sources (this neglects minor oily water generated from accidental spills which will be handled by the Spill Response Plan):

- Vehicle maintenance and wash facilities (i.e. truck wash, equipment and floor wash down water).
- Fuel tank farm run-off.
- Emulsion plant wash water.
- Freight dock.
- Airstrip.

The vehicle maintenance and wash facility will have a sump located in close proximity to the maintenance facilities. Wash water produced in the maintenance facility (truck washing, equipment and floor washdown) will flow by gravity and be collected in the local sump. Suspended material in the wastewater will settle in the sump. Free oil in the wastewater will be removed by an oil/water separator system in order to meet the required oil discharge limits. The waste will then be further treated in the oily water treatment plant by activated carbon and clay to meet other specific parameters. The effluent will then be pH adjusted, if required, to meet discharge criteria.

Treated effluent from the oily water treatment plant will be pumped to discharge, or recycled and reused as washdown water at the maintenance shops. The separated waste oil will be stored in a local tank. Periodically, the oil will be drained and shipped off site or incinerated. Accumulated suspended solids will be periodically removed and sent to the landfarm for treatment, if necessary.

Run-off from the tank fuel storage areas will have to be treated by the mobile oily water separator system that will be used as needed. The resulting water will be discharged directly to the receiving body (Steensby – Ocean). The water will be periodically tested such that if any parameter is out of compliance the water will be removed by vacuum truck and treated in the vehicle maintenance shop wastewater treatment plant.

Run-off water from the freight dock will be collected and treated in a manner similar to the treatment scheme for the run-off from the tank fuel storage areas.

The emulsion plant shall be supplied with its own wastewater treatment plant which utilizes an evaporation system to evaporate the water leaving solid residue and oil. This residue will be tested for toxicity and if necessary taken off-site for disposal at a licensed facility otherwise the waste will be land filled.

Run-off water from the air strip run-off also has the potential for some oily water content. As such, this water will be collected through a drainage system and transported as needed by vacuum truck to the vehicle maintenance shop wastewater treatment plant.

Small amounts of propylene glycol will be used for de-icing of aircraft. The spent propylene glycol will be collected, stored in containers and sent by ship off-site to a licensed treatment/disposal facility. Some interim treatment of the spent propylene glycol may occur to reduce the overall waste volume generated. This will be evaluated during the detailed design.

Some dust suppression solution will be applied to roads at the Steensby site. The suppressant will be DL-10. This is an asphalt based emulsion and as such some water will be consumed for the dilution of the solution. This is an approved dust suppressant as specified by the Nunavut Department of Sustainable Development Environmental Protection Service (Environmental Guideline for Dust Suppression).

In addition, some Calcium Chloride solution will be used for drilling activities. The spent brine will be applied to nearby roads as a dust suppressant. This is an approved dust suppressant as specified by the Nunavut Environmental Protection Service. Treated oily water will be blended with treated sewage and discharged or discharged directly based on sampling.

E.2.2.2 Rail Camps

Two tunnels are to be built along the railway and a small amount of water will be consumed in the tunnelling operation. Calcium Chloride brine solution is used for tunnelling. This waste brine generated during the tunnelling will be collected and disposed of as per the Waste Management Plan for Construction, Operation and Closure. In addition, some Calcium Chloride solution will be used for drilling activities.

Appendix F
Polishing Waste Stabilization Ponds (PWSP) Effluent Discharge Plan

Technical Memorandum

To: Jim Millard, Baffinland Iron Mines

From: Dave Ellis, P.Eng., AMEC
Jered Munro, AMEC

Date: March 27, 2012

REGISTERED PROFESSIONAL ENGINEER
D.D.J. ELLIS
LICENSEE
Mar 27/12
NT/NU

Subject: PWSP Effluent Discharge Plan

Baffinland Iron Mines Corporation (BIM) has retained AMEC Environment & Infrastructure (AMEC) to prepare this plan for the management, treatment, and disposal of the wastewater stored in the polishing/ waste stabilization ponds (PWSPs) at the Milne Inlet and Mary River facilities.

This plan updates the previous plan presented March 2010. To the extent possible, the discharge plans and options presented herein are flexible with a view to accommodating various seasonal operating requirements.

AMEC was retained by BIM in 2009 to develop and design a polishing treatment system for treating the effluent from the Mary River sanitary treatment system stored in the three PWSPs at that site. This memorandum identifies the following:

- the design criteria,
- overall discharge approach,
- the polishing system treatment components and functionality, and
- the sampling and performance monitoring plan.

This PWSP effluent discharge plan remains largely unchanged from the 2009 plan.

POLISHING SYSTEM DESIGN CRITERIA

Discharge Quality

The design criteria for the effluent discharge quality are defined in the water licence issued by the Nunavut Water Board, Licence 2BB-MRY1114 dated April 5, 2011 and are summarized below:

Table 1: Discharge Criteria of PWSP Effluent

Parameter	Discharge Criteria (Maximum Concentration of any Grab Sample)	
Location	**Mary River WWTF**	**Milne Inlet WWTF**
BOD_5	30 mg/ L	100 mg/L
TSS	35 mg/L	120 mg/ L
Faecal Coliform	1,000 CFU/100mL	10,000 CFU/100mL
Oil and Grease	No visible sheen	No visible sheen
pH	Between 6.0 and 9.5	Between 6.0 and 9.5
Toxicity	Final effluent not acutely toxic	Final effluent not acutely toxic
Ammonia[1]	N/A	N/A
Total Phosphorus[2]	0.5 – 1.0 mg/L	N/A

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Notes: 1. No specific criteria for ammonia, but effluent must be acutely non-toxic.
2. The range set for total phosphorus discharge target levels to Sheardown Lake were set based on results of the mass loading model developed by North South Consultants.

The phosphorus limit was confirmed to not be detrimental to the receiving aquatic environment by North/South Consultants, who employed modelling software to predict the effects of the effluent discharge based on the maximum design parameters listed in Table 1.

Following Part I, Items 4 and 5, the water licence requires sampling of the effluent from the PWSPs to be completed once prior to discharge, and every four weeks thereafter, for the following parameters:

- Biochemical oxygen demand (BOD),
- Total suspended solids,
- pH,
- Faecal coliform, and
- Oil and grease (visual).

Toxicity testing on treated effluent is required to be completed once annually during open water season at the final discharge point in accordance with the following tests:

- Acute lethality to Rainbow Trout (Oncorhynchus mykiss) as per Environment Canada's Environmental Protection Series Biological Test Method EPS/1/RM/13.
- Acute lethality to Daphnia magna as per Environment Canada's Environmental Protection Series Biological Test Method EPS/1/RM/14.

The discharge criteria remain largely unchanged from the previous licence 2BB-MRY0710 with the notable exception that the current licence specifies the compliance parameters in terms of "maximum concentration of any grab sample" as compared to the previous licence which listed compliance parameters as "maximum average" concentrations.

Discharge Flow

The design polishing system flow rate was originally determined based on a desired operating schedule of 24 hours per day, 7 days per week, for a duration of 3 weeks. The combined storage volume contained in the Mary River PWSPs No. 2 and 3 was estimated at approximately 6 million liters (~1.5 MUSG).

The flow rate of 375 L/min (100 USgpm) was set as the nominal design flow rate for the polishing system. This design flow rate was used to select the required chemical dosing equipment and was used for initial planning purposes based on an assumed 75% uptime rate and a discharge of 75% of the design flow rate.

The effluent discharge pipe to Sheardown Lake is a 3" diameter, HDPE pipe that is approximately 1.5 km long. To achieve the 100 USgpm design flow rate through the long discharge pipe requires considerable discharge pressure be developed at the pump discharge. Practical limitations in operating gas-powered centrifugal pumps in series have prevented the planned flow rate from being achieved.

The Milne PWSP is estimated to hold approximately 0.5 million litre (approximately 130,000 USgals) of combined RBC sludge, grey water, and snow melt.

OVERALL PWSP DISCHARGE APPROACH

Once the water in the PWSPs begins to thaw in late May, a sample from each of the PWSPs is submitted for analysis of the regulated effluent criteria parameters. Depending on the water quality confirmed in the respective PWSP, discharge may commence, as detailed below.

Option #1—Spring Discharge

If the PWSP melt water sample is in compliance with the regulated criteria, Baffinland will commence discharge of the compliant effluent.

Once discharge has commenced, Baffinland will field test for pH, and turbidity and complete confirmatory sampling using bench-top screening methods to monitor the effluent quality. Discharge will be discontinued following established Standard Operating Procedures (SOPs) if any of the tests approach effluent criteria limits.

Sheardown Lake remains ice covered during the Spring Discharge. This ice cover requires a hole be augered through the ice and a temporary discharge pipe installed. The temporary discharge pipe conducts the effluent to a point below the ice to prevent erosion or sediment entrainment due to the discharge flow. At the completion of the Spring Discharge the temporary pipe is removed from Sheardown.

The quality of the water in the Milne PWSP has typically been such that the spring melt water has been compliant with the criteria without further polishing treatment.

Option #2—Summer Polishing Treatment and Discharge

If the water quality in the PWSPs does not meet all effluent discharge criteria, then the effluent would be treated using all or part of the polishing treatment system, depending on the particular parameters of concern. During the start-up of the polishing treatment system, the effluent is discharged back into a PWSP. The treated effluent would not be discharged until laboratory analytical results confirmed that the polishing treatment system was producing compliant effluent.

Following confirmation of effluent quality, the polishing system is operated and the treated water discharged to Sheardown Lake until the PWSPs have been emptied or weather conditions become unfavourable for treatment.

Should the Milne PWSP water require further polishing treatment, it can be transferred to Mary River for treatment and discharge through the Mary River PWSP system.

POLISHING TREATMENT SYSTEM COMPONENTS AND FUNCTIONALITY

The polishing treatment system was designed to provide additional treatment for total suspended solids (TSS) and total phosphorus (TP) removal, as well as pH control.

The polishing system contains the following unit processes, as shown in the attached Process Flow Diagram, PFD-01 (Attachment A) and the attached photographs (Attachment B). A more detailed description and photographs are included in the system Operation and Maintenance Manual.

Influent Pump and Flow Meter

A pump draws from one of the ponds and feeds water at a design flow of 100 USgpm. A flow meter with totalizer is used to monitor this influent flow. Flow to the polishing system can be controlled by throttling the influent pump speed or by adjusting a 3-inch ball-valve that bleeds water back into the pond.

Chemical Addition

Water treatment chemicals were added to the influent water to aid in the treatment process. The following chemicals were used in the 2009 and 2011 polishing system:

- Aluminum sulphate (commonly called “alum”), and
- A polymer, marked “Polyfloc AP1138” by the manufacturer, GE Betz Inc.

Aluminum Sulphate (Alum) Addition

Aluminum sulphate is added to achieve three goals:

- Precipitation of soluble phosphorous to a solid,
- Coagulation of algae and other suspended solids, and
- Reduction of pH.

Alum is dosed into the influent pipe by means of a chemical metering pump and then mixed in the flocculator piping to promote precipitation and coagulation chemical reactions and achieve flocc formation.

Polymer Addition

Polymer is added, after the alum, to further enhance the formation of larger solids allowing them to separate more quickly from the bulk liquid once in the DAF tank. The polymer serves as a flocculant which promotes the agglomeration of smaller coagulated solids into larger flocs. These larger flocs are more readily removed by downstream processes.

Polymer is added in a similar fashion as the aluminum sulphate, with mixing in the flocculator piping before entrance into the DAF.

Dissolved Air Flotation (DAF) System

Water containing alum and polymer is combined with a recirculating stream of water which is supersaturated with dissolved air. As the dissolved air comes out of solution, microscopic air bubbles are formed on the flocculated solids, thus increasing their buoyancy. These buoyant solids float to the surface and can be easily skimmed off.

Air Dissolving Pump

The dissolved air flotation (DAF) system is comprised of a number of components. The heart of the system is a Hellbender-brand air dissolving pump. This pump is specifically designed to accept large amounts of air mixed with water, and operates under high pressure to dissolve and shear the air into fine micro bubbles. When the high pressure, air-rich, stream meets the lower pressure flocculated influent water, dissolved air comes out of solution forming small air bubbles. These small bubbles attach to the flocculated solids causing them to rise to the surface once inside the DAF tank.

DAF Tank

Influent water that has already been combined with the air-rich recirculation water is distributed across the width of the rectangular DAF tank through a relatively large, 6-inch diameter distribution header. This large inlet header is used to minimize water entrance velocity and facilitate a quiescence of the water in the tank.

These quiescent conditions in the DAF tank allow the buoyant solids to float to the surface. Solids are periodically skimmed off the top of the tank, over a collection beach, into a sludge trough. The sludge trough discharges collected solids by gravity to two large totes for disposal.

At the opposite end of the DAF tank from the inlet is the outlet. Clarified water is collected through a 4-inch diameter effluent header located halfway up the height of the tank. The clarified water is directed to the final effluent clear-well tanks.

Floated Solids Storage and Pumping

Two parallel solids holding tanks have been provided to capture the floated solids. A pump is used to pump the float solids into PWSP No. 1 for storage.

Final pH Adjustment

Two effluent clear-well tanks are connected in series so that the water can be pH adjusted with sodium bicarbonate, if needed.

Final Filtration

If desired, the effluent can be passed through a final filtration process prior to discharge.

Effluent Pumping and Flow Monitoring

Clarified water is pumped through Tsurumi brand trash pumps, that discharge into the 3-inch Sheardown discharge pipeline. The treated water discharge flow is measured using a flowmeter with totalizer.

SAMPLING AND PERFORMANCE MONITORING

During operation, the treatment system is attended on a continuous basis. Samples of the daily field logs are attached (Attachment C). Attachment C.1 is the daily field log used during the spring discharge, when there is little or no treatment of the PWSP water required. Attachment C.2 is used when the full polishing system is required as may be necessary during late summer.

The polishing system is controlled using field testing devices for pH and turbidity measurement. Adjustments were made to the aluminum sulphate and sodium bicarbonate dosing pumps to control the pH and the polymer dosing pump was used to control the turbidity (indicative of total suspended solids-TSS). Physical inspection of the DAF inlet and discharge streams, as well as the consistency of the floated solids layer, indicated to the operators how well the system was operating. In the event of a suspect test result, a bypass valve is used to redirect effluent back to the PWSP while the system operation was adjusted and retested.

A summary of the PWSP external lab and in-house analysis program can be found in tables (2) and (3).

Table 1 – On-site lab analysis parameters and schedule.

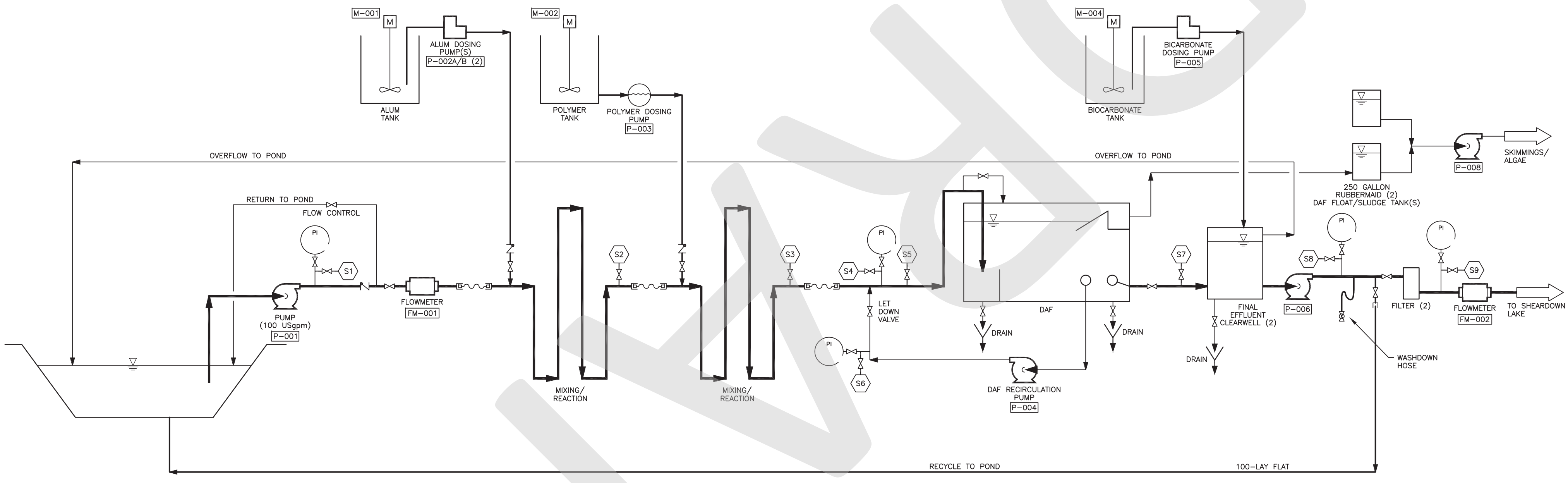
In House Analysis	Daily (onsite lab)	Hourly (in field)
pH	✓	✓
Temperature	✓	✓
Turbidity	✓	✓
TP	✓	
Ammonia	✓	
COD	✓	

Table 2 – External lab analysis parameters and schedule.

External Lab Analysis	Pre Discharge	Middle of Discharge	Every Week
BOD	✓		✓
COD	✓		✓
TSS	✓		✓
TP	✓		✓
Fecal Coliforms	✓		✓
Toxicity	✓	✓	
O&G	✓		✓

Attachment A

PWSP Polishing System Process Flow Diagram (PFD-01)



CAUTION: THIS PLAN MAY BE REDUCED 0 25mm 50mm ORIGINAL SCALE

NO.	REVISION	DATE	APRVD
0	O&M REVISIONS	08/10	

DRAWN	JR	AUG 2010
DESIGNED	JW	AUG 2010
CHECKED		
REVIEWED		

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PROCESS FLOW AND INSTRUMENTATION DIAGRAM
BAFFINLAND IRON MINES
POND WASTEWATER TREATMENT
DISSOLVED AIR FLOATATION SYSTEM

DATE:	MARCH 2012
SCALE:	N.T.S.
SHEET:	1 OF 1 SHEETS
PROJ No: TR1662	P&ID-01

Filepath: T:\Pete\Geomatics\2012\122684-I Baffinland (TR)\TR1662-P&ID01.dwg
Plot Time: Mar 23, 2012 - 11:43am, Plotted By: Del Surey2

Appendix G
Mobile Oily Water Separator (OWS) Manual

(See BAF-PH1-830-T07-0001)

Baffinland Iron Mines Corporation

Mobile Oily Water Separator (OWS) Manual

BAF-PH1-830-T07-0001

Rev 0

Prepared By: Andrew Vermeer
Department: Environment
Title: Environmental Coordinator
Date: March 21, 2016

Signature: 

Approved By: Allan Knight
Department: Environment
Title: Environmental Superintendent
Date: March 21, 2016

Signature: 

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