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# **Baffinland Iron Mines Corporation**

Fresh Water Supply, Sewage, and Wastewater Management Plan

BAF-PH1-830-P16-0010

Rev 3

Prepared By: Jim Millard **Department: Environment** 

Title:

**Environmental Manager** 

Date:

March 19, 2015

Signature:

Approved By: Erik Madsen

Department: Sustainable Development, Health, Safety &

**Environment** 

Title:

Vice President, Sustainable Development, Health,

Safety & Environment

Date:

March 19, 2015

Signature:

Cl Molean



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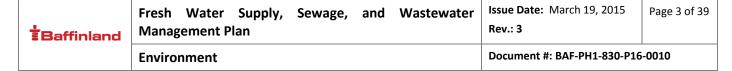
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# Index of Major Changes/Modifications in Revision 3

Item No.	Description of Change	Relevant Section
1	Updated Introduction for annual reporting requirements.	Section 1
2	Updated Table 4-1: Water Use for Domestic and Industrial Purposes During the Construction Phase to include the requirements of both the Type A Water Licence (2AM-MRY1325) and the Type B Water Licence (8BC-MRY1416).	Table 4-1
3	Updated Freshwater Section for Milne Port and Mine Site to account for future construction and operation.	Sections 4.2, 4.3.1 and 4.3.2
4	Updated Table 5-1: STP Average Sewage Flow Design Basis for future construction and operations.	Table 5-1
5	Updated Table 5-3: Approximate Treated Effluent Generation and Discharge/Outfall Locations to include the as-built Milne Port and Mine Site discharge locations.	Table 5-3
6	Updated Sewage Section for Milne Port and Mine Site to include discharge locations for future construction and operation.	Section 5.2, 5.3, 5.4, 5.4.1 and 5.4.2
7	Updated Oily Water Treatment Section for Milne Port and Mine Site for future construction and operations.	Section 6.2.1
8	Added Sedimentation Pond Section for future construction and operations.	Section 7
9	Updated Sampling, Monitoring, and Reporting Section for annual reporting requirements.	Section 10.2 and 10.3
10	Updated Organizational Chart	Figure 11-1

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Item No.	Description of Change	Relevant Section
11	Updated Appendix A Table of Concordance to include both the Type A	Appendix A, Table A-2
	Water Licence (2AM-MRY1325) and the Type B Water Licence (8BC-	
	MRY1416).	
12	Included 2015 Work Plan	Appendix B
13	Updated Site Layouts for Mine Site and Milne Port	Appendix B
14	Updated Block Flow Diagrams for Construction Water Supply at Milne Inlet	Appendix C
	and Mine Site	
15	Updated date statements where appropriate in Appendix E – Steensby and	Appendix E
	Rail Camps Freshwater Supply, Sewage and Waste Water – Plans for Future	
	Work	

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Appendix D - Sewage Treatment Plant O & M Manual

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## 1 INTRODUCTION

This document describes the plan to manage the fresh water supply and wastewater for the various camp sites to be developed for the Mary River Project during the construction and operation phases of the Project. Specifically, this document focuses on freshwater supply and wastewater treatment and disposal at Milne Port, Mine Site, Steensby Port and various rail camps.

In accordance with annual reporting requirements this plan has been updated to take into account commitments made with respect to submissions received during the preliminary and technical review of various regulatory Application documents as well as final submissions and issues raised during Public Hearing Processes. This plan has also been updated to support the 2015 Work Plan (see Appendix B).

The Fresh Water Supply, Sewage, and Wastewater Management Plan (the Plan) is an update to the existing plan and supersedes the BAF-PH1-830-P16-0010, Revision 2, dated January 2014 plan. This Plan will continue to support the Membrane Biological Reactor (MBR) sewage treatment plants (STPs) installed in 2014 which service the Mine Site Complex (MSC) and Port Site Complex (PSC) camps, and continue to support the potable water supply and oily water treatment activities under the Type 'A' Water Licence. This Plan will also support the 2015 upgrades and additions to the MBR STPs which will service the 2015 MSC and PSC camp expansions at Mine Site and Milne Port, respectively.

This Plan should be used in conjunction with the Aquatic Effects Monitoring Plan (AEMP)<sup>1</sup>, (BAF-PH1-830-P16-0039) and the Surface Water Sampling Program – Quality Assurance and Quality Control (QA/QC) Plan<sup>2</sup> (BAF-PH1-830-P16-0001).

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<sup>&</sup>lt;sup>1</sup> Baffinland Iron Mines Corporation. Mary River Project – Aquatic Effects Monitoring Plan, Rev. 0. June 27, 2014.

<sup>&</sup>lt;sup>2</sup> Baffinland Iron Mines Corporation, Mary River Project - Surface Water, Aquatic Ecosystems, Fish and Fish Habitat Management Plan, Rev. 3, March 2015.

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# 2 REGULATIONS, STANDARDS, AND CODES

As a minimum standard of acceptability, all actions undertaken will be compliant with appropriate sections of both Federal and Provincial legislation as indicated in the table below:

TABLE 2-1: APPLICABLE REGULATIONS, STANDARDS AND CODES

Number/Acronym	Title		
AWWA	American Water Works Association		
IBC	International Building Codes		
NSF	National Sanitation Foundation		
GCDWQ	Guidelines for Canadian Drinking Water Quality		
NWT Regulation 108-2009	Northwest Territories Water Supply System Regulations		
Ontario Regulation 170/03 Safe Drinking Water Act, 2002			
Nunavut Waters and Nunavut Surfa	ce Rights Tribunal Act, SC 2002, c 10		
Northwest Territories Water Act			
Northwest Territories Water Regula	tions (SOR/93-303)		
Ontario Drinking Water Quality Standards			
Canadian Fisheries Act			
Canadian Environmental Protection	Act (1999)		
CCME Water Quality Guidelines for the Protection of Aquatic Life			
Ontario Guidelines for Sewage Worl	ks 2008		
CCME Guidelines for Compost Quality			
NSF/ANSI Standard 61	Drinking Water System Components		
AWWA Standard B100	Filtering Material		
AWWA Standard B604	Granular Activated Carbon		
OSHA Occupational Safety and Health Administration			



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# 3 SUSTAINABLE DEVELOPMENT POLICY



#### SUSTAINABLE DEVELOPMENT POLICY

At Baffinland Iron Mines Corporation, we are committed to conducting all aspects of our business in accordance with the principles of sustainable corporate responsibility and always with the needs of future generations in mind. Everything we do is underpinned by our responsibility to protect the environment, to operate safely and fiscally responsibly and to create authentic relationships. We expect each and every employee, contractor, and visitor to demonstrate a personal commitment to this policy through their actions. We will communicate the Sustainable Corporate Policy to the public, all employees and contractors and it will be reviewed and revised as necessary on an annual basis. These four pillars form the foundation of our corporate responsibility strategy:

#### 1.0 HEALTH AND SAFETY

- We strive to achieve the safest workplace for our employees and contractors; free from occupational injury and illness from the very earliest of planning stages.
   Why? Because our people are our greatest asset. Nothing is as important as their health and safety.
- We report, manage and learn from injuries, illnesses and high potential incidents to foster a workplace culture focused on safety and the prevention of incidents.
- We foster and maintain a positive culture of shared responsibility based on participation, behaviour and awareness. We allow our workers and contractors the right
  to stop any work if and when they see something that is not safe.

#### 2.0 ENVIRONMENT

- We employ a balance of the best scientific and traditional Inuit knowledge to safeguard the environment.
- · We apply the principles of pollution prevention and continuous improvement to minimize ecosystem impacts, and facilitate biodiversity conservation.
- We continuously seek to use energy, raw materials and natural resources more efficiently and effectively. We strive to develop pioneering new processes and more sustainable practices.
- We understand the importance of closure planning. We ensure that an effective closure strategy is in place at all stages of project development and that progressive reclamation is undertaken as early as possible to reduce potential long-term environmental and community impacts.

#### 3.0 INVESTING IN OUR COMMUNITIES AND PEOPLE

- We respect human rights and the dignity of others. We honour and respect the unique culture, values and traditions of the Inuit people.
- We contribute to the social, cultural and economic development of sustainable communities adjacent to our operations.
- We honour our commitments by being sensitive to local needs and priorities through engagement with local communities, governments, employees and the public.
   We work in active partnership to create a shared understanding of relevant social, economic and environmental issues, and take their views into consideration when making decisions.

#### 4.0 TRANSPARENT GOVERNANCE

- We will take steps to understand, evaluate and manage risks on a continuing basis, including those that impact the environment, employees, contractors, local communities, customers and shareholders.
- We ensure that adequate resources are available and that systems are in place to implement risk-based management systems, including defined standards and
  objectives for continuous improvement.
- We measure and review performance with respect to our environmental, safety, health, socio-economic commitments and set annual targets and objectives.
- We conduct all activities in compliance with the highest applicable legal requirements and internal standards
- We strive to employ our shareholder's capital effectively and efficiently. We demonstrate honesty and integrity by applying the highest standards of ethical conduct.

Tom Paddon

President and Chief Executive Officer

September 2011

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# Mary River Project Health, Safety and Environment Policy

The Baffinland Iron Mines Corporation (BIMC) Mary River Project Health, Safety and Environment Policy is a statement of our commitment to achieving a safe, healthy and anvironmentally responsible workplace. We will not compromise this policy for the achievement of any other organizational goal.

#### The Mary River Project implements this Policy through the following commitments:

- Continual improvement of safety, occupational health and environmental performance.
- Meeting or exceeding the requirements of regulations and company policies.
- Integrating sustainable development principles into our decision-making processes.
- Maintaining an effective Health, Safety and Environment Management System.
- Sharing and adopting improved technologies and best practices to prevent injuries, occupational illnesses and environmental impacts.
- Engaging stakeholders through open and transparent communication.
- Efficiently using resources, and practicing responsible minimization, reuse, recycling and disposal of waste.
- Rehabilitation of disturbed lands to a safe, acceptable, and localized state.

# Our commitment to provide the leadership and action necessary to accomplish this policy is exemplified by the following principles:

- All injuries, occupational illnesses and environmental impacts can be prevented.
- Employee involvement and active contribution is essential and required.
- Management is responsible for preventing Injuries, occupational illnesses and environmenta impacts.
- Working in a manner that is healthy, safe and environmentally sound is a condition of employment.
- All operating exposures can be safeguarded.
- Training employees to work in a manner that is healthy, safe and environmentally according assential.
- Prevention of personal injuries, occupational illnesses and environmental impacts is good husinesse
- Respect for the communities in which we operate is the basis for productive relationships.

We have a responsibility to provide a safe workplace and utilize systems of work to meet this goal. All employees must be clear in understanding the personal responsibilities and accountabilities in relation to the tasks we undertake.

The Mary River Project has no higher priority than the health and safety of all people working on our behalf and the responsible management of the environment. In ensuring our overall profitability and business success every Berfinland and business partner employee working at one of our work sites is required to adhere to this policy.

Tom Peddon President and Chief Executive Officer March 2013 Baffinland

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## 4 FRESH WATER

#### 4.1 GENERAL MITIGATION MEASURES FOR WATER USE

#### 4.1.1 WATER INTAKES

#### 4.1.1.1 ENGINEERING INTAKE STRUCTURES

Engineered intake structures are designed to minimize erosion, avoid sediment issues, and provide protection from ice and peak water flow. Care is taken to ensure that disturbance to aquatic environments is minimized during installation and maintenance of infrastructure. Rip rap used in construction is clean, free of fine sediment, non-acid leaching, and non-metal generating.

### 4.1.1.2 SCREENS ON INTAKE PIPES

Intakes are screened in accordance with the Department of Fisheries and Oceans (DFO) Freshwater Intake End-of-Pipe Fish Screen Guideline (DFO Guideline) to ensure no entrapment of fish. This guideline requires a 2.54 mm mesh size on the water intake pipeline to prevent entrainment of fish greater than 25 mm in length. It also requires a water withdrawal rate such that fish do not become impinged on the screen.

#### 4.1.1.3 SELECTION OF SHORT-TERM WATER TAKE LOCATIONS

Short-term water intake will be required at many locations for a variety of needs. This includes concrete manufacture, dust suppression, drill water, etc. A screening process will be used to confirm whether water sources are considered adequate as water take locations. Source selection begins by looking for the largest possible water body that is feasible for use. Lakes are considered first, followed by ponds and then large rivers. Streams and creeks will not be used for short term water take without prior approval of the Water Licence Inspector. The DFO guideline used for water taken from water bodies is to restrict removal of water to a maximum of 5% of the total volume. During winter under ice conditions water must be drawn from below two (2) m of non-frozen water (as the top two (2) m of water contain the majority of oxygen for fish). During the open water season, the water taking guideline states that no significant drawdown shall be caused. There must be no impact to fish or fish habitat.

## 4.1.2 WATER METERING AND WATER CONSERVATION MEASURES

Water meters are installed at strategic locations to monitor water consumption and enable the development of management strategies to reduce water usage/consumption. These strategies include the installation of low flow water taps, water use for drilling operation, etc.

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#### 4.2 FRESH WATER SOURCES

All fresh water for domestic camp use and industrial purposes, during Construction Phase of the Project shall be obtained in amount and from sources listed in the Table below:

TABLE 4-1: WATER USE FOR DOMESTIC AND INDUSTRIAL PURPOSES DURING THE CONSTRUCTION PHASE \*

Site	Source	Volume
Milne Port	Phillips Creek	367.5 m <sup>3</sup> /day
(Milne Inlet)	(summer)	
	Km 32 Lake (Winter)	
Mine Site (Mary	Camp Lake	657.5 m³/day
River)		
Steensby Port	ST 347 Km Lake	435.8 m³/day
(Steensby Inlet)	3 Km Lake	
Raven River	Camp Lake	145.2 m <sup>3</sup> /day
Mid-Rail	Nivek Lake (Summer)	79.5 m <sup>3</sup> /day
	Ravn Camp Lake	
	(Winter)	
Cockburn North	Cockburn Lake	101.4 m³/day
(Tunnels Camp)		
Cockburn South	Cockburn Lake	111.1 m³/day
Camp		
	TOTAL	1,898 m <sup>3</sup> /day

\*Source: Type 'A' Water Licence (2AM-MRY1325) and Type 'B' Water Licence (8BC-MRY1416).

The above water sources have been approved by the Water Board for freshwater sources. Streams will not be used as a water source unless authorized and approved by the Board in writing and no material shall be removed from below the ordinary High Water Mark of any water body unless authorized. There is currently an amendment application for the Type "A" Water Licence to increase take from specific water bodies along the Tote Road for dust suppression. When the amendment is granted, there will be an additional table detailing location and quantity of water draw from these sources in this management plan. This revision will occur in time for the next Annual Report. For remote fresh water requirements such as dust suppression, tunnelling, geotechnical and exploration drilling, some water may be drawn by truck from nearby lakes and ponds and used directly.



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### 4.3 FRESH WATER SYSTEM PROCESS DESCRIPTION

The following sections describe the fresh water systems at the various sites.

Each site also includes a potable water treatment system which produces drinking water for the personnel at the site during construction and operation phases. These systems treat water to meet the Guidelines for Canadian Drinking Water Quality as well as the Ontario Drinking Water Quality Standards.

Minimum process equipment requirements are based upon the Northwest Territories Water Supply System Regulations, NWT Regulation 108-2009, Ontario Design Guidelines for Drinking Water Systems 2008, Ontario Regulation 170/03 – Drinking Water Systems, the Procedure for Disinfection of Drinking Water in Ontario, as well as best management practice.

#### 4.3.1 MILNE PORT

Currently onsite at Milne Port there are existing camps that support construction, operations and minor exploration activities. These camps include the Shanco Camp, Port Weatherhaven Tent Camp and the Port Site Complex (PSC) Camp. Each camp contains Potable Water Treatment Plants (PWTP) within the camps as well as freshwater tanks to store raw water being delivered. The freshwater demand for construction and operation are shown on drawing Milne Inlet – Water Supply Balance Block Flow Diagram in Appendix C of this plan.

A raw water truck draws water from either 32 km lake (in winter/summer) or Phillips Creek (in summer) and delivers the water to a water storage tank near the camp. 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 ensures that fire water is always available in the tank. The Milne Inlet camp layout including locations for potable water related infrastructure is presented in Appendix B.

The potable water treatment scheme consists of coagulation followed by media filtration and disinfection by ultraviolet radiation. The water then undergoes a secondary disinfection by sodium hypochlorite injection to ensure residual chlorine content at the point of use.

In 2015 the existing Shanco Camp will be decommissioned and removed from site on the sealift, and the PSC will be expanded to accommodate increased personnel onsite. The PSC PWTP will be upgraded to accommodate the larger PSC facility.



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#### 4.3.2 MARY RIVER SITE

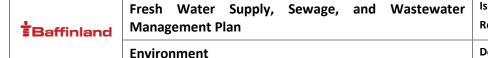
Currently onsite at Mine Site there are existing camps that support construction, operations and site wide exploration activities. These camps include the Weatherhaven Camp and the Mine Site Complex (MSC) Camp. Each camp contains Potable Water Treatment Plants (PWTP) within the camps as well as freshwater tanks to store raw water being delivered. The freshwater demand for construction and operation are shown on drawing Mine Site – Water Supply Balance Block Flow Diagram in Appendix C of this plan.

Fresh water supply for the Mary River Mine Site is obtained using an electric pump positioned inside a heated and insulated pumphouse on a raw water jetty, adjacent to the shoreline of Camp Lake. Water is pumped directly from the lake source to water storage tanks located at both camps. Water from these tanks will be used to provide fire water as well as meet the fresh water requirements of the site. A stand pipe within each tank ensures that fire water is always available in the tank. The Mine Site camp layout including locations for potable water related infrastructure is presented in Appendix B of this Plan.

Some fresh water requirements such as road dust suppression, exploration drilling, quarry dust suppression, concrete and explosives manufacturing will be provided directly from nearby lakes using a vacuum truck. Exploration drilling will continue throughout the construction phase.

The potable water treatment scheme consists 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.

In 2015 the MSC will be expanded to accommodate increased personnel onsite. The MSC PWTP will be upgraded to accommodate the larger MSC facility.



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# 5 SEWAGE TREATMENT

#### 5.1 SEWAGE GENERATION RATE

The estimated generation of sewage is based upon a per capita generation as shown below:

TABLE 5-1: STP AVERAGE SEWAGE FLOW DESIGN BASIS

Parameter Design Value		Source	
Sewage Generation per Capita	300 L/person/day	Design Basis – Sewage Treatment Plant, Doc. No. H337697-4000-10-109-0002 (FEIS, Appendix 3B).	

Note: The rate of sewage generation given above may be reduced when actual representative water usage data is obtained from site. Additional reductions may be achieved by water conservation.

## 5.2 SEWAGE DISCHARGE CRITERIA

All Sewage generated from relevant Project sites is directed to the Sewage Treatment Facilities or as otherwise approved by the Nunavut Water Board. As per the Type A Water Licence (2AM-MRY1325) and construction Type B Water licence (8BR-MRY1416) Baffinland is constructing and operating infrastructure and facilities designed to contain, withhold, divert or retain Water and/or Waste in accordance with applicable legislation and industry standards. Effluent will be discharged such that surface erosion is minimized and no additional impacts are created. The quality of the sewage treatment plant effluent discharging to Freshwater or directly into the ocean shall be in accordance with the applicable site discharge limits and the approved Type A Water Licence (2AM-MRY1325) as listed in the following table:

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TABLE 5-2: EFFLUENT DISCHARGE QUALITY LIMITS FOR SEWAGE TREATMENT FACILITIES TO FRESHWATER AND TO THE OCEAN \*

Parameter	Unit	Maximum Concentration of Any Grab Sample discharging into Fresh Water (mg/L) Monitoring Locations: MP- 01, MP-01a, MP-MRY-04, MP-MRY-04a,	Maximum Concentration of any Grab Sample discharging into Ocean (mg/L)  Monitoring Locations: SP- 01, SP-01a MS-01, MS-01a, MS-MRY-04, MS-MRY-04a
BOD <sub>5</sub>	mg/L	30	100
TSS	mg/L	35	120
Faecal Coliform	cfu/100 mL	1000 CFU /100 ml	10,000 CFU /100 ml
Oil and Grease*	mg/L	No visible sheen	No visible sheen
рН		Between 6.0 and 9.5	Between 6.0 and 9.5
Ammonia	mg/L NH3-N	4.0	-
Total Phosphorus (MS-01)	mg/L	4.0	-
Total Phosphorus (MS- 01a)	mg/L	1.0	-
Toxicity		Final effluent not acutely toxic	Final effluent not acutely toxic

<sup>\*</sup>Source: Type A Water Licence (2AM-MRY1325) Table 4 and 5. Note, that locations MP-01 and MP-01a as well as MRY-MP-4 and MRY-MP-4a discharge directly into the ocean, therefore ocean discharge criteria would apply.

Recycled water and use of reclaimed water from the various Treatment Facilities, surface water management ponds and embankment dams and approved discharge locations may be used if waters meet appropriate discharge criteria for those facilities. Sludge generated from Sewage Treatment Facilities or any other facilities shall be confirmed to be non-hazardous prior to disposal at any Landfill facility or approved location.

# 5.3 TREATED WASTEWATER GENERATION AND DISCHARGE/OUTFALL LOCATIONS

Treated sewage and wastewater for the Project are discharged to the following locations:

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TABLE 5-3: APPROXIMATE TREATED EFFLUENT GENERATION AND DISCHARGE/OUTFALL LOCATIONS\*

Comp/Site	Discharge/O	Coordinates	
Camp/Site	Summer Winter		
Milne Port	Ocean at Milne Inlet		N: 7976338 E: 503636
	Sheardown Lake for Exploration Camp Storage Pond		N: 7913630 E: 559733
Mine Site	Winter Discharg	N: 7911946 E: 562321	
	Winter Dischar	N: 7911938 E: 562342	
	Summer Disch	narge Mary River	N: 7912010 E: 562249
Tote Road Work Sites	Conveyed to Mine Site or Milne Port Sewage Treatment		N/A
Steensby (Port)	Ocean at Steensby Port		N: 7801412 E: 593378
Ravn River Area	Conveyed to Mine Site Sewage Treatment		N/A
Mid-Rail Area	Conveyed to Mine Site Sewage Treatment		N/A
Cockburn Tunnels Area	Conveyed to Steensby Sewage Treatment		N/A
Cockburn South Camp	Conveyed to Steensby Sewage Treatment		N/A

Note\* Refer to Site Block Flow Diagrams in Appendix C for Milne Port and Mine Site anticipated annual effluent discharge.

All discharge from the Landfill Facilities will not exceed the following Effluent quality limits in the table below:

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TABLE 5-4: EFFLUENT DISCHARGE QUALITY LIMITS FOR THE LANDFILL FACILITIES\*

Parameter Maximum Concentra Any Grab Sample (mg	
pH range	Between 6.0 and 9.5
Total As	0.5
Total Cu	0.3
Total Pb	0.2
Total Ni	0.5
Total Zn	0.5
TSS	15
Oil and Grease	No visible sheen

<sup>\*</sup>Source: Type A Water Licence (2AM-MRY1325) Table 7

All discharge from the Bulk Fuel Storage Facilities will not exceed the following Effluent Quality Limits provided in the table below:

TABLE 5-5: EFFLUENT DISCHARGE QUALITY LIMITS FOR THE BULK FUEL STORAGE FACILITIES\*

Parameter	Maximum Concentration of any Grab Sample (ug/L)	
Benzene	370	
Toluene	2	
Ethylbenzene	90	
Lead	1	
Oil and Grease	15,000 and no visible sheen	

<sup>\*</sup>Source: Type A Water Licence (2AM-MRY1325) Table 8

All discharge from the Landfarm Facilities will not exceed the following Effluent quality limits provided in the table below:

TABLE 5-6: EFFLUENT DISCHARGE QUALITY LIMITS FOR THE LANDFARM FACILITIES\*

Parameter	Maximum Concentration of any Grab Sample (mg/L)	
pH range	Between 6.0 and 9.0	
Total Suspended Solids	15	
Oil and Grease	15 and no sheen	
Total Lead	0.001	
Benzene	0.370	
Toluene	0.002	
Ethylebenzene	0.090	

<sup>\*</sup>Source: Type A Water Licence (2AM-MRY1325) Table 9

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All discharge from the Bulk Sample Open Pit, Bulk Sample Weathered Ore Stockpile, Bulk Sample Processing Stockpile Area and Bulk Sample Stockpile Area Seepage will not exceed the following Effluent quality limits:

TABLE 5-7: EFFLUENT DISCHARGE QUALITY LIMITS FOR ORE STOCKPILES AND PITS\*

Parameter	Maximum Concentration of any Grab Sample (mg/L)		
Total Arsenic	0.50		
Total Copper	0.30		
Total Lead	0.20		
Total Nickel	0.50		
Total Zinc	0.50		
TSS	15		
Oil and Grease	No visible sheen		
Toxicity Not acutely toxic			
The waste discharge shall have a pH of between 6.0 and 9.5			

\*Source: Type A Water Licence (2AM-MRY1325) Table 10

All discharge from the Ponds associated with the Run of Mine Ore Stockpile, Crushing and Screening Pad, Ore Stockpile, West and East Sediment Ponds at Monitoring stations MS-06+, MS-07, MS-08 MS-09 and SP-07 shall not exceed the Effluent quality limits in the table above. All monitoring points can be found in the Aquatic Effect Monitoring Plan (BAF-PH1-830-P16-0039).

## 5.4 SEWAGE TREATMENT PROCESS DESCRIPTION

The process description for the sewage treatment systems at each site are described in the sections that follow. Note that for design purposes originally a per capita sewage generation rate of 344L/person/day had been considered which is higher than the per capita potable water consumption rate (300L/person/day). This was to ensure that the sewage treatment systems would have a higher design allowance. For consistency 300L/person/day will now be used for both potable water consumption and sewage generation. Also please note that actual camp occupancy can be optimized based on potable water conservation measures that can be implemented to reduce per capita water consumption and reduce overall sewage generation.

#### 5.4.1 MILNE PORT

Currently onsite the primary sewage treatment plant (Membrane Biological Reactor (MBR)) is the new facility installed in 2014. The Rotating Biological Contactor (RBC) type Sewage Treatment Plant (STP) (Seprotech manufactured), previously used to treat sewage from the Shanco camp and Port Weatherhaven camp, will eventually be decommissioned however in the interim is being used as a temporary holding facility/surge tank. Raw sewage is transported from the RBC by vacuum truck to the MBR for treatment.

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Treated effluent from the MBR sewage treatment plant is stored in a treated effluent tank which has a hydraulic retention time of 8 hours (at minimum) based upon nominal flows. It is designed such that the effluent tank will be at a low level during operation. This design allows for delay of discharge should sampling indicate that the effluent quality does not meet the applicable criteria. Such delay allows the effluent to be mixed, retreated, and retested before discharge. Once sampling indicates that effluent is meeting discharge criteria the treated effluent stream is directed to discharge via truck or pipeline to the overland outfall discharge location (See Table 5-3 for co-ordinates). The discharge location at Milne Inlet is shown on the Milne Port Site Layouts (refer to Appendix B).

Should discharge be necessary from the treated effluent tank due to volume, the off-spec effluent will be stored in the polishing waste stabilization pond (PWSP). The off-spec effluent will be removed by vacuum truck and fed into the new sewage plant feed tank for re-processing or treated by means of a pond treatment system that is described and approved in the existing Wastewater Management Plan. Should there be high volumes of off-spec effluent greater than the capacity of the existing PWSP, the Type B water licence (8BC-MRY1416) allows for the construction of a second PWSP to be built at Milne Port. This second PWSP (No. 2) would work in parallel treated in the same manner as the existing PWSP.

In the event that there is an electrical power outage that causes either of the sewage treatment plants to be completely inoperable, raw sewage will be diverted temporarily, trucked to the PWSP, until the sewage plant is operating again. At that time, partially or untreated sewage from the PWSPs will be either be trucked back to the treatment plant for treatment or an in situ pond treatment system will be operated and the discharge directed to the ocean outfalls (Refer to Appendix F - PWSP Effluent Discharge Plan).

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

The sewage treatment system basis as described above will be applicable for current and future construction and operations requirements. The site layout showing the location of camp, sewage treatment and ancillary facilities is presented in Appendix B.

In 2015 the MBR sewage treatment plant at Milne Port will be decommissioned, dismantled, and relocated to the Mine Site. A new MBR will be installed in its place at Milne Port with capacity to treat sewage from the existing facilities and the expanded PSC.

#### 5.4.2 MARY RIVER MINE SITE

Currently onsite the primary sewage treatment plant (Membrane Biological Reactor (MBR)) is the new facility installed in 2014. The Rotating Biological Contactor (RBC) type Sewage Treatment Plant (STP) (Seprotech manufactured), previously used to treat sewage from the Mine Weatherhaven camp, will



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eventually be decommissioned however in the interim it is being used as a temporary holding facility/surge tank. Raw sewage is transported from the RBC by vacuum truck to the MBR for treatment.

Treated effluent from the new MBR sewage treatment plant is stored in a treated effluent tank which has a hydraulic retention time of 8 hours (at minimum) based upon nominal flows. It is designed such that the effluent tank will be at a low level during operation. This design allows for delay of discharge should sampling indicate that the effluent quality does not meet the applicable criteria. Such delay allows the effluent to be mixed, retreated, and retested before discharge. Once sampling indicates that effluent is meeting discharge criteria the treated effluent stream is directed to discharge via pipeline to the Mary River discharge locations (See Table 5-3 for winter and summer discharge co-ordinates). The discharge locations at Mine Site is shown on the Mine Site Layouts (refer to Appendix B).

Rip rap has been used at the discharge locations to reduce sedimentation and erosion at the discharge location and along the drainages upstream of Mary River. Specific discharge locations into Mary River can be seen on the Mine Site Layout found in Appendix B. The discharge strategy will be reviewed annually and optimized as necessary.

In the event that there is an electrical power outage that causes the sewage treatment plant to become inoperable, raw sewage will be temporarily trucked to local existing polishing waste stabilization ponds until the sewage plant comes on line again. Partially or untreated sewage from the PWSPs from this event will either be trucked back to the treatment plant for treatment reprocessing or treated in situ at the pond location (Refer to Appendix F - PWSP Effluent Discharge Plan).

The sludge generated at the new MBR is dewatered using a mechanical dewatering device, a filter press, and then incinerated. Sludge cake is 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 are installed where deemed necessary. The incinerator design considered the solids content of the sludge from the dewatering device.

The MBR sewage treatment plant is designed to also process raw or partially treated sewage from Ravn and Mid-Rail camps once these facilities have been constructed. The sewage will be conveyed to the Mary River permanent sewage treatment facility by vacuum truck.

The sewage treatment system basis as described above will be applicable for current and future construction and operations requirements. The site layout showing the location of camp, sewage treatment and ancillary facilities is presented in Appendix B.

In 2015 a second MBR sewage treatment plant will be installed at Mine Site. This second MBR will be decommissioned, dismantled, and relocated from Milne Port to the Mine Site to accommodate the increased capacity required by the expanded MSC. Both the existing MBR facility and the relocated MBR facility will be upgraded to address noted operational concerns and function in parallel.



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# 6 OILY WATER/WASTEWATER TREATMENT

There are two sources of potentially oily water that have been identified at Milne Port and the Mine site. There is the wash-water generated at the vehicle maintenance facilities, waste management building, emergency response garage and truck wash and then there is water that collects within the fuel berms at the sites. Based on the different nature of these two wastewater sources, distinct discharge criteria (and treatment plans) have been developed for each.

#### 6.1 OILY WATER TREATMENT PLANT DISCHARGE CRITERIA

All discharge from the Oily Water/Wastewater Treatment Facilities for monitoring stations MP-02, MS-02, SP-02 will not exceed the following Effluent quality limits provided in the Table below.

TABLE 6-1: EFFLUENT DISCHARGE QUALITY LIMITS FOR OILY WATER TREATMENT FACILITIES\*

Parameter	Maximum Concentration of Any Grab Sample (mg/L)
рН	6-9.5
TSS	35
Ammonia	4
Phosphorous	4
Benzene	0.370
Ethylbenzene	0.090
Toluene	0.002
Oil and Grease	15 and no visible sheen
Arsenic	0.5
Copper	0.30
Lead	0.20
Nickel	0.50
Zinc	0.50

<sup>\*</sup>Source: Type A Water Licence (2AM-MRY1325) Table 6.

# 6.2 OILY WATER/WASTEWATER TREATMENT PROCESS DESCRIPTION

Oily water and wastewater generated by the Project shall be treated at the Oily Water/Wastewater Treatment Facilities allowed under the scope of the Licence. The process description for both oily water/wastewater treatment systems at each site are described in the sections that follow.

### 6.2.1 MILNE PORT

The Site layouts showing the locations of the maintenance facility and fuel containment/other berm expansions are presented in Appendix B.

Any oily water generated from the expanded tank farm is collected in a sump located at the tank farm. The water will then be treated directly by the mobile trailer based oily water treatment system.

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The vehicle maintenance 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 oily water will be blended with treated sewage and discharged, or discharged directly based on sampling.

#### 6.2.2 MARY RIVER SITE

Oily water generated throughout the site in lined containment facilities is treated using a mobile trailer based oily water treatment system to handle any spills. Treated oily water is blended with treated sewage and discharged or discharged directly based on sampling.

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 management 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.
- Airstrip.

The vehicle maintenance and wash facility is designed to recycle up to 90% of the water used. The facility does 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 water is then reused by the facility. Should there need to be a discharge from the facility, the wastewater would 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 reused if possible or incinerated. Accumulated suspended solids will be periodically removed by bucket loader vehicle and sent to a land fill for disposal.

Collected stormwater run-off from the tank fuel storage areas will be treated by a local oily water separator system that will be used as needed. The resulting water will be discharged directly to the adjacent land surface. The water will be periodically tested such that if any parameter is out of compliance



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the water will be removed by vacuum truck and treated in the vehicle maintenance shop wastewater treatment plant.

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 in a licensed facility otherwise the waste will be land filled.



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# 7 SEDIMENTATION PONDS

The following ponds will be constructed or completed in 2015.

Water in these ponds will be monitored as part of the site drainage monitoring strategy to meet applicable effluent quality criteria.

#### 7.1 MILNE PORT STOCKPILE SEDIMENTATION PONDS

The two (2) Milne Port stockpile sedimentation ponds (east and west) were constructed to temporarily retain the runoff water from the Milne Port stockpile area and contain the sediment load. During normal operation, runoff from the stockpile area drains to the stockpile sedimentation ponds. The ponds were designed with sufficient retention time to ensure the sediment would gravity-settle to the bottom of the pond and tested before the water reaches the overflow weirs. The ponds are equipped with overflow weirs designed to allow the unloaded surface water to drain through a controlled discharge to Milne Inlet. Alternatively, the pond can be pumped out using a portable pump arrangement.

The ponds were designed to fit within the foreshore areas north of the stockpile and not encroach near the shoreline.

2015 construction will include installation of the drainage ditches to carry runoff from the ore stockpile pad to the ponds and completion of the overflow weirs on both ponds.

#### 7.2 MINE SITE ORE CRUSHER PAD SEDIMENTATION POND

The Mine Site ore crusher pad sedimentation pond is scheduled for construction in early 2015. This pond is designed to temporarily retain the runoff water from the Mine Site crusher pad area and contain the sediment load, particularly during seasonal freshet activities. During normal operation, runoff from the crusher area drains to the sedimentation pond (west of the crusher pad). The pond is equipped with an overflow weir designed to allow, for extreme weather periods (e.g. greater than a 1 in 10 year, 24 hour design storm), the unloaded surface water to drain through a controlled discharge to Sheardown Lake. The ponds were designed with sufficient retention time to ensure the sediment would gravity-settle to the bottom of the pond before the water reaches the overflow weir.

The pond is also equipped with a pump pad on the northwest side. The normal operation of the pond will be to test the water quality for MMER requirements and when on spec, pump out using a portable pump arrangement. This pump arrangement tees into the treated effluent discharge pipeline to discharge to Mary River.

## 7.3 MINE SITE WASTE ROCK STOCKPILE POND

The initial Mine Site waste rock stockpile and sedimentation pond are scheduled for construction in 2015. This pond is designed to temporarily retain the runoff water from the first Mine Site waste rock dump area and contain the sediment load. During normal operation, runoff from the stockpile area drains to the

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waste rock sedimentation pond (north of the waste rock dump area). The pond is equipped with a pump pad on the north side. The pond will be tested to ensure the water meets MMER requirements and then pumped out seasonally using a portable pump arrangement. The pump arrangement discharges to the same discharge diversion channel accessed by the overflow weir to a small natural drainage that then in turn discharges to Mary River at a location designated in the AEMP.

In high rainfall periods (e.g. greater than a 1 in 10 year, 24 hour design storm), the pond is also equipped with an overflow weir on the north side designed to allow the unloaded surface water to drain through a controlled discharge diversion channel, also to Mary River. The pond was designed with sufficient retention time to ensure the sediment would gravity-settle to the bottom of the pond before the water reaches the overflow weir.

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# 8 OPERATIONS AND MAINTENANCE (O & M)

The project specific O & M Manual for Sewage Treatment Systems is provided by Newterra Ltd in Appendix D. Sample plans for operation and maintenance of proposed potable and oily water systems are given below. These plans were provided by vendors of potable and oily water treatment.

# 8.1 POTABLE WATER TREATMENT SYSTEM O & M PLAN

#### 8.1.1 REGULAR MAINTENANCE SCHEDULE

The system will be designed for fully automatic operation, and only requires limited supervision and regular maintenance.

The following recommended maintenance schedule is subject to regulations from local government, and instructions from original equipment manufacturers.

The recommended maintenance schedule is common for all potable treatment plants.

TABLE 8-1: RECOMMENDED MAINTENANCE SCHEDULE- POTABLE TREATMENT PLANTS

Items	Description		
Daily	Alarm check.		
	Chemical storage level check.		
	Controller time check.		
	Pressure gauge check.		
Monthly	Turbidity analyzer check/calibration.		
	Residual chlorine/pH analyzer check/calibration.		
Annual	Filter media level check, and refill if required.		
	UV lamp replacement.		

#### 8.1.2 MONITORING PLAN

The monitoring plan is subject to local regulations of drinking water and other related codes. The following instruments will be provided to monitor the operation and performance of system.

- Inlet flow meter: to monitor feed flow, backwash flow, rinse flow and filtered flow.
- Effluent turbidity analyzer: to monitor turbidity in produced water.
- Effluent pH/residual chlorine analyzer: to monitor pH and residual chlorine of produced water.

The PLC system in control panel will totalize raw water, produced water, backwash water, chemical injection, pump running time etc.

Raw water and treated water storage/distribution system will be monitored by systems from others.

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Periodically sampling and lab test for raw water and treated water will be applied to ensure the treated water meeting drinking water standards. The frequency of the sampling and testing will be determined by the ministry and outlined in the certificate of approval.

#### 8.2 MOBILE OILY WATER TREATMENT SYSTEM O & M PLAN

#### 8.2.1 REGULAR MAINTENANCE AND MONITORING SCHEDULE

Regular system maintenance entails routine inspection of mechanical and electrical components.

It is recommended that the system be inspected weekly to ensure that components are in good working order. Spare parts lists will be included with the Operations and Maintenance Manuals, with critical spare parts and system expendables highlighted. Recommended stock quantities will also be given.

Additional, non-routine maintenance will be required throughout the life of the equipment. The recommended spare parts list and appropriate site stock levels are designed to keep the system running continuously with only scheduled downtime.

In addition to maintenance, monitoring the system performance and effluent quality are also necessary. It is further recommended that a flow totalizer be used at the effluent discharge to accurately summate the volume of treated water being released. This in conjunction with the quality data from the various system flows will allow forecasting for media and consumable change-out as well as waste oil and sludge generation. Residual contaminants below the regulatory limits can also be used in conjunction with treated volumes to determine area loadings over certain periods of time.

#### 8.2.2 INFLUENT PUMP

When starting up influent pump make sure valves are open to allow the process to flow. The influent pump is a gas powered pump. The start up procedure for the pump is:

- Make sure there is oil and gas in each of the tanks.
- Turn the gas switch on.
- Turn the on switch on.
- If the pump has not been running for an extended period of time make sure the choke is on.
- If it has been running for an extended period of time the choke does not have to be on.
- Make sure the throttle in on a low setting.
- Pull the ignition cord until the pump starts.
- Increase the throttle to your desired throughput.

#### 8.2.3 PARTICLE FILTER

The maximum pressure across the particle filter can be 14 psig. This would indicate that the particle filter has become plugged and must be changed. The bag and spaghetti media are to be changed out once a month during operation.

#### 8.2.4 CLAY ABSORPTION MEDIA FILTER



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The media will be changed depending on the differential pressure across the housing. When handling the material a repertory mask must be worn due to inhalation of the silica dust. The MSDS for the material should be reviewed before handling this material.

## 8.2.5 MyCelx FILTRATION SYSTEM

The MyCelx filtration system has three polymeric surfactant vessels. The first two vessels operate at 30 and 28 psig respectively. The pressure across the third vessel can decline to as low as 2 psig. At this point the filter cartridges have to be changed.

# 8.2.6 GRANULAR ACTIVATED CARBON (GAC)

The frequency of GAC change out is to be determined by testing the internal and external TOG after the first GAC train. When an indication that the GAC was not removing enough TOG, the media would be changed.

A joint maintenance/monitoring log should be kept to ensure that operational data and changes/responses are properly documented.

These guidelines are recommended as a minimum to ensure proper operation, health, safety and protection of the surrounding environment. If corporate or regional policies in effect or enacted require more stringent monitoring, the scope and schedule should be adjusted to meet these requirements.

# 8.3 OILY WATER TREATMENT PLANT (FOR VEHICLE WASH WATER) O & M PLAN

#### 8.3.1 REGULAR MAINTENANCE AND MONITORING SCHEDULE

Regular system maintenance entails routine inspection of mechanical and electrical components. It is recommended that the system be inspected weekly to ensure that components are in good working order. Spare parts lists will be included with the Operations and Maintenance Manuals, with critical spare parts and system expendables highlighted. Recommended stock quantities will also be given.

Operational maintenance is mainly comprised of waste removal and expendable replacement in addition to some preventative maintenance on mechanical components. Maintenance activities, locations and their recommended frequencies are given below.



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TABLE 8-2: MAINTENANCE ACTIVITIES, LOCATIONS AND THEIR RECOMMENDED FREQUENCIES

Maintenance Task	Location	Frequency
Sludge Removal	Primary clarifier	Twice/week
Oil Removal	Waste oil storage	Weekly
De-emulsifier chemical refill (if applicable)	Chemical room	TBD
Sulfuric acid chemical refill	Chemical room	TBD
(if applicable)		
Alum chemical refill	Chemical room	TBD
Sodium hydroxide chemical	Chemical room	TBD
Refill		
Polymer chemical refill	Chemical room	TBD
Clay chemical refill	Chemical room	TBD
Filter Bag change-out	Media room	Daily
Organoclay change-out	Media room	Every two month
Carbon change-out (both)	Media room	Every two month
Pump seals	Various	Annually

Additional, non-routine maintenance will be required throughout the life of the equipment. The recommended spare parts list and appropriate site stock levels are designed to keep the system running continuously with only scheduled downtime.

In addition to maintenance, monitoring the system performance and effluent quality are also necessary. It is further recommended that a flow totalizer be used at the effluent discharge to accurately summate the volume of treated water being released. This in conjunction with the quality data from the various system flows will allow forecasting for media and consumable change-out as well as waste oil and sludge generation. Residual contaminants below the regulatory limits can also be used in conjunction with treated volumes to determine area loadings over certain periods of time.

Monitoring tasks, locations and frequencies are listed in the table below. The prefix, GI, in the task column denotes "General Inspection".



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**TABLE 8-3: MONITORING TASKS, LOCATIONS AND FREQUENCIES** 

Monitoring Task	Location	Frequency
GI – Clarifier (levels, appearance, pump	Primary clarifier	Daily
operation)		
Sample – Clarifier	Primary clarifier	Quarterly/Monthly
GI – OWS (levels, appearance, dosing pump)	OWS room	Daily
Sample – OWS Inlet	OWS room	Quarterly/Monthly
GI – Chemical Treatment (tanks, totes,	Chemical room and	Daily
levels, appearance, mixers, dosing pumps,	Lamella plate clarifier	
effluent pump, pressures)	room	
Sample – Chemical treatment inlet	Tank 1 – Lamella plate	Quarterly/Monthly
	clarifier room	
Sample – Chemical treatment effluent	Pump outlet – Lamella	Quarterly/Monthly
	plate clarifier room	
GI – Bag Filtration (units, pressures)	Media room	Daily
GI – Media Vessels (units, pressures,	Media room	Daily
backwash pump, treated water storage)		
Sample – Organoclay effluent	Media room – post	Quarterly/Monthly
	organoclay	
Sample – Primary carbon effluent	Media room – post	Quarterly/Monthly
	Primary carbon	
Sample – Effluent water	Media room – effluent	Quarterly/Monthly
	water	
	storage tank	
GI – Miscellaneous (vertical heaters, air	Various	Daily
compressors, air dryers, controls)		

A joint maintenance/monitoring log should be kept to ensure that operational data and changes/responses are properly documented.

The monitoring guidelines are recommended as a minimum to ensure proper operation, health, safety and protection of the surrounding environment. If corporate or regional policies in effect or enacted require more stringent monitoring, the scope and schedule should be adjusted to meet these requirements.



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# 9 CONTINGENCY MEASURES

Design criteria for the potable, sewage and oily water treatment systems have been reviewed and revised to provide additional safety factor.

The sewage treatment systems will set back sufficiently from surface water bodies. The sewage treatment systems will be fully enclosed units. In the event of a spill of untreated or partially treated sewage from these facilities, Baffinland will follow the procedures in its Spill Response Plan. Sewage spills are treated the same as more immediately hazardous hydrocarbon based spills.

# 10 SAMPLING, MONITORING, AND REPORTING

Generally, sampling and monitoring of the potable and wastewater treatment systems will include the following:

- Regular sampling of sewage and wastewater discharge in accordance with Water Licence requirements.
- More frequent internal process sampling (minimum once per week) and monitoring (daily) to identify
  potential upset conditions early that could lead to non-compliance.
- Record of volumes of sewage and wastewater effluent discharged and sludge generated in accordance with water licence requirements.
- Completion of daily checklists related to the O & M requirements for the facilities and the reporting
  of any upset conditions that require action.
- Aquatic effects monitoring program to confirm/validate environmental predictions.

The monitoring program will identify upset conditions related to the sewage treatment plants which will be immediately reported to the Camp Manager for corrective action.

#### 10.1 POTABLE WATER SYSTEM MONITORING

Untreated Fresh water will be sampled or in accordance to final established potable water take locations. Treated potable water will be sampled from the potable treatment plant effluent.

Samples shall be collected at every active water take location for select analyses at frequencies specified in applicable regulations/guidelines. A typical list of parameters to be tested includes the following:

Calcium, Magnesium, Sodium, Potassium, Aluminum, Arsenic, Boron, Barium, Cadmium, Chromium, Cobalt, Copper, Iron, Lead, Manganese, Molybdenum, Nickel, Selenium, Silver, Strontium, Thallium, Vanadium, Zinc, Tin, pH, Conductivity, Alkalinity as CaCO3, TDS (COND-CALC), TSS (total suspended solids), Turbidity, Phenols, N-NH3, SO4, Cl, Br,N-NO2, N-NO3, NO2 + NO3 as N, Mercury, Hardness as CaCO3, COD (chemical oxygen demand), Oil and Grease

A comparison of the sampling results to the Guidelines for Canadian Drinking Water Quality (GCDWQ) will be completed.

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# 10.2 SEWAGE TREATMENT SYSTEM MONITORING

Treated sewage effluent will be monitored and sampled at proposed locations specified in the Aquatic Effects Monitoring Program, BAF-PH1-830-P16-0039, (June 2014), and Type 'A' Water Licence (2AM-MRY1325) Schedule I. The proposed effluent discharge criteria was summarized in Table 5.2

# 10.3 OILY WATER TREATMENT SYSTEM MONITORING

Treated oily water effluent will be monitored and sampled at proposed locations specified in the Aquatic Effects Monitoring Program, BAF-PH1-830-P16-0039, (June 2014), and Type A Water Licence (2AM-MRY1325) Schedule I..



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# 11 ENVIRONMENTAL RESPONSIBILITIES

#### 11.1 ROLES AND RESPONSIBILITIES

The Baffinland Environmental Team is organised into two parts, on site as well as off site. The organisational structure for the Mary River Project in relation to the environment discipline is shown in the Table 11-1 below. Communication channels are described as liaisons in the tables outlining the responsibilities and accountabilities in the following sections.

#### 11.1.1 ENVIRONMENTAL PROJECT TEAM

#### 11.1.1.1 THE BAFFINLAND ENVIRONMENTAL TEAM

The Baffinland Environmental Team will oversee environmental and community works on and off site. The Baffinland Corporate Environmental Team responsibilities are summarized in Table 11-1.

TABLE 11-1: BAFFINLAND IRON MINES CORPORATION SENIOR MANAGEMENT

Baffinland Iron Mines Corporation Senior Management				
Position	Responsibilities and Accountabilities			
VP Operations	- Reports to Baffinland's CEO			
	- Overall accountability for the operation of the Project			
	- Allocation of resources (human and financial) for the implementation of			
	Baffinland's commitments and objectives related to health, safety and			
	environment during operation			
	- Accountable for on-site environmental, health and safety performance			
	during operation			
VP Sustainable	- Reports to Baffinland's CEO			
Development,	- Establish corporate environmental policies and objectives			
Health, Safety and	- Monitors and reports on Baffinland's performance related to			
Environment	environmental, health and safety policies and objectives			
	- Liaise with regulatory authorities			
	- Obtains necessary permits and authorizations			
	- Monitors compliance with terms and conditions of permits and licences			
	- Routine EHS audit of contractor performance while on site			
Manager Purchasing	- Reports to Baffinland's VP Operations			
and Contract	- Accountable for procurement and purchasing			
	- Ensure that environmental commitments, policies and objectives are			
	included in all contract documents			
VP Corporate and	- Reports to Baffinland's CEO			
Government Affairs	- Accountable for external communication (Governments, media, NGO,			
	others) related to Baffinland's press release and overall communication of			
	site incidents/events			
	- Community liaisons report to position			

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The Baffinland on-site Environmental Team will oversee all environmental activities on site. These responsibilities on site are outlined in Table 11-2.

TABLE 11-2: BAFFINLAND IRON MINES CORPORATION ON-SITE MANAGEMENT TEAM

Baffinla	and Iron Mines Corporation On-Site Environmental Team			
Position	Responsibilities and Accountabilities			
Environmental Manager	<ul> <li>Reports directly to VP Sustainable Development, Health, Safety and Environment and Indirect reporting and coordination with Operations VP and Director Environment</li> <li>Overall accountability for environmental staff and performance at site</li> <li>Coordinates implementation and monitors the performance of the Environmental Management System at site</li> <li>Liaises with the senior management, regulators and stakeholders</li> <li>Ensures effective monitoring and auditing of environmental performance of departments and contractors on site and identifies opportunities for improvement</li> <li>Monitors compliance with permits, licenses and authorizations</li> <li>Ensures all regulatory environmental monitoring and reporting requirements (monthly, annual) are met</li> <li>Leads and coordinates site permitting requirements.</li> <li>Initiates and oversees environmental studies</li> <li>Oversees investigations and reporting of environmental incidents to regulatory bodies, stakeholders and senior management</li> <li>Reviews and updates environmental management plans</li> </ul>			
Environmental Superintendent  Environmental Coordinator	<ul> <li>Reports to Environmental Manager</li> <li>Specific accountabilities for environmental monitoring and reporting</li> <li>Leads investigations and reporting of environmental incidents onsite</li> <li>Serves as the liaison for regulators during onsite inspections and visits</li> <li>Provides ongoing environmental education and environmental awareness training to all employees and contract workers</li> <li>Oversees environmental database management</li> <li>Prepares updates for management plans</li> <li>Reports to the Environmental Superintendent and Manager</li> <li>Specific accountabilities for environmental monitoring and reporting</li> </ul>			
Environmental Advisor	<ul> <li>Provides day to day direction to Environmental staff onsite</li> <li>Serves as a liaison for regulators during onsite inspections and visits.</li> <li>Provides ongoing environmental education and environmental awareness training to all employees and contract workers</li> <li>Assists with environmental database management</li> <li>Reports to the Environmental Superintendent and Manager</li> <li>Specific accountabilities for environmental monitoring and reporting</li> <li>Assists with environmental database management</li> <li>Prepare updates for management plans</li> </ul>			

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Baffinla	Baffinland Iron Mines Corporation On-Site Environmental Team					
Position	Responsibilities and Accountabilities					
Environmental Monitor	- Reports to the Environmental Superintendent or designate					
and Technician	- Assists with environmental database management					
	<ul> <li>Assists with monitoring and sampling activities as per the Project's</li> </ul>					
	management plans					
QIA Monitor	<ul> <li>Works alongside the Baffinland Environment Department to ensure the proper implementation of all environmental management and monitoring plans</li> </ul>					
	- Acts as the QIA liaison for onsite environmental matters					
Environmental Support	- Assists with sampling, monitoring and reporting activities as required					
Groups (Consultants,	by permits, licenses and environmental management plans					
etc.)	- Provides technical expertise to various environmental studies					

#### 11.2 TRAINING AND AWARENESS

Staff and sub-contractors working on site will receive environmental training as part of the Site Orientation, to achieve a basic level of environmental awareness understanding of their obligations regarding compliance with regulatory requirements, commitments and best practices.

Operations superintendents and contractor supervisors will be provided with this Management Plan, and will receive additional orientation with respect to the requirements outlined in this Plan. In addition, supervising level staff and sub-contractors will be provided with the Operational Standards (found in the Environmental Protection Plan) as a written guidance for their work.

Targeted environmental awareness training will be provided to both individuals and groups of workers assuming a specific authority or responsibility for environmental management or those undertaking an activity with an elevated high risk of environmental impact. These will be delivered in the form of toolbox/tailgate meetings or other means as appropriate.

The content of the environmental component of the site induction will include at a minimum:

- a. Location of environmental sensitivities.
- b. Location of additional information on environmental matters.
- c. Due diligence responsibilities.
- d. Responsibilities related to waste management, minimizing noise as necessary, road traffic rules, etc.
- e. Principles and necessary steps to avoid encounters with bears or other wildlife and what to do if one such encounter occurs.

#### 11.3 COMMUNICATION

The types of communications for which members of the team will participate include the following:

a. Formal written correspondence and meetings with stakeholders.

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- b. Site visits by community representatives.
- c. Design, construction and planning meetings.
- d. Field inspections and monitoring reports disseminated by the Environmental Manager.
- e. Electronic communications.
- f. Tailgate/toolbox meetings.
- g. Formal written correspondence and meetings with government regulatory bodies.
- h. Formal environmental awareness training.

Communications will be appropriately recorded and filed for future reference. Where appropriate, the copies of communications will be forwarded to the Operations Manager(s), and Environmental Manager.

#### 11.4 EXTERNAL COMMUNICATIONS

Effective forms of communication include the proactive notification to external stakeholders of Project activity. Project activity updates will be provided to the communities of North Baffin through various means including regular meetings, public notices and radio announcements as appropriate. Baffinland will maintain Community Liaison Offices to assist in this regard.

#### 11.5 CONSTRUCTION

During the construction phase of the Project, the Baffinland Environmental Manager will be responsible for implementing this Plan. This Management Plan will be updated to take into account the numerous construction sites, and types of construction equipment utilized.

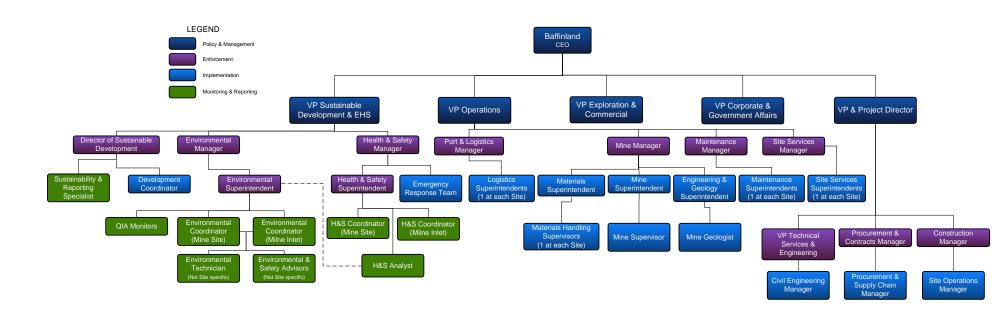
#### 11.6 OPERATION AND CLOSURE

For the operations and closure phases, Baffinland will revise its organizational structure to reflect the realities of the operation. The Environmental Manager will be responsible for subsequent updates and implementation of the Plan.

#### 11.7 MARY RIVER PROJECT ORGANIZATIONAL CHARTS

For further information regarding the Mary River Projects organizational structure in relation to the environment discipline, please refer to the Figure 11-1 Organization Chart below:

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**FIGURE 11-1: ORGANIZATIONAL CHART** 



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# Appendix A Table of Concordance with Type A Water Licence (2AM-MRY1325) and Type B Water Licence (8BCMRY1416)



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Table A-1 shows the Part, number and Condition of the Type A water License (Water Licence No: 2AM-MRY1325) and the location where the condition is located within the Freshwater Supply, Sewage and Wastewater Management plan.

**TABLE A-1: CONCORDANCE TABLE - TYPE A WATER LICENCE 2AM-MRY1325** 

Part	Number	Condition	Section
В	15c	The Licensee shall update and revise, for submission to the Board for review, within sixty (60) days of issuance of this Licence, the following management plans. The updates are to take into account commitments made with respect to submissions received during the preliminary and technical review of the Application documents, as well as final submissions and issues raised during the Public Hearing Process, where applicable. Baffinland Iron Mines Corporation Mary River Project Attachment 5: Fresh Water Supply, Sewage and Wastewater Management Plan Appendix 10D-3, dated January 2012;	Plan has been updated from March 2013 Version to incorporate conditions of Type A Water Licence (2AM- MRY1325)
D	2	The Licensee shall submit to the Board for review and acceptance, at least sixty (60) days prior to construction or in a timeframe otherwise approved by the Board in writing, final design and for-construction drawings, stamped and signed by a Professional Engineer, for all infrastructure and/or facilities designed to contain, withhold, divert or retain Water and/or Waste including the following:  - Bulk Fuel Storage Facilities - Explosives Facilities - Incineration Systems - Landfarm Facility - Oily Water and/or Wastewater treatment Facilities - Sewage Treatment Facilities - Site Drainage and Surface Water Management Systems - Waste Management Facilities (including temporary and permanent structure for hazardous and non-hazardous waste) - Water Supply Facilities - Water crossings including, pipelines, bridges, and roads - Water course training, flood control, diversions	60 days prior to construction If more immediate timeline required, will issue letter to NWB with early drawings



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Part	Number		Condi	tion		Section
D	3	The Licensee shalleast sixty (60) da an addendum to Wastewater Man operational aspecand Wastewater accordance with the "Guidelines for Maintenance Ma Disposal Facilities where applicable. This Nameasures in the sludge and any of procedures	ys prior to co the Fresh Wa agement Pla cts of the Sev Treatment Fa or the Prepar nual for Sewa in the North Manual shall in	Appendix D		
E	3	for those facilities.  The Licensee shall obtain all fresh Water for domestic camp use and industrial purposes, during the Construction Phase of the Project, in the amount and from the sources as listed in following table, or from sources otherwise approved by the Board in writing. In addition to the source-specific limits prescribed in the table, the Licensee shall not exceed one thousand five hundred and eighty-nine (1,589) cubic metres per day or five hundred and eighty thousand (580,000) cubic metres per year total water use from all sources during the Construction Phase of the Project.				Table 4-1
		Milne Port (Milne Inlet)	Phillips Creek (summer) Km 32 Lake (winter)	68.5 m <sub>3</sub> /day	25,000 m³/year	
		Mine Site (Mary River)	Camp Lake	<sup>3</sup> 657.5 m/day	240,000 m³/year	
		Steensby Port (Steensby Inlet	ST 347 Km Lake 3 km Lake	3 435.8 m/day	3 155,400 m/year	
		Ravn River  Mid-Rail	Camp Lake Nivek Lake (summer) Ravn Camp Lake (winter)	79.5 ms/day		
E	5	The Licensee may from the various management por approved discharge location appropriate disch	Treatment Fands and embans under the	acilities, surf ankment dar licence if su	ace water ns and ch waters meet	5.2



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Part	Number	Condition	Section
Е	6	The Licensee shall equip all Water intake hoses with	4.1.1.2
		screens of an appropriate mesh size, consistent with the	
		requirements of Fisheries and Ocean Canada's (DFO)	
		Freshwater Intake End-of-Pipe Fish Screen Guidelines	
		(1995), to prevent the entrainment of fish are and shall	
		withdraw Water at a rate such that fish do not become	
		impinged on the screen.	
Е	8	Streams cannot be used as a water source unless	4.2
		authorized and approved by the Board in writing.	
Е	10	The Licensee shall update or revise annually following the	The Plan is updated to include
		commencement of the Operations Phase, the Project	the planned construction
		Blockflow Diagram Water Supply Balance information for	numbers as well as the 2015
		the various Project sites, provided with the Application	work plan. Updates will be
		and submit for review of the Board. The submission shall	provided as required to include
_	4.0	be included with the Annual Report under Part B, Item 4.	the Operations Phase
E	12	The Licensee shall not remove any material from below	4.2
		the ordinary High Water Mark of any water body unless	
		authorized.	
F	10	The Licensee shall treat oily water and wastewater	6.3
		generated by the Project at the Oily Water/Wastewater	
		Treatment Facilities allowed under the scope of the	
-	12	Licence.	
F	13	The Licensee shall, unless otherwise approved by the	
		Board in writing, discharge effluent at a distance of least thirty-one (31) metres above the Ordinary High Water	
		Mark of any Water body, where direct flow into the	
		Water body is not possible, such that surface erosion is	
		minimized and no additional impacts are created.	
F	15	The Licensee shall direct all Sewage generated from the	5.2
Ι'	13	relevant Project sites to the Sewage Treatment Facilities	3.2
		or as otherwise approved by the Board in writing.	
F	16	The Licensee shall treat all Sewage waste generated at	Appendix E
1		the Ravn River and Mid-Rail camps and Sewage generated	
		at the Cockburn North and Cockburn South camps at	
		either the Mine Site Sewage Treatment Facility or the	
		Steensby Port Sewage Treatment Facility, unless	
		otherwise approved by the Board in writing.	
	1	11 /	



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Part	Number	Condition		Section
F	18	All discharge from the Sewage Trea	atment Facilities	Table 5.2
		including the Polishing Waste Stabi		
		into fresh Water bodies at Monitor	=	
		MP-		
		01a, MP-MRY-04, MP-MRY-04a, M	S-01 MS-01a MS-	
		MRY-04, MS-MRY-04a, must not ex		
			Reced the following	
		Effluent quality limits		
			Maximum Concentration	
		Parameter	of Any Grab	
		BOD <sub>5</sub>	Sample 30 mg/L	
		Total Suspended Solids	35	
		Faecal Coliform	1000 CFU/100 mL	
		Oil and Grease	No visible sheen	
		рН	Between 6.0 and 9.5	
		Ammonia (NH3-N)	4.0 mg/L	
		Total Phosphorous (MS-01) Total Phosphorous (MS-01a)	4.0 mg/L 1.0 mg/L	
		Toxicity	Not acutely	
		TOALLY	toxic	
		(Note that treated effluent dischar	ge from MS-01 and	
		MS-01a is directly to the ocean, the	erefore ocean	
		discharge criteria (F19) would there	efore apply)	
		. ,		
F	19	All discharge from the Sewage Trea	atment Facilities	Table 5-2
		including Polishing Waste Stabilizat		
		Monitoring Stations SP-01, SP-01a		
		or to ditches flowing into the ocean		
		following Effluent quality limits:	in shall not exceed the	
		Tollowing Efficient quality limits.		
			Maximum Concentration	
		Parameter	of Any Grab	
			Sample (mg/L)	
		BOD5	100 mg/L	
		Total Suspended Solids	120 mg/L 10,000	
		Faecal Coliform	CFU/100 mL	
		Oil and Grease	No visible sheen	
		рН	Between 6.0 and 9.5	
		Toxicity	Not acutely toxic	
		(Note that treated effluent dischar		
		MS-01a is directly to the ocean, the		
		ocean discharge criteria are applie		
F	20	Sludge generated from the Sewage		5.2
'	20	any other facilities shall be confirm		3.2
		•		
		hazardous and the results provided		
		review prior to disposal at any Land	•	
		otherwise approved by the Board i	n writing.	



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Part	Number	Coi	ndition	Section
F	21	All discharge from the Oily	Water/Wastewater Treatment	Table 6-1
		Facilities at Monitoring Stat		
		must not exceed the follow		
		Thus not exceed the follow	Maximum	
		_	Average	
		Parameter	Concentration	
			(mg/L)	
		pH range	6 – 9.5	
		TSS Ammonia	35 4	
		Phosphorous	4	
		Benzene	0.370	
		Ethylbenzene	0.090	
		Toluene	0.002	
		Oil and Grease	15 and no	
			visible sheen 0.50	
		Arsenic Copper	0.50	
		Lead	0.20	
		Nickel	0.50	
		Zinc	0.50	
F	22	All discharge from the Land	fill Facilities at Monitoring	Table 5-4
		_	/IRY-13b and SP-08 must not	
		exceed the following Efflue	nt quality limits:	
			Maximum	
		Parameter	Average	
		2 424112 102	Concentration	
			(mg/L)	
		pH	6.0-9.5	
		Total As	0.5	
		Total Cu	0.3	
		Total Pb	<del>- i</del>	
		Total Ni Total Zn	0.5	
		Total Suspended Solids	15	
		Oil and Grease	No No	
		OI and Oicasc	1110	
F	23	All discharge from the Bulk	Fuel Storage Facilities at	Table 5-5
		Monitoring Stations MP-03	, MPMRY-7, MS-03, MS-04,	
		MS-MRY-6, SP-04 and SP-05		
		following Effluent quality lin		
			Maximum Concentration	
		Parameter	of Any Grab	
			Sample (ug/L)	
		Benzene	370	
		Toluene Ethylbenzene	90	
		Lead	1	
		Oil and Grease	15,000 and no	
		On and Grease	visible sheen	



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Part	Number	C	Section	
F	24	_	ndfarm Facilities at Monitoring nd SP-06 must not exceed the limits:	Table 5-6
		Parameters	Maximum Average Concentration (mg/L)	
		рН	6.0-9.0	
		Total Suspended Solids	15	
		Oil and Grease	15 and no sheen	
		Total Lead	0.001	
		Benzene	0.370	
		Toluene	0.002	
		Ethylebenzene	0.090	
		_	MRY-09, MS-MRY-10, MS-MRY- exceed the following Effluent  Maximum Concentration of Any Grab Sample (mg/L)	
		Total Arsenic	0.50	
		Total Copper	0.30	
		Total Lead	0.20	
		Total Nickel Total Zinc	0.50 0.50	
		Total Suspended Solids	15.0	
		Oil and Grease	No visible sheen	
		Toxicity	Not acutely toxic	
		The waste discharge shall have a pH of	f between 6.0 and 9.5	
F	26	All discharge from the Po Mine Ore Stockpile, Ore S Sediment Ponds at Monit MS-08 MS-09 and SP-07 s quality limits of Part F, Ite		



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Table A-2 shows the Part, number and Condition of the Type B Water Licence (Water Licence No: 8BC-MRY1416) and the location where the condition is located within the Freshwater Supply, Sewage and Wastewater Management plan.

TABLE A-2: CONCORDANCE TABLE - TYPE B WATER LICENCE 8BC-MRY1416

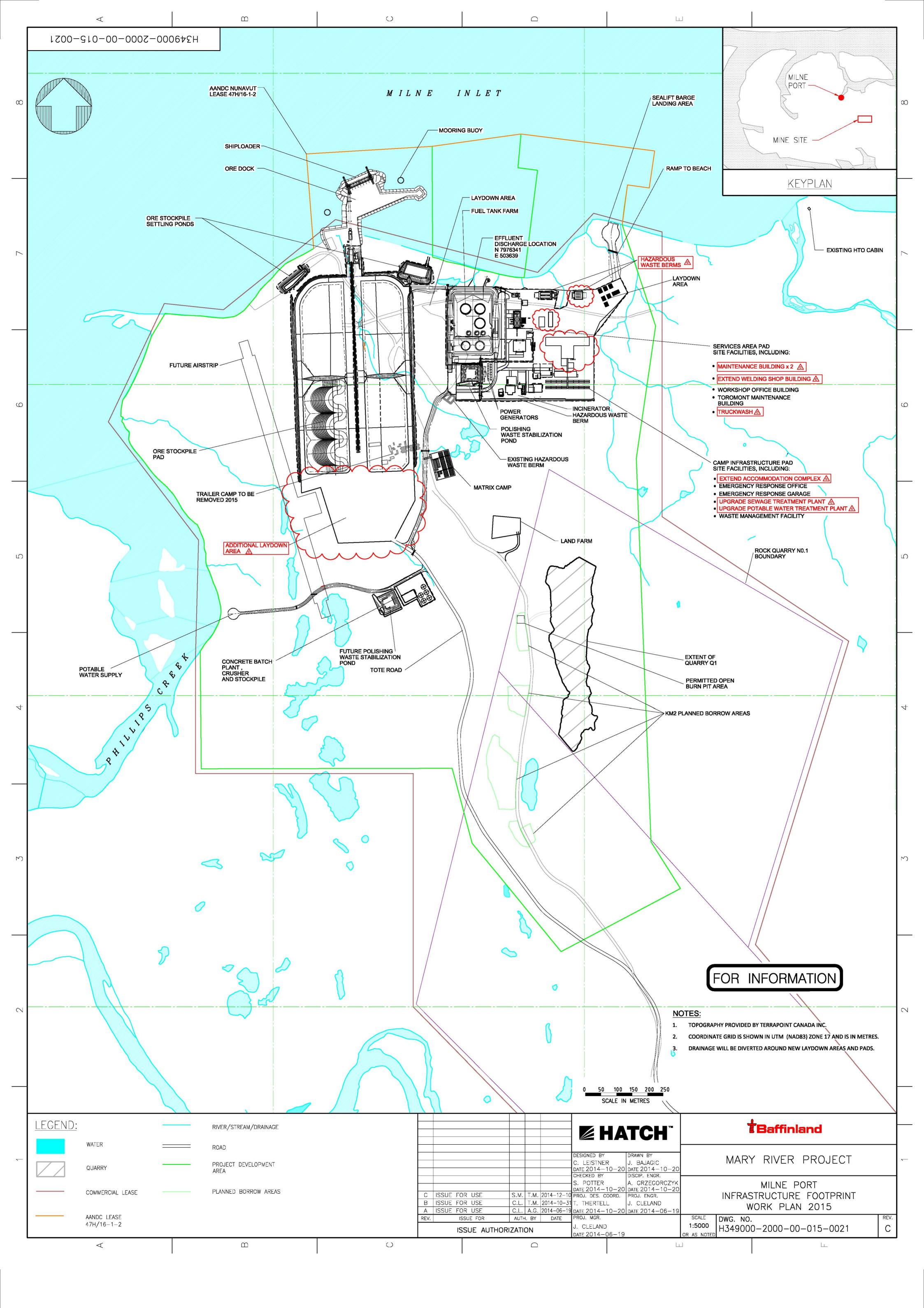
Part	Number	Condition	Section
С	1	The Licensee shall withdraw Water for domestic camp use, not exceeding fifty (50) cubic metres per day, from Phillips Creek during the summer or open-water period and Km-32 Lake during the winter months or freeze-up period. Water for construction or industrial purposes, not exceeding two hundred and forty-nine (249) cubic metres per day, shall be withdrawn from Phillips Creek during the summer months or open water period or and Km-32 Lake during the winter months freeze-up period. The volume of water for all purposes under this Licence shall not exceed two hundred and ninety-nine (299) cubic metres per day.	Table 4-1
E	3	The Licensee shall not directly discharge effluent associated with the operations of the Milne Inlet PWSP (No. 2) and the Milne Port Ore Dock Facility referred to in Part E, Item 1 unless otherwise approved by the Board in writing.	5.4.1

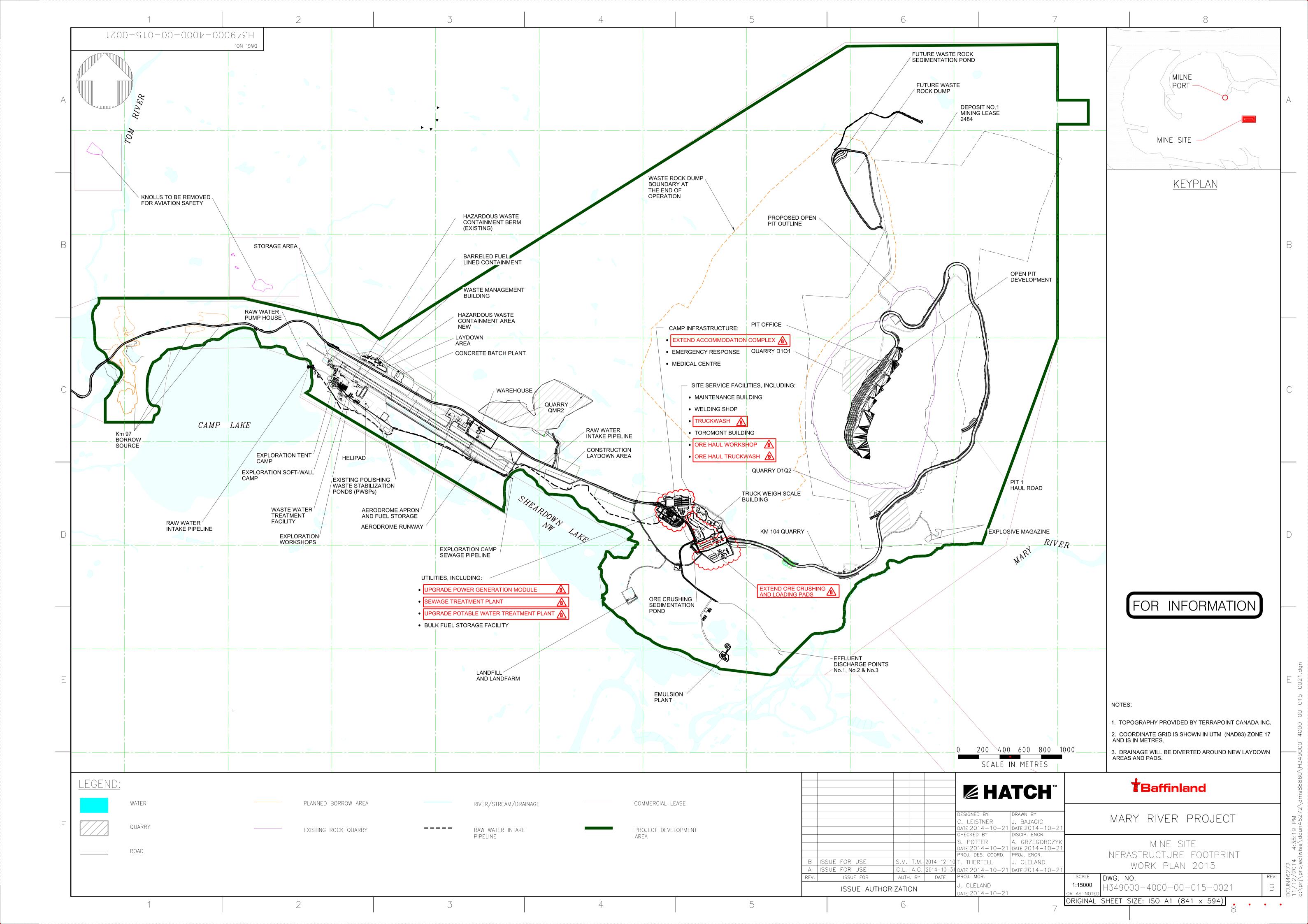


Environment					Document #: BAF-PH1-830-P16	-0010
Management		•			Rev.: 3	
Fresh Water	Supply,	Sewage,	and	Wastewater	Issue Date: March 19, 2015	

## Appendix B - 2015 Work Plan and Updated Site Layouts

- Please refer to the 2015 Work Plan submitted to the NWB and QIA on October 31, 2014. Subsequently, an addendum to that Work Plan was submitted on December 12, 2014.
- Included here are the updated Site Layout Drawings as submitted with the Addendum to the Work Plan

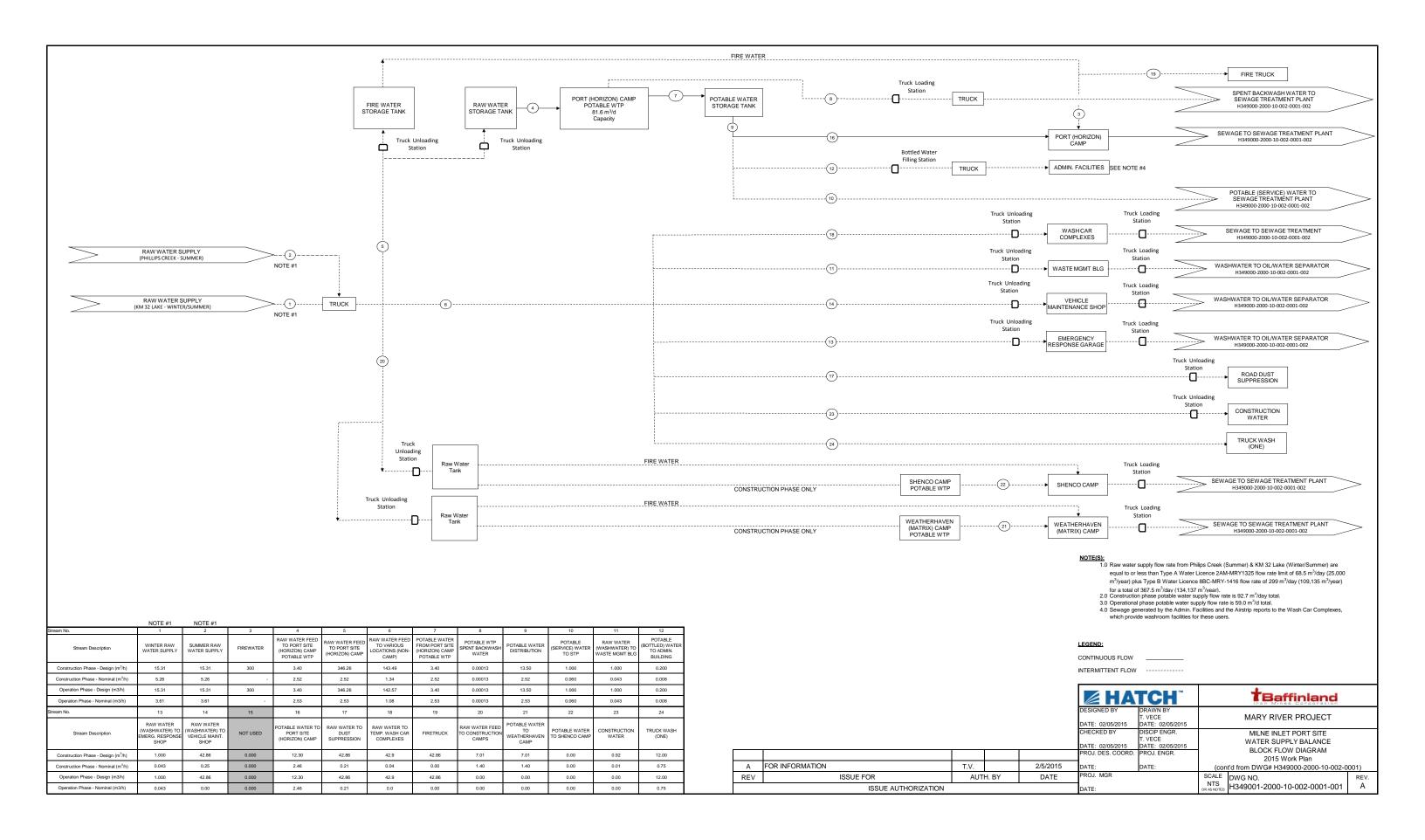


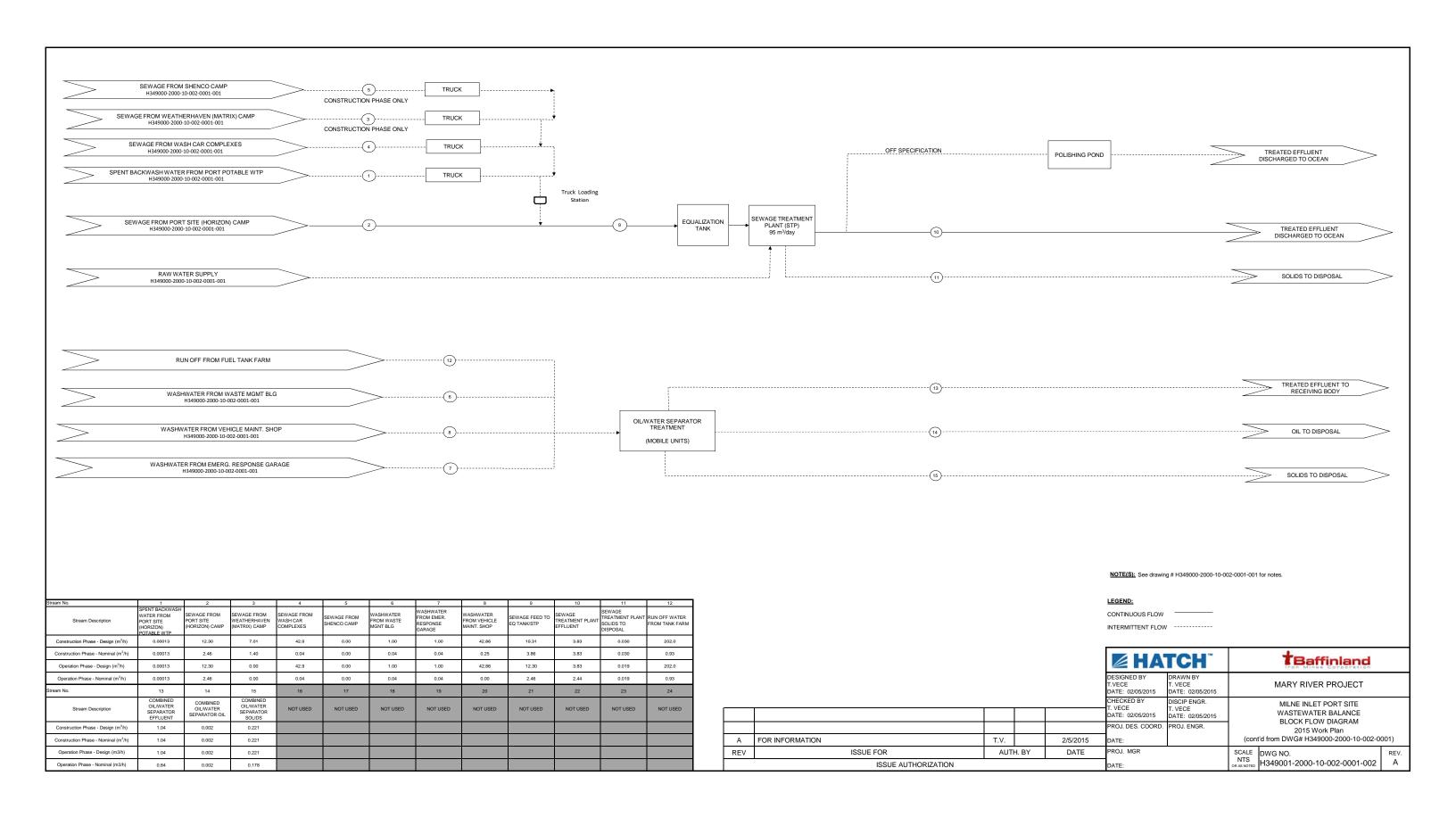


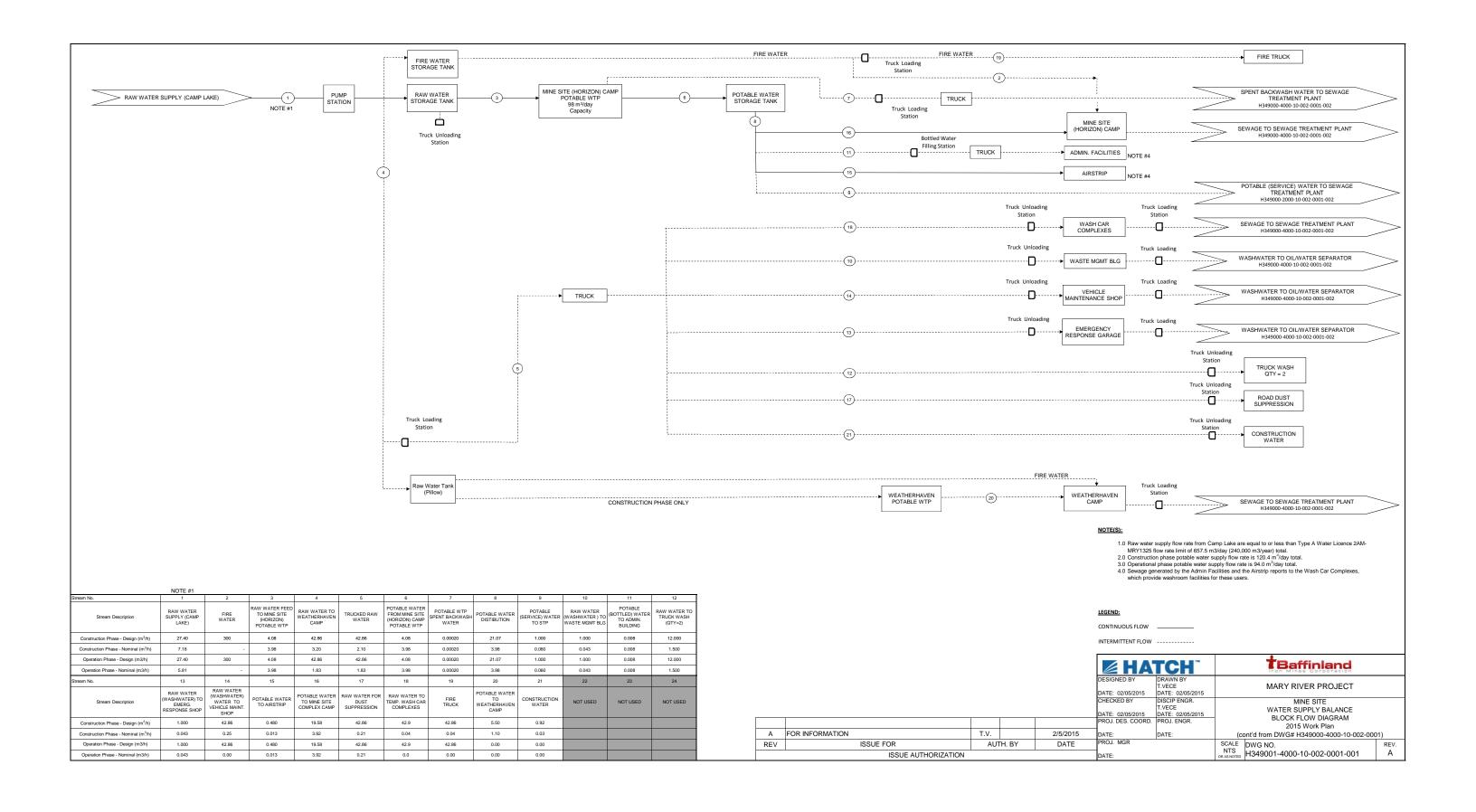


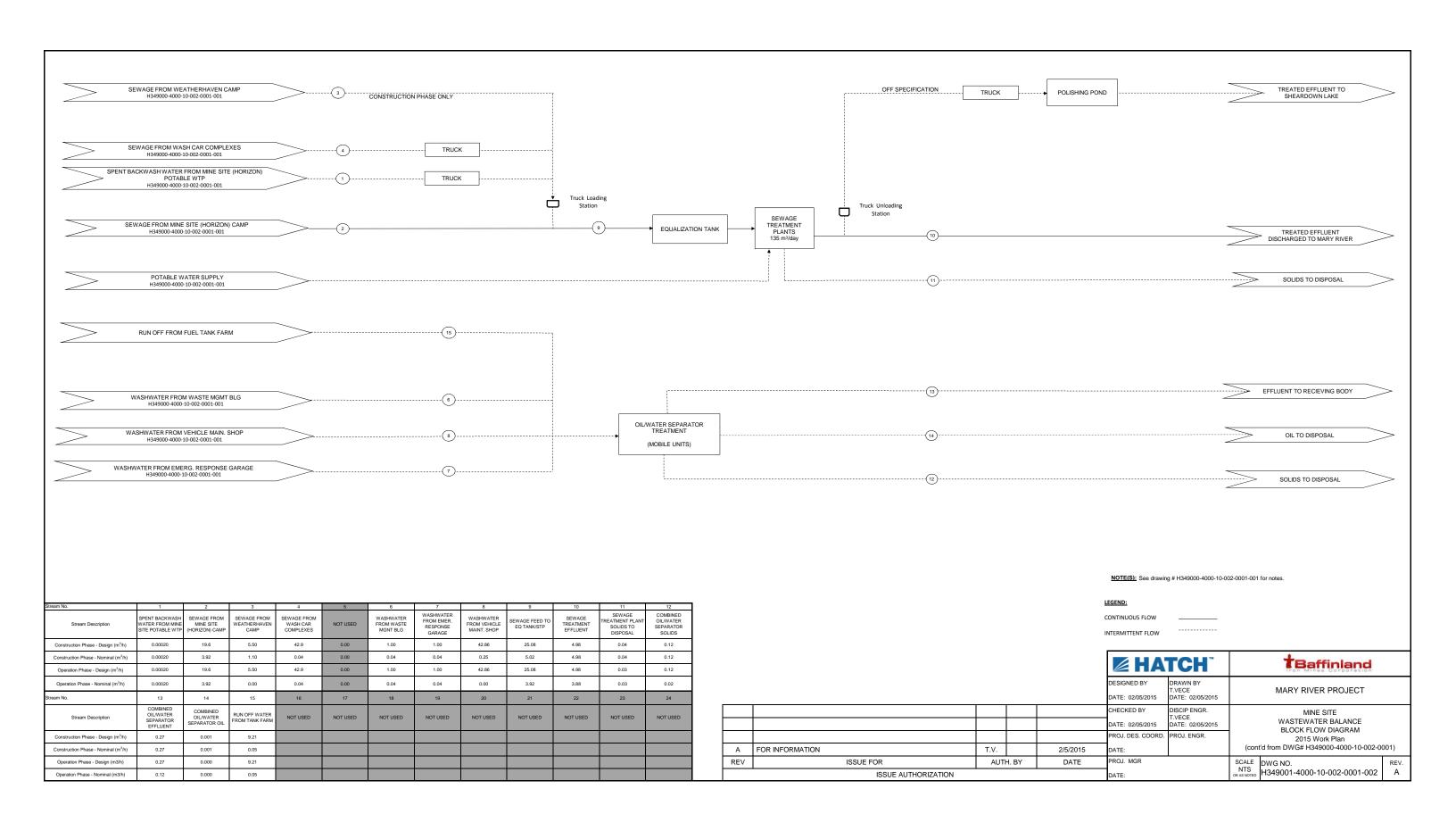
Fresh Water Supply, Sewage, and Wastewater	Issue Date: March 19, 2015
Management Plan	Rev.: 3
Environment	Document #: BAF-PH1-830-P16-0010

## Appendix C - Block Flow Diagrams – Milne Port and Mine Site











Environment	Document #: BAF-PH1-830-P16-0010	1
Management Plan	Rev.: 3	
Fresh Water Supply, Sewage, and Wastewater	Issue Date: March 19, 2015	

## Appendix D - Sewage Treatment Plant O & M Manual



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<b>MATCH</b>	VENDOR DATA RI	EVI	EW	
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	with exceptions as noted to next	As-Built		
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C4 - No furthe	er submission required - Cancelled			
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### E349000-PM-009-00-118-0001

### Sewage Treatment Plant

# Operations & Maintenance Manual



### newterra MicroClear<sup>TM</sup> Membrane Bioreactor (MBR) Wastewater Treatment Plant

#### **OPERATION AND MAINTENANCE MANUAL**

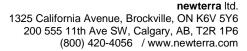
System:	Milne Port & Mine Site Wastewater Treatment Plants
Location:	Baffin Island, Nunavut
Client:	Baffinland Iron Mines Corporation (via Hatch)
Project:	300106
Rev.:	0
Date:	June, 2013





#### **MANUAL OVERVEW**

Section	Section Title	Section Description
1	Introduction	Introduction to <b>newterra</b> MBR WWTP O&M Manual
2	Safety	General personal and environmental safety information for operators serving newterra MBR WWTP.
3	Wastewater Treatment Plant Design Basis	<b>newterra</b> MBR WWTP Specification, Influent / Effluent Characteristics, and Prohibited Items.
4	Plant Installation, Inspection, and Testing	Overview of general procedures and actions followed during the plant installation, inspection and initial testing.
5	Process Control Narrative	Description of wastewater treatment process and equipment functionality. Control narrative & Control system touchscreen operation.
6	System Start-Up, Operating Guidelines and Monitoring	Overview of the plant start-up procedure & operational conditions; monitoring and testing requirements.
7	System Maintenance	Schedule for Routine Operation and Maintenance Checkups; membrane cleaning.
8	Membrane Filtration Unit Shut Down	Overview of the procedure followed during membrane filtration unit temporary and permanent shut downs; winterization procedure.
9	Service & Support	Information regarding the support services offered by <b>newterra</b> ltd. including start-up and emergency services; training sessions during plant commissioning.
10	Warranty and Performance Guarantee	General warranty statements and conditions for the membrane warranty.





#### **APPPENDICES:**

**Appendix A** Drawings and Bill of Materials

**Appendix B** Packing Slip

**Appendix C** Testing Checklists / Pre-commissioning Test Checklist

**Appendix D** Spare Parts List

**Appendix E** Technical Specs and Brochures for Parts and Equipment

**Appendix F** Material Safety Data Sheets

**Appendix G** Glossary & Terms

**Appendix H** Biological Treatment & Monitoring Parameters

**Appendix I** Process and Chemicals Dosage Calculations

**Appendix J** Membrane Fouling

**Appendix K** newterra MicroClear™ Membrane Cleaning Log Sheet

**Appendix L** Alarms Troubleshooting Guide

**Appendix M** Process Troubleshooting Guide



#### 1.0 INTRODUCTION

The purpose of this manual is to provide necessary information for the Installation, Operation and Maintenance of the Waste Water Treatment Plant equipment.



The newterra MicroClear™ MBR wastewater treatment plant (WWTP) functions optimally if the operating procedures described in this manual are followed. If you have any questions after reading through this manual, please contact newterra ltd.

- This O&M Manual must be kept on-site and available to employees at all time.
- It is IMPERATIVE that employees read the manual BEFORE working in the plant.
- Employees' must read Section 2 Health and Safety.
- Technical Support Department contacts are provided in Section 9.



CAUTION: Once wetted, the membrane should remain wet, and not be allowed to dry out, to prevent irreversible damage to the membrane.



WARNING: 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.



#### 2.0 SAFETY

#### 2.1 Introduction

This section provides general personal and environmental safety information for newterra MBR WWTP operators.

#### Always refer to local codes and regulations.

Specific equipment and parts safety information can be found in Appendix E. Material Safety Data Sheets (MSDSs) include detailed information regarding health & safety of chemicals used in wastewater treatment process and are presented in Appendix F.

Information and guidelines outlined in this manual **must** be followed at all times prior to system installation and during operation and maintenance.

#### **ESSENTIAL FOR SAFE OPERATION:**

- Installation and operation of the newterra MBR WWTP must only be carried out by trained and qualified personnel.
- All necessary safety precautions must be carefully exercised, including but not limited
  to proper use of personal protective equipment considering given working environment
  and conditions.
- All electrical installations and troubleshooting must only be carried out by licensed electricians.
- 4. All **plumbing work must** only be carried out by licensed plumbers or qualified personnel.
- 5. Please keep in mind that trees and shrubs taller than two meters located in close proximity to the plant buildings may become a safety concern at the time of installation or service.

#### **DEFINITION OF SAFETY AND WARNING SIGNS USED IN THE MANUAL**



#### **ATTENTION SYMBOL**

Special attention is required to ensure compliance with instructions concerning correct operating sequences to prevent damage to the plant or its function.





#### **GENERAL WARNING SIGN**

This symbol accompanies all important instructions or warnings associated with risks of injury as well as possible equipment damage.



#### CRITICAL WARNING SIGN

Warns against an unsafe situation or practice associated with severe injury as well as major equipment damage.

#### 2.1 Personal Protective Equipment (PPE)

Personal protective equipment refers to protective clothing, helmets, goggles, or other garments used to prevent injury.

The following list includes the minimum scope of PPE that should be available to newterra MBR WWTP operators:

#### **Eye and Face Protection:**

Protective glasses, goggles and face shields prevent wastewater and chemical splashes, tiny dust particles and vapors from getting in eyes and face.

#### **Foot Protection:**

Each operator should wear safety boots with steel toe and shank inserts at all times in wastewater plant operating area to protect feet from falling /rolling objects, wastewater and chemicals splashes, and electrical hazards.

#### **Hand Protection:**

Wear protective gloves at all times working in wastewater plant operating area; chemical-resistant gloves must be worn when handling chemicals



#### **Clothing**

Wear protective clothing to minimize risk of biohazards. Chemical splash apron must be worn when operator handles chemicals.

#### 2.2 Bacterial Safety

The wastewater contains a mixture of viable bacteria and other biological organisms. A wastewater treatment plant poses a number of bacterial hazards and consequently potential health risk. Immunization protects operator against infection. The use of proper hygiene measures, protective equipment, good housekeeping and common sense prevent contact with pathogens.

#### These measures prevent infection!



Ensure that hands are washed with an antibacterial soap and warm water and dried by disposable towels on a regular basis, especially prior eating!

Do not expose cuts or open sores to wastewater!

Use personal protective equipment (PPE) at all times in wastewater treatment facility!

Any concern about possible infection should be brought to the attention of medical physician immediately!

#### 2.3 Chemical Safety

The following chemicals are used in operation of newterra MBR WWTP:

- **Sodium hydroxide (NaOH)** is used for pH adjustment, in case there is a deficiency in alkalinity in influent sewage and pH drops. It is very corrosive and hazardous in case of skin/ eye contact, and ingestion.
- Sodium hypochlorite (NaOCI) and Citric Acid (C<sub>6</sub>H<sub>8</sub>O<sub>7</sub>) are used for cleaning the membranes.
  - √ **Sodium hypochlorite (NaOCI)** is a common disinfectant, which can be an irritant or corrosive, depending on its concentration. It cannot be mixed with organics, ammonia compounds or acids. **Contact with acids produces highly toxic chlorine gas. It has to be mixed only with pure water.**
  - √ **Citric Acid (C<sub>6</sub>H<sub>8</sub>O<sub>7</sub>)** is hazardous in case of skin contact (irritant, sensitizer), or ingestion, eye contact (irritant) and inhalation (lung irritant).



When handling chemicals, it is important to wear proper personal protective equipment such as chemical goggles with combination full face shield, protective clothing with chemical splash apron and chemical-resistant rubber gloves.



The detailed information regarding health & safety of chemicals used in wastewater treatment process can be found in MSDSs presented in Appendix F of the O&M Manual Material.

#### 2.4 Locking out Equipment

Lockout procedures must be followed prior to performing mechanical or electrical maintenance to ensure that equipment has been de-energized.

All relevant local guidelines and procedures must be applied

#### 2.5 Entering Confined Spaces

**Confined space** is defined as an area which is enclosed with limited access. The confined space:

- is large enough and so configured that an employee's body can enter and perform assigned work;
- has limited or restricted means for entry or exit; and
- is not designed for continuous employee occupancy;
- the accumulation of hazardous or toxic gases, vapor, dust, fumes, or the creation of an oxygen-deficient atmosphere may occur in confined space.

Follow local laws and regulations with respect to entering a confined space.

#### 2.6 Vision Hazard

An Ultraviolet light (UV) unit is used in the wastewater treatment plant for final disinfection of treated effluent. Do not look directly at the blue UV lamps. Immediate or prolonged exposure to UV light can result in painful eye injury and skin burn.



#### 2.7 Responsibility for Safety

#### **Management:**

Management is responsible for providing a safe working environment. This is accomplished partly by:

- Ensuring that all facilities and equipment are built and maintained in accordance with the appropriate safety standards
- Providing adequate funds for equipment and plant maintenance
- Establishing, promoting, and enforcing a safety policy
- Establishing a safety training program
- Supplying easy accessible eyewash and first-aid stations and proper personal protective equipment (PPE) for personnel servicing wastewater treatment facility.

#### Worker:

- To develop a positive and professional attitude towards safety.
- To avoid mistakes caused by indifference to safety, poor work habits, lack of attentiveness, rushing the job, failure to observe established safety procedures and poor physical condition.



### Remember the "ABC" of accident prevention: ALWAYS BE CAREFUL!!!

In addition to "being careful", it is the responsibility of all workers to:

- Work in accordance with established safety procedures
- Follow the established safety rules
- Wear appropriate personal protective equipment (PPE)
- Report all accidents, no matter how minor
- Report potential safety hazards
- Participate in safety programs



#### Plant Safety - Simple Rules to Follow

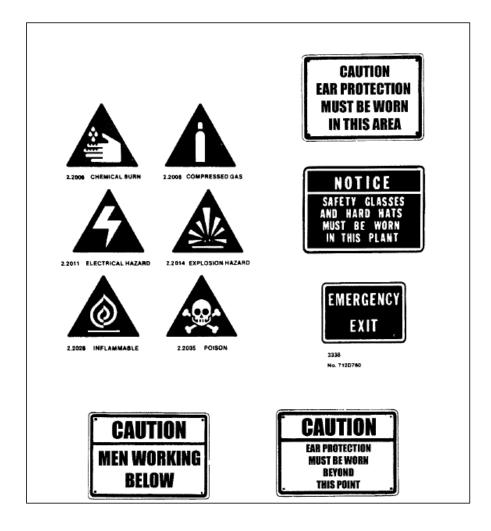


### Common sense plays a very important part in the safe operation of any type of plant!

- Wear the appropriate personal protective equipment at all times.
- Keep walkways clear of snow and ice, and loose objects such as pails, shovels, tools, etc.
- Clean up spills of oil, grease, chemicals, or other substances immediately.
- Keep all tools and similar equipment clean, in good condition, and properly stored when not in use.
- Replace all manhole covers, access trap doors, etc. as soon as possible. Erect a safety barrier if it is necessary to leave the opening uncovered.
- Use the proper tools when removing or replacing a manhole cover.
- Wear a safety belt whenever there is the possibility of falling even a short distance, or when working over water.
- Lock out and tag electrical equipment before working on it or the associated equipment.
- Ensure that moving machinery is properly guarded. Wear ear protection in noisy environments.
- Ensure that fire-fighting equipment is in good working condition.



#### **Hazard Warning Signs/Symbols**





#### 3.0 WASTEWATER TREATMENT PLANT DESIGN BASIS

The **newterra** MBR Wastewater Treatment Plants (WWTPs) are designed for treatment of domestic wastewater from 200-m Mine Site camp with an average design flow of 72 m<sup>3</sup>/d and 175-m Milne Port camp with an average design flow of 63 m<sup>3</sup>/d. The wastewater treatment plants have been designed to meet the required effluent quality.

#### newterra MicroClear<sup>™</sup> MBR Process Specification

		Value		
Parameters	Unit	Mine Site WWTP	Milne Port WWTP	
Design Hydraulic Load				
Average Daily Flow ( ADF)	m³/d	72	63	
Selected Design Flow (Q <sub>h</sub> )	m³/h	3	2.63	
Organic Load				
COD Load	[kgCOD/d]	76.32	66.78	
BOD Load	[kgBOD/d]	38.16	33.39	
TKN Load	[kgTKN/d]	5.4	4.73	
TAN Load	[kgTAN/d]	3.24	2.84	
TP Load	[kgTP/d]	0.86	0.76	
TSS Load	[kgTSS/d]	41	35.9	
Process Tanks				
One (1) Equalization Tank				
Effective volume	m <sup>3</sup>	43.5	43.5	
Hydraulic Retention Time (HRT <sub>EQ</sub> )	h	14.5	16.5	
One (1) Aeration Tank				
Effective volume	m <sup>3</sup>	48	48	
HRT <sub>AEROBIC</sub>	h	16	18.3	
Two (2) Membrane Tanks				
Total Effective Volume	m <sup>3</sup>	5.0	5.0	
HRT <sub>MEMBRANE</sub>	h	1.7	1.9	

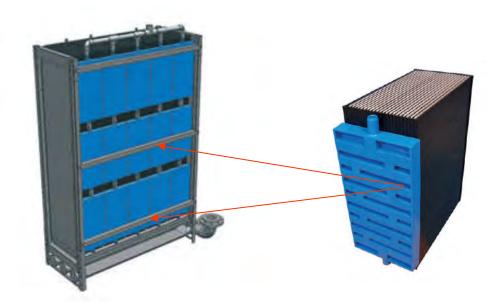


		Value	
Parameters	Unit	Mine Site WWTP	Milne Port WWTP
MBR System (including aeration tank and membrane tanks)			
Overall Effective Volume	$m^3$	53	
Overall HRT	h	17.7	20.2
Overall SRT	d	15	16
Internal recirculation rate: Membrane tanks  →Aeration tank		4 – 5x influent flow	
Average Design Flux	LMH	18	
Sludge wasting rate (at 1%, 10 g/L)	m³/d	3.8	2.93
Minimum / maximum design operating temperature	°C	10 / 35	

MicroClear <sup>™</sup> MB3-1 membrane module		
MCXL cassettes in each MB3-1 module	nr	15
Individual MB3-1 module filtration area	m <sup>2</sup>	105
MB3-1 modules in each membrane tank	nr	1
Total Membrane Filtration Area in two (2) membrane tanks	$m^2$	210
MB3-1 Module Dimensions (L x W x H)	m	1.30 x 0.70 x 1.85
		Stainless steel
Housing materials	-	1.4571 (316 Ti)

Sludge Treatment System	Unit	Value
One (1) Mixing Tank		
Effective Volume	m³ (gal)	0.9 (240)
One (1) 6 ft <sup>3</sup> (expandable to 10 ft <sup>3</sup> ) 630 mm filter press		
Feed from aeration tank		
Sludge volume	m³	2.93
Sludge concentration	%	1
Dewatered sludge dryness	%	25
Filter press daily run time		
Cycles	c/day	4
Cycle duration	h	4
Overall daily run time	h	16
		Heavy duty steel
		skeleton, panted
Construction materials	-	with two part epoxy
Polymer consumption (40 mg/L addition ratio of polymer at		
<u>0.25%)</u>	L/d	150





MicroClear<sup>™</sup> MB3-1 membrane module

MicroClear<sup>™</sup> MCXL membrane cassette

Influent

#### **Wastewater/Treated Effluent Characteristics:**

Parameters	Unit	Influent Quality	Effluent Quality	
			Mine Site WWTP	Milne Port WWTP
pH	S.U.	6.0 - 9.0	6.0 – 9.5	6.0 - 9.5
Turbidity	NTU		<5	< 5
Fat, Oil, Grease (FOG)	mg/L	< 30	No visible seen	No visible seen
Chemical Oxygen Demand (COD)	mg/L	1060	-	-
Biological Oxygen Demand (BOD <sub>5</sub> )	mg/L	530	< 10	< 20
Total Suspended Solids (TSS)	mg/L	570	< 10	< 20
Total Kjeldahl Nitrogen (TKN)	mg/L	75		-
Ammonia Nitrogen (NH <sub>3</sub> -N)	mg/L	45	< 2	< 2
Total Phosphorus (TP)	mg/L	12	< 0.1	-
E-Coli / Fecal Coliform	CFU/100 mL		< 200*	< 200*
Alkalinity (assumed)	mg/L as CaCO₃	10 – 14	-	-

<sup>\*</sup>After UV disinfection



#### **Prohibited Items**

The raw wastewater should not contain any of the following substances:

- Hydrocarbons lubricants, gasoline, diesel, etc.;
- Paints, solvents, silica, silicones and polymers;
- Antibacterial solutions, and products with quaternary ammonia;
- Large quantities of chemicals such as water softener, disinfectants, strong acids & alkalis, pesticides or photographic chemicals;
- Silicone based defoamers;
- Non-biodegradable solid waste (plastic, rubber products, disposable diapers, etc.);
- High amount of metals, such as iron, magnesium, calcium, barium and strontium.



#### TOXIC MATERIALS SHOULD NOT BE THROWN INTO THE DRAIN!

The raw wastewater should also comply with the following compatibility chart. The lipophilic substances concentration must be lower than **50 mg/L**.

#### MicroClear<sup>™</sup> Membrane Compatibility Chart

Group	Substances	SP-Type Membrane
	Methylene Chloride, Chloroform, Carbon Tetrachloride, Chlorobezene, Trichloroethane	
Chlorinated solvents	(<1%)	
Esters	Ethyl Acetate, Butyl Acetate, Butyl Acrylate (<1%)	-
Ethers	Ethyl Ether, Polyethylene Oxide (<1%)	
$H_2O_2$	<2000 ppm	++
Inorganic acids	HF, HCI, H₂SO₄	pH 0 - 14
Ketones	Acetone, Methyl Ethyl Ketone	
NaOCI	100,000 ppmxh	++



	Sulfamic Acid, Formic Acid, Oleic Acid, Sulfonic	
Organic acids	Acid, Acetic Acid, Acrylic Acid, Latic Acid	pH 0 - 14
Phenols		
Silicones		
Alcohols	Ethanol, Butanol, Isopropranol (<50%)	+
Aldehydes	Formaldehyde (<1%)	++
Alkali		pH 0 - 14
	Dimethyl Formamide, Dimethyl, Acetamid Dioxane, N-Methyl, Pyrrolidone, Tetramethyl Acetamide	1
Aprotic Solvents	Benzene, Toluene, Xylene, Anthracene, Naphatalene, Gasoline	-
Aromatic hydrocarbon	Methoxyethanol, Ethoxyethanol, Buthoxyethanol	?

(++ = Very good, + = good, - = fair, -- = not recommended)

# **Removal of Oily Materials**

The wastewater must pass through a grease trap (or similar facility for grease/fat removal), if there is kitchen usage onsite. The large amount of oil and fat can harm treatment facility (e.g., clogging pumps and piping and cause foaming in the aeration tank). To avoid premature membrane fouling, maximum FOG concentrations should not exceed 30 mg/L.



Fats, oils and grease (FOG) must be removed prior to MBR. Removing of FOG significantly reduces membrane fouling, foaming potential and increases aeration efficiency.



### 4.0 PLANT INSTALLATION, INSPECTION, AND TESTING

The **newterra** MicroClear<sup>TM</sup> MBR WWTP is a packaged plant which comes complete with containerized inlet screen, equalization tank, post EQ screen, aeration tank, membrane tanks, UV disinfection systems and a sludge dewatering unit. The plant is housed inside multiple 40-ft modified high-cube shipping containers - completely pre-assembled, pre-piped, pre-wired and pre-tested, ready for a quick site installation and start-up. The standard containerized design also allows for modular expandability, portability and quick deployment, particularly beneficial features for work camp applications.

# 4.1 Site Conditions Requirements

- Installation site for the **newterra** MicroClear<sup>™</sup> MBR WWTP should be close to the sewer drain and have a sufficient power source (refer to Electrical Drawings in Appendix A of this manual).
- Location must permit easy access for equipment capable of transporting, offloading, and handling of the designed loads.
- There should be adequate space around the containers for safe operation and maintenance.
- The firm base (foundation) must be built to support the full operating weight of the plant to prevent buildings from shifting and pipe/electrical conduit connection failure - pilings or rig mats are recommended (based on site conditions).



The firm base for the container must be level and must be capable of supporting the operating weight.



death.

WARNING: Always check with the local utility companies for the location of water lines, electrical and telephone cables, or any additional hazards below grade, prior to excavation. Failure to do so could result in severe bodily injury or





# 4.2 Inspection upon Delivery

The **newterra** MicroClear<sup>™</sup> MBR WWTP is carefully manufactured, checked, and tested at the manufacturing plant. All equipment is pre-wired, pre-piped, mounted inside the enclosure and factory tested. Upon receiving the system, please perform the following:

- Place the containers onto the prepared firm base to avoid sagging, equipment vibration, and shifting. When lifting the container, ensure that lifting equipment is clear of overhead obstructions such as power lines, trees or rooftops. Be careful during this procedure!
- Be careful when offloading the containers to prevent damage to the internal pipe work.
- Check the containers for any signs of shipping damages.
- Inspect the containers to ensure that no components or parts are missing (refer to the Packing Slip presented in Appendix B of this manual). Also, inspect for visual damage of the tanks, pumps, blowers, piping, and control panel.
- If the containers, equipment inside and any parts shipped loose are free of damage, proceed with the installation.

For any damages or loss of equipment, please notify newterra ltd. at (800) 420-4056 immediately.

# 4.3 Plant Initial Set up

WARNING: The installer must ensure that the installation site is safe from hazards. These could include excavations left open overnight, debris left lying around, and tanks & equipment not properly blocked. Provisions must be made to eliminate the potential hazards by roping off and proper shoring around the excavations, cleaning up at the end of each workday, and proper storage of equipment. Failure to do so could result in severe injury or death.



# **Enclosures Specifications**

WWTP Enclosures	newterra MicroClear™ MBR WWTP consists of six (6) cMET certified, built to NEC standard enclosures
Enclosure #1 (SCREEN BLD-7903)	Room #1 - Class 1 Div 2, contains Screen Modules with Screw Screen Compactors (SCR-201/SCR-401), Screen Discharge Tanks (TNK-202/TNK-401), and pumps  Room #2 - General Purpose (GP), contains Control Panel
Enclosure #2 (EQUALIZATION BLD-7901)	General Purpose (GP), contains Equalization Tank (TNK-301)
Enclosure #3 (AERATION BLD-7902)	General Purpose (GP), contains Aeration Tank (TNK-501)
Enclosure #4 (MBR FILTRATION BLD-7900)	General Purpose (GP), contains Membrane Tanks (TNK-601/TNK-602), scouring blowers, pumps, permeate withdrawal systems, UV system, and chemical units
Enclosure #5 (EFFLUENT BLD-7905)	General Purpose (GP), contains Effluent Tanks (TNK-811/TNK-812/TNK-813/TNK-814), pumps, and chemical units
Enclosure #6 (SLUDGE BLD-7904)	Room #1 - Class 1 Div 2, contains sludge dewatering module including Filter Press (FP=901), mixing tank (TNK-901), air , and pumps
(020002 020 700 1)	Room #2 - General Purpose (GP), contains pumps and blowers for aeration tank, and office space
Estimated Dry shipping weight for each enclosure	SCREEN BLD-7903 – 20 000 lb (9072 kg) EQUALIZATION BLD-7901 – 26 000 lb (11 793 kg) AERATION BLD-7902 – 28 000 lb (12 700 kg) MBR FILTRATION BLD-7900 - 23 000 lb (10 432 kg) EFFLUENT BLD-7905 - 15 000 lb (6804 kg) SLUDGE BLD-7904 – 20 000 lb (9072 kg) All enclosures are 40-ft high-cube modified shipping
Enclosures Dimensions	containers: 12.2 m L x 2.44 m W x 2.89 m H (40' L x 8' W x 9'6" H)
Influent supplied head	3.0 m (10')
Treated effluent discharged head pressure	1.5 m (5') 3" steel FNPT for wastewater from lift station; 3" steel with
Inlet pipes	female camlock from sewage truck
Discharge pipe	2" steel pipe with 2" flange

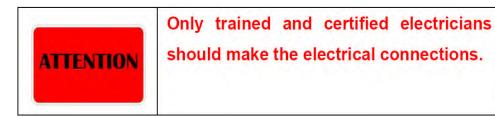


Verify site power per system design criteria.

# **System Electrical Specifications:**

System Power	600-V, 3-Phase, 3-Wire, 60 Hz	
Main Disconnect	200 A	
Panel Approval and Classification	cMET, Classified	
System Approval and Classification	cMET, Classified GP & C1 Div 2	
Telemetry Setup	-	

### Please refer to the as-built electrical drawings in Appendix A of this manual.



#### **Installation Instructions:**

- 1. Remove hatch covers from the interconnecting ports.
- 2. Place containers tight against each other with the interconnecting ports lining up.
- 3. Connect electrical power to the **Main Switch Panel** located inside the enclosure **(BLD-CONTROL)** 3 phase, 380 V from available source ensuring correct phase rotation.
- 4. Ensure that proper electrical grounding and lightning protection is available.
- 5. Switch Main Switch Panel's isolator to the ON position.
- 6. Check all internal lighting, heating, and ventilation for correct operation.
- 7. Install packed external lighting into brackets above the doorway (double man doors), route the cables to the inside of the container through the ports provided and plug into sockets provided (check for correct operation).



- 8. Ensure that a potable water supply is available (used for hydraulic testing during startup, membrane cleaning, washing hands and for performing onsite testing).
- 9. Ensure availability of an emergency eyewash station and personal protection equipment onsite.
- 10. Verify membrane modules are secured within the membrane tanks i.e. verify wheel chocks (if applicable) 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 tanks.

## 4.4 Plant Initial Testing

The **newterra** MBR WWTP (except the membrane modules) undergoes electrical and leakage tests in our manufacturing facility prior to shipment; however, fittings could shift during shipment, so it is our standard practice to perform plant initial testing including **dry and hydraulic tests.** 

# 4.4.1 Dry Test

The following tasks have to be performed **before potable water** is introduced into the system:

- Ensure that all tanks are clean and free of any dirt or debris (this is to prevent obstruction or damage to the piping, pumps, and membranes).
- Ensure that all connections have been provided and joints have been tightened.
- Check the placement of the air diffusers in the equalization tank **(TNK-301)** and aeration tank **(TNK-501)** if incorrectly positioned, proper adjustment has to be performed.
- Ensure that a functional check of the electrical and control system has been performed (please refer to the newterra Pre-commissioning Test Checklist presented in Appendix C).

### 4.4.2 Hydraulic Test

The hydraulic test is performed using potable water to:

- Check for and fix any leakage;
- Check the setting of level switches/transmitters;
- Check the hydraulic flow through the plant;



- Check if all the ancillary equipment and controls of the plant function as per design;
- Recalibrate instruments (if applicable);
- Perform clean water test on membranes.



Caution: Once wetted, the membrane should remain wet, and not be allowed to dry out to prevent irreversible damage to the membrane.

## **Performing the Hydraulic Test**

- Fill the system [equalization tank (TNK-301) and aeration tank (TNK-501)] with potable water, run the pumps and check for any signs of leakage.
- Perform electrical and instrumentation (E&I) functional checks and adjustment of level switches.
- Turn on the air blowers B-301/B-302/B-303/B-304/B-305/B-306 for the equalization tank (TNK-301) and blowers B-501/B-502 for the aeration tank (TNK-501), and check for:
  - Buoyancy of air diffusers and if this occurs, empty the tank and fix;
  - Air leakages: if this occurs, tighten up the fittings;
  - Manually check water temperature and DO (dissolved oxygen): with a hand-held DO meter and adjust air flow to keep it up to 0.5 – 1 mg/L for equalization tank (TNK-301) and 2-3 mg/L for aeration tank (TNK-501); check the DO readings on the touch screen.
  - DO Control System: check automatic ON/OFF of aeration tank air blowers at low and high settings of DO without the return of aerated water from the membrane tanks to aeration tank, and record blower ON/OFF duration.

# Membrane Tanks (TNK-601/TKN-602):

- Enable membrane operation.
- Start the pumps (P-501/P-502) for aeration tank and fill the membrane tank (TNK-601) with potable water.
- Start the air blowers (B-601/B-602/B-603/B-604/B-605) for membrane tank (TNK-601) and blowers (B-606/B-607/B-608/B-609/B-610) for membrane tank (TNK-602) and check for an even distribution of air across the membrane filter area and air bubble uniformity above the membrane modules/cassettes.





- Check hydraulic flow pattern through the membranes and between membrane modules/ cassettes and tank wall.
- Make a clean copy of the Clean Water Testing Sheet presented in Appendix K of this O&M Manual.
- Start the permeate (vacuum) pumps P-701/P-702
- Record all checked parameters in the Clean Water Testing Sheet:
  - Record the vacuum (TMP) on gauges PI-701/PI-702 [for clean water could be 0.05 to 0.07 bar (20" to 29" WC)].
  - Record ambient temperature, and water temperature and DO with a hand-held DO meter.
  - Gradually increase the permeate flow while recording the vacuum (TMP) on the gauges up to the anticipated peak wastewater flow.
- Forward a complete Clean Water Testing Sheet to newterra for analysis.



# 5.0 OPERATION of newterra MicroClear™ MBR

Membrane Bioreactor (MBR) treatment technology is an effective combination of an activated sludge biological treatment process with MicroClear MBR membrane filtration technology. The MBR operates at MLSS (mixed liquor suspended solids) concentrations between 8,000 to 12,000 mg/L.

This section provides a brief description of the treatment process and how it is controlled. Most of the equipment in the **newterra** WWTP can be operated in either manual or automatic mode. The system is designed to always run in auto mode. The manual option is provided mainly for maintenance purposes. Equipment and instrumentation identification numbers are referenced from the **Process & Instrumentation Diagram** and **System Layout** presented in **Appendix A** of this O&M Manual.

## **Automatic Operation**

The PLC-based control system is the default operation mode for the **newterra** MicroClear<sup>™</sup> MBR. The system operates as a programmable computer that:

- Receives analog and digital input signals from the switches and transmitters being controlled:
- Processes this information using the structure and rules entered into the program;
- Generates outputs that control the equipment turn equipment OFF or ON.

Under normal operation, all switches are set in the AUTO position on the HMI.

All alarms are visually indicated on a beacon stack on the roof of the exterior of the container:

- Green System OK
- Green Flashing System Auto Restart
- Red Solid Warning Alarm
- Red Flashing Critical Alarm
- No Light Loss of Power

The MBR will always remain in auto run mode, unless the kill switch is pressed or power is down. The MBR will automatically restart after power failure given that the system was running when the power failed.



All high high level alarms (identified as LSHH on P&ID) indicate a critical situation for imminent tank overflow and could result in pump(s) shutting off to avoid overflow situations and requires immediate operator attention.



### **Manual Operation**

The manual mode of operation is provided for maintenance purposes and for emergency operation of the plant in the unlikely event of a failure of the automatic control system (default operation mode). Operators <u>must be present when equipment is operated in the manual mode</u>.

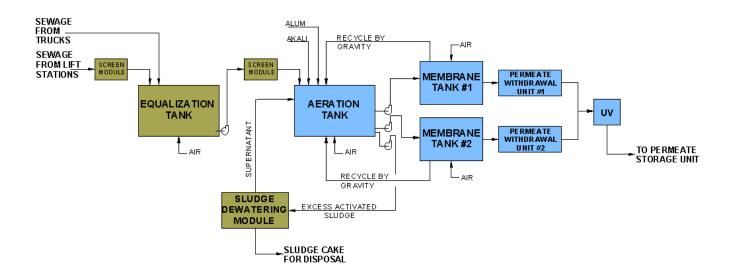
A HAND-OFF-AUTO (H-O-A) switch is provided on the touch screen of the control panel. The HAND position on the switch allows the equipment to be operated in the manual mode.



For safety reasons, a motor in the HAND position will only run for two minutes before it will be automatically stopped.

# 5.1 Wastewater Treatment Process Description / Control Narrative

The **newterra** MBR WWTP comprises screen modules, equalization tank, aeration tank, membrane filtration module, UV system, permeate storage tank, and sludge dewatering module.





# 5.1.1 Buildings/ Utilities

The newterra MBR WWTP is housed inside six (6) enclosures (buildings):

- Screen building (BLD-7903) with two (2) rooms: Room #1 (Electrical Classification Class 1, Div 2 area), and Room #2 (GP area)
- Equalization tank building (BLD-7901)
- Aeration building (BLD-7902), GP area
- Membrane Filtration building (BLD-7900), GP area
- Effluent building (BLD-7905), GP area
- Sludge building (BLD-7904) with two (2) rooms: Room #1 (Electrical Classification Class 1 Div 2 area), and Office Room #2 (GP area)

The main control panel is located in the Screen building (BLD-7903), Room #2 (GP area)

# 5.1.1.1 Wastewater Treatment Plant Power Supply



Please refer to the as-built Electrical Block Diagram presented in Appendix A of this manual.

A power monitor has been installed in the main power distribution panel to ensure proper power and phase rotation is delivered to the system. The main power distribution panel is located in the Screen BLD-7903, Room #2 (GP area).

# **E-STOP**

There are several emergency stop buttons wired to a common system kill circuit (KILL-7901) in the plant:

- Kill Switch Emergency Stop MCP-01 (ESD-8201) located in the control room of the BLD-7903, Room #2, (GP area)
- Emergency Stop MCP-02 (ESD-8202) located in BLD-7900
- Emergency Stop MCP-03 (ESD-8203) located in BLD-7905
- Emergency Stop MCP-04 (ESD-8204) located in BLD-7904, Room #2 (GP area)
- Emergency Stop Screen (ESD-7931) located in BLD 7903, Room #1 1 (Class 1 Div 2 area)
- Emergency Stop Membrane Filtration (ESD-7911) located in BLD-7900

The following emergency stop switches are used for local shut off:

- Emergency Stop Effluent (ESD-7905) located in BLD-7905
- Emergency Stop Sludge (ESD-7941) located in BLD-7904



#### 5.1.1.2 SCREEN BLD-7903

### Ventilation

Two (2) exhaust blowers (B-7931 & B-7932) provide constant ventilation for the Screen Modules and Building BLD-7903 Room #1 (Electrical Classification – Class 1 Div 2 area). The air from the blowers is passed through a heat recovery system prior to discharging outside. The blowers run at all times at a rate of ~12 air changes per hour to ensure the requirements of the electrically classified location are met.

#### **Alarms**

If the blowers' motors stop running an alarm signal will be sent to the PLC from current switches (YI-7931/ YI-7932).

A single exhaust fan (F-7911) is locate in the Room #2 (GP) of the BLD-7903 where the main control panel is located. The purpose of the fan is to prevent the building temperature from climbing higher than desired room set point temperature. The desired room temperature must be set by the operator with the building high temperature switch TSH-7911. If this switch is tripped the exhaust fan will run until the temperature drops below the set point.

**Note**: The fan (F-7911) is to be used primarily during the summer months - freezing cold air in to the building can lead to condensation/potential freezing risks for critical pieces of equipment.

### **Hydrogen Sulphide Detection**

A Hydrogen Sulphide ( $H_2S$ ) Detector (AIT-7931) is installed in the screen building (BLD-7903) Room #1 (Electrical Classification – Class 1 Div 2 area). This sensor allows continuous monitoring for  $H_2S$  gas. In the event the  $H_2S$  alarm level set point is exceeded an alarm will be triggered and indicated on the HMI, an internal and external audible buzzer will sound, the alarm beacon light will illuminate. The water treatment process will continue to run.

#### **Temperature control**

For building (BLD-7903), temperature is controlled manually at the local thermostats of the heaters: H-7931/H-7932 for the Room #1 (Electrical Classification - Class 1 Div 2) and H-7933 for the Room #2 (GP area). They are not linked to the PLC.

The operator is required to set the desired building temperature set point in °F at the temperature switches (TSL-7931 and TSL-7932) located in the general purpose room of this building. If the building temperature falls below the temperature switch setting the electric heaters (H-7931/H-7932) will turn on. H-7933 is locally controlled only.

CAUTION: The temperature switch units are in °F.



#### **Alarms**

If the temperature of the room #1 and room #2 in the BLD-7903 drops below the low low temperature set point, the alarm switches (TSLL-7931 & TSLL-7932) will trip and after 300 sec a low temperature alarm will register on the HMI and the red beacon light will illuminate. This may indicate that heaters (H-7931/H-7932) are faulty.

#### 5.1.1.3 EQUALIZATION TANK BLD-7901

### Ventilation

The Equalization Tank (TNK-301) is equipped with a ventilation exhaust blower (B-307) located in classified area of BLD-7903. The blower runs at all times providing constant ventilation of the equalization tank. The blower vents air at a rate of 12 air changes per hour and exhausts to the exterior of the building.

If the blower's motor stops running an alarm signal will be sent to the PLC from current indicator switch (YI-307).

### **5.1.1.4 AERATION TANK BLD-7902**

## Ventilation

The aeration tank head space is vented by a blower (B-503) to the aeration foam tank (see details in subsection 5.2.3).

### **5.1.1.5 MEMBRANE FILTRATION BLD-7900**

## **Hydrogen Sulphide Detection**

A Hydrogen Sulphide ( $H_2S$ ) Detector (AIT-7911) is installed below the control panel in the permeate extraction system room of building 7900. This sensor allows continuous monitoring for  $H_2S$  gas. In the event the  $H_2S$  alarm level set point is exceeded an alarm will be triggered and indicated on the HMI, an internal and external audible buzzer will sound, the alarm beacon light will illuminate. The water treatment process will continue to run.

#### **Temperature control**

For building (BLD-7900), temperature is controlled manually at the local thermostats for the wall mounted heaters: H-7911/H-7912. They are not linked to the PLC.

The operator is required to set the desired building temperature set point in  ${}^{\circ}F$  at the temperature switch (TSL-7912). If the building temperature falls below the temperature switch setting the wall mounted electric heaters (H-7911/H-7912) will turn on.

### CAUTION: The temperature switch units are in °F.



#### **Alarms**

If the temperature in the BLD-7900 drops below the low low temperature set point, the alarm switch (TSLL-7901/TSLL-7905) will trip and after 60 sec the room's temperature alarm will register on the HMI and the red beacon light will illuminate. This may indicate that heaters (H-7911/H-7912) are faulty.

### **5.1.1.6 EFFLUENT STORAGE BLD-7905**

### Temperature control

For BLD-7905, temperature is controlled manually at the local thermostat for the wall mounted heaters (H-7951/H-7952). They are not linked to the PLC.

The operator is required to set the desired building temperature set point in °F at the temperature switch (TSL-7952). If the building temperature falls below the temperature switch setting the wall mounted electric heaters (H-7951/H-7952) will turn on.

# CAUTION: The temperature switch units are in °F.

#### **Alarms**

If the temperature in the BLD-7905 drops below the low low temperature set point, the alarm switch (TSLL-7951) will trip and after 60 sec a building temperature alarm will register on the HMI and the red beacon light will illuminate. This may indicate that heaters (H-7951/H-7952) are faulty.

### 5.1.1.6 SLUDGE BLD-7904

## **Ventilation**

Building (BLD-7904), Room #1, Class 1 Div 2 is equipped with an exhaust blower (B-7941). The blower runs at all times providing constant ventilation of the room. The blower vents air at a rate of 12 air changes per hour. The air from the blower (B-7941) is passed through a heat recovery system prior to discharging outside the BLD-7904.

If the blower's motor stops running an alarm signal will be sent to the PLC from current (YI-7941).

#### Temperature control

For BLD-7904, temperature is controlled manually at the local thermostats for the wall mounted heaters: H-7941/H-7942 for the Room #1, Class 1 Div 2 and H-7943 for the Room #2 General Purpose. They are not linked to the PLC. There are temperature switches in the BLD-7904: TSL-7941/TSL-7942 for the Room #1 (Class 1 Div 2).



#### **Alarm**

Alarm switch (TSLL-7941) is activated when the temperature falls below set point. This may indicate that heaters (H-7941/H-7942) are faulty.

### Compressed air

Air compressor (C-901) supplies air to operate the filter press (FP-901). The air compressor has level switches:

- an oil level switch alarm (LSLL-901) is activated when the oil level is low
- if pressure switch (PSL-901) is activated an alarm will register on the HMI indicating the air compressor has malfunctioned.

#### 5.1.1.7 FIRE AND EXPLOSION PROTECTION

There are some areas in the plant defined as Class 1 Div 2 according to the National Electrical Code Classification (NFPA 70). These areas are:

- Screen building (BLD-7903), Room #1
- Equalization tank zone, (BLD-7901)
- Sludge building (BLD-7904), Room #1

This classification refers to the areas with potential hazards as flammable gas which is not present under normal conditions.

Fire alarm system is implemented across the plant. The fire protection measures include fire alarm system (FAS), fire detection system (FDS), and portable fire extinguishers. Please refer to the Fire Alarm Layout Drawing presented in Appendix A of this manual.

### **5.1.2 Process Description**

### 5.1.2.1 Screen Modules Building (SCREEN BLD-7903)

**Function**: a screening process is provided to remove hair, and fibrous materials from wastewater supplied from the lift stations and delivered by sewage trucks.

There are two (2) screen systems in the plant:

- screen module (SCR-201) for screening incoming raw sewage pumped from lift stations
- screen module (SCR-401) for screening effluent from equalization tank (TNK-301) taking into account addition of raw sewage delivered by sewage trucks and added into the equalization tank (TNK-301)

Both screen modules are located in the building (BLD-7903), Room #1 (Class 1 Div 2 area).



# Screw Screen Compactor (SCR-201)/Screen Tank

The screw screen compactor module consists of:

- screw screen compactor with 2-mm opening, equipped with solids bagging
- discharge tank (TNK-202) for collection of the screened wastewater
- external discharge pumps (P-201/P-202) to transfer screened wastewater to the equalization tank (TNK-301)
- self cleaning spray nozzles set on a timer through the HMI

#### **Screw Screen Basin Level Control**

The screw screen (SCR-201) will run when the permissive signal (YC-101) to receive from the lift station is ON, and the high level in the screen tank has been reached. If the high level in the screw screen basin has been reached this indicates the screen is clogged. The screw will continue to turn for 2 minutes after the high level condition has cleared.

Screened wastewater flows by gravity from screw screen basin to the screen discharge tank (TNK-202) through 6" discharge pipe.

#### **Alarms**

If the clogged screen cannot be cleared and the high high level in the screw screen basin is reached the LSHH-201 will trip. If the LSHH-201 level switch is tripped, an alarm will be generated and will remain visible on the HMI until the alarm condition has cleared. The permissive to receive wastewater from the lift station will be lost. **Operator intervention is required in the event of this alarm!** 

In the event the SCR-201 motor trips off on overload an alarm will register on the HMI and the red beacon light will flash.

#### **Screen Tank Level Control:**

The screen discharge tank (TNK-202) is equipped with:

- (2) external discharge pumps (P-201 Duty and P-202 Standby)
- discharge pressure indicator (PI-201/ PI-202) to measure the discharge pressure
- motor current switch (YA-201 /YA-202)
- variable frequency drive (VFD-201/VFD-202)
- discharge tank (TNK-202) is equipped with level transmitter (LT-202) and high high level switch (LSHH-202)

After completion of 4 cycles the standby pump will run for 1 cycle. Each time a pump starts the cycle count goes up. As long as the wastewater level in TNK-202 is between the high and low set point, the PLC will allow the operation of the pumps (P-201/P-202) to transfer wastewater to the equalization tank (TNK-301). The VFD's regulate the flow of the pumps to keep the discharge flow rate at the desired set point flow.



If current switches (YA-201/YA-202) are ON and level transmitter (LT-202) indicates the high set point, then the pumps turn on until the level transmitter (LT-202) gets to its low set point.

If the high level set point is on for more than 5 seconds, pumps (P-201/P-202) will increase speed to clear the high level condition.

#### **Alarms**

In the event the screen tank discharge pumps motor current switches (YA-201/YA-202) trip, an alarm will register on the HMI and the red beacon light will flash.

### Screen Cleaning:

A potable water connection to the screw screen compactor unit (SCR-201) is used to clean the screw screen. A solenoid valve (SV-201) is controlled on a timer to open the solenoid valve for 2 seconds every 60 minutes, with the goal of removing solid build up on the screw screen. Frequency of cycle can be changed through the HMI.

## 5.1.2.2 Equalization Tank (TNK-301)

**Function**: Buffers influent variable flow to prevent concentration fluctuations in (i.e. BOD, TSS etc.) through the MBR treatment system.

The equalization tank (TNK-301) receives screened wastewater from the screen tank (TNK-202). The equalization tank (TNK-301) can also receive raw wastewater from the sewage trucks. There are two truck hook-ups from the screen building (BLD-7903) side equipped with 3" female camlocks, valves and 3" PVC pipes.

WARNING: NO CONTROLS ARE IN PLACE TO SHUT OFF TRUCK INFLUENT TO THE EQUALIZATION TANK IN THE EVENT OF A HIGH OR HIGH HIGH LEVEL CONDITION IN THE EQUALIZATION TANK. THE LEVEL OF THE EQ TANK MUST BE MANUALLY MONITORED AT ALL TIMES DURING THE OFFLOADING OF TRUCKS.

The effective volume of the EQ tank is 43.5 m³, providing a hydraulic retention time of 14.5 hours. The equalization tank is equipped with:

- level monitoring/control equipment
- 2 electric immersion heaters with local temperature control
- blowers (B-301to B-306) supply air to the air diffusers
- 10 EDI fine-bubble air diffusers for mixing and assisting the elimination of potential odour
- 12 magnesium anodes which act as the tank ground and will be sacrificially eroded as a means of prolonging the tank life
- discharge pumps (P-301/ P-302) for transferring wastewater to the SCR-401



# **Air Diffusers Control**

Blowers (B-301- B-306) supply air to the air diffusers installed in the bottom of the equalization tank. A pressure indicator (PI-301) and switch (PLS-301) is installed on the discharge side of the blowers.

#### **Alarms**

If the blower air pressure drops below set point, the low pressure switch (PLS-301) will trip and a low pressure alarm will be activated through the PLC. The flashing red beacon light will illuminate.

## **Temperature Control**

The equalization tank (TNK-301) is heated via 2 electric immersion heaters (H-301/H-302). Temperature in the tank is controlled via a local thermostat. Recommended temperature setting for TSL-301/TSL-302 is 10°C to 15°C.

#### **Alarms**

If the Temperature Switch Low Low (TSLL-301) is tripped an alarm signal will register on the HMI and the flashing red beacon light will illuminate.

**Note**: As a low water level in the tank can cause damage to the heaters, the Level Switch Low Low (LSLL-301) is installed in the equalization tank to protect the immersion heaters and if tripped will shut the tank heaters off and initiate an alarm signal from the PLC.

### **Transfer Pumps/Level Control**

The equalization tank (TNK-301) has two (2) external pumps (P-301, P-302) with one of the pumps acting as a standby. Pump (P-301) operates for 4 cycles, pump (P-302) for 1. This pump transfers the wastewater from the equalization tank (TNK-301) to SCR-401 screw screen basin tank.

The equalization tank discharge pumps (P-301/P-302) have local pressure indicators (PI-302/PI-303) to measure discharge pressure and motor current switches (YI-301/YI-302). The discharge pressure can be used to determine an estimation of the flow rate based on the pump curve.

A level transmitter (LT-301) is used to indicate the liquor level in the equalization tank (TNK-301). As long as the level in the tank is above set point, the PLC will allow the operation of either EQ tank discharge pump (P-301 or P-302). If the high level in the EQ tank is met the screen tank supply pumps will be turned off.

#### **Alarms**

In the event the equalization tank discharge pumps motor current switches (YI-401/YI-402) trip, an alarm will register on the HMI and the red beacon light will flash.



The Level Switch High High (LSHH-301) if tripped will send a signal to the PLC to warn of imminent overflow in the equalization tank (TNK-301).

## Post EQ Screw Screen Compactor (SCR-401)

The screw screen compactor module consists of:

- screw screen compactor with 2-mm opening, equipped with solids bagging
- discharge tank (TNK-401) for collection of the screened wastewater
- external discharge pumps (P-401/P-402) to transfer screened wastewater to the aeration tank (TNK-501)
- self cleaning spray nozzles set on a timer through the HMI

#### **Screw Screen Basin Level Control**

The screw screen (SCR-401) will run when the high level in the screen tank has been reached. If the high level in the screw screen basin has been reached this indicates the screen is clogged. The screw will continue to turn for 2 minutes after the high level condition has cleared.

Screened wastewater flows by gravity from screw screen basin to the screen discharge tank (TNK-401) through 6" discharge pipe.

#### **Alarms**

If the clogged screen cannot be cleared after 5 minutes a high high level alarm (LSHH-402) will be triggered and will remain visible on the HMI until the alarm condition has cleared. The permissive to receive wastewater from the equalization tank (TNK-301) will be lost. **Operator intervention is required in the event of this alarm!** 

In the event the SCR-401 motor trips off on overload an alarm will register on the HMI and the red beacon light will flash.

#### **Screen Tank Level Control:**

The screen discharge tank (TNK-401) is equipped with:

- (2) external discharge pumps (P-401 Duty and P-402 Standby)
- discharge pressure indicator (PI-401/ PI-402) to measure the discharge pressure
- motor current switch (YA-401 /YA-402)
- discharge tank (TNK-401) is equipped with a low level switch(LSL-402), high level switch (LSH-402) and a high high level switch (LSHH-202)

After completion of 4 cycles the standby pump will run for 1 cycle. Each time a pump starts the cycle count goes up. As long as the wastewater level in TNK-401 is above the low level switch level, the PLC will allow the operation of the discharge pumps (P-401/P-402) to transfer wastewater to the equalization tank (TNK-301).

#### **Alarms**

In the event the screen tank discharge pumps motor current switches (YA-201/YA-202) trip, an alarm will register on the HMI and the red beacon light will flash.



## **Screen Cleaning:**

A potable water connection to the screw screen compactor unit (SCR-401) is used to clean the screw screen. A solenoid valve (SV-401) is controlled on a timer to open the solenoid valve for 2 seconds every 60 minutes, with the goal of removing solid build up on the screw screen. Frequency of cycle can be changed through the HMI.

## 5.1.2.3 Aeration Tank (AERATION BLD-7902)

**Function:** Oxygen is added to the wastewater to ensure microorganism concentration is at optimum levels to metabolize contaminants. (i.e. oxidation of carbonaceous BOD; nitrification (conversion of TKN to NO<sub>3</sub>-N).

One (1) aeration tank (TNK-501) located in BLD-7902 has an overall effective volume of 48 m³, providing a hydraulic retention time of 16 hours. TNK-501 receives screened wastewater from the screen tank (TNK-401) of the post EQ screen module (SCR-401), return flow from the membrane tanks (TNK-601/ TNK-602), and supernatant from (TNK-901) of sludge dewatering module.

Blowers supply air to the submerged fine-bubble diffusers to ensure biological oxidation (aeration) and to keep solids in the water suspended. Mixed liquor is constantly re-circulated from the bottom of the tanks to the top through spray nozzles. This recirculation process is in place for foam suppression. Alum and soda ash chemical metering systems are in place to ensure regulation of aeration tank water pH and phosphorus levels.

The aeration tank (TNK-501) is equipped with:

- level, temperature, pH, and dissolved oxygen (DO) monitoring and control equipment.
- 2 electric immersion heaters (H-501/H-502) to keep the temperature of the biological process above 15-20° C.
- Blowers (B-501, B-502) equipped with VFD's to supply air to the fine-bubble air diffusers in (TNK-501)
- 30 EDI fine-bubble air diffusers
- Tank recirculation/sludge removal pump (P-503)
- Tank discharge pumps (P-501/P-502) transfer wastewater to the membrane tanks (TNK-601/TNK-602)
- Chemical Metering Systems soda ash tank (TNK-6101) with dosing pump (P-6101) and alum tank (TNK-6102) with dosing pump (P-6102)

## **Temperature Control**

The aeration tank (TNK-501) is heated via electric immersion heaters (H-501/H-502). Temperature in the tank is controlled via a local thermostat. Recommended temperature setting for TSL-301/TSL-302 is 15°C to 20°C.



#### **Alarms**

If the Temperature Switch Low Low (TSLL-501) is tripped an alarm signal will register on the HMI and the flashing red beacon light will illuminate.

**Note**: As a low water level in the tank can cause damage to the heaters, the Level Switch Low Low (LSLL-501) is installed in the equalization tank to protect the immersion heaters and if tripped will shut the tank heaters off and initiate an alarm signal from the PLC.

## **Discharge Pump/Level Control**

The aeration tank (TNK-501) has two (2) external transfer pumps (P-501, P-502). Pump (P-501) transfers wastewater to membrane tank (TNK-601) and pump (P-502) transfers wastewater to membrane tank (TNK-602).

Level transmitter (LT-501) indicates the liquor level in the aeration tank (TNK-501). As long as the level in the tank is above set point the PLC will allow the operation of both discharge pumps (P-501 or P-502).

#### **Alarms**

If the Level Switch High High (LSHH-501) is tripped an alarm will register on the HMI, the flashing red beacon light will illuminate and the equalization discharge pumps will be shut down or disabled from running for the duration of the high high level condition.

The aeration tank discharge pumps (P-501/P-502) have pressure indicators (PI-501/PI-502) to measure discharge pressure and motor current switches (YA-P501/YA-P502). The discharge pressure can be used to determine an estimation of the flow rate based on the pump curve.

#### **Alarms**

In the event the aeration tank discharge pumps motor current switches (YA-P501/YA-P502) trip, an alarm will register on the HMI and the red beacon light will flash.

### **Dissolved Oxygen Control**

The aeration tank (TNK-501) is equipped with a dissolved oxygen (DO-501) sensor. The PLC is programmed to ensure the level of DO remains above 2 mg/L. If the level of DO falls below the set point value a 4-20 mA signal is sent to the VFD (VFD-501) that controls the speed of the blowers (B-501, B-502). The speed of the blowers is regulated to maintain the DO at set point level.

### **Alarms**

In the event the Dissolved Oxygen level set point cannot be achieved within 15 minutes of the detection of the level being outside of the set point range a low DO alarm will register on the HMI and the red beacon warning light will illuminate. The duty blower will run at full speed for



15 minutes to attempt to regain the oxygen level. If after 15 minutes the oxygen level has not returned to below set point the duty blower defaults to a manual speed setting until operator intervention is possible.

## **pH Control**

A chemical dosing pump (P-6101) is provided to inject soda ash (Na<sub>2</sub>CO<sub>3</sub>) into the aeration tank (TNK-501) to maintain the pH at desired pH set point. If the pH measured by pH probe (PH-501) falls below set point, the PLC will turn the pump on for 30 seconds, turn the pump off for 30 seconds and repeat this cycle until tank pH has regained desired set point. The pump stroke must be set by the MBR system operator.

#### **Alarms**

In the event the pH level set point cannot be achieved a low or high pH alarm will register on the HMI and the red beacon warning light will illuminate. The system will continue to adjust to achieve set point pH throughout the duration of the alarm.

# **Phosphorus Concentration Control**

A chemical dosing pump (P-6102) is provided to inject alum  $[Al_2(SO_4)_3]$ . The dosing pump will be stroked based on an influent volume set point entered on the HMI by the system user. Alum is used to remove phosphorus from the influent. The alum dosage volume is manually set locally at the metering pump by adjusting the pump stroke.

#### **Foam Suppression**

The aeration tank (TNK-501) is equipped with an external pump (P-503) and a spray nozzle system for foam suppression. The pump (P-503) has a pressure indicator (PI-503) measuring its discharge pressure. The flow is controlled by opening a manual gate valve installed in the foam suppression line. The foam suppression line is equipped with a de-ragger unit to prevent spray nozzles from plugging.

### Sludge Dewatering Unit Supernatant Return

Supernatant can be returned to the aeration tank (TNK-501) if the MBR system is operating in conjunction with a sludge dewatering system. Supernatant will be returned as long as the aeration tank level is below the High Level set point. The PLC will shut down pump (P-503) for the duration of the return cycle.

# **Sludge Removal**

A sludge removal pipeline is provided at a tee off of the aeration tank recirculation line, isolated by a manual ball valve. The manual isolation valve must remain closed at all times. To remove sludge the manual isolation valve is opened along with the manual isolation valve at the entrance of TNK-901, while P-503 is running.



# 5.1.2.3 Membrane Filtration (TNK-601/602)

**Function**: Mixed liquor filtration and supplemental biological oxidation.

Membrane filtration is comprised of a membrane tank and permeate extraction unit

#### Membrane unit includes:

- Two (2) membrane tanks, each tank is equipped with submersible membrane filtration module, level controls, gravity recycling line, drain, access hatch, viewing window, and sample port
- Blower unit for membrane tanks; each unit contains five (5) blowers and it is equipped with pressure indicator, pressure switch low alarm, and motorized three-way valve
- Recirculation pumps transferring mixed-liquor from the membrane tanks (TNK-601/TNK-602) to the aeration tank (TNK-501)

#### Permeate extraction unit includes:

- Permeate pumps (P-701/P-702) with VFD, current switches, pressure and flow rate control equipment, solenoid valves, and motorized valves
- Backwash tank (T-801) equipped with level control switches, submersible pump (P-801), and solenoid valve
- UV disinfection unit with two (2) UV lights (UV-751/UV-752)

#### **Membrane Unit Operation**

External pumps (P-501/P-502) housed in (BLD-7900) transfer mixed liquor from the aeration tank (TNK-501) to the membrane tanks (TNK-601/TNK-602). Each membrane tank contains One (1) MicroClear<sup>TM</sup> MB3-1 submerged membrane module (membrane cassettes are complete with stainless steel housing and permeate piping with header).

Each membrane tank is equipped with air diffusers for the purpose of scouring the membranes to assist in the prevention of membrane fouling.

Mixed liquor from the membrane tanks (TNK-601/TNK-602) is constantly recycled back to the aeration tank (TNK-501) by external pumps (P-601/ P-602) to maintain even biomass inventory within the aeration tank and membrane tanks.

Each of the respective pumps (P-601/P-602) are equipped with pressure indicators (PI-603/PI-604) to measure the discharge pressure of the pumps, and current switches (YA-601/YA-602). The membrane tanks are also equipped with gravity overflow lines that recycle mixed liquor back to the aeration tank (TNK-501).

### **Membrane Tanks Level Control**

The membrane tanks (TNK-601/TNK-602) contain high level switches (LSH-601/LSH-602) which activate the permeate pumps (P-701/P-702) to start pulling permeate out of the membrane tanks (TNK-601/TNK-602).



#### **Alarms**

The level switches high high alarm (LSHH-601/LSHH-602) inform the operator of an imminent overflow. It also shuts off the aeration tank discharge pumps (P-501/P-502) to prevent more mixed liquor from entering the membrane tank (TNK-601/TNK-602).

# **Recycle Pump Control**

Recycle (RAS) pumps (P-601/P-602) recycle mixed liquor from membrane tanks (TNK-601/TNK-602) back to the aeration tank (TNK-501) as long as the discharge pumps (P-501/P-502) are on, water level switches in the membrane tanks (LSH-601/LSH-602) are ON, and there is no High High Level in aeration tank.

#### **Alarms**

In the event the RAS pumps motor current switches (YA-601/YA-602) trip, an alarm will register on the HMI and the red beacon light will flash.

# **Blower Units Control**

The membrane air scouring blowers (B-601 to B-605 for TNK-601 and B-606 to B-610 for TNK-602) are connected to the air diffusers in the membrane tanks (TNK-601/TNK-602) respectively. The common airlines to the membrane tanks are equipped with a discharge pressure indicators (PI-601/PI-602) and a pressure switches (PSL-601/PSL-602).

Each blower unit is also equipped with an electrically actuated three-way valve (MV-601/ MV-602) to direct the flow of air through medium air diffusers or coarse air diffuser. The valves (MV-601/MV-602) are installed with closed position switches (ZSC-601/ZSC-602) that is monitored by the PLC.



The blowers scouring the membranes:

- Operates continuously (24/7)
- Turned off for one minute every hour to relax the membranes

## **Coarse Air Diffuser Cycle**

Under normal operation, air is directed through the medium air diffusers at the base of the membrane housing. If the level switch high (LSH-601) has not been reached in 30 minutes, the air is diverted to the coarse air diffusers in the membrane tank. Changing where air enters into the membrane tank (TNK-601) changes the direction of scouring, helping remove debris on the membrane modules/cassettes.

The air will be directed to the coarse air diffusers for the time interval set point entered through the HMI. The duration of the coarse air diffuser cycle time is adjustable up to 15 minutes, by changing the set point on the HMI screen to meet the particular plant operating conditions.

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Blower for scouring air must be on 24/7, as failure of air supply can lead to clogging of the air diffusers and membranes.

#### **Alarms**

If the pressure switches low alarm (PSL-601/PSL-602) are tripped, a signal will be sent to the PLC which will generate an alarm indicating a potential blowers (B-601 to B-610) malfunction which will cause the corresponding membrane permeate tank discharge pumps (P-701/P-702) to stop. This interlock is in place to prevent damaging the membranes.

Please note: At no time shall the vacuum pumps P-701/P-702 operate when the pressure switches (PSL-601/PSL-602) are active; this is to ensure that air for membrane scouring is available at all times, and to protect the membranes from fouling.

## **Permeate Extraction Unit Operation**

Vacuum pumps (P-701/ P-702) draw the water through the membranes under a preset flow rate of 31.5 Lpm (at a design flux of 18 LMH). Permeate is run through UV system for final disinfection before entering permeate storage tank (TNK-811).

### **Permeate Flow Control**

There are two (2) operational modes for permeate flow control, flow mode (constant flux mode) or vacuum mode (constant TMP mode). The operator has the option of selecting the permeate flow control mode on the screen. Flow transmitters (FT-701/FT-702) are installed on the permeate discharge line to measure the effluent flow from each membrane tank.

## Flow Mode (default for newterra MBR)

- Normal permeate flow rate is 31.5 Lpm (corresponds to a design flux rate of 18 LMH)
- This setpoint is used for vacuum pumps (P-701/P-702) VFDs control
- The maximum permeate flow setpoint is 52.5 Lpm (corresponds to a maximum flux rate of 30 LMH)
- The operator has the option of changing the permeate flow rate on the screen, but the set point should not be greater than 31.5 Lpm under normal operating condition and cannot exceed 52.5 Lpm, at any given time

Note: If the vacuum reaches -0.250 bar the system automatically switches to Vacuum Mode.



### Vacuum Mode

There are two vacuum set points for the permeate withdrawal system:

- Normal vacuum rate to pull the permeate out at a pre-set vacuum setpoint of -0.100 bar
- Higher vacuum rate (-0.120 bar) is used when the EQ tank's high level (LSH-301) is on, signalling the MBR to run at a higher vacuum to keep up with the incoming water
- The highest vacuum of the permeate extraction system is -0.300 bar

# Permeate Discharge Pump Control

The permeate discharge pumps (P-701/P-702) will run continuously as long as the high level switches (LSH-601/P-602) in the membrane tanks (TNK-601/TNK-602) are activated. Permeate withdrawal is done based on the preset permeate normal flow rate or vacuum rate.

If the level switch (LSH-301) in the equalization tank (TNK-301) is active for more than 5 seconds, permeate pumps (P-701/P-702) start increasing the permeate flow rate using the variable frequency drives (VFD-701/VFD-702). The trans-membrane pressure (TMP) indicated by vacuum transmitters (VT-701/VT-702) and the calculated permeability are displayed on the touch screen. The permeability is a key indicator of membrane fouling state.

### **Membrane Relax Cycle**

- After every 9 minutes of permeate flow the permeate discharge vacuum pumps (P-701, P-702) will stop and the electrically actuated valves SV-701/SV-702 will open to release vacuum through the membranes.
- The resulting removal of vacuum in the system allows the membranes to relax for 1 minute.

### **Membrane Backwash Cycle**

- When necessary conditions have been met the backwash tank sump pump (P-801) will be activated, permeate pumps (P-701/P-702) shut off and the backwash supply valves (MV-701/MV-702) open, to allow the reversal of flow over the membrane surface.
- The duration of the relax and backwash time is adjustable by changing the set point on the HMI screen to meet the particular plant operating conditions. A combination of backwash and relaxation (no permeation) is carried out for the best performance of the membranes.



- Maximum head required for backwash is one meter.
- During the entire backwash cycle, the scouring of the membranes is continuous.



At design flow when the membrane discharge vacuum exceeds 0.2 bar/80" WC (transmitted by VT-701, and indicated locally at PI-701), or permeability drops rapidly to 50 LMH/bar, it is necessary to take the membrane tanks (TNK-601/TNK-602) offline for chemically enhanced backwash (CEB) cleaning (please refer to Section 7 of this O&M manual)..



The permeability is a key indicator of membrane fouling state. A permeability of less than 50 LMH/bar (or transmembrane pressure exceeding 0.2 bar) indicates a membrane chemical clean is required.

A chemical addition unit is provided in the building (BLD-7900) for membrane in-situ chemically enhanced backwash (CEB) and recovery cleaning. The unit includes:

- Citric acid tank (TNK-802) with chemical dosing pump (P-802)
- Sodium hypochlorite tank (TNK-803) with chemical dosing pump (P-803)

## **Backwash Tank**

The backwash tank (TNK-801) has 3 level switches (LSL-801, LSH-801, LSHH-801). When the low level switch LSL-801 is tripped this indicates a low water level in the backwash tank. Solenoid valve (SV-801) will open to fill the tank to the high level switch (LSH-801).

#### **Alarms**

LSHH-801 indicates imminent overflow. An alarm signal will register on the HMI and the flashing red beacon light will illuminate. **Operator intervention is required**.

### **Disinfection System**

The MBR permeate is run through UV system for final effluent disinfection. The disinfection system consists of two high intensity UVmax Lights (UV751/ UV752) installed in series. The UVmax lights provide disinfection with a UV dosage of 40 mJ/cm² and a flow rate of 303 L/min. This system is installed for protection in the event of a membrane breakthrough. The UV-Lights are connected to a solenoid safety (UVL-751, UVL-752) to restrict the flow in case the UV-Light system have been compromised.

#### **Turbidity Meter**

Turbidity transmitter (AIT-801) connected after the UV systems indicates the turbidity (solids content) in the treated effluent. High turbidity will activate an alarm as this can indicate possible breakthrough of the membranes.



# 5.1.2.4 Permeate /Treated Effluent Building (EFFLUENT BLD-7905)

**Function:** Treated effluent storage, ammonia oxidation with calcium hypochlorite followed by dechlorination.

Prior to final discharge to the receiving water body the treated effluent will be tested. In the event the biological process upset occurs, due to a toxic shock load or cold weather, it may result in a discharge of ammonia or total nitrogen into the receiving water body. Therefore, calcium hypochlorite addition system is supplied as a stand-by solution for ammonia removal in the wastewater. The sodium bisulfite dosing system is used for dechlorination.

The treated effluent from UV lights is stored in four (4) identical storage tanks (TNK-811, TNK-812, TNK-813, TNK-814). All tanks are connected with 3" PVC pipes.

### **Calcium Hypochlorite Concentration Control**

Chemical dosing system including calcium hypochlorite tank and dosing pumps (P-813 Duty / P-814 Standby) is provided to inject calcium hypochlorite [Ca(ClO)<sub>2</sub>] to the tank (TNK-811). The calcium hypochlorite dosage rate is manually set locally at the metering pump by adjusting the pump stroke. The operator must determine what the dosage rate needs to be and manually set the stroke at the pump and enter influent flow rate set point through the HMI.

The calcium hypochlorite tank is equipped with low level switch alarm (LSLL-815) indicating if tank is empty; this is to protect dry running of the pumps (P-813/P-814).

### Effluent Storage System Discharge pumps / Level control

The storage tanks have two (2) external pumps (P-811 Duty / P-812 Standby) for sending treated effluent to final discharge. Each pump is equipped with discharge pressure indicator (PI-811/PI-812) to measure the discharge pressure and motor current switch (YA-811 /YA-812).

Tank (TNK-814) is equipped with a high level switch (LSH-814) and low level switch. As long as the water level in the tank is above the low level height, pumps (P-811/P-812) will run.

### **Alarms**

All effluent storage tanks (TNK-811/TNK-812/TNK-813/TNK-814) are equipped with level switches alarm (LSHH-801/LSHH-802 /LSHH-803/LSHH-804) for indicating imminent overflow; an alarm signal will register on the HMI and the flashing red beacon light will illuminate, operator intervention is required.



### **Sodium Bisulfite Concentration Control**

Chemical dosing system including sodium bisulfite tank and metering pumps (P-815 Duty / P-816 Standby) is provided to inject sodium bisulfite  $[Na_2S_2O_5]$  to the discharge line for effluent dechlorination. The sodium bisulfite dosage rate is manually set locally at the metering pump by adjusting the pump stroke. The operator must determine what the dosage rate needs to be and manually set the stroke at the pump and enter influent flow rate set point through the HMI.

The sodium bisulfite tank is equipped with low level switch alarm (LSLL-815/LSLL-816) indicating if tank is empty; this is to protect dry running of the pumps (P-815/P-816).

## 5.1.2.5 Sludge Treatment Module (SLUDGE BLD-7904)

Excess waste activated sludge (WAS) from the aeration tanks (TNK-501) is pumped to the sludge treatment module housed inside container (SLUDGE BLD-7904), Room#1 Cl1 Div 2.

Sludge treatment module includes:

- Polymer tank (TNK-902) with mixer (M-902), and polymer transferring pump (P-902)
- Sludge mixing tank (TNK-901) equipped with level control switch, mixer (M-901), and transferring pump (P-901)
- One (1) Filter Press unit equipped with air driven hydraulic pump, and sludge dumpster
- Supernatant tank (TNK-903) equipped with level control switches, and supernatant transferring pump (P-903)
- Air compressor (C-901) equipped with oil level switch and pressure switch; air compressor located in Room #2 GP of the building (SLUDGE BLD-7904)

# Polymer preparation unit

The polymer unit is used for preparation and dosing polymer solution into the mixing tank (TNK-902) for sludge treatment. The batch-wise polymer preparation process includes:

- Hydration stage, when dry polymer is added to the tank for mixing with potable water
- Blending the polymer to a homogenous and activated solution, when the gentle agitation/mixing is provided
- Dosing the polymer activated solution into the sludge mixing tank (TNK-901) for sludge treatment using air diaphragm pump (P-902)

The mixer (M-902) and the pump (P-902) are driven by compressed air supplied by air compressor (C-901). Compressed air lines are equipped with pressure indicators (P-901/P902) to measure pressure in the air lines. The mixer (M-902) and the pump (P-902) are operated manually.



# Sludge mixing unit

The waste activated sludge is pumped from the aeration tank (TNK-501) into the mixing tank (TNK-901) where it is mixed with the polymer solution sent by pump (P-902) from the polymer tank (TNK-902). The sludge is mixed with polymer by submersible mixer (M-911). The mixer is driven by compressed air supplied by air compressor (C-901); compressed air line is equipped with pressure indicator (P-903) to measure pressure in the air line.

#### Alarm

The mixing tank (TNK-901) is equipped with level switches alarm (LSHH-901) indicating imminent overflow; an alarm signal will register on the HMI and the flashing red beacon light will illuminate, operator intervention is required. If the high high condition occurs an if the sludge transfer pump is running the PLC will shit P-503 off.

Treated (flocculated) sludge is transferred from mixing tank (TNK- 901) to the filer press (FP-901) by air diaphragm pump (P-901); compressed air line is equipped with pressure indicator (P-904) for measure pressure in the air line.

## Filter press

The incoming treated sludge enters the filter press (FP-901) via the center feed pipe. The center feed plates contain a recess on either side of the plates. The cylinder will be shut closed (and hence compress the plates together) with the air driven hydraulic pump and then pressurized shut with approximately 4300 PSI of pressure. When the plates are closed, a cavity is created between the plates where the sludge will be captured.

The filtered water (supernatant) exits through the filter cloth (while the solids are captured within the clothed chambers) and goes to the supernatant tank (TNK-903) by gravity.

The feed pressure of the filter press (FP-901) may start at about 25 PSI, due to the low resistance of an empty filter press. As solids accumulate in the chambers of the filter press, the feed pressure will need to be increased to maintain a stroke count of about one stroke every 1-5 seconds or until a maximum feed pressure of 100 PSI is obtained.

Once the filter press (FP-901) is filled with sludge, the feed pump (P-901) and air driven hydraulic pump are shut off and the sludge blow down process will then commence for further water removal. The air enters via air valve into the sludge chamber via the upper left hand corner of the three button plates, and exits via the bottom right hand corner of the one button plates. This process will push excess water out through the outlet manifold.

Once the sludge blown down process is complete, the filter press is ready to be opened. To open the automatic filter press, reverse the air valve on the automatic pump to allow the pump to slowly pull open the pushing plate. For opening and closing the filter press the controls are right on the hydraulics for safety reasons. It is a forward, off, reverse lever.

Now that the plates are released, index the plates one by one, and most of the sludge will fall into the sludge dumpster below the press. A sludge spatula is provided to aid in the sludge removal.



Once all plates are clean, the filter press (FP-901) is ready to be closed hydraulically. The three outlet manifold ball valves should be opened, the center feed pipe should be opened and the pump is ready to be turned on again.

## Supernatant unit

The supernatant tank (TNK-903) receives spernatant from the filter press (FP-901). The tank is equipped with:

- Liquid level switches (LSL-902/LSH-902/LSHH-902)
- Pump (P-903) transferring supernatant from the supernatant tank (TNK-903) to the aeration tank (TNK-501) located in the building (AERATION BLD-7902); pump is equipped with current switch (YA-903) and pressure indicator (PI-903) for pressure control.

## **Level / Pump Operation and Control**

The supernatant transferring pump (P-903) will run based on liquid level in the supernatant tank (TNK-903):

- Pump (P-903) run, when level switch LSL-902 is ON and YA- 903 is ON
- Pump (P-903) stops, when level switch (LSL-902) is OFF; this is to protect dry running of the pump

#### **Alarms**

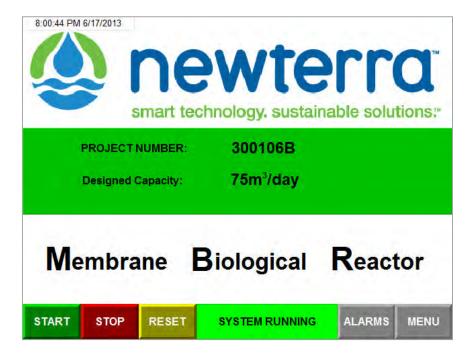
LSHH-902 indicates the imminent overflow. Operator intervention is required.



# **5.2 Process Control System Touchscreen Operation**

The MicroClear<sup>TM</sup> MBR system is designed to be fully automatic. Since the unit operates through a touchscreen, simply press the screen in an area where a button or text appears.

#### 5.2.1 Main Control Screen



#### **System Operation Commands**

- START button puts the system in RUN mode
- STOP button stops the system operation. Some equipment continues to run even after this STOP button has been pressed, however the E-STOP button (located on the panel front) will stop all equipment
- RESET button is used to clear alarms after they have been addressed
- SYSTEM ON (RUNNING) / SYSTEM OFF indicates whether the system is currently in RUN mode or turned off
- ALARM button when it is flashing red (it is on), it indicates an alarm is present in the system. Press ALARMS button to be routed to the alarm screen
- MENU button is used for screen navigation to show individual screens



#### 5.2.2 Process Screens

The main process screens are accessed from the main menu by pressing either the "BIOLOGY" button or the "MBR SYS" button.

On the main process screens, switches are displayed as **Grey** when **OFF**, **Green** when **ON** and **Red** when in alarm condition.

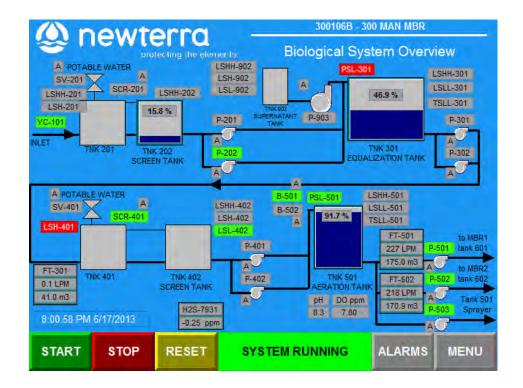
- LSHH level switch high high
- LSH level switch high
- LSLL level switch low low
- TSHH temperature switch high high
- LSL level switch low
- PSL pressure switch low

Individual devices can be monitored and controlled from the process screens.

- The letter indicated beside a device shows the current operational status of that device (H for hand, O for off, A for automatic)
- Touching a device on the process screen will open an HOA popup for that device.
- Devices are shown in green if they are currently running



# 5.2.2.1 Biological System Overview Screen

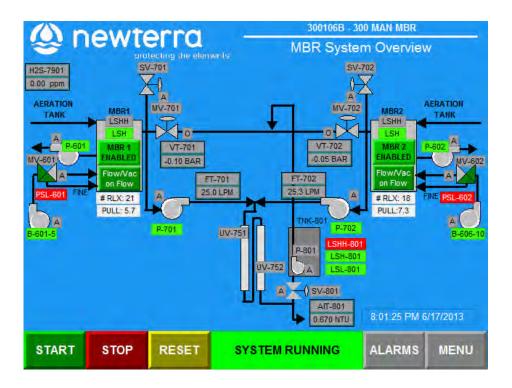


On the Biological System Overview Screen the following equipment and parameters are displayed:

- Inlet screen module (SCR-201) including screen basin (TNK-201) connected with screen tank (TNK-202), pumps and controls
- Equalization module including EQ tank (TNK-301) with controls, blowers; EQ tank level is displayed in %
- The second screen module (SCR-401) including screen basin (TNK-401) connected with screen tank (TNK-402), pumps and controls
- Aeration Tank (TNK-501) with all interconnecting piping, pumps and controls. Aeration tank level is displayed in %, dissolved oxygen (DO) and pH is displayed for the tank
- Status of blowers, pumps, level switches, flow transmitters and H<sub>2</sub>S detector are displayed



# 5.2.2.2 Membrane Filtration System (MBR) Overview Screen

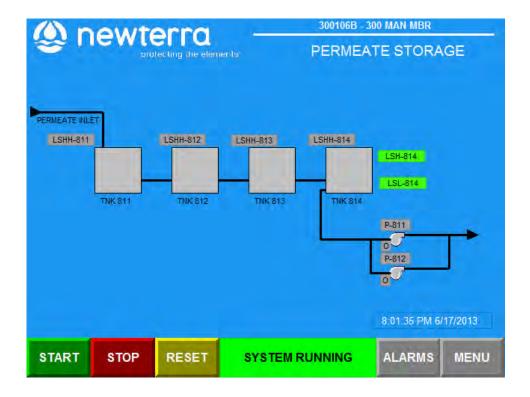


On this screen the following equipment and parameters are displayed:

- Membrane Tanks (TNK-601 and TNK-602), and Backwash Tank (TNK-801) with all interconnecting piping
- Permeate flow and vacuum are indicated for both membrane systems
- The number of relaxes performed in the current cycle is displayed
- The time on the current pull cycle is displayed
- Status of blowers, pumps, level switches, flow transmitters and H<sub>2</sub>S detector are displayed
- The time on the current pull cycle



# 5.2.2.3 Permeate Storage Module Overview Screen



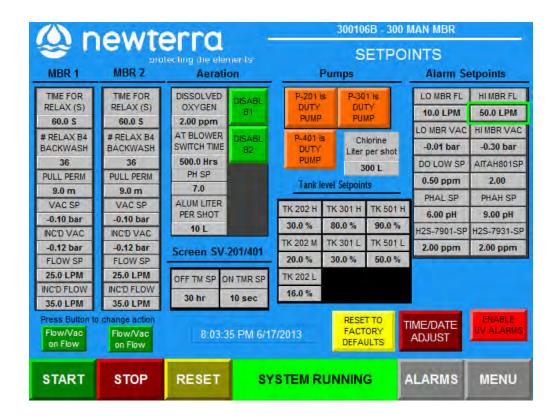
On this screen the following equipment and parameters are displayed:

- Permeate Storage Tanks (TNK-811/TNK-812/TNK-813/TNK-814) with all interconnecting piping and pumps
- Status of level switches and pumps are displayed



#### 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.



# newterra MBR Operational Setpoints Description

Process Location	Setpoint	Value	Description
Inlet Screen Module	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)
(SCR-201)	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	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)
Module (SCR-401)	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)
	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
Membranes	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)



Process Location	Setpoint	Value	Description					
	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					
Membranes	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.					
DISSOLVED 2		2.00 ppm	Setpoint for the amount of dissolved oxygen in ppm in the aeration tank					
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					
	TK 202 H 3		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)					
Tank Level Setpoint	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)					



## newterra MBR Alarm Setpoints Description

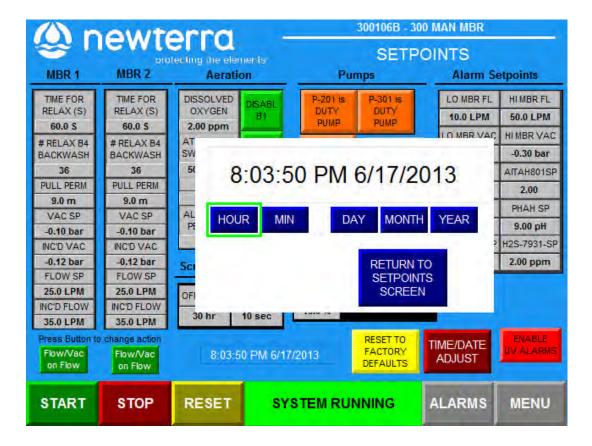
		10.0	If the discharge flow is below this setpoint for more than 5 minutes, an alarm will be
	LO MBR FL	LPM	initiated.
Alarm Setpoints	HI MBR FL	50.0 LPM	If the discharge flow is higher this setpoint for more than 5 minutes, an alarm will be initiated.
	LO MBR VAC	-0.01 bar	If the vacuum on the membrane 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 <sub>2</sub> S-7901-SP	2.00 ppm	If the concentration of detected H <sub>2</sub> S reaches this setpoint for more than 5 minutes, an alarm will be initiated.
	H <sub>2</sub> S-7931-SP	2.00 ppm	If the concentration of detected H <sub>2</sub> S reaches this setpoint for more than 5 minutes, an alarm will be initiated.





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.





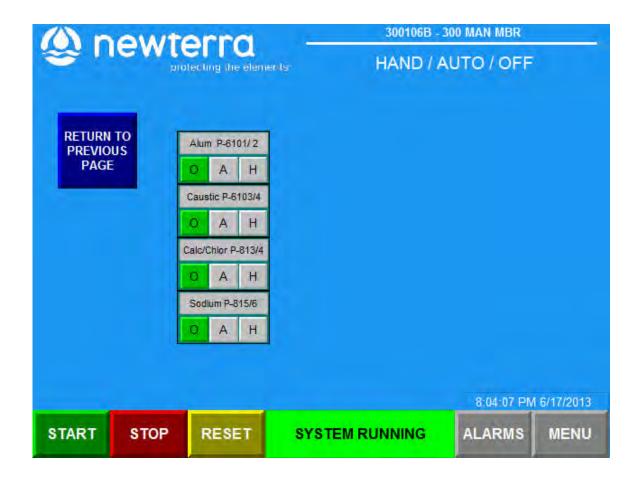
# 5.2.4 System HAO's (HAND /AUTOs/ OFF)

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.

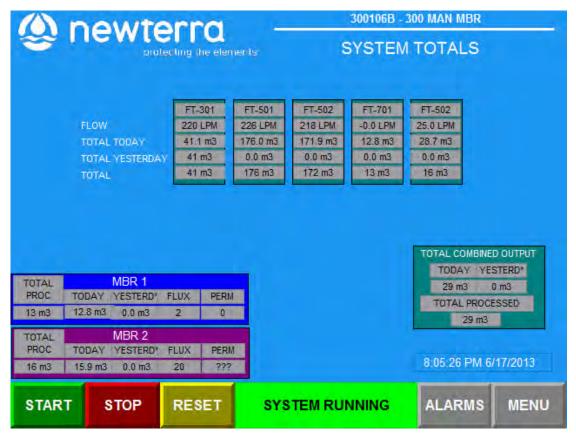
- When the SERVICED button is pressed, it resets the hours since service to zero (0)
- When the REPLACED button of a motor is pressed, it resets the total hours to zero (0).





# 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:

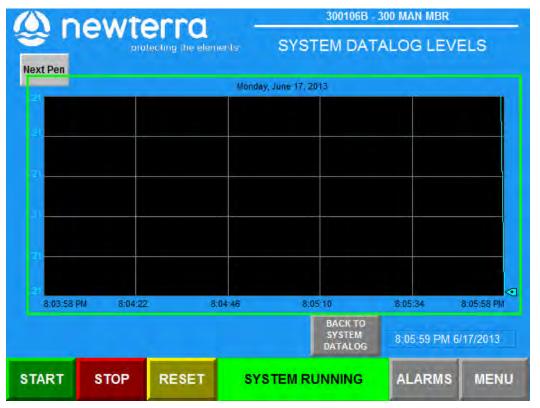
- The total amount of water processed through the process train, and also current (today) amount and amount of water processed yesterday
- Flux (J) for membrane unit expressed in LMH (L/m²-h)
- Permeability (K) for membrane unit expressed in LMH/bar

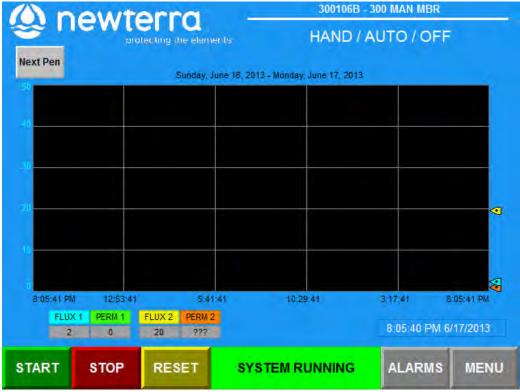


# 5.2.8 System Data Log Screens

- 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









# 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<sub>s</sub>: Total volume of seed sludge for MBR system (m<sup>3</sup>)

V<sub>i</sub>: Total volume of process tanks in MBR system (m<sup>3</sup>)

MLSS<sub>s</sub>: 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).



- 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.
- 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.



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



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.



## 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.



Avg Flux Rate	15 LMH (9 gpd)	Average flux rate with permeation 9 minutes out of 10 minutes
ТМР	< 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 <b>–</b> 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 (m³/d) x BOD conc (mg/l)] / [Process volume (m³) x MLSS conc (mg/l)]
F:M (kg COD/kg MLSS/d)	0.15	0.05 – 0.3	F:M = [Flow (m³/d) x BOD conc (mg/l)] / [Process volume (m³) x MLSS conc (mg/l)]
SRT	> 15	12 – 50	

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



# 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)	М			AR
Ammonia Nitrogen(NH <sub>4</sub> -N)				AR
Nitrate Nitrogen (NO <sub>3</sub> -N)				AR
Total Phosphorus (TP)	W			W
Mixed Liquor Suspended Solids (MLSS)			W	
Mixed Liquor Volatile Suspended Solids (MLVSS)			AR*	
Temperature		D (PLC)		
рН	AR	D (PLC)		W
Dissolved Oxygen (DO)		D (PLC)		
Filterability			TW	
Turbidity				AR**
Fecal Coliform / E-Coli				W

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

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

<sup>\*\*</sup>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.

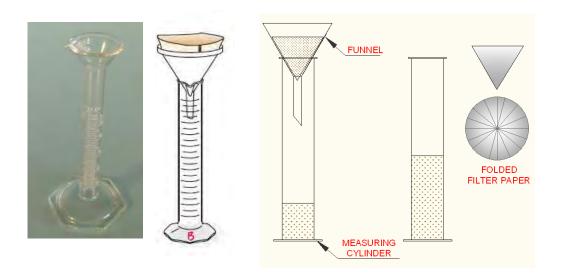
<sup>\*\*\*</sup> Explanation and definition of abbreviations, acronyms and terms used in the manual are presented in Appendix G – Glossary & Terms and Appendix H – Biological Treatment & Monitoring Parameters.



## **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.
- 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.



#### 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.



#### 7.0 SYSTEM MAINTENANCE



ATTENTION: MAINTENANCE SHOULD BE PERFORMED ONLY BY TRAINED PERSONNEL!

When providing maintenance or cleaning the plant, avoid direct contact with wastewater, organic materials, etc.

Always wear protective clothing, e.g. waterproof, protective gear, boots, and gloves to keep these materials from body. Wear face and eye protection as required by health & safety protocols and standards, especially when handling chemicals,

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 <sup>™</sup> 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.



# 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		Х	X*			*Kitchen grease trap(s) should be checked weekly and cleaned monthly to ensure proper performance.
	Inspect lift station with sump pumps		Х				
	Remove grease from lift stations and top of PC tank		Χ				
PROCESS	Perform visual check	X					Refer to Plant Visual Checks
	Check for proper wasting to sludge system		Х				
	Record permeate flow rate	Х					
	Record DO in the aeration tank	Χ					
	Record pH in the aeration tank	Х					
	Record vacuum pressure at the membranes	Х					Normal range: 0.07 – 0.15 bar (28" -61" WC)
Note: When the	e vacuum at the membranes reaches	0.2	bar/2	2.9 ps	ig/8	o" WC	c), stop the
permeation and	d perform recovery cleaning (please	see	proc	edure	e se <sub>l</sub>	oarate	ely)
MECHANICAL & PROCESS	Inspect membranes and permeate withdrawal system		Х				1 hour
	Clean and calibrate the DO sensor			Χ			1 hour
	Inspect and maintain valves & fittings for leaks		Х				
	Clean manually Fine Screen and direct solids to primary settling/sludge holding tank		Х				may require daily cleaning during start-up (subject to PI502 reading)
	Membrane in-situ cleaning				Х		2-4 hours
	Remove membrane module for mechanical cleaning and inspection					Х	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.



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



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.



#### 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



# 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<sup>™</sup> 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 °C (better cleaning efficiency if water temperature ranges from 20 to 30 °C)

#### **Procedure**

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



# Step 1: Cleaning with sodium hypochlorite (NaOCI) - 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 NaOCI into the backwash tank to a concentration of 500 mg/L (acceptable range of 200 to 1,000 mg/L).

Volume of concentrated NaOCI 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<sub>s</sub>: Concentrated NaOCI concentration (%)

V<sub>x</sub>: Volume of concentrated NaOCI 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 NaOCI 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 NaOCI solution before treatment with citric acid. Mixing NaOCI 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 °C (better cleaning efficiency if water temperature ranges from 20 to 30 °C)

#### **Procedure**

#### Step 1: Cleaning with Sodium Hypochlorite (NaOCI)

- 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 NaOCI 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 NaOCI required can be calculated with the following formula:

$$V_{x} = \frac{V_{m} \times 0.05}{C_{s}}$$

V<sub>m</sub>: Volume of membrane tank (Gallon, or Litre)

C.: NaOCI concentration (%)

V<sub>x</sub>: Volume of NaOCl required (Gallon, or Litre)



- 4. Keep the membranes soaked for a min 12 hours in the NaOCI 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 NaOCI 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 NaOCI solution before treatment with citric acid. Mixing NaOCI 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).
- 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.



# 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.



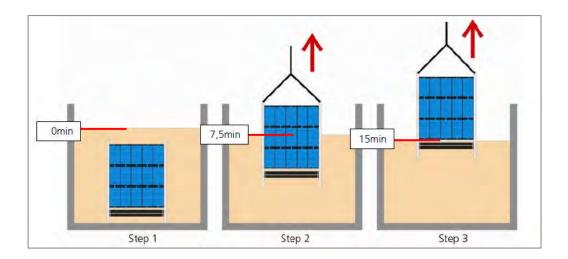
Once membrane inspection or replacement has begun, it must be completed promptly. It is important that the membrane DO NOT DRY OUT OR FREEZE during this procedure.

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 <sup>™</sup> 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.





Schematic of MicroClear<sup>™</sup> 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.



#### **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 NaOCI 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.



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<sup>3</sup>. 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 ( $4^{\circ}$ C -  $20^{\circ}$ 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.



#### 9.0 SERVICE & SUPPORT

#### **Commissioning and Start-up**

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

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.



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



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There will be no construction and development of Steensby and the Rail camps during 2015 and work is not planned for the immediate 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). 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

During 2015, 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 A.

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 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 vessel based potable water treatment scheme will include the same equipment as well as a membrane based system to desalinate the seawater source.



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### E.1.1.2 Mid-Rail Site

During 2015, 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 A.

A heated and insulated pump house will be built at adjacent Unnamed Lake with duty/standby pumps to deliver fresh water to a fresh water tank during summer. During 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 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

During 2015, 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 A.

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 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.



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

During 2015, 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 A.

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.1.1.5 Cockburn South Camp Site

During 2015, 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 A.

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.



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# **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 during 2015.

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 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.



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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 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 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 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 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



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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 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 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 had 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 Mary River (mine site) and Milne sites includes 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 criteria 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.



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# 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 management 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 reused if possible or incinerated. Accumulated suspended solids will be periodically removed by bucket loader vehicle and sent to a land fill for disposal.

Run-off from the tank fuel storage areas will have to be treated by a local 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



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toxicity and if necessary taken off-site for disposal in 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.

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



# **Technical Memorandum**

To:

Jim Millard, Baffinland Iron Mines

From:

Dave Ellis, P.Eng., AMEC

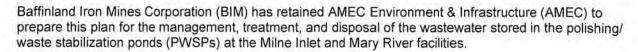
Jered Munro, AMEC

Date:

March 27, 2012

Subject:

PWSP Effluent Discharge Plan



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

Discharge Criteria (Maximum Concentration of any Grab Sample)		
et WWTF		
nL		
9.5		
acutely toxic		

AMEC Environment & Infrastructure A division of AMEC Americas Limited 900 Maple Grove Road, Unit 10 Cambridge, ON N3H 4R7 Tel 519-650-7100

Fax 519-653-6554

www.amec.com



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)
рН	✓	✓
Temperature	✓	✓
Turbidity	✓	✓
TP	✓	
Ammonia	<b>√</b>	
COD	<b>√</b>	



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	<b>√</b>	<b>√</b>	_
O&G	✓		✓



# Attachment A

PWSP Polishing System Process Flow Diagram (PFD-01)

