Baffinland Iron Mines Corporation
Mary River Project

Fresh Water Supply, Sewage, and Wastewater Management Plan

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1. Introduction

This document describes the fresh water supply and wastewater management plan 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 Part B, Item 15 of Baffinland's Type A Water Licence No. 2AM-MRY1325 for the Mary River Project, the licencee will update and revise this management plan within sixty (60) days of issuance of the Licence. This plan has been updated to take into account commitments made with respect to submission received during the preliminary and technical review of Application documents, as well as final submissions and issues raised during Public Hearing Process. The year 2013 is a regulatory transition year with the granting of a new Type B licence (8BC-MRY1314) which allowed for site preparation that includes the construction of limited infrastructure prior to receipt of the recently received Type A Water Licence (2AM-MRY1325). In consideration of this, project environmental management plans have been updated to support the 2013 Work Plan (see Appendix B) which spans the applicability between the Type B Water Licence, as well as the incorporation of the Type A Water Licence.

The Fresh Water Supply, Sewage, and Wastewater Management Plan (the Plan) is an update to the existing plan (Revision 0, dated 31 March 2013) and supplements the existing Wastewater Management Plan (Revision 3, dated March 2012). The existing March 2012 Wastewater Management Plan will continue to support the existing Sewage Treatment Plants (STPs) at the Mine Site and Milne Port which service existing exploration camps, while the new Plan will support the construction and commissioning of the new STPs for new camps at the Mine Site and Milne Port, as well as supporting potable water supply and oily water treatment activities under the Type A Water Licence.

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
GCWQ	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 Surface Rights Tribunal Act, SC 2002, c 10	
Northwest Territories Water Act	
Northwest Territories Water Regulations (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 Works 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

3. Sustainable Development Policy

Baffinland Iron Mines Corporation

1.0 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. Health and Safety
2. Environment
3. Investing in our Communities and People
4. Transparent Governance

2.0 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.

3.0 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.

4.0 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.

5.0 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

Baffinland
Iron Mines Corporation

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 environmentally 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 environmental 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 sound is essential.
- Prevention of personal injuries, occupational illnesses and environmental impacts is good business.
- 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 Baffinland 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

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

4.1.1.2 Screens on Intake Pipes

All intakes will be 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 take 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 water taking guideline states that no significant drawdown can 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.

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	Combined Volume
Milne Port (Milne Inlet)	Phillips Creek (summer)	68.5 m^3/day	25,000 m^3/year
	Km 32 Lake (Winter)		
Mine Site (Mary River)	Camp Lake	657.5 m^3/day	240,000 m^3/year
Steensby Port (Steensby Inlet)	ST 347 Km Lake	435.8 m^3/day	155,400 m^3/year
	3 Km Lake		
Raven River			
Mid-Rail	Nivek Lake (Summer)	79.5 m^3/day	
	Ravn Camp Lake (Winter)		
Cockburn North (Tunnels Camp)	Cockburn Lake	101.4 m^3/day	
Cockburn South Camp	Cockburn Lake	111.1 m^3/day	
	TOTAL	**1,589 m^3/day**	**580,000 m^3/year**

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

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. 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.

The dust 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).

For drilling/tunnelling activities a Calcium Chloride brine solution will be used.

4.3 Fresh Water System Process Description

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

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

Minimum process equipment requirements will be 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

4.3.1.1 2013 Work Plan

A camp currently operates in Milne Port to support exploration activity at the Mine Site. During the summer of 2013 new equipment will begin to arrive onsite for use during the future construction and mining operation phase of the site. Throughout the remainder of 2013 the construction and operation phase facilities will need to be installed, commissioned and brought into service. The existing potable water facilities at Milne Port accommodate approximately 50 people. The number of personnel at site will gradually increase from this number. Current estimates of the work force are as follows:

- Pre-sealift period: 70 person
- Sealift period: 60 to 120 people
- Post sealift period: ramp up to ~ 150 people (full camp capacity).

During start-up and commissioning of the new potable water treatment plant personnel levels will remain below the existing potable water supply capacity at site. Potable supplies will be rationed as necessary during this period. Once the new facility is installed and operating in accordance with design criteria the existing facility will be decommissioned. A raw water truck will draw water from 32 km lake (in winter) and Phillips Creek (in summer) and deliver the water to a water storage tank near the camp. Milne Inlet Camp Layout including locations for potable water related infrastructure for the 2013 Work Plan is presented in Appendix B.

4.3.1.2 Future Construction and Operation Phase

During the construction phase the on-site population will be approximately 150 people. A new potable water treatment system and fresh water distribution system will be put in place to support the construction phase operations. The existing fresh water equipment will not be used. The fresh water demand for construction and operation are shown on the drawing Milne Inlet - Water Supply Balance Block Flow Diagram in Appendix A.

A heated and insulated pump house will be built with duty/standby pumps to deliver fresh water from Phillips Creek to a fresh water tank during summer. During winter fresh water from 32 Km lake will be trucked to the fresh water tank. 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 concrete manufacturing will be provided directly from nearby lakes and ponds 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.

4.3.2 Mary River Site

4.3.2.1 2013 Work Plan

A camp currently operates at the Mine Site to support exploration and limited construction activity. For the existing system fresh water supply for the Mary River Camp was obtained using a diesel pump positioned adjacent to the shoreline of Camp Lake. Water was then pumped directly from the lake source to water storage tanks located at the camp. The system was originally designed for a camp population of 120 people.

During the summer of 2013 new equipment will arrive onsite for use during the construction and mining operation phase of the site. Throughout the remainder of 2013 the construction and operation phase facilities will be installed, commissioned and brought into service. The existing potable water facilities at the Mine Site accommodate approximately 120 people. The number of personnel at site will gradually increase from this number. The number of personnel at site will gradually increase from this number. Current estimates of the work force are as follows:

- Pre-sealift period: 8 to 12 persons
- Sealift period: ramp up to 250 persons
- Post sealift period: ramp up to 180 people.

During start-up and commissioning of the new potable water treatment plant personnel levels will remain below the existing potable water supply capacity at site. Potable supplies will be rationed as necessary during this period. Once the new facility is installed and operating in accordance with design criteria the existing facility will be decommissioned. Mine Site Camp Layout including locations for potable water related infrastructure for the 2013 Work Plan is presented in Appendix B.

4.3.2.2 Future Construction and Operation Phase

During the construction phase the peak on-site population will be approximately 1000 people. This is in addition to the existing exploration camp which will continue to house up to 120 people. Two new potable water treatment systems will be installed to support the construction and operation phases. One of the potable water treatment systems will be for the construction phase only and will support a population of 500 people. The other potable system will be a permanent system to support the other 500 people during both construction and operation phases. The existing fresh water equipment will not be used for construction and a new fresh water distribution system will be installed. The fresh water demand for future construction and operation are shown on the drawing Mine Site - Water Supply Balance Block Flow Diagram in Appendix A. Note that water demand in 2013 will be much lower than the flows anticipated for the future construction and operation phase.

A new heated and insulated pump house at Camp Lake will be built with duty/standby pumps to deliver fresh water to a fresh water tank (located in close proximity to the new potable water treatment plants). 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, exploration drilling, quarry dust suppression, concrete and explosives manufacturing will be provided directly from nearby lakes using vacuum truck. Exploration drilling will continue throughout the construction phase.

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.

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	360 L/person/day	Design Basis – Sewage Treatment Plant, Doc. No. H337697-4000-10-109-0002 (FEIS, Appendix 3B). Includes a 20% design allowance.

Note**:** The rate of sewage generation given above may be reduced after a review of possible re-use of some sewage for urinal flushing. Additional reductions may be achieved by water conservation.

5.2 Sewage Discharge Criteria

1

All Sewage generated from relevant Project sites will be directed to the Sewage Treatment Facilities or as otherwise approved by the Nunavut Water Board.The Licensee shall construct and operate all infrastructure and Facilities designed to contain, withhold, divert or retain Water and/or Waste in accordance with all applicable legislation and industry standards. The Unless otherwise approved by the Board in writing, effluent will be discharged 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. The quality of the sewage treatment plant effluent discharging to Freshwater or directly into 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

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)	Maximum Concentration of any Grab Sample discharging into Ocean (mg/L)
		Monitoring Locations: MP-01, MP-01a, MP-MRY-04, MP-MRY-04a, MS-01, MS-01a, MS-MRY-04, MS-MRY-04a	**Monitoring Locations: SP-01, SP-01a**
BOD_5	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
pH	---	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

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

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

1

Treated sewage and wastewater for the mine sites will be discharged to the following locations:

Table 5-3: Approximate Treated Effluent Generation and Discharge/Outfall Locations*

Camp/Site	Discharge/Outfall Location		Coordinates	Annual Effluent (m^3/year)
	Summer	Winter		
Milne Port	Ocean at Milne Inlet		N: 7976482 E: 503211	25,000
Mine Site	Mary River	Storage Pond	Mary River: N:7912429 E:562962	322,000
	Sheardown Lake for existing camp (see notes)			13,140 m^3/year to Sheardown Lake
Tote Road Camp	Conveyed to Mine Site or Milne Port Sewage Treatment		N/A	N/A
Steensby (Port)	Ocean at Steensby Port		N: 7801412 E: 593378	233,000
Ravn River Area	Conveyed to Mine Site Sewage Treatment		N/A	N/A
Mid-Rail Area	Conveyed to Mine Site Sewage Treatment		N/A	N/A
Cockburn Tunnels Area	Conveyed to Steensby Sewage Treatment		N/A	N/A
Cockburn South Camp	Conveyed to Steensby Sewage Treatment		N/A	N/A

Source: Type A Water Licence Application (FEIS, Appendix 3D, 2012), Aquatic Effects Monitoring Framework, Schedule 4 (February 2013), and Draft Water License Terms and Conditions submitted for consideration to the NWB (February 2013).

Notes:

1) The treated effluent generated at the Mine Site and Steensby Port includes the treated sewage from the rail camps which are trucked to these sites.
2) The sewage generated at the Mine Site from the existing 120-man camp will continue to be discharged to Sheardown Lake while sewage generated by the new sewage treatment systems will be discharged to Mary River (during summer) and a Storage Pond (during winter).
3) The treated effluent generated at Milne Port includes the treated sewage from the Tote Road camp which will either be treated at this site or at the Mine Site such that the total effluent discharge at either camp falls within the limits prescribed within the applicable water license.
4) The site specific compliance locations proposed for the Project are presented in the aquatic effects Monitoring Framework, Schedule 4 (February 2013). The locations presented are end-of-pipe to final receiver.

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

Table 5-4: Effluent Discharge Quality Limits for the Landfill Facilities*

Parameter	Maximum Concentration of Any Grab Sample (mg/L)
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**

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

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 (mg/L)
Benzene	370
Toluene	2
Ethylbenzene	90
Lead	1
Oil and Grease	15,000 and no visible sheen

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

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**

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

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* 1

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

*Source: Type A Water Licence (2AM-MRY1325)
Note: 1. Waste discharge shall have a pH between 6.0 and 9.5

All discharge from the Ponds associated with the Run of Mine Ore Stockpile, 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.

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. A 20% design allowance is added to this requirement.

5.4.1 Milne Port

5.4.1.1 2013 Work Plan

A camp currently operates at Milne Port to support exploration activity. Currently sewage generated by the camp site is managed through an existing RBC type sewage treatment plant (Seprotech manufactured) that has operated under the existing Class B Water Licence and Wastewater Management Plan. Sludge is discharged to a dedicated waste pond. Treated effluent is stored in a small heated tank. The effluent is then withdrawn by a vacuum truck and if it meets discharge requirements it is discharged to the overland outfall which drains by gravity to the ocean. If the effluent doesn't meet the discharge requirements the vacuum truck delivers it to a local polishing/waste stabilization storage pond for additional treatment. During

the winter, latrines are used and the waste collected is incinerated; any small quantities of grey water are collected in a greywater sump and allowed to infiltrate into the subsurface.

Throughout the summer of 2013 new equipment will arrive onsite for use during the construction and mining operation phase of the site. During the remainder of 2013 the construction and operation phase facilities will be installed, commissioned and brought into service. The site layout showing the location of camp, sewage treatment and ancillary facilities for the 2013 Work Plan is presented in Appendix B. The existing sewage treatment facilities at Milne Port accommodate approximately 50 people. The number of personnel at site will gradually increase from this number. Current estimates of the work force are as follows:

- Pre-sealift period: 70 person - operated under existing Type B Water Licence and current Wastewater Management Plan (March 2012).
- Sealift period: 60 to 120 people – operated under future Type A Water Licence
- Post sealift period to January 2014: ramp up to ~ 150 person (full camp capacity) – operated under future Type A Water Licence.

To accommodate the additional sewage waste generated a new sewage treatment system (using membrane based technology) will be installed adjacent and in parallel to the existing unit. This new unit will be designed to meet the project sewage effluent discharge limits. Once the new sewage plant is onsite, installation of the unit will begin. Vendor projections indicate that this can be completed within a week. Once installed commissioning of the system will begin. During start-up and commissioning of the new sewage treatment plant personnel levels will remain below the existing sewage plant treatment capacity at site. Water saving measures will be implemented as necessary (such as reduced shower use) during this period.

Once the new system is ready a small portion of the camp wastewater will be directed through the unit. In addition biosolids from the existing RBC treatment system will be added into the new unit aeration tank to ‘seed’ the unit with biomass. Vendors have committed to meeting discharge criteria after a 2 week start-up period. During this period, effluent generated by the newly installed sewage plant will be directed to the existing or new Polishing Waste Stabilization Pond (PWSP). The flow rate for the treatment unit will be steadily be increased until the unit is operating at full capacity.

Treated effluent will be stored in a treated effluent tank which will have a hydraulic retention of time of 8 hours (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 delayed to allow this effluent to be mixed, retreated, and retested. Once sampling indicates that effluent is meeting discharge criteria the treated sewage stream will be directed to discharge via truck or pipeline to the ocean discharge. Off-spec effluent remaining in the pond 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 under the existing Type B Water Licence.

In the event that there is an outage that causes the sewage treatment plant to be completely inoperable raw sewage will be temporarily trucked to local existing polishing waste stabilization ponds until the sewage plant is operating again. At that time untreated raw sewage from the polishing ponds will be trucked back to the treatment plant for treatment.

The sludge generated will be dewatered using a mechanical dewatering device such as belt filter or filter press and then incinerated. Sludge 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.

5.4.1.2 *Future Construction and Operation Phase*

The requirements for future construction and operations for the existing approved Project will be similar to the requirements under the 2013 Work Plan with respect to sewage treatment requirements. Therefore, it is anticipated that the sewage treatment system basis as described above will be applicable for future construction and operations requirements.

5.4.2 *Mary River Site*

5.4.2.1 *2013 Work Plan*

A camp currently operates at the Mine Site to support exploration activity. Currently the mine site has a functioning RBC based sewage treatment system designed to accommodate 120 people. The RBC and ancillary facilities (three PWSPs and discharge pipeline) operate under the existing Type B Water Licence and Wastewater Management Plan (March 2012). As such, the existing equipment will continue to be used during the 2013 period under the existing and approved Type B Water Licence. It is anticipated that there will be year round operations of the existing exploration camp and RBC during 2013 to 2014, with the camp and sewage treatment system operating seasonally, thereafter. Sludge is currently vacuumed from the existing RBC unit periodically and allowed to settle in Polishing Waste Stabilization Ponds (PWSP) No. 1; the supernatant from these ponds is tested, mixed, and then reprocessed/discharged to Sheardown Lake. With the approval of the new Type A Water Licence (2AM-MRY1325) issued July 15, 2013, the sewage treatment plant and ancillary facilities at the existing Mine Site Exploration Camp have migrated to the Type A.

During the summer of 2013, new equipment will begin to arrive onsite for use during the early construction phase of the Project. Throughout the remainder of 2013 the early construction phase facilities will need to be installed, commissioned and brought into service. The site layout showing the location of camp, sewage treatment and ancillary facilities for the 2013 Work Plan is presented in Appendix B. The existing sewage treatment facilities at the Mine Site accommodate approximately 120 people. The number of personnel at site will gradually increase from this number. Current estimates of the work force are as follows:

- Pre-sealift period: Up to 120 persons- operated under existing Type B Water Licence and current Wastewater Management Plan (March 2012).
- Sealift period: Up to 150 persons – operated under future Type A Water Licence.
- Post sealift period to January 2014: ramp up to 180 person) – operated under future Type A Water Licence.

Once the new sewage plant is onsite, installation of the unit will begin. Vendor projections indicate that this can be completed within a week. Once installed commissioning of the system will begin under the new Type A water licence. During start-up and commissioning of the new sewage treatment plant personnel levels will remain below the existing sewage plant treatment capacity at site. Water saving measures will be implemented as necessary (such as reduced shower use) during this period.

Once the new system is ready a small portion of the camp wastewater will be directed through the unit. In addition biosolids from the existing RBC treatment system will be added into the new unit aeration tank to 'seed' the unit with biomass. Vendors have committed to meeting discharge criteria after a 2 week start-up period. During this period, effluent generated by the newly installed sewage plant will be directed to a PWSP (one of the existing PWSPs or a newly constructed PWSP). The flow rate to the unit will then steadily be increased until the unit is operating at full capacity. Off-spec effluent remaining in the pond will be removed by vacuum truck and fed into the new sewage plant feed tank for re-processing or treated at the PWSP using established methods currently used for the Exploration Camp.

Once sampling indicates that effluent is meeting discharge criteria, then normal operations can be undertaken. The treated sewage stream will be directed to discharge via truck or pipeline to Mary River during the open water season and to a treated effluent storage pond during the October to June period. In the early summer of each year the treated effluent storage pond will be discharged to Mary River over a two to three week period, typically in early to late June.

Sludge generated by the new treatment plant will be dewatered mechanically using a filter press and then incinerated.

5.4.2.2 Future Construction and Operation Phase

For the future construction and operation phase, the existing RBC for the exploration camp will operate on a seasonal basis with sludge and effluent discharged as described above. The camp population will increase during future construction to a maximum size of 1000 people. This is in addition to the existing exploration camp which will house up to 120 people. The new sewage treatment plants will be designed to process raw or partially treated sewage from Ravn and Mid-Rail camps which will be conveyed to the Mary River permanent sewage treatment facility usually by truck.

Similar to early construction, treated sewage effluent will be stored in a treated effluent tank. The effluent tank will have a hydraulic retention of time of 8 hours (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 to allow this effluent to be mixed, retreated, and retested.

Treated effluent will be discharged to Mary River during summer and stored in a storage pond during winter. Prior to discharge of stored sewage from the winter period the regional compliance officer will be notified.

The equalization tank that feeds the new sewage treatment plants will be sized to accommodate the sewage from the rail camps. The rail camp sewage will be added during periods of low sewage generation at the mine site 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.

Off-spec treated sewage will be sent to the winter storage pond temporarily. The quality of the treated sewage in the pond will be given an opportunity to improve as new treated effluent enters the pond and mixes in with the treated effluent already in the pond. If this blended water meets discharge criteria it shall be discharged. If not, a vacuum truck will remove the effluent and allow it to be re-treated through the sewage treatment plant. In the event that there is an outage that causes the sewage treatment plant to be completely inoperable raw sewage will be temporarily trucked to local existing polishing waste stabilization ponds until the sewage plant is operating again. At that time untreated raw sewage from the polishing ponds will be trucked back to the treatment plant for treatment.

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 waste vehicle washwater generated at the vehicle maintenance facilities 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. The Type A Water Licence Proposed Terms and Conditions (February 2013) identifies these two sources using the following terms:

- Oily Water Treatment Plant – refers to vehicle maintenance facility washwater
- Mobile Oily Water Treatment System – refers to treatment system for fuel berm water

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	Discharge Limits
pH	6 – 9.5
TSS	35
Ammonia	4 mg/L
Phosphorous	4 mg/L
Benzene	0.370 mg/L
Ethylbenzene	0.090 mg/L
Toluene	0.002 mg/L
Oil and Grease	15 mg/L and no visible sheen
Arsenic	0.5 mg/L
Copper	0.30 mg/L
Lead	0.20 mg/L
Nickel	0.50 mg/L
Zinc	0.50 mg/L

*Source: Type A Water Licence (2AM-MRY1325).

6.2 Mobile Oily Water Treatment System Discharge Criteria

Limits for Mobile Oily Water Treatment Systems approved under the Type A Water Licence 2AM-MRY1325 are provided in the table below:

Table 6-2: Mobile Oily Water Treatment System Proposed Effluent Discharge Limits*

Parameter	Maximum Average Concentration (mg/L)
Benzene	0.370
Toluene	0.002
Ethyl benzene	0.090
Lead	0.001
Oil and Grease	15 and no visible sheen

*Source: Type A Water Licence Application (2AM-MRY1325)

6.3 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.

6.3.1 Milne Port

6.3.1.1 2013 Work Plan

There currently exists an oily water treatment system to treat highly impacted run-off from the fuel tank (bladder) farm at Milne Port. This system will be operational during 2013 and will be available to treat oily water generated throughout the site which can be transferred by vacuum truck. A separate mobile trailer based oily water treatment system will also be brought on-site to handle minor oily water contamination. This system will be ideal for treating minor contamination expected to be present in stormwater within the steel fuel tank containment berms. A maintenance facility will be constructed in 2013 that has an oily water treatment plant to treat contaminated wash water from routine operations. Site layouts showing the locations of the maintenance facility and fuel containment/other berm expansions are presented in Appendix B. The existing bulk fuel bladder farm will be decommissioned during 2013 and 2014. The treatment system that services this facility will not likely be needed for normal operations after that time, but if the need arises, can be re-commissioned for that purpose.

6.3.1.2 Future Construction and Operation Phase

The oily water generated from the expanded tank farm will be 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.

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.

Some 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. Treated oily water will be blended with treated sewage and discharged or discharged directly based on sampling.

6.3.2 Mary River Site

6.3.2.1 2013 Work Plan

During 2013 potentially oily water generated throughout the site during 2013 will be treated using a mobile trailer based oily water treatment system to handle any spills. Treated oily water will be blended with treated sewage and discharged or discharged directly based on sampling.

6.3.2.2 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 (Mine Site - Mary River). The water will be periodically tested such that if any parameter is out of compliance the water will be removed by vacuum truck and treated in the vehicle maintenance shop wastewater treatment plant.

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

The emulsion plant shall be supplied with its own wastewater treatment plant which utilizes an evaporation system to evaporate the water leaving solid residue and oil. This residue will

be tested for toxicity and if necessary taken off-site for disposal 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 both Mary River and Steensby sites. 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.

7. 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.

7.1 Potable Water Treatment System O & M Plan

7.1.1 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 7-1: Recommended Maintenance Schedule- Potable Treatment Plants

Items	Description
Daily	• Alarm check. • Chemical storage level check. • Controller time check. • Pressure gauge check.

Items	Description
Monthly	• Turbidity analyzer check/calibration. • Residual chlorine/pH analyzer check/calibration.
Annual	• Filter media level check, and refill if required. • UV lamp replacement.

7.1.2 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.

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.

7.2 Mobile Oily Water Treatment System O & M Plan

7.2.1 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 all 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.

7.2.2 *Influent Pump*

When starting up influent pump make sure all 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.

7.2.3 *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.

7.2.4 *Clay Absorption Media Filter*

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.

7.2.5 *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.

7.2.6 *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 all 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.

7.3 Oily Water Treatment Plant (For Vehicle Wash Water) O & M Plan

7.3.1 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 all 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.

Table 7-2: 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 (if applicable)	Chemical room	TBD
Alum chemical refill	Chemical room	TBD
Sodium hydroxide chemical refill	Chemical room	TBD
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”.

Table 7-3: Monitoring Tasks, Locations and Frequencies

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

A joint maintenance/monitoring log should be kept to ensure all 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.

8. 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 be located sufficiently remote 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.

9. 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.

9.1 Potable Water System Monitoring

Untreated Fresh water will be sampled at the locations specified in Table XX, 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.

9.2 Sewage Treatment System Monitoring

Treated sewage effluent will be monitored and sampled at proposed locations specified in the Aquatic Effects Monitoring Framework, Schedule 4 (February 2013), and Type A Water Licence (2AM-MRY1325). The proposed effluent discharge criteria was summarized in Table 5.2

9.3 Oily Water Treatment System Monitoring

Treated oily water effluent will be monitored and sampled at proposed locations specified in the Aquatic Effects Monitoring Framework, Schedule 4 (February 2013), and Type A Water Licence (2AM-MRY1325).

10. Roles and Responsibilities

10.1 Organization Chart for Environment

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 Figure 10-1 below. Communication channels are described as liaisons in the tables outlining the responsibilities and accountabilities in the following sections.

10.1.1 The Baffinland Environmental Team

The Baffinland Environmental Team will oversee all environmental and community works on and off site. The Baffinland Corporate Environmental Team responsibilities are summarized in Table 10-1.

The Baffinland Environmental Team will oversee all environmental activities on site. These responsibilities on site are outlined in Table 10-2.

10.1.2 Construction Contractor's Environmental Team

The Construction Contractor will have their own organisational structure which is yet to be defined, but at a minimum the responsibilities for the environmental portion are summarized in Table 10-3.

10.2 Monitoring and Inspection

The monitoring and inspection requirements are described in Sections 8 and 9 of this Plan. Responsibilities have been assigned to various personnel on the Project team. Where required, third party resources will be retained to supplement in-house resources and capabilities.

Table 10-1: Baffinland Iron Mines Corporation Senior Management

Baffinland Iron Mines Corporation Senior Management	
Position	**Responsibilities and Accountabilities**
Project Director	- Reports to Baffinland's CEO - Overall accountability for the Project execution - Allocation of resources (human and financial) for the implementation of Baffinland's commitments and objectives related to health, safety and environment during Construction of the Project - Accountable for on-site environmental, health and safety performance during construction of the Project
VP Operations	- Reports to Baffinland's CEO - Overall accountability for the Operation of the Project once constructed - 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 Development, Health, Safety and Environment	- Reports to Baffinland's CEO - Establish corporate environmental policies and objectives - Monitors and reports on Baffinland's performance related to environmental, health and safety policies and objectives - Community liaison - 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 and Contract	- Reports to Baffinland's Project Director - Accountable for procurement and purchasing - Ensure that environmental commitments, policies and objectives are included in all contract documents
VP Corporate Affairs	- Reports to Baffinland's CEO - Accountable for external communication (Governments, media, NGO, others) related to Baffinland's press release and overall communication of site incidents/events

Table 10-2: Baffinland Iron Mines Corporation On-Site Management Team

Baffinland Iron Mines Corporation On-Site Management Team	
Position	**Responsibilities and Accountabilities**
Construction Manager	- Reports to the Project Director - Responsible for daily on-site management of construction activities - Accountable to the Project director for site environmental, health and safety performance - Organize and provides necessary induction, safety and environmental training for all employees - Ensure that all contractors on-site abide by Baffinland's policies, EHS commitments
Environmental Manager	- Reports to VP Sustainable Development, Health, Safety and Environment - Liaises with the Project Director, Construction Manager and the Emergency Response Team - Monitors environmental performance of contractors on site - Monitors compliance with permits, licences and authorizations - Regulatory environmental monitoring and reporting (monthly, annual) - Routine audit of contractor's environmental performance on-site - Initiate/supervise environmental studies - Investigate and reports on accidents and incidents when they occur - Review and update environmental management plans
Environmental Supervisor (s)	- Reports to Environmental Manager - Specific accountabilities for environmental monitoring and reporting - Provides induction and environmental awareness training to new employees and contract workers
Environmental Support Groups	- Reports to the Environmental Manager - Environmental database management - Various sampling, monitoring and reporting activities as required by permits, licences and environmental management plans - Prepare updates to environmental protection plan and management plans
Environmental Monitors	- Reports to the Environmental Manager - Conduct monitoring activities as per the management plans
QIA Monitors	- Various monitoring and follow up activities - Roles will be defined in the IIBA agreement

Table 10-3: Construction Contractor(s)

Construction Contractor(s)	
Position	**Responsibilities and Accountabilities**
Construction Manager	- Reports to the Baffinland's Construction Manager - Accountable for the EHS components of his scope of work - Accountable for implementation of the Construction Environmental Protection Plan - Co-ordination/interaction with Baffinland and Baffinland's Representative Environmental Monitors.
EHS Superviser	- Reports to the Contractor's Construction Environmental Manager - Liaise with Baffinland's Environmental Supervisors and monitors. - Holds daily EHS briefing - Monitors and ensures that Contractor complies with requirements of management plans, terms and conditions of all authorization, licences and permits associated with the Contractor's scope of work - Investigate, reports and follow up on environmental accidents and incident - Provides site specific environmental monitoring - Daily supervision of construction activities for environmental performance - Attendance at all environmental meetings/Project meetings (as required). - Routine interaction with construction crews to ensure all construction activities are in compliance with requirements of the CEPP and Contractors Environmental Method Statements. Monitor the environmental permitting status of the Project to ensure that no work proceeds until appropriate and complete permitting is received for the applicable facility.

10.3 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, all 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.

10.4 Communication

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

a) Formal written correspondence and meetings with stakeholders.

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.

10.5 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.

10.6 Construction

During the construction phase of the Project, the Baffinland Environmental Manager and EPCM (Engineering Procurement and Construction Management) contractor 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. The organizational structure of the EPCM contractor will reflect the complexity of the construction phase.

The EPCM contractor and its subcontractors will appoint a Construction Phase Environmental Supervisors who will oversee the application and adherence to all of Baffinland`s EMMP. They will report to the site Construction Manager as well as to the Environmental Manager or his designate.

10.7 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.

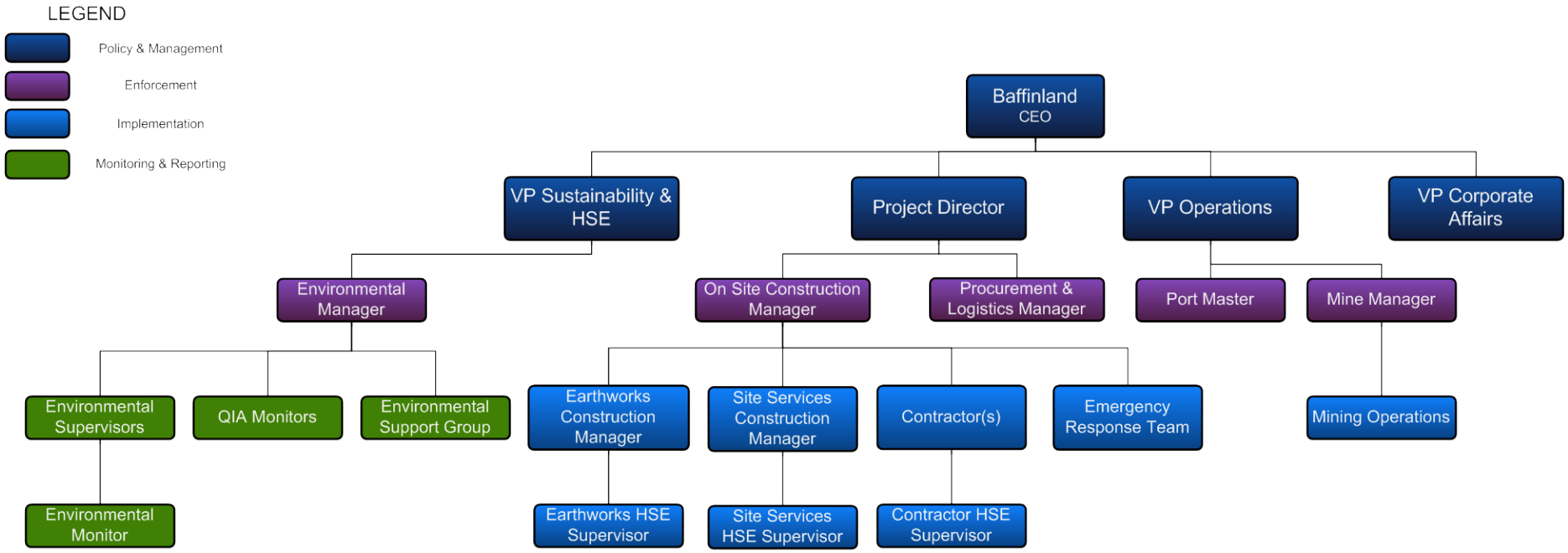


Figure 10-1: Organizational Chart

Appendix A
Table of Concordance with NIRB Project Certificate and Type A Water Licence (2AM-MRY1325)

1. Table of Concordance

Project Certificate Terms and Conditions

Groundwater and Surface Water

No.	Terms and Conditions	Comments
24	The Proponent shall monitor as required the relevant parameters of the effluent generated from Project activities and facilities and shall carryout treatment if necessary to ensure that discharge conditions are met at all times.	Refer to Sections 5.2 and 6.1.

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.

Part	Number	Condition	Section
B	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

<table>
<tr><th>Part</th><th>Number</th><th>Condition</th><th>Section</th></tr>
<tr><td>D</td><td>3</td><td>The Licensee shall submit to the Board for approval, at least sixty (60) days prior to completion of construction, an addendum to the Fresh Water Supply, Sewage and Wastewater Management Plan that addresses operational aspects of the Sewage Treatment Facilities and Wastewater Treatment Facilities, prepared in accordance with
the “Guidelines for the Preparation of an Operation and Maintenance Manual for Sewage and Solid Waste Disposal Facilities in the Northwest Territories, 1996”, where
applicable. This Manual shall include contingency measures in the event of facility malfunction, disposal of sludge and any other operational and maintenance procedures
for those facilities.</td><td>Appendix D</td></tr>
<tr><td>E</td><td>3</td><td>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>
<tr><th>Site</th><th>Source</th><th>Volume</th><th>Combined Volume</th></tr>
<tr><td rowspan="2">Milne Port
(Milne Inlet)</td><td>Phillips Creek (summer)</td><td rowspan="2">68.5 m3/day</td><td rowspan="2">25,000 m3/year</td></tr>
<tr><td>Km 32 Lake (winter)</td></tr>
<tr><td>Mine Site
(Mary River)</td><td>Camp Lake</td><td>3
657.5 m /day</td><td>240,000 m3/year</td></tr>
<tr><td rowspan="2">Steensby
Port (Steensby Inlet</td><td>ST 347 Km Lake</td><td rowspan="2">3
435.8 m /day</td><td rowspan="2">3
155,400 m /year</td></tr>
<tr><td>3 km Lake</td></tr>
<tr><td>Ravn River</td><td>Camp Lake</td><td>145.2 m3/day</td><td></td></tr>
<tr><td rowspan="2">Mid-Rail</td><td>Nivek Lake (summer)</td><td rowspan="2">79.5 m3/day</td><td rowspan="2"></td></tr>
<tr><td>Ravn Camp Lake (winter)</td></tr>
</table></td><td>Table 4-1</td></tr>
<tr><td>E</td><td>5</td><td>The Licensee may recycle water and use reclaimed water from the various Treatment Facilities, surface water management ponds and embankment dams and approved
discharge locations under the licence if such waters meet appropriate discharge criteria for those facilities.</td><td>5.2</td></tr>
</table>

Part	Number	Condition	Section
E	6	The Licensee shall equip all Water intake hoses with 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.	4.1.1.2
E	8	Streams cannot be used as a water source unless authorized and approved by the Board in writing.	4.2
E	10	The Licensee shall update or revise annually following the commencement of the Operations Phase, the Project Blockflow Diagram Water Supply Balance information for the various Project sites, provided with the Application and submit for review of the Board. The submission shall be included with the Annual Report under Part B, Item 4.	The Plan is updated to include the planned construction numbers as well as the 2013 work plan. Updates will be provided as required to include the Operations Phase
E	12	The Licensee shall not remove any material from below the ordinary High Water Mark of any water body unless authorized.	4.2
F	10	The Licensee shall treat oily water and wastewater generated by the Project at the Oily Water/Wastewater Treatment Facilities allowed under the scope of the Licence.	6.3
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 relevant Project sites to the Sewage Treatment Facilities or as otherwise approved by the Board in writing.	5.2
F	16	The Licensee shall treat all 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.	Appendix E

<table>
<tr><th>Part</th><th>Number</th><th>Condition</th><th>Section</th></tr>
<tr><td>F</td><td>18</td><td>All discharge from the Sewage Treatment Facilities including the Polishing Waste Stabilization Ponds directly into fresh Water bodies at Monitoring Stations MP-01, MP-01a, MP-MRY-04, MP-MRY-04a, MS-01, MS-01a, MS-MRY-04, MS-MRY-04a, must not exceed the following Effluent quality limits
<table>
<tr><th>Parameter</th><th>Maximum Concentration of Any Grab Sample</th></tr>
<tr><td>BOD_5</td><td>30 mg/L</td></tr>
<tr><td>Total Suspended Solids</td><td>35</td></tr>
<tr><td>Faecal Coliform</td><td>1000 CFU/100 mL</td></tr>
<tr><td>Oil and Grease</td><td>No visible sheen</td></tr>
<tr><td>pH</td><td>Between 6.0 and 9.5</td></tr>
<tr><td>Ammonia (NH3-N)</td><td>4.0 mg/L</td></tr>
<tr><td>Total Phosphorous (MS-01)</td><td>4.0 mg/L</td></tr>
<tr><td>Total Phosphorous (MS-01a)</td><td>1.0 mg/L</td></tr>
<tr><td>Toxicity</td><td>Not acutely toxic</td></tr>
</table></td><td>Table 5.2</td></tr>
<tr><td>F</td><td>19</td><td>All discharge from the Sewage Treatment Facilities including Polishing Waste Stabilization Ponds at Monitoring Stations SP-01, SP-01a directly into the ocean or to ditches flowing into the ocean shall not exceed the following Effluent quality limits:
<table>
<tr><th>Parameter</th><th>Maximum Concentration of Any Grab Sample (mg/L)</th></tr>
<tr><td>BOD_5</td><td>100 mg/L</td></tr>
<tr><td>Total Suspended Solids</td><td>120 mg/L</td></tr>
<tr><td>Faecal Coliform</td><td>10,000 CFU/100 mL</td></tr>
<tr><td>Oil and Grease</td><td>No visible sheen</td></tr>
<tr><td>pH</td><td>Between 6.0 and 9.5</td></tr>
<tr><td>Toxicity</td><td>Not acutely toxic</td></tr>
</table></td><td>Table 5-2</td></tr>
<tr><td>F</td><td>20</td><td>Sludge generated from the Sewage Treatment Facilities or any other facilities shall be confirmed to be non-hazardous and the results provided to the Board for review prior to disposal at any Landfill Facility or as otherwise approved by the Board in writing.</td><td>5.2</td></tr>
</table>

<table>
<tr><th>Part</th><th>Number</th><th>Condition</th><th>Section</th></tr>
<tr><td>F</td><td>21</td><td>All discharge from the Oily Water/Wastewater Treatment Facilities at Monitoring Stations MP-02, MS-02, SP-02 must not exceed the following Effluent quality limits:
<table>
<tr><th>Parameter</th><th>Maximum Average Concentration (mg/L)</th></tr>
<tr><td>pH range</td><td>6 – 9.5</td></tr>
<tr><td>TSS</td><td>35</td></tr>
<tr><td>Ammonia</td><td>4</td></tr>
<tr><td>Phosphorous</td><td>4</td></tr>
<tr><td>Benzene</td><td>0.370</td></tr>
<tr><td>Ethylbenzene</td><td>0.090</td></tr>
<tr><td>Toluene</td><td>0.002</td></tr>
<tr><td>Oil and Grease</td><td>15 and no visible sheen</td></tr>
<tr><td>Arsenic</td><td>0.50</td></tr>
<tr><td>Copper</td><td>0.30</td></tr>
<tr><td>Lead</td><td>0.20</td></tr>
<tr><td>Nickel</td><td>0.50</td></tr>
<tr><td>Zinc</td><td>0.50</td></tr>
</table></td><td>Table 6-1</td></tr>
<tr><td>F</td><td>22</td><td>All discharge from the Landfill Facilities at Monitoring Stations MS-MRY-13a, MSMRY-13b and SP-08 must not exceed the following Effluent quality limits:
<table>
<tr><th>Parameter</th><th>Maximum Average Concentration (mg/L)</th></tr>
<tr><td>pH</td><td>6.0-9.5</td></tr>
<tr><td>Total As</td><td>0.5</td></tr>
<tr><td>Total Cu</td><td>0.3</td></tr>
<tr><td>Total Pb</td><td>0.2</td></tr>
<tr><td>Total Ni</td><td>0.5</td></tr>
<tr><td>Total Zn</td><td>0.5</td></tr>
<tr><td>Total Suspended Solids</td><td>15</td></tr>
<tr><td>Oil and Grease</td><td>No</td></tr>
</table></td><td>Table 5-4</td></tr>
<tr><td>F</td><td>23</td><td>All discharge from the Bulk Fuel Storage Facilities at Monitoring Stations MP-03, MPMRY-7, MS-03, MS-04, MS-MRY-6, SP-04 and SP-05 must not exceed the following Effluent quality limits:
<table>
<tr><th>Parameter</th><th>Maximum Concentration of Any Grab Sample (ug/L)</th></tr>
<tr><td>Benzene</td><td>370</td></tr>
<tr><td>Toluene</td><td>2</td></tr>
<tr><td>Ethylbenzene</td><td>90</td></tr>
<tr><td>Lead</td><td>1</td></tr>
<tr><td>Oil and Grease</td><td>15,000 and no visible sheen</td></tr>
</table></td><td>Table 5-5</td></tr>
</table>

<table>
<tr><th>Part</th><th>Number</th><th>Condition</th><th>Section</th></tr>
<tr><td>F</td><td>24</td><td>All discharge from the Landfarm Facilities at Monitoring Stations MP-04, MS-05 and SP-06 must not exceed the following Effluent quality limits:
<table>
<tr><th>Parameters</th><th>Maximum Average Concentration (mg/L)</th></tr>
<tr><td>pH</td><td>6.0-9.0</td></tr>
<tr><td>Total Suspended Solids</td><td>15</td></tr>
<tr><td>Oil and Grease</td><td>15 and no sheen</td></tr>
<tr><td>Total Lead</td><td>0.001</td></tr>
<tr><td>Benzene</td><td>0.370</td></tr>
<tr><td>Toluene</td><td>0.002</td></tr>
<tr><td>Ethylebenzene</td><td>0.090</td></tr>
</table></td><td>Table 5-6</td></tr>
<tr><td>F</td><td>25</td><td>All discharge from the Bulk Sample Open Pit, Bulk Sample Weathered Ore Stockpile, Bulk Sample Processing Stockpile Area and Bulk Sample Stockpile Area Seepage at Monitoring Stations MS-MRY-09, MS-MRY-10, MS-MRY-11, MP-MRY-12 shall not exceed the following Effluent quality limits:
<table>
<tr><th>Parameter</th><th>Maximum Concentration of Any Grab Sample (mg/L)</th></tr>
<tr><td>Total Arsenic</td><td>0.50</td></tr>
<tr><td>Total Copper</td><td>0.30</td></tr>
<tr><td>Total Lead</td><td>0.20</td></tr>
<tr><td>Total Nickel</td><td>0.50</td></tr>
<tr><td>Total Zinc</td><td>0.50</td></tr>
<tr><td>Total Suspended Solids</td><td>15.0</td></tr>
<tr><td>Oil and Grease</td><td>No visible sheen</td></tr>
<tr><td>Toxicity</td><td>Not acutely toxic</td></tr>
<tr><td colspan="2">The waste discharge shall have a pH of between 6.0 and 9.5</td></tr>
</table></td><td>Table 5-7</td></tr>
<tr><td>F</td><td>26</td><td>All discharge from the Ponds associated with the Run of Mine Ore Stockpile, 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 of Part F, Item 25</td><td>5.3 and Table 5-7</td></tr>
</table>

Appendix B
2013 Work Plan and Site Layouts

2013 WORK PLAN

1.0 Introduction

The following document presents the activities Baffinland intends to undertake as part of its 2013 Work Plan. In the event the Project does not advance, all work items described and constructed as per the 2013 Work Plan will be subject to reclamation, as per relevant regulatory and permit obligations.

2.0 Overview of Site Activities for March 2013 to December 2013

This 2013 Work Plan provides for:

1) The development and construction of infrastructure required for site capture at Milne Port and the Mine Site for the launching of the 18 MT Mary River Project.
2) Ongoing environmental baseline data collection and geotechnical drilling in order to sustain the development of the 18 MT Project. These activities will resume at the Milne Port site, along the Tote Road, at the Mine Site, at numerous quarry sites and at other Project development areas.

The specific scope of activities to be undertaken at each Project site is presented in Section 3 of this Work Plan. The Work Plan is presented within the context of the applicable regulatory authorizations and schedule.

Baffinland holds, or will soon hold, all the permits and authorizations required to carry out the 2013 Work Plan. The main regulatory instruments that allow for the 2013 Work Plan activities include:

- Project Certificate
    - All works and activities proposed have been screened by the NIRB and have been considered in the Project Certificate issued by the NIRB on December 28, 2012.
- Type B Water Licence
    - The current Type B Water Licence (2BB-MRY1114) authorizes Baffinland to operate the existing sewage treatment plants, incinerators, landfill, wastewater treatment and other facilities regulated by the Nunavut Water Board. A request for a modification to this licence will be submitted shortly, for the construction of an additional 5ML fuel tank construction within the existing secondary containment as well as for the construction of a second PWSP pond at Milne Port (these work items are discussed in section 3.1.2 of this letter). The Type B Water Licence also authorizes Baffinland to undertake mineral exploration and geotechnical drilling programs. Prior to March 31st 2013, Baffinland will submit to the NWB an update of all the environmental management plans associated with the Type B water Licence.
- Type A Water Licence
    - The final hearings for the Type A Water Licence associated with the Project Certificate are scheduled for April 23 to 25, 2013, in Pond Inlet. Baffinland expects that the Type A Water Licence will be granted by mid June 2013. The scope of the Type A Water Licence exceeds the requirement of the 2013 Work Plan for all

activities considered in this 2013 Work Plan. Following the issuance of the Type A Water Licence, Baffinland will submit to the NWB updates for the environmental management plans associated with this Water Licence.

- Use and Storage of Explosives
  - Baffinland's Explosives Contractor will obtain the necessary permits and authorizations from NRCan for the use and storage of explosive at the Project sites. It is anticipated that these permits will be obtained prior to commencement of the 2013 Work Plan (expected in mid April 2013).
- Quarry Permits
  - Schedule 'B' Quarry Concession Agreement under IOL Commercial Lease Q10C3001.
    - It is anticipated that quarrying of rock and gravel from permitted quarry locations (as shown on Schedule "A1") of this Lease will continue. In addition, Baffinland will be applying for access and quarry permits to extract rock and gravel material adjacent and near the existing Milne Inlet Tote Road by means of an Amendment to the existing Schedule 'B' to the Lease.
  - The Project Certificate included the detailed assessment of 5 quarries. Two of these quarries will be developed at the onset of the 2013 Work Plan:
    - Quarry Q1 located at Milne Inlet – a site specific Quarry Management Plan was provided in the FEIS (Volume 3, Appendix 3B, Attachment 6: Operation and Management Plan Milne Inlet Quarry). The surface area of the quarry is 200,000 m^2 and the volume of material to be extracted is approximately 300,000 m^3.
    - Quarry QMR2 located at the Mary River Mine Site - a site specific Quarry Management Plan was provided in the FEIS (Volume 3, Appendix 3B, Attachment 6: Operation and Management Plan Mary River Mine Site Quarry). The surface area of the quarry is 252,700 m^2 and the volume of material to be extracted is approximately 538,000 m^3.
  - AANDC Land Use Permit and Quarry Permit to access existing and possibly new borrow and rock quarries adjacent and near the Tote Road.

3.0 Scope of 2013 Construction Activities

3.1 Pre-Sealift Activities – mid April to June 30, 2013

Construction activities will commence in April 2013. Equipment already on site will be used to begin earthworks and site preparation. Beginning in April 2013, key activities will include:

3.1.1 Mary River Mine Site

- Operate the Mary River Exploration Camp and increase occupancy as of mid April 2013. The camp with its associated sewage treatment plant and incinerator will operate in accordance to the terms and conditions of Baffinland's Type B Water Licence.

- Fly in pre-packaged explosives to the Mary River airstrip and transport to explosives magazines at Milne Port for storage and use in quarry operations.
- Construct camp pad and begin installation of construction camp.

3.1.2 Tote Road

Routine maintenance of the Tote Road will continue in 2013. The following activities will be undertaken prior to the sealift:

- Open the Tote Road (snow clearing) in early April;
- Relocate crusher train from the Mary River mine site to Milne quarry site (the crusher will be transported across river ice at four locations where box culverts are now in place);
- Follow up on the requirements pursuant to the Fisheries Authorization for the Tote Road Net Loss and Monitoring Program, QIA lease, and AANDC land permit and quarry permit requirements;
- Implementation of a freshet management plan for the Milne Inlet Tote Road to minimize associated environmental risks;
- Develop laydown areas for storage of explosive magazines (3 areas) in proximity of Q1 quarry at Milne Inlet. Position explosive magazines.

Milne Port

- Open the Milne Port camp site (mid April) and operate at full capacity (60 beds). Restart and operate the existing sewage treatment plant at Milne Port and the camp incinerator. The camp will operate in accordance with the terms and conditions of Baffinland's Type B Water Licence.
- Construct a second polishing waste stabilization pond (PWSP) at Milne in preparation for larger off-specification sewage treatment capacity during construction ramp up.
- Begin development of quarry Q1 1+100 (submitted with FEIS) to generate crushed and screened aggregate for the development of the Milne Port site. An estimated aggregate volume of 100,000 m^3 will be required for Milne Port site development.
- Earthworks at Milne Port prior to the sealifts will focus on the following areas:
    - Develop laydown area B (used for Owner/Contractor laydown);
    - Develop laydown area A for storage of material and equipment to be received during the 2013 sealift;
    - Develop pad for the expanded camp facilities;
    - Upgrade (extend) the airstrip runway;
    - Construct fuel tank farm secondary containment area;
    - Construct one 5ML diesel fuel storage tank within the secondary containment constructed in 2011 (same construction as existing 5 ML tank);
    - Construct laydown area for waste storage/transfer;
    - Development of parking areas for heavy equipment and rolling stock fleet to be delivered during the sealifts.

3.2 2013 Sealift – July 1st to October 1st, 2013

For Milne Port, it is expected that sealifts will occur between July 1st and October 1st, 2013. An estimated 14 barges/ships (dimension of barges approximately 35 m x 140 m) will be necessary to transport the equipment and material required for the execution of the 2013 Work Plan and execution of the work planned for January to June of 2014.

Material, equipment, fuel and supplies required for construction activities at the Mine Site and the operation of the Mary River facilities will be transported to the Mine Site via the Tote Road during the fall of 2013 and the winter of 2014.

The material, equipment, supplies, buildings and machinery received at Milne Inlet during the sealifts will consist of the following:

3.2.1 Prefabricated Buildings and Fold-away Structures

- Camps complete with dormitories, kitchen facilities, washrooms, laundry facilities;
- Pre-assembled sewage treatment facilities;
- Camp incinerators;
- Emergency services building;
- Power generation equipment with electrical distribution system (several generators ranging from 50 kW to 500 kW);
- Two concrete batch plants;
- Boiler modules;
- Temporary emulsion plant;
- All modular buildings and fold-away structures to be used for offices during the 2013-2014 period. A preliminary list is presented in the table below:

Facility	Quantity
Maintenance shops	3
Trade shops (electrical, carpentry, piping, mechanical)	3
Warehouses	3
Parking garages	3
Tire shops	3
Office complexes	3
Lunchrooms	3
Wash cars	13
Field offices and lunch rooms	10
Fold-away structures	5

3.2.2 Heavy Equipment and Rolling Stock

- All heavy equipment and rolling stock required for the construction activities scheduled from July 2013 to July 2014 (next sealift). An overview of the rolling stock is presented in the table below:

Preliminary list of Rolling Stock and Heavy Equipment			
Description	Quantity	**Description**	Quantity
Loader	26	Emulsion Delivery Trucks	3
Grader	7	Loader Snow Blower Attachments	5
Track Dozer	13	Development Rock Drills	2
Excavator	11	Production Rock Drill	2
Haul Trucks	23	Crusher 6000 Ton/Day 6" (Cone Crusher)	2
Service trucks (pick-ups)	27	45ft Van Trailer Generator	2
Skidsteer	5	Hot Box	4
Highway Tractor Truck	4	Frost Fighters	12
Low Boy Trailers	8	Drive on Compactor	8
Boom Truck	3	Walk Behind Compactor	4
80 Ton Mobile RT Crane	2	Plate Compactors	4
200 Ton Track Mount	2	Trash Pumps	8
Crane RT	1	Development Drills	4
Crawler Crane	1	Roll Off Truck	2
Vac Truck - Roll Off	2	Potable Water Tank	1
Potable Water Tanks	2	Water Truck	2
Raw Water Tanks	2	Snow Cat	2
Sewage Vac Tanks	4	Fuel and Lube Truck	4
Garbage Bins	25	Tractor Truck	2
Container Handler	2	Low Boy Float	2
Telehandler	4	Low Boy Drop Deck	2
Ambulance	2	Portable Concrete Batch Truck	2
Fire Truck	2	10 cu.yd Mixer Truck	6
Dewatering Pump	4	100ft Pump Trucks	2
Plow/Sand Truck	4	320000BTU Frost Fighter	20
Buses	8	8kW Light Towers	10
Manlift	6	20kW Whisper Watt Gen Set	7
Scissor Lifts	4	185cfm Air Compressor	2
Maintenance Truck c/w Pick	2	400 Amp Welding Machines	
Fuel Delivery Truck - B-Train	2	Portable Grout Plant (3 off Sea Cans)	
Camp Power-Genset(1250)	10	Ice Profiler	
Boiler Modules	1	4" Ice Auger	
Solution Modules	1	4 ton Propane Bullet c/w Refill Station	
Bob Cat	1	10,000 L Gasoline ISO Container	
Air Compressors	2	Rock Breaker	
Magazines	15	Spray Equipment	

3.2.3 Fuel Delivery

At least two bulk fuel deliveries will occur during the 2013 sealift. At the onset of the shipping season, arctic diesel will be delivered to fill the existing 5 ML storage tank and the newly constructed 5 ML steel tank located at the Milne tank farm. In addition, 1.5 ML of jet A fuel will also be included in the initial fuel delivery.

Throughout the summer months, construction will continue on two additional 10 ML steel tanks (within the confine of the tank farm secondary confinement) for the storage of diesel fuel.

Towards the end of the open water season, a second fuel delivery will occur to fill all tankage available at Milne Port. It is expected that this second fuel delivery will consist of 25 ML of arctic diesel and 1.5 ML of jet A fuel.

In addition to bulk fuel delivery, an estimated twelve 100,000L double wall isocontainer fuel storage tanks will be delivered to Milne Port. These isocontainers will provide the fuel storage at various quarry sites and construction sites for the execution of the 2013 Work Plan and the work scheduled for the Tote Road upgrade and bridge construction during the winter of 2014.

3.2.4 Material and Supplies

To the extent practicable, all materials and supplies required to execute the 2013 Work Plan and the work scheduled for January to June 2014 will be received during the 2013 sealifts. This includes:

- Delivery of ammonium nitrate (1.5 million kg);
- Delivery of pre-package explosives;
- Delivery of cement (12,000 tonnes);
- Delivery of construction material (generators, cabling, control centres, etc.);
- Delivery of consumables (lubricants, grease, detergents, dry goods, food, household supplies, etc.);
- Delivery of twelve 100,000L double wall isocontainers for fuel.

3.3 Construction Activities from July 1 to December 31, 2013

As mentioned in Section 2.1, Baffinland expects to be granted its Type A Water Licence by mid June 2013. As equipment and material is delivered by sealifts, additional construction activities will begin. These include:

3.3.1 Milne Port

During the sealift, most of the activities at Milne Port will focus on unloading the barges and positioning received equipment and material in designated laydown areas. In addition, the following construction activities will continue:

- Install emergency response building;
- Construct and commission two 10 ML diesel fuel steel tanks at the tank farm (construction completion before the end of sealift season);
- Construct and commission two additional 10 ML diesel fuel steel tanks at the tank farm;
- Install and commission fuel dispensing system for bulk fuel facility;
- Install and commission camp extension (100 person camp) including sewage treatment plant and incinerator;
- Install concrete batch;
- Construct landfarm;

- Ongoing decommission of the bladder farm;
- Install maintenance shops;
- Install trade shops;
- Install warming shed and parking garage;
- Install warehouses;
- Install administration buildings and field offices.

3.3.2 Tote Road

During the second half of 2013, all equipment, material, fuel, and supplies required for construction activities at Mary River will be transported from Milne Port to the Mine Site via the Tote Road.

The upgrade of the road will commence late in 2013 and is expected to take 8 to 10 months. In order to improve construction efficiency, contractors have expressed the need for establishing a temporary 49 person camp mid-way along the Tote Road.

Should this camp be required, it will be erected in the later part of 2013. Water required for the camp operation would be trucked to this camp from the Mine Site or Milne Port water supply (approved under Type A and current Type B). All sewage generated from this camp would be trucked to either the Mine Site or Milne Port sewage treatment plants. Finally, all waste generated at the camp would also be transported to either the Mine Site or to Milne Port for ultimate disposal. There will be no local discharge from this camp.

3.3.2 Mine Site

Construction activities at the Mine Site will begin shortly after the first sealift. The activities will consist of:

- Development of the quarry QM2 at Mine Site (submitted with FEIS). The expected volume of aggregate required at the Mine Site for the 2013 work is 200,000 m^3;
- Complete construction camp pad and installation of the 400 person construction camp facility including sewage treatment plant, incinerator and treated sewage storage pond(s) and discharge pipeline to Mary River;
- Upgrade (extend) of the Mary River airstrip;
- Development of equipment laydown areas for Owner/Contractor;
- Development of parking area for mobile equipment. Mobile equipment fleet will include:
    - Flat bed trucks;
    - Boom trucks;
    - Fuel Tanker trucks;
    - Water tanker trucks;
    - Cranes;
    - Excavators;
    - Graders;

    - Pick-up trucks;
- Erect/install:
    - Emergency response building;
    - Concrete batch plant;
    - Emulsion plant;
    - Maintenance shop (including truck wash facility);
    - Trade shops;
    - Warming shed and parking garage;
    - Warehouses;
    - Administration buildings and field offices.
- Construct fuel tank farm secondary containment structure;
- Install 4 x 500,000L double wall diesel fuel tank (tank complete with fuel dispenser);
- Install one 50,000L double wall jet A fuel tank;
- Transfer fuel from Milne Port tankfarm to newly install fuel tanks at the Mine Site;

4.0 Ongoing Exploration and Geotechnical Activities

It is anticipated that the 2013 field work program would include the following items:

- Potentially seasonal occupation of Steensby Inlet and Mid-Rail Camps;
- Fixed wing aircraft and helicopter to support general site activities including environmental monitoring and potentially additional exploration drilling and regional exploration;
- Geotechnical drilling and surveys at project development areas, as required to support Project design requirements:
    - The Tote Road alignment and bridge crossings, a portion of the drilling for bridge design being on ice as well as near water bodies;
    - Port site(s), with land based drilling as well as possible barge based and ice based drilling on the sea ice in Steensby Inlet;
    - Waste rock and ore disposal areas;
    - Milne Inlet Tote Road and bridge crossings, a portion of the drilling for bridge design being on ice as well as near water bodies;
    - Prospective quarry sites and borrow areas along the Tote Road.
- Continue archaeological surveys at project component areas as required.

5.0 Progressive Reclamation of the Exploration and Bulk Sample Project

There will be continued progressive reclamation of areas of current and past use in association with drilling, bulk sample, and historical exploration programs. In addition, progressive reclamation plans will include:

- Development of an action plan to address concerns from stakeholders about long term salt storage;

- The completion of a program to test and dispose of incinerator bottom ash and the development of a plan to management and dispose of ongoing generation of ash;
- Continuing with the ongoing decommissioning of the existing bladder farm at Milne Inlet and the transport of hydrocarbon impacted soils to the planned landfarm facility;
- Development and implementation of a long term multi-year plan to address localized areas of permafrost melting associated with current borrow areas, and taking into consideration the longer term plans for Tote Road upgrades and new quarry development;
- Continued progressive reclamation of areas of current and past use in association with drilling, bulk sample, and historical exploration programs;
- Demobilization of equipment and supplies not required for near term activities, as well as the current inventory of hazardous waste and other materials by means of sealift from Milne Port;
- Continued development of the Mine Site landfill and deposition of non-hazardous wastes in accordance with the landfill operations and maintenance manual; and,
- Discharge of treated sewage stored in PWSPs at Mary River Camp and Milne Inlet after treatment as required. Two periods of discharge are planned, the first corresponding to freshet (May-June), and the second later in the summer if required.

6.0 Workforce and Employment Opportunities

The site work program is expected to begin in April 2013. Until material and equipment are received by sealifts, to a large extent, development activities are limited by availability of equipment currently on site. The work force is expected to peak during the sealifts period. Current estimates of the work force are as follows:

- Milne Port:
    - Pre-sealift period: 70 person
    - Sealift period; 60 to 120 persons
    - Post sealift period: ramp up to 150 person (full camp capacity)
- Mine Site Construction personnel:
    - Pre-sealift period: 8 to 12 persons
    - Sealift period; ramp up to 250 persons
    - Post sealift period: ramp up to 180 person

The 2013 work program will offer employment opportunities for many residents of northern Baffin Island. Baffinland will endeavor to maximize Inuit employment throughout 2013. Baffinland's "Work Ready Program" along with site specific training will prepare potential Inuit employees for these job opportunities. Job advertisements for a number of positions are currently posted in all the North Baffin communities. In addition, Baffinland will provide guidance to all its Contractors for training requirements and Inuit employment in the contract documents.

7.0 Early Revenue Phase (ERP) Environmental Impact Assessment

As stated in correspondence to the NIRB on January 13, 2013, due to various business drivers, Baffinland proposes to make changes to the schedule and some activities in the initial stages of project development associated with the Mary River Project Proposal for which the NIRB recently issued Project Certificate No. 005 (the 'Project Certificate').

In its request to the NIRB, Baffinland indicated that although the Proponent remains committed in the long-term to developing the Project as authorized in the Project Certificate, in the short term Baffinland proposes to change some development activities and project timelines to accommodate a proposed "Early Revenue Phase" which would include development of a nominal 3.5 million tonnes per annum (Mt/a) road haulage operation from the Mary River mine site to a port facility at Milne Inlet for shipping of iron ore during the open water season. As noted by Baffinland, this development option was presented previously as a project alternative, and was included within the initial technical review of the Draft Environmental Impact Statement for the Mary River Project Proposal.

Baffinland recognizes that this Early Revenue Phase will require an amendment to the Project Certificate which in turn requires the submission and review of an Environmental Impact Assessment. In accordance to the directives issued by the NIRB, Baffinland expects to complete its Environmental Impact Assessment for the Early Revenue Phase (ERP) of the Project by June 2013. It is anticipated that this EIA will be submitted to the NIRB by June 30, 2013, and the proposal will be subjected to the NIRB review process which is expected to be completed by the first quarter of 2014.

Once a favorable decision is granted from the Minister of AANDC with respect to the ERP, and subject to obtaining any amendments (if any) which might be necessary to the Water Licence, Baffinland will proceed with the construction of facilities required for the completion of the ERP. This work will be included in the 2014 Work Plan, once the Project Certificate has been amended.

8.0 Potential 2014 Bulk Sampling Campaign

In addition to the scope of activities described herein, Baffinland is also considering the undertaking of a second "bulk ore sampling" campaign. This campaign would consist of mining up to 500,000 tonnes of ore for shipment to potential customers via Milne Port during the 2014 open water season. A feasibility study is in progress and a decision by Baffinland's Board of Directors on whether to proceed with this bulk sampling campaign is expected by the end of March 2013. Should the decision of the Board be favorable, an addendum to this 2013 Work Plan will be submitted in April 2013. This addendum will highlight additional activities that must be undertaken in 2013 in order to execute the 2014 bulk sampling campaign.

H349000-2000-00-015-0002

MILNE INLET

EFFLUENT DISCHARGE LOCATION
TO RECEIVING ENVIRONMENT
N:7976482.047
E:503211.450

LAYDOWN A1
EARTHWORKS
CONTRACTOR YARD

10 ML
P-50 DIESEL

5 ML
P-50 DIESEL

FUEL TANK FARM

RAMP TO BEACH

SEALIFT BARGE
LANDING AREA

DRAINAGE DIVERSION
DITCH

EXISTING HTO CABIN

LAYDOWN B1

LAYDOWN A1
AREA

EXISTING POLISHING
WASTE STABILIZATION
POND

INCINERATOR

SERVICES AREA PAD B3
SITE FACILITIES, INCLUDING:

- MAINTENANCE/WAREHOUSE BUILDING
  OILY WATER TREATMENT PLANT
- WELDING SHOP BUILDING
- WORKSHOP OFFICE BUILDING

750,000L
JET A FUEL

POWER
GENERATORS

POLISHING
WASTE STABILIZATION
POND

HAZARDOUS WASTE
BERM

EXISTING
BLADDER FARM

TENT CAMP

LINED STORAGE
AREA

EXISTING TRAILER
CAMP

LINED STORAGE

EXISTING
WASTE WATER
TREATMENT
FACILITY

CAMP INFRASTRUCTURE PAD B2
SITE FACILITIES, INCLUDING:

- ACCOMMODATION COMPLEX
- EMERGENCY RESPONSE OFFICE
- EMERGENCY RESPONSE
  GARAGE
- SEWAGE TREATMENT
  PLANT
- POTABLE WATER
  TREATMENT PLANT
- WASTE MANAGEMENT FACILITY

LAYDOWN
AREA

AIRSTRIP

WASTE DISPOSAL
LAND FARM

ROCK QUARRY NO.1

EXISTING
LAND LEASE
BOUNDARY

PROJECT
DEVELOPMENT
AREA

POTABLE
WATER SUPPLY

CONSTRUCTION PAD C
CONCRETE BATCH PLANT

TOTE ROAD

PROPOSED EXTENT OF
QUARRY

PERMITTED OPEN BURN PIT AREA

PHILLIPS CREEK

BORROW PITS

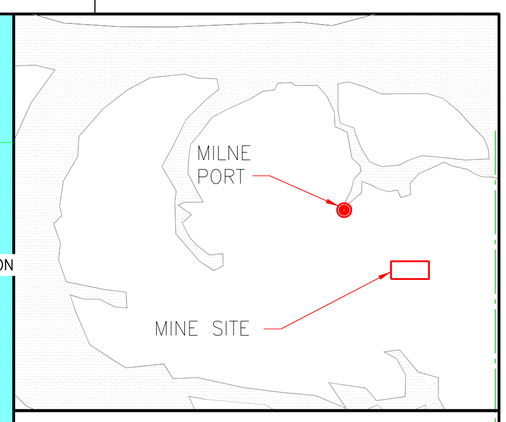
BORROW SOURCE NO.1

MILNE INLET TOTE ROAD

BORROW PITS

0 50 100 150 200 250
SCALE IN METERS

KEYPLAN



NOTES:

1. TOPOGRAPHY PROVIDED BY TERRAPOINT CANADA INC.
2. COORDINATE GRID IS SHOWN IN UTM (NAD83) ZONE 17 AND IS IN METRES.
3. CONTOURS ARE IN METRES. CONTOUR INTERVAL IS 1.5 METRES.
4. AS-CONSTRUCTED INFORMATION PROVIDED BY GENIVAR IN 2008.

LEGEND:

- WATER
- PROPOSED QUARRY
- LAYDOWN AREA (CONSTRUCTION PHASE)
- ADVANCED EXPLORATION UNDER EXISTING TYPE 'B' WATER LICENSE
- EARLY WORKS (MAY TO JULY 2013) UNDER NEW TYPE 'B' WATER LICENSE (IN PROCESS)
- CONSTRUCTION PHASE UNDER FUTURE TYPE 'A' WATER LICENSE (JULY TO DECEMBER 2013)
- EXISTING BORROW AREA (IOL COMMERCIAL LEASE)
- EXISTING ROCK QUARRY (IOL COMMERCIAL LEASE)
- RIVER/STREAM/DRAINAGE
- PROJECT DEVELOPMENT AREA
- BAFFINLAND'S COMMERCIAL LEASE ON INUIT OWNED LAND
- ROAD

Baffinland Iron Mines Corporation

MARY RIVER PROJECT

MILNE PORT

SITE LAYOUT

SCALE	DWG. NO.	REV.
1:5000 OR AS NOTED	H349000-2000-00-015-0002	A

DWG. NO. H349000-4000-00-015-0002

TOM RIVER

CAMP LAKE

SHEARDOWN NW LAKE

MARY RIVER

BORROW PIT #3
BORROW PIT •2
BORROW PIT •1
BORROW PIT •5
BORROW PIT •4
STORAGE AREA
INCINERATOR
POTABLE WATER PUMP HOUSE
HAZARDOUS WASTE CONTAINMENT BERM
BARRELED FUEL LINED CONTAINMENT
SEALIFT LAYDOWN AREA
EXISTING LAYDOWN AREA
LAYDOWN AREA
BULK FUEL STORAGE FACILITY
NEW AERODROME APRON
QUARRY QMR2
RAW WATER INTAKE
ORIGINAL CAMP
EXISTING CAMP FACILITIES
WASTE WATER TREATMENT FACILITY
HELIPAD
EXISTING POLISHING WASTE STABILIZATION PONDS (PWSPs)
EXISTING AERODROME
AERODROME RUNWAY AND APRON
CONSTRUCTION LAYDOWN AREA
CRUSHER AND STOCKPILE PAD
CAMP INFRASTRUCTURE
• ACCOMMODATION COMPLEX
• EMERGENCY RESPONSE
• MEDICAL CENTRE
• SEWAGE TREATMENT PLANT & OFF-SPEC POND
• POTABLE WATER TREATMENT PLANT
EXISTING SEWAGE DISCHARGE PIPELINE
SITE SERVICE FACILITIES, INCLUDING:
POWER PLANT
MINE TANK FARM & DYKE
MAINTENANCE BUILDING
WAREHOUSE
TRUCK WASH FACILITY
EXISTING LAND ROAD
EXISTING LANDFILL
EXISTING EXPLOSIVES MAGAZINES
UTILITY BERM
EXPLOSIVES PADS
EXPLOSIVES MAGAZINE
EMULSION PLANT
WASTE ROCK DUMP BOUNDARY AT THE END OF OPERATION
PROJECT DEVELOPMENT AREA
DEPOSIT NO.1 MINING LEASE 2484
PROPOSED OPEN PIT OUTLINE
NEW HAUL ROAD
EXISTING WEATHERED ORE AND WASTE ROCK STOCKPILE
2008 BULK SAMPLE PIT
OPEN PIT DEVELOPMENT
EXISTING HAUL ROAD
RAIL PHASE PRIMARY AND SECONDARY CRUSHING
PIT 1 HAUL ROAD
EXISTING HAUL ROAD
ROCK QUARRY NO.2
ORE CRUSHING AND LOADING
RAIL PHASE STOCKPILE AND INFRASTRUCTURE
TREATED EFFLUENT POND

0 200 400 600 800 1000
SCALE IN METRES

MILNE PORT
MINE SITE

KEYPLAN

LEGEND:

- WATER
- PROPOSED QUARRY
- LAYDOWN AREA (CONSTRUCTION PHASE)
- ADVANCED EXPLORATION UNDER EXISTING TYPE 'B' WATER LICENSE
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- CONSTRUCTION PHASE UNDER FUTURE TYPE 'A' WATER LICENSE (JULY TO DECEMBER 2013)
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- EXISTING ROCK QUARRY (IOL COMMERCIAL LEASE)
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- PROJECT DEVELOPMENT AREA
- BAFFINLAND'S COMMERCIAL LEASE ON INUIT OWNED LAND
- ROAD

Baffinland Iron Mines Corporation

MARY RIVER PROJECT

MINE SITE

SITE LAYOUT

SCALE	DWG. NO.	REV.
1:15000 OR AS NOTED	H349000-4000-00-015-0002	A

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28/02/2013 4:57:57 PM
eis59970

DWG. NO. H349000-4000-00-015-0003

CAMP INFRASTRUCTURE
- ACCOMMODATION COMPLEX
- EMERGENCY RESPONSE
- MEDICAL CENTRE
- SEWAGE TREATMENT PLANT & OFF-SPEC POND
- POTABLE WATER

CONSTRUCTION LAYDOWN AREA

SHEARDOWN NW LAKE

PROPOSED OPEN PIT OUTLINE

DEPOSIT NO. 1
MINING LEASE 2484

EXISTING ROAD

NEW HAUL ROAD

ORE CRUSHING AND LOADING

SITE SERVICE FACILITIES, INCLUDING:
POWER PLANT
MINE TANK FARM & DYKE
MAINTENANCE BUILDING
WAREHOUSE
TRUCK WASH FACILITY

EXISTING EXPLOSIVES MAGAZINES

UTILITY BERM

RAIL PHASE STOCKPILE AND INFRASTRUCTURE

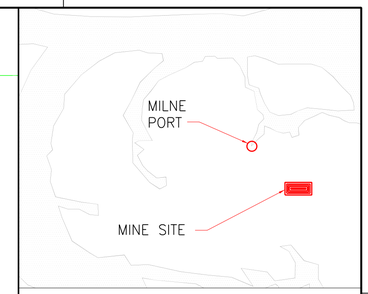
EXISTING LAND FILL ROAD

EXISTING LANDFILL

EXPLOSIVES PADS
EXPLOSIVES MAGAZINE
EMULSION PLANT

TREATED EFFLUENT POND

0 50 100 150 200 250
SCALE IN METRES



KEYPLAN

NOTES:

1. TOPOGRAPHY PROVIDED BY TERRAPOINT CANADA INC.
2. COORDINATE GRID IS SHOWN IN UTM (NAD83) ZONE 17 AND IS IN METRES.
3. CONTOURS ARE IN METRES. CONTOUR INTERVAL IS 1.5 METRES.
4. AS-CONSTRUCTED INFORMATION PROVIDED BY GENIVAR IN 2008.
5. FOR RAIL PHASE OVERALL GA SEE DWG. H340960-4000-00-014-0001

LEGEND:

- WATER
- PROPOSED QUARRY
- LAYDOWN AREA (CONSTRUCTION PHASE)
- ADVANCED EXPLORATION UNDER EXISTING TYPE 'B' WATER LICENSE
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Baffinland Iron Mines Corporation

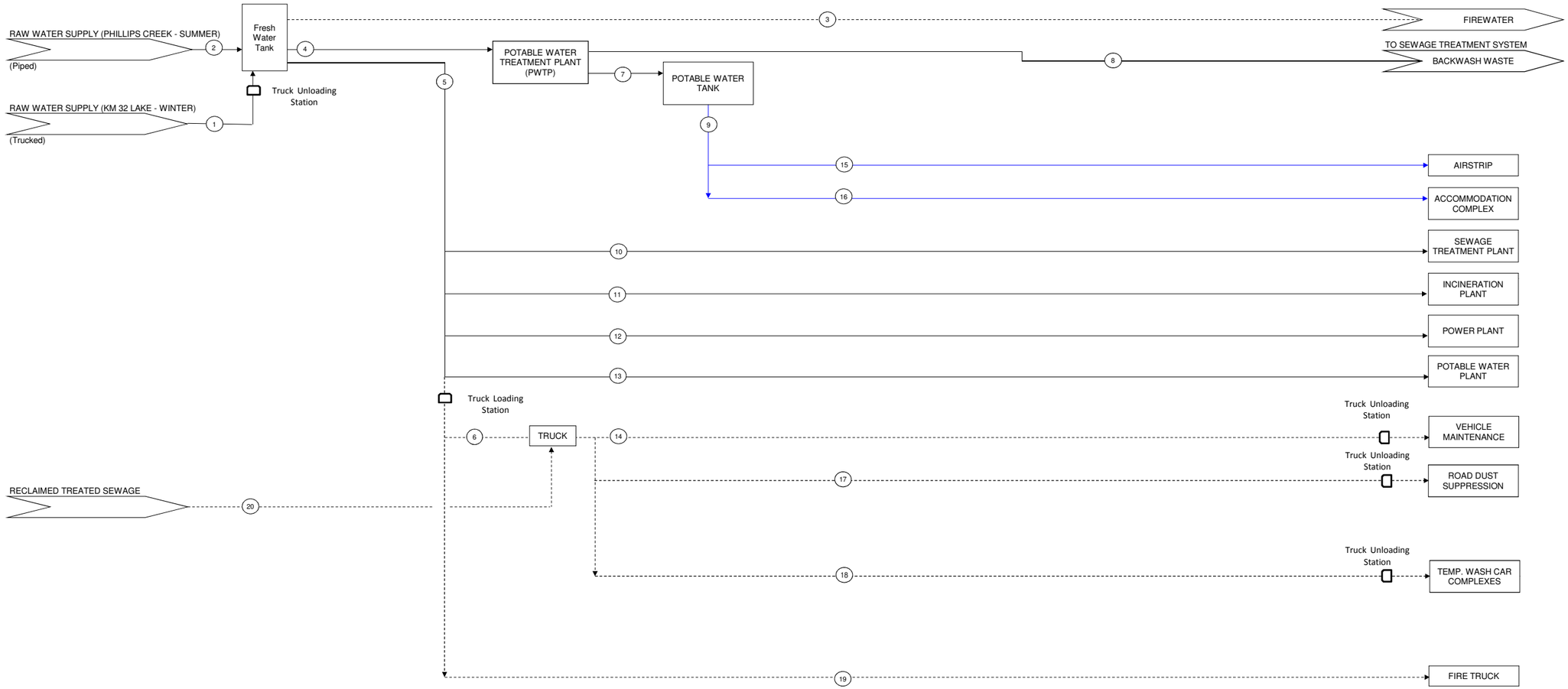
MARY RIVER PROJECT

MINE SITE

ENHANCED LAYOUT

SCALE	DWG. NO.	REV.
1:5000 OR AS NOTED	H349000-4000-00-015-0003	A

Appendix C
Figures



NOTES:

1) The peak flows for the accommodation facilities were determined using a peaking factor.
2) The division of trucked and piped facilities is based upon the proximity of the various facilities as indicated on layouts prepared by Hatch.
3) Bottled water distribution by pickup truck is not shown but will be in use to provide potable water to some remote facilities.

LEGEND:

———— CONTINUOUS FLOW.

---------- INTERMITTENT FLOW.

Stream No.	1	2	3	4	5	6	7	8	9	10
Stream Description	WINTER RAW WATER SUPPLY	SUMMER RAW WATER SUPPLY	FIREWATER	FEED TO POTABLE TREATMENT SYSTEM	PIPED FRESH WATER	TRUCKED FRESH WATER	POTABLE SYSTEM PRODUCT FLOW	POTABLE SYSTEM WASTE FLOW	PIPED POTABLE WATER	WASH WATER TO STP
Construction Phase - Design (m^3/h)	5.1	5.1	300	4.2	46.9	42.9	4.2	0.0002	16.7600	1.0000
Construction Phase - Nominal (m^3/h)	4.1	4.1	.	3.4	0.2	0.5	3.4	0.0002	3.3600	0.0598
Operation Phase - Design (m^3/h)	3.9	3.9	300	3.3	4.0	42.9	3.3	0.00016	8.34500	1.00000
Operation Phase - Nominal (m^3/h)	3.1	3.1	.	2.6	0.2	0.2	2.6	0.00013	2.62500	0.05983

Stream No.	11	12	13	14	15	16	17	18	19	20
Stream Description	WASH WATER TO INCIN. PLANT	WASH WATER TO POWER PLANT	WASH WATER TO PWTP	WASH WATER FOR VEHICLE MAINT. SHOP	POTABLE WATER TO AIRSTRIP	POTABLE WATER TO ACC. COMPLEX	FRESH WATER FOR DUST SUPPRESS	FRESH FOR TEMP. WASH CAR COMPLEXES	FIRETRUCK	RECLAIMED WATER
Construction Phase - Design (m^3/h)	1.0	1.0	1.0	42.86	0.5	16.28	42.9	42.9	42.9	42.9
Construction Phase - Nominal (m^3/h)	0.0	0.14	0.0	0.25	0.0	3.35	0.2	0.0	0.0	0.5
Operation Phase - Design (m^3/h)	1.0	1.0	1.0	0.00	0.48000	7.87	42.9	42.9	42.9	42.9
Operation Phase - Nominal (m^3/h)	0.0	0.14	0.0	0.00	0.01250	2.61	0.2	0.0	0.0	0.2

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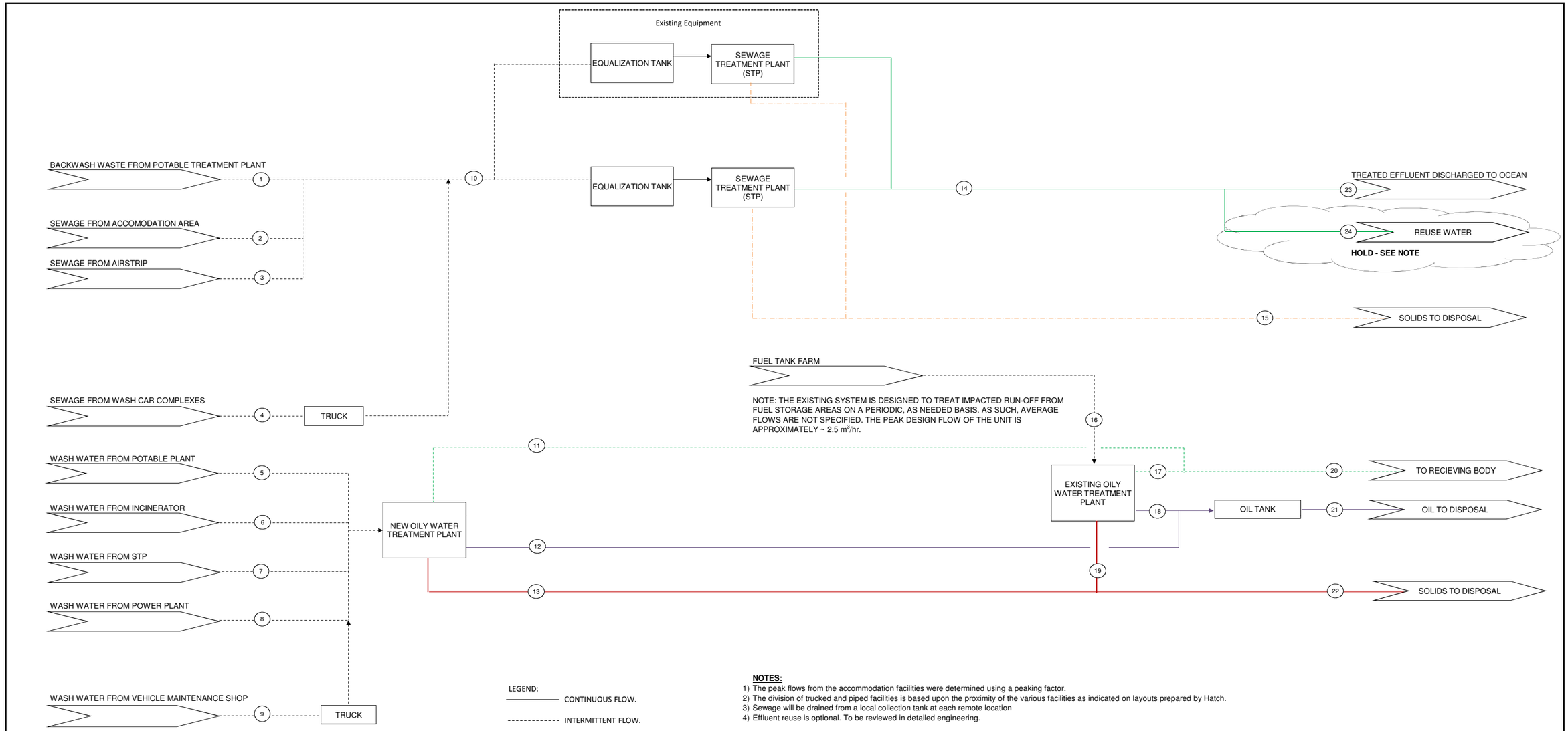
DESIGNED BY R. KAPADIA Date: 12/03/2013	DRAWN BY R. KAPADIA Date: 12/03/2013
CHECKED BY Date: 12/03/2013	DISCIP ENGR. R. KAPADIA Date: 12/03/2013
PROJ. DES. COORD.	PROJ. ENGR. Date: 12/03/2013
PROJECT MANAGER Date: 12/03/2013	

MILNE INLET - MARY RIVER PROJECT
BLOCK FLOW DIAGRAM
WATER SUPPLY BALANCE

Drawing No. H337697-7000-10-002-0001
SHEET 1 OF 2

Rev. E



NOTES:

1) The peak flows from the accommodation facilities were determined using a peaking factor.
2) The division of trucked and piped facilities is based upon the proximity of the various facilities as indicated on layouts prepared by Hatch.
3) Sewage will be drained from a local collection tank at each remote location
4) Effluent reuse is optional. To be reviewed in detailed engineering.

Stream No.	1	2	3	4	5	6	7	8	9	10	11	12
Stream Description	BACKWASH WASTE FROM PWTP	SEWAGE FROM ACC. COMPLEX	SEWAGE FROM AIRSTRIP	SEWAGE FROM WASH CAR COMPLEXES	WASH WATER FROM PWTP	WASH WATER FROM INCIN. PLANT	WASH WATER FROM STP	WASH WATER FROM POWER PLANT	WASH WATER FROM VEHICLE MAINT.	FEED TO STP	NEW WWTP EFFLUENT	NEW WWTP OIL WASTE
Construction Phase - Design (m^3/h)	0.0002	18.7	0.5	42.9	1.0	1.0	1.0	1.0	42.9	19.1	0.5	0.0
Construction Phase - Nominal (m^3/h)	0.0002	3.3	0.01	0.04	0.01	0.04	0.1	0.1	0.2	3.4	0.4	0.0
Operation Phase - Design (m^3/h)	0.00016	9.0	0.5	42.9	1.0	1.0	1.0	1.0	-	9.5	0.3	0.0
Operation Phase - Nominal (m^3/h)	0.00013	2.6	0.01	0.04	0.01	0.04	0.1	0.1	-	2.6	0.2	0.0

Stream No.	13	14	15	16	17	18	19	20	21	22	23	24
Stream Description	NEW WWTP SOLIDS WASTE	STP EFFLUENT	STP SOLIDS TO DISPOSAL	WWTP FEED	WWTP EFFLUENT	WWTP OIL WASTE	WWTP SOLIDS	COMBINED WWTP EFFLUENT	COMBINED WWTP OIL	COMBINED WWTP SOLIDS	STP EFFLUENT TO OCEAN	RECLAIMED WATER
Construction Phase - Design (m^3/h)	0.108	4.17	0.03	202.00	1.4	0.0	0.306	1.9	0.00	0.414	4.167	42.857
Construction Phase - Nominal (m^3/h)	0.087	3.33	0.03	1.40	1.2	0.0	0.245	1.6	0.00	0.332	2.877	0.457
Operation Phase - Design (m^3/h)	0.0538	3.26	0.026	202.000	1.4	0.0	0.306	1.7	0.003	0.360	3.256	42.857
Operation Phase - Nominal (m^3/h)	0.0431	2.60	0.021	1.400	1.2	0.0	0.245	1.4	0.003	0.288	2.396	0.208

HATCH™ Baffinland Iron Mines Corporation

DESIGNED BY R. KAPADIA Date: 12/03/2013	DRAWN BY R. KAPADIA Date: 12/03/2013
CHECKED BY Date: 12/03/2013	DISCIP ENGR. R. KAPADIA Date: 12/03/2013
PROJ. DES. COORD.	PROJ. ENGR. Date: 12/03/2013
PROJECT MANAGER Date: 12/03/2013	Drawing No. H337697-7000-10-002-0001 SHEET 2 OF 2

MILNE INLET - MARY RIVER PROJECT
BLOCK FLOW DIAGRAM
WASTE WATER BALANCE

Rev. E

Stream No.	1	2	3	4	5	6	7	8	9	10
Stream Description	RAW WATER FEED	PIPED FRESH WATER	FIRE-WATER	FEED TO POTABLE SYSTEM	FEED TO TEMP. PWTP	FEED TO EXISTING PWTP	WASH WATER TO STP	WASH WATER TO INCIN. PLANT	WASH WATER TO SERVICES BLDG.	WASH WATER TO POWER PLANT
Construction Phase - Design (m^3/h)	10.3	61.2	300.0	2.6	4.9	1.88	1.00	1.0	0.0	1.0
Construction Phase - Nominal (m^3/h)	8.2	8.2	0.0	2.1	3.9	1.50	0.06	0.0	0.0	0.1
Operation Phase - Design (m^3/h)	4.7	62.8	300.0	2.1	0.0	1.88	1.00	1.0	11.0	1.0
Operation Phase - Nominal (m^3/h)	3.7	3.7	0.0	1.7	0.0	1.50	0.06	0.0	0.3	0.1
Stream No.	11	12	13	14	15	16	17	18	19	20
Stream Description	WASH WATER TO BOILER PLANT	WASH WATER TO PWTP	FRESH TO TEMP. STP	FRESH TO TEMP. INCIN. PLANT	FRESH TO TEMP. POWER PLANT	FRESH TO TEMP. PWTP	FRESH WATER FOR FIRE TRUCK	WATER FOR FRESH WATER TRUCK	WATER FOR MINE WATER TRUCK	RECLAIMED WATER
Construction Phase - Design (m^3/h)	1.0	1.0	1.0	1.00	1.0	1.0	42.9	42.9	42.9	42.9
Construction Phase - Nominal (m^3/h)	0.0	0.01	0.06	0.04	0.1	0.0	0.00	10.5	0.0	10.3
Operation Phase - Design (m^3/h)	1.0	1.0	0.0	0.00	0.0	0.0	42.9	42.9	42.9	42.9
Operation Phase - Nominal (m^3/h)	0.0	0.01	0.00	0.00	0.0	0.00	0.00	1.52	0.00	1.52

NOTES:

1) The peak flows for the accommodation facilities were determined using a peaking factor.
2) The division of trucked and piped facilities is based upon the proximity of the various facilities as indicated on layouts prepared by Hatch.
3) Bottled water distribution by pickup truck is not shown but will be in use to provide potable water to some remote facilities.

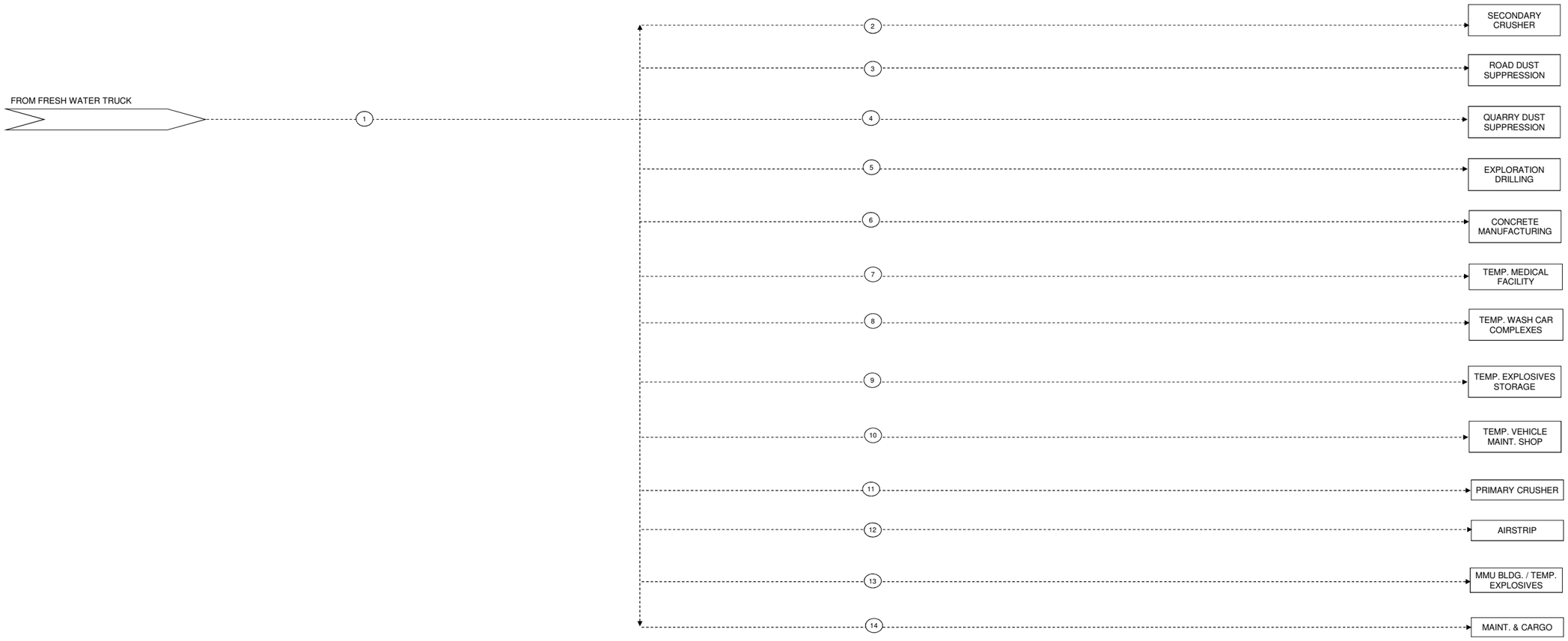
HATCH™ Baffinland Iron Mines Corporation

DESIGNED BY R. KAPADIA Date: 12/03/2013	DRAWN BY R. KAPADIA Date: 12/03/2013
CHECKED BY Date: 12/03/2013	DISCIP ENGR. R. KAPADIA Date: 12/03/2013
PROJ. DES. COORD.	PROJ. ENGR. Date: 12/03/2013
PROJECT MANAGER Date: 12/03/2013	

MINE SITE - MARY RIVER PROJECT
BLOCK FLOW DIAGRAM
WATER SUPPLY BALANCE

Drawing No. H337697-4210-10-002-0001
SHEET 1 OF 5

Rev. H



LEGEND:

---------- CONTINUOUS FLOW.

_____ INTERMITTENT FLOW.

NOTES:

1) The peak flows for the accommodation facilities were determined using a peaking factor.
2) The division of trucked and piped facilities is based upon the proximity of the various facilities as indicated on layouts prepared by Hatch.
3) Dust suppression will occur in summer period only.

Stream No.	1	2	3	4	5	6	7
Stream Description	TRUCKED FRESH WATER	FRESH TO SECONDARY CRUSHER	FRESH FOR ROAD DUST SUPPRESS	FRESH FOR QUARRY DUST SUPPRESS	FRESH FOR EXPLORATION DRILLING	FRESH FOR CONCRETE MFG.	FRESH FOR TEMP. MEDICAL FACILITY
Construction Phase - Design (m^3/h)	42.9	42.9	42.9	42.9	42.9	42.9	42.9
Construction Phase - Nominal (m^3/h)	10.5	0.0	0.4	-	8.2	0.8	0.1
Operation Phase - Design (m^3/h)	42.9	42.9	42.9	42.9	-	-	-
Operation Phase - Nominal (m^3/h)	1.5	0.04	0.4	-	-	-	-
Stream No.	8	9	10	11	12	13	14
Stream Description	FRESH FOR TEMP. WASH CAR COMPLEXES	FRESH FOR TEMP. EXPLOSIVES	FRESH FOR TEMP. VEHICLE MAINT. SHOP	FRESH WATER FOR PRIMARY CRUSHER	FRESH WATER FOR AIRSTRIP	FRESH WATER FOR MMU BLDG.	FRESH WATER FOR MAINT. & CARGO BLDG.
Construction Phase - Design (m^3/h)	42.9	42.9	42.9	42.9	42.9	42.9	42.9
Construction Phase - Nominal (m^3/h)	0.2	0.5	0.3	0.05	0.16	0.00	0.01
Operation Phase - Design (m^3/h)	-	-	-	42.9	42.9	42.9	42.9
Operation Phase - Nominal (m^3/h)	-	-	-	0.05	0.16	0.84	0.01

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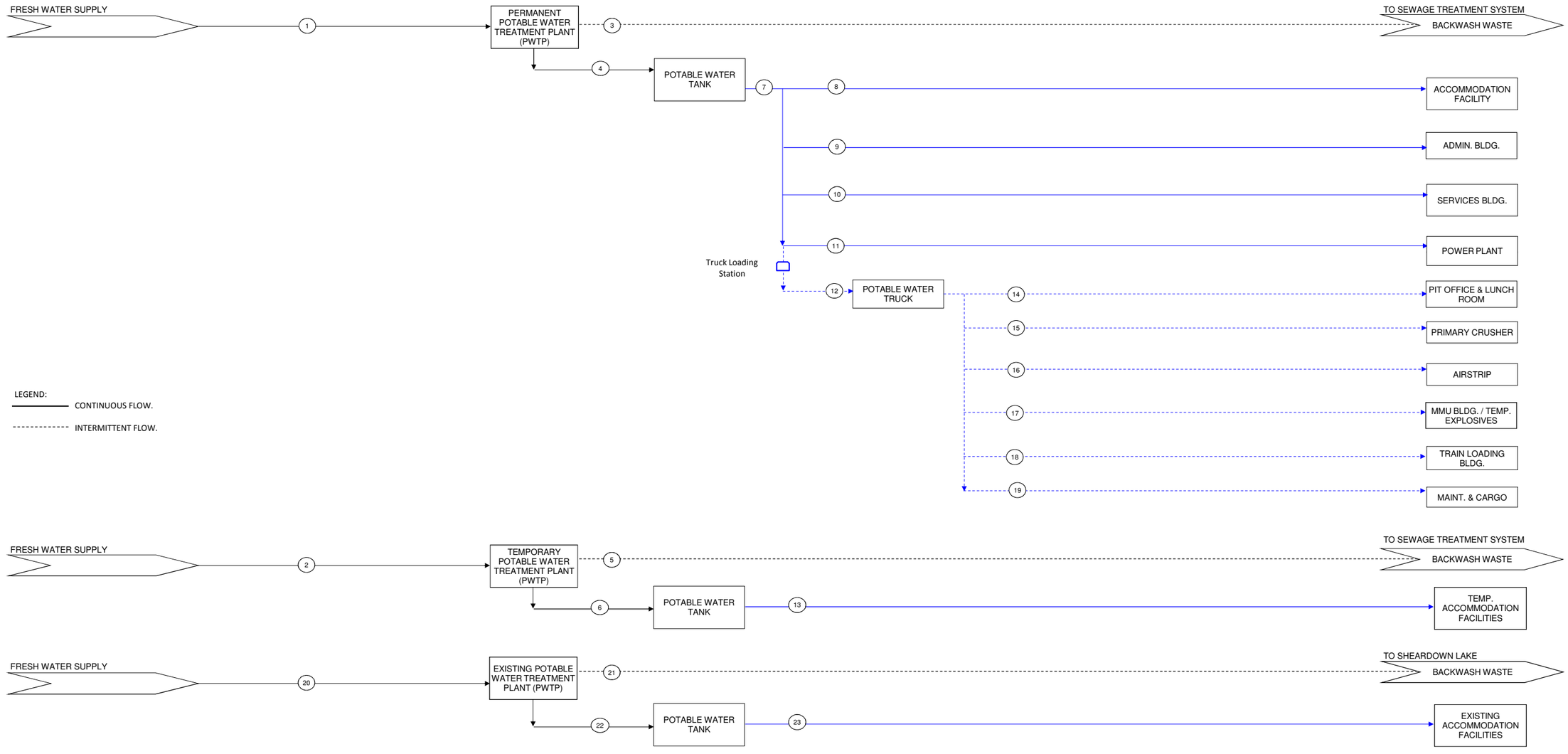
PROJ. DES. COORD.	PROJ. ENGR. Date: 12/03/2013
PROJECT MANAGER Date: 12/03/2013	

MINE SITE - MARY RIVER PROJECT
BLOCK FLOW DIAGRAM
WATER SUPPLY BALANCE

Drawing No.
H337697-4210-10-002-0001
SHEET 2 OF 5

Rev.
H



Stream No.	1	2	3	4	5	6	7	8	9	10	11
Stream Description	FEED TO POTABLE SYSTEM	FEED TO TEMP. PWTP	POTABLE SYSTEM WASTE FLOW	POTABLE SYSTEM PRODUCT FLOW	WASTE FROM TEMP. PWTP	PRODUCT FROM TEMP. PWTP	PIPED POTABLE WATER	POTABLE FOR ACC. COMPLEX	POTABLE FOR ADMIN. BLDG.	POTABLE FOR SERVICES BLDG.	POTABLE FOR POWER PLANT
Construction Phase - Design (m^3/h)	2.6	4.9	0.0	2.6	0.0	4.88	82.85	33.8	1.9	3.8	0.5
Construction Phase - Nominal (m^3/h)	2.1	3.9	0.0	2.1	0.0	3.90	2.10	0.5	0.3	0.6	0.0
Operation Phase - Design (m^3/h)	2.1	0.0	0.0	2.1	0.0	0.00	80.93	33.8	1.9	1.9	0.5
Operation Phase - Nominal (m^3/h)	1.7	-	0.0	1.7	0.0	0.00	1.68	1.0	0.3	0.3	0.0

Stream No.	12	13	14	15	16	17	18	19	20	21	22	23
Stream Description	TRUCKED POTABLE WATER	POTABLE WATER TO TEMP. ACC. COMPLEX	POTABLE FOR PIT OFFICE	POTABLE FOR PRIMARY CRUSHER	POTABLE FOR AIRSTRIP	POTABLE FOR MMU BLDG.	POTABLE FOR TRAIN LOADING BLDG.	POTABLE FOR MAINT. & CARGO	FEED TO EXIST. PWTP	WASTE FROM EXIST. PWTP	EXIST. PWTP PRODUCT	POTABLE TO EXIST. ACC.
Construction Phase - Design (m^3/h)	42.9	33.8	42.9	42.86	42.9	42.9	42.86	42.9	1.9	0.0	1.9	9.0
Construction Phase - Nominal (m^3/h)	0.7	3.90	0.18	0.02	0.3	0.1	0.02	0.0	1.5	0.0	1.5	1.5
Operation Phase - Design (m^3/h)	42.9	0.0	42.9	42.86	42.9	42.9	42.86	42.9	1.9	0.0	1.9	9.0
Operation Phase - Nominal (m^3/h)	0.1	0.00	0.02	0.01	0.0	0.01	0.01	0.00	1.50	0.00	1.50	1.50

NOTES:

1) The peak flows for the accommodation facilities were determined using a peaking factor.
2) The division of trucked and piped facilities is based upon the proximity of the various facilities as indicated on layouts prepared by Hatch.
3) Bottled water distribution by pickup truck is not shown but will be in use to provide potable water to some remote facilities.

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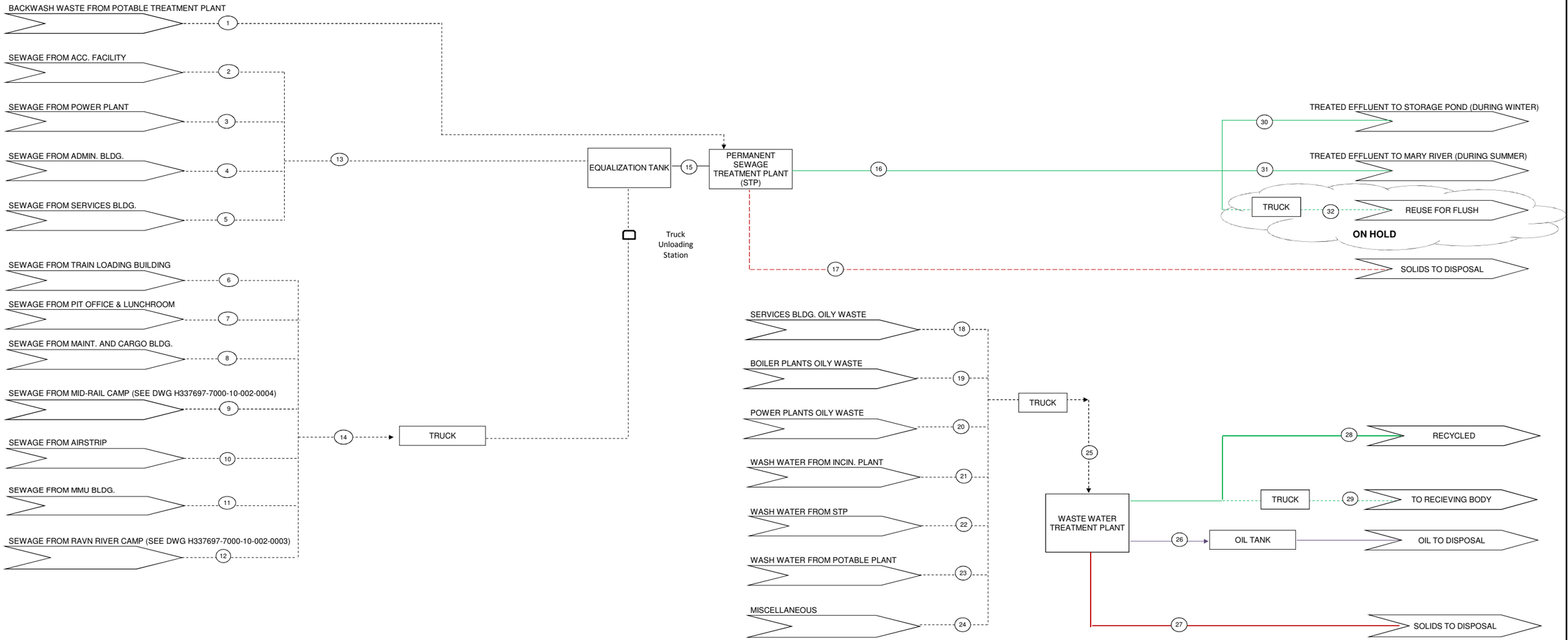
PROJ. DES. COORD.	PROJ. ENGR. Date: 12/03/2013
PROJECT MANAGER Date: 12/03/2013	Drawing No. H337697-4210-10-002-0001 SHEET 3 of 5

MINE SITE - MARY RIVER PROJECT
BLOCK FLOW DIAGRAM
WATER SUPPLY BALANCE

Rev. H



Stream No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Stream Description	BACKWASH WASTE FROM PWTP	SEWAGE FROM ACC. COMPLEX	SEWAGE FROM POWER PLANT	SEWAGE FROM ADMIN. BLDG.	SEWAGE FROM SERVICES BLDG.	SEWAGE FROM TRAIN LOADING BLDG.	SEWAGE FROM PIT OFFICE & LUNCHROOM	SEWAGE FROM MAINT. AND CARGO BLDG.	SEWAGE FROM MID-RAIL CAMP	SEWAGE FROM AIRSTRIP	SEWAGE FROM MMU BLDG.	SEWAGE FROM RAVN RIVER CAMP	PIPED SEWAGE	TRUCKED SEWAGE	FEED TO STP	TREATED EFFLUENT
Construction Phase - Design (m^3/h)	0.001	40.5	0.5	1.9	3.8	42.9	42.9	42.9	42.9	42.9	42.9	42.9	46.7	42.9	11.3	11.2
Construction Phase - Nominal (m^3/h)	0.000	1.4	0.0	0.3	0.6	0.0	0.2	0.01	3.0	0.3	0.12	3.0	2.4	6.6	9.0	8.9
Operation Phase - Design (m^3/h)	0.000	40.5	0.5	1.9	1.9	42.9	42.9	42.9	-	42.9	42.9	-	44.8	42.9	6.0	6.0
Operation Phase - Nominal (m^3/h)	0.000	4.1	0.0	0.3	0.3	0.01	0.02	-	-	0.01	0.01	-	4.75	0.05	4.80	4.76

Stream No.	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Stream Description	STP SOLIDS TO DISPOSAL	MAINT. SHOP - OILY WASTE	BOILER PLANT - OILY WASTE	POWER PLANT - OILY WASTE	WASH WATER FROM INCIN. PLANT	WASH WATER FROM STP	WASH WATER FROM PWTP	MISC. OILY WASTE	TOTAL FEED TO WWTP	OIL TO DISPOSAL	WWTP SOLIDS TO DISPOSAL	RECYCLED WASH WATER	WWTP EFFLUENT TO DISPOSAL	EFFLUENT TO STORAGE POND	STP EFFLUENT TO MARY RIVER	STP EFFLUENT FOR REUSE
Construction Phase - Design (m^3/h)	n/a	-	42.9	42.85714	42.9	42.9	42.9	42.9	42.9	0.0005	n/a	0.2382	0.060	11.2	11.2	42.9
Construction Phase - Nominal (m^3/h)	0.1	-	0.01	0.14768	0.04	0.1	0.01	0.03	0.29	0.0005	0.05	0.1906	0.048	1.68	0.84	6.41
Operation Phase - Design (m^3/h)	n/a	11.0	42.9	42.9	42.9	42.9	42.9	42.86	42.9	0.0009	n/a	0.491	0.123	6.0	6.0	42.9
Operation Phase - Nominal (m^3/h)	0.0	0.3	0.01	0.1	0.04	0.06	0.01	0.05	0.6	0.0009	0.10	0.393	0.098	2.2	1.1	1.5

NOTES:

1) The peak flows from the accommodation facilities were determined using a peaking factor.
2) The division of trucked and piped facilities is based upon the proximity of the various facilities as indicated on layouts prepared by Hatch.
3) Sewage will be drained from a local collection tank at each remote location
4) Effluent reuse is optional. To be reviewed in detailed engineering.
5) Miscellaneous refers to potential oily water flow from the bermed tank farm areas only if sampling indicates that additional treatment of this run-off is necessary.
6) The explosives plant will come complete with it's own evaporation system such that no liquid waste will be generated.

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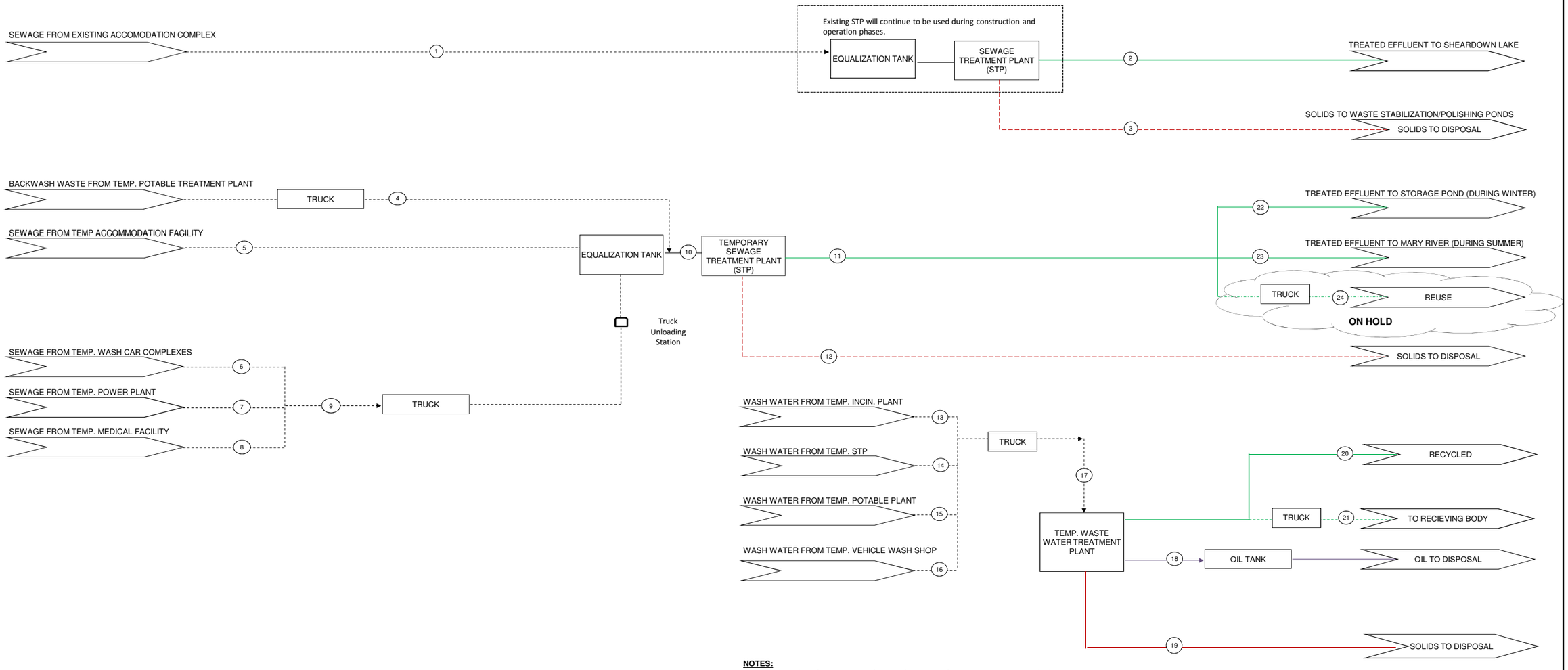
CHECKED BY Date: 12/03/2013	DISCIP ENGR. R. KAPADIA Date: 12/03/2013
PROJ. DES. COORD.	PROJ. ENGR. Date: 12/03/2013
PROJECT MANAGER Date: 12/03/2013	

MINE SITE - MARY RIVER PROJECT
BLOCK FLOW DIAGRAM
WASTE WATER BALANCE

Drawing No. H337697-4210-10-002-0001
SHEET 4 of 5

Rev. G



NOTES:

1) The peak flows from the accommodation facilities were determined using a peaking factor.
2) The division of trucked and piped facilities is based upon the proximity of the various facilities as indicated on layouts prepared by Hatch.
3) Sewage will be drained from a local collection tank at each remote location
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5) Miscellaneous refers to potential oily water flow from the bermed tank farm areas only if sampling indicates that additional treatment of this run-off is necessary.
6) The explosives plant will come complete with it's own evaporation system such that no liquid waste will be generated.

Stream No.	1	2	3	4	5	6	7	8	9	10	11	12
Stream Description	SEWAGE FROM EXIST. ACC.	EXIST. STP EFFLUENT	EXIST. STP SOLID WASTE	BACKWASH FROM TEMP. PWTP	SEWAGE FROM TEMP. ACC. COMPLEX	SEWAGE FROM WASH CAR COMPLEX 001	SEWAGE FROM TEMP. POWER PLANT	SEWAGE FROM TEMP. MEDICAL FACILITY	TRUCKED SEWAGE	FEED TO STP	TREATED EFFLUENT	SOLIDS TO DISPOSAL
Construction Phase - Design (m^3/h)	9.0	1.9	n/a	42.86	40.5	42.9	42.9	42.9	42.9	4.9	4.9	n/a
Construction Phase - Nominal (m^3/h)	1.50	1.5	0.01	0.001	3.90	0.16	0.02	0.02	0.05	3.95	3.92	0.03
Operation Phase - Design (m^3/h)	9.0	1.9	n/a	-	-	-	-	-	-	-	-	-
Operation Phase - Nominal (m^3/h)	1.50	1.5	0.01	-	-	-	-	-	-	-	-	-

Stream No.	13	14	15	16	17	18	19	20	21	22	23	24
Stream Description	WASH WATER FROM TEMP. INCIN. PLANT	WASH WATER FROM TEMP. STP	WASH WATER FROM TEMP. PWTP	WASH WATER FROM TEMP. VEHICLE WASH	FEED TO WWTP	WWTP OILY WASTE	WWTP SOLIDS WASTE	RECYCLED EFFLUENT	TO MARY RIVER OR STORAGE POND	EFFLUENT TO STORAGE POND	STP EFFLUENT TO MARY RIVER	STP EFFLUENT FOR REUSE
Construction Phase - Design (m^3/h)	42.9	42.9	42.9	42.9	42.9	0.001	0.064	0.4	0.00	4.9	4.9	42.9
Construction Phase - Nominal (m^3/h)	0.04	0.06	0.01	0.26	0.4	0.001	0.064	0.3	0.00	0.00	0.00	3.9
Operation Phase - Design (m^3/h)	-	-	-	-	-	-	-	-	-	-	-	-
Operation Phase - Nominal (m^3/h)	-	-	-	-	-	-	-	-	-	-	-	-

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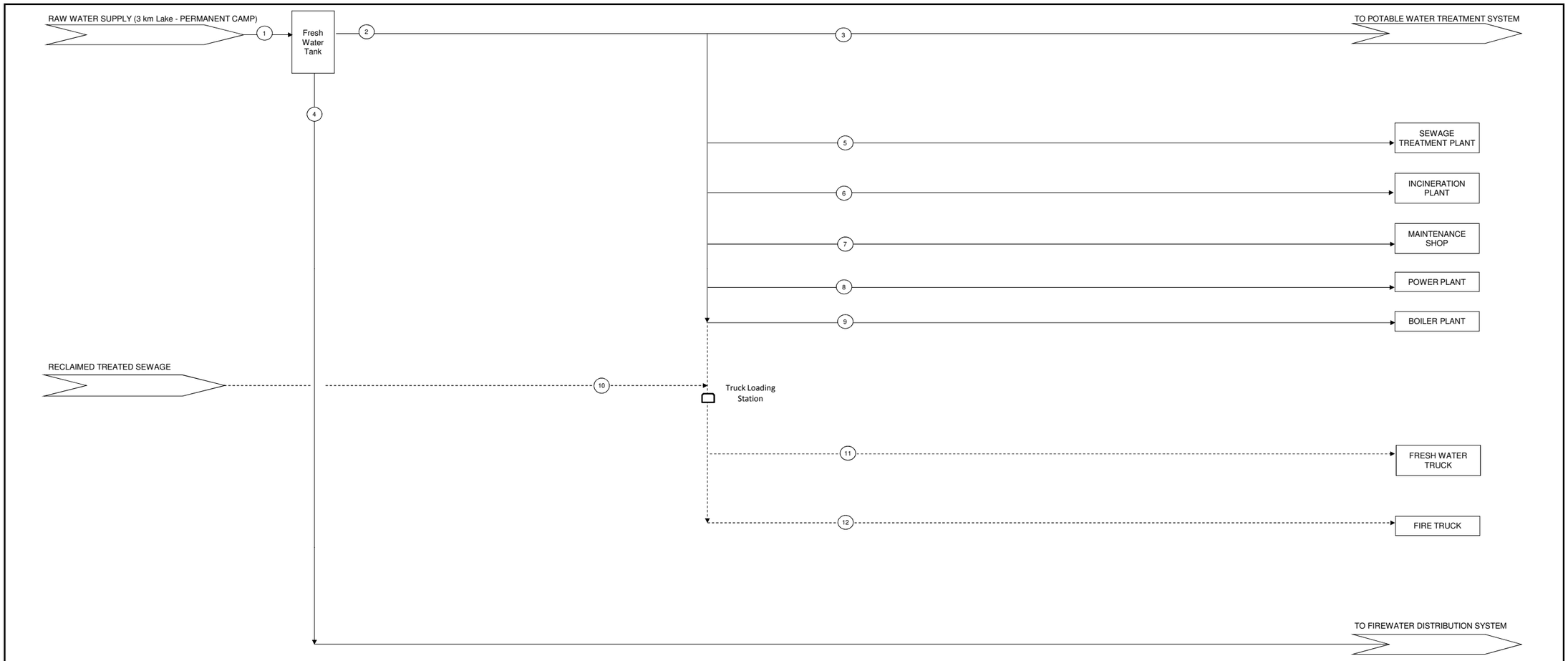
PROJ. DES. COORD.	PROJ. ENGR. Date: 12/03/2013
PROJECT MANAGER Date: 12/03/2013	Drawing No. H337697-4210-10-002-0001 SHEET 5 of 5

MINE SITE - MARY RIVER PROJECT
BLOCK FLOW DIAGRAM
WASTE WATER BALANCE

Rev. G



LEGEND:

CONTINUOUS FLOW.

INTERMITTENT FLOW.

NOTES:

1) The peak flows for the accommodation facilities were determined using a peaking factor.
2) The division of trucked and piped facilities is based upon the proximity of the various facilities as indicated on layouts prepared by Hatch.
3) Bottled water distribution by pickup truck is not shown but will be in use to provide potable water to some remote facilities.

Stream No.	1	2	3	4	5	6
Stream Description	RAW WATER SUPPLY	PIPED FRESH WATER	FEED TO PWTP	FIREWATER	WASH WATER TO STP	WASH WATER TO INCIN. PLANT
Construction Phase - Design (m^3/h)	6.5	10.6	6.6	300.0	1.0	1.0
Construction Phase - Nominal (m^3/h)	5.2	5.2	4.5	0.0	0.0	0.0
Operation Phase - Design (m^3/h)	7.1	21.6	6.6	300.0	1.0	1.0
Operation Phase - Nominal (m^3/h)	5.7	5.7	4.5	0.0	0.0	0.0
Stream No.	7	8	9	10	11	12
Stream Description	WASH WATER TO MAINTENACE SHOP	WASH WATER TO POWER PLANT	WASH WATER TO BOILER PLANT	RECLAIMED WATER	TRUCKED FRESH WATER	FIRE TRUCK WATER
Construction Phase - Design (m^3/h)	0.0	1.0	1.00	42.86	42.9	42.9
Construction Phase - Nominal (m^3/h)	0.0	0.1	0.01	2.54	3.0	0.00
Operation Phase - Design (m^3/h)	11.0	1.0	1.00	42.86	42.9	42.9
Operation Phase - Nominal (m^3/h)	0.7	0.1	0.01	0.00	0.3	0.00

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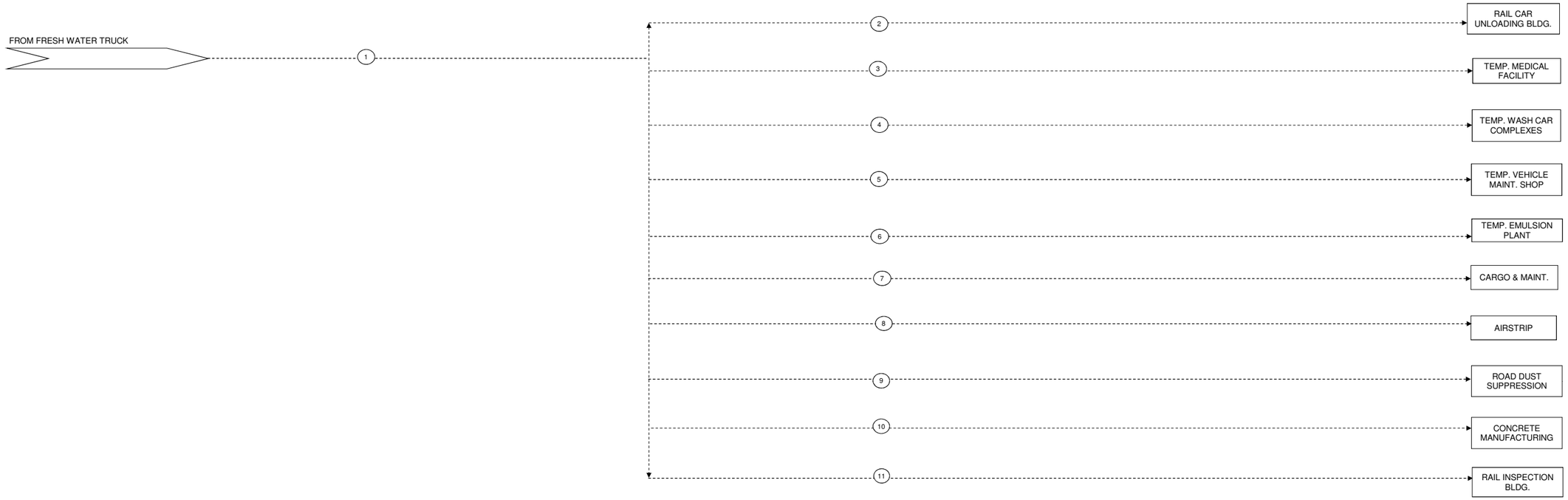
DESIGNED BY R. KAPADIA Date: 12/21/2011	DRAWN BY R. KAPADIA Date: 12/21/2011
CHECKED BY R. RADAKOVIC Date: 12/21/2011	DISCIP ENGR. R. KAPADIA Date: 12/21/2011
PROJ. DES. COORD.	PROJ. ENGR. J. CASSON Date: 12/21/2011
PROJECT MANAGER H. CHARALAMBU Date: 12/21/2011	Drawing No. H337697-4510-10-002-0001 SHEET 1 OF 5

STEENSBY - MARY RIVER PROJECT
BLOCK FLOW DIAGRAM
PERMANENT CAMP - WATER SUPPLY BALANCE

Rev. F



LEGEND:

CONTINUOUS FLOW.

INTERMITTENT FLOW.

NOTES:

1) The peak flows for the accommodation facilities were determined using a peaking factor.
2) The division of trucked and piped facilities is based upon the proximity of the various facilities as indicated on layouts prepared by Hatch.
3) Bottled water distribution by pickup truck is not shown but will be in use to provide potable water to some remote facilities.

Stream No.	1	2	3	4	5	6	7	8	9	10	11
Stream Description	FROM FRESH WATER TRUCK	FRESH WATER TO RAIL CAR UNLOAD BLDG.	FRESH TO TEMP. MEDICAL FACILITY	FRESH TO TEMP. WASH CAR	FRESH TO TEMP. VEHICLE SHOP	FRESH TO EMULSION PLANT	FRESH TO CARGO & MAINT. BLDG.	FRESH TO AIRSTRIP	FRESH FOR ROAD DUST SUPPRESS	FRESH FOR CONCRETE MFG.	FRESH FOR RAIL INSPECTION BLDG.
Construction Phase - Design (m^3/h)	42.9	42.9	42.9	42.9	42.9	42.9	42.9	42.9	42.9	42.9	42.9
Construction Phase - Nominal (m^3/h)	3.01	0.01	0.0	0.1	1.1	0.5	0.0	0.0	0.1	0.9	0.1
Operation Phase - Design (m^3/h)	42.9	42.9	-	-	-	-	42.9	42.9	42.9	42.9	42.9
Operation Phase - Nominal (m^3/h)	0.33	0.01	0.04	-	-	-	0.01	0.01	0.13	-	0.12

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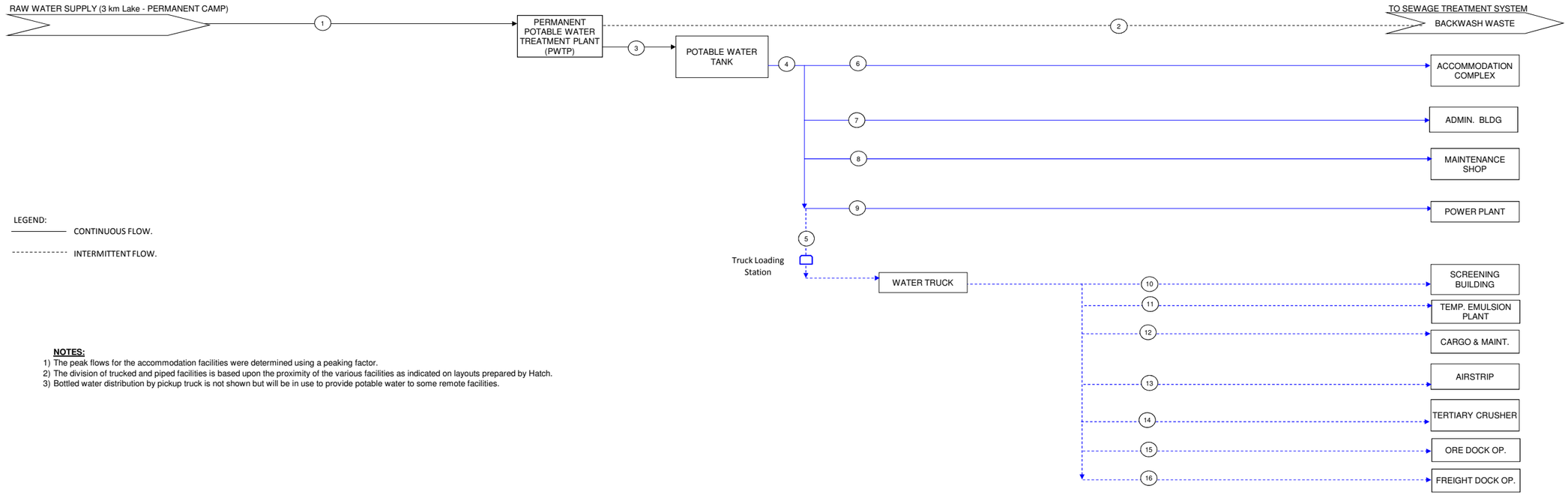
PROJ. DES. COORD.	PROJ. ENGR. J. CASSON Date: 12/21/2011
PROJECT MANAGER H. CHARALAMBU Date: 12/21/2011	

STEENSBY - MARY RIVER PROJECT
BLOCK FLOW DIAGRAM
TEMPORARY CAMP - WATER SUPPLY BALANCE

Drawing No. H337697-4510-10-002-0001
SHEET 2 OF 5

Rev. F



NOTES:

1) The peak flows for the accommodation facilities were determined using a peaking factor.
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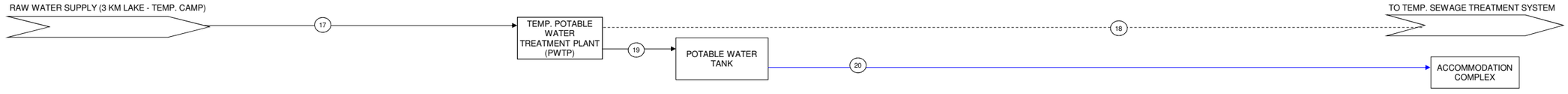


Stream No.	1	2	3	4	5	6	7	8	9	10
Stream Description	FEED TO PWTP	WASTE FROM PWTP	PRODUCT FROM PWTP	PIPED POTABLE WATER	TRUCKED POTABLE WATER	POTABLE TO ACC. COMPLEX	POTABLE TO ADMIN. BLDG.	POTABLE TO MAINTENANCE SHOP	POTABLE TO POWER PLANT	POTABLE TO SCREENING BLDG.
Construction Phase - Design (m^3/h)	6.6	0.003	5.6	72.8	42.9	22.3	3.8	3.8	-	42.9
Construction Phase - Nominal (m^3/h)	4.5	0.002	4.5	4.5	0.8	0.9	1.3	1.5	-	0.1
Operation Phase - Design (m^3/h)	6.6	0.003	5.6	61.5	42.9	14.9	1.4	1.9	0.5	42.9
Operation Phase - Nominal (m^3/h)	4.5	0.002	4.5	4.5	0.2	3.1	0.4	0.7	0.1	0.1
Stream No.	11	12	13	14	15	16	17	18	19	20
Stream Description	POTABLE TO EMULSION PLANT	POTABLE TO CARGO & MAINT. BLDG.	POTABLE TO AIRSTRIP	POTABLE TO TERTIARY CRUSHER	POTABLE TO ORE DOCK OP.	POTABLE TO FREIGHT DOCK OP.	FEED TO TEMP. PWTP	WASTE FROM TEMP. PWTP	PRODUCT FROM TEMP. PWTP	POTABLE TO TEMP. ACC. COMPLEX
Construction Phase - Design (m^3/h)	42.9	42.9	42.9	42.9	42.9	42.9	27.0	0.003	27.00	27.00
Construction Phase - Nominal (m^3/h)	0.3	0.03	0.05	0.05	0.2	0.2	4.5	0.002	4.50	4.50
Operation Phase - Design (m^3/h)	42.9	42.9	42.9	42.9	42.9	42.9	0.0	0.000	0.00	0.00
Operation Phase - Nominal (m^3/h)	0.03	-	0.001	0.05	0.04	0.0	0.0	0.000	0.00	0.00

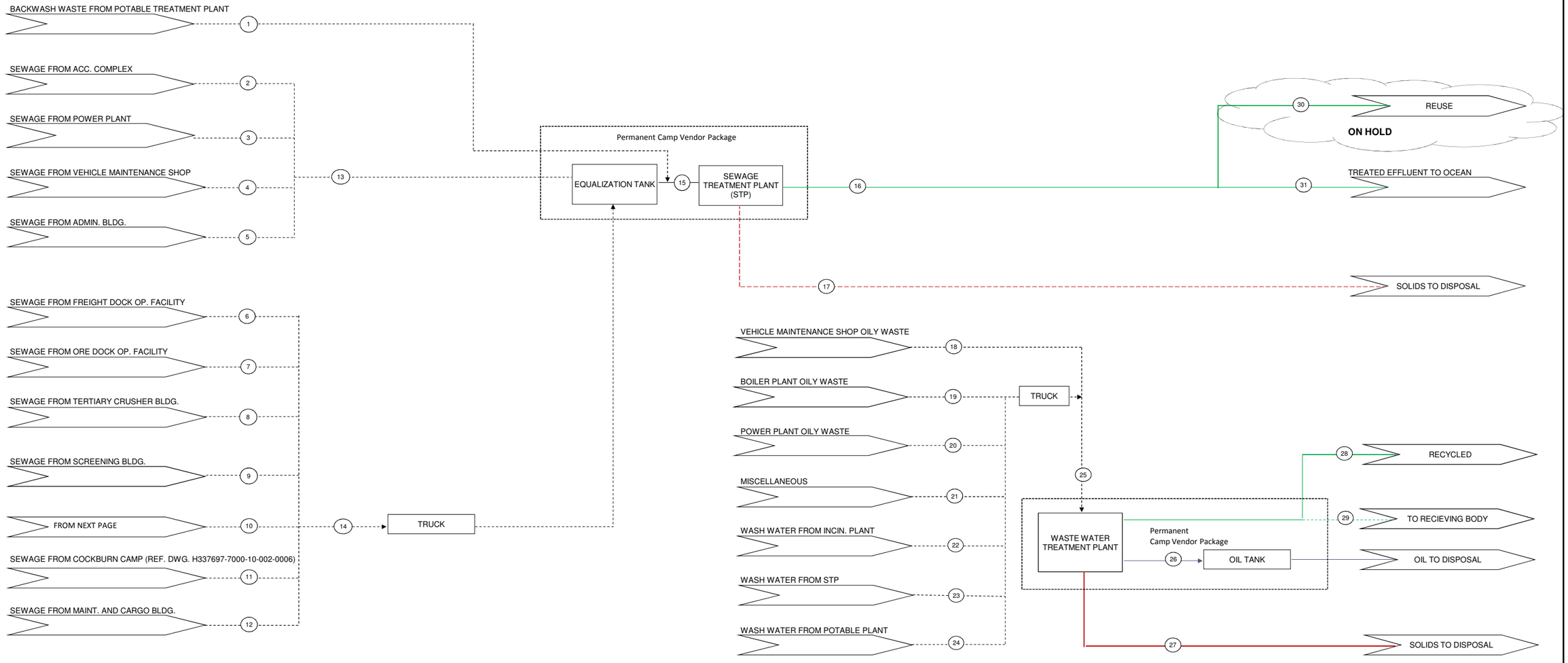
HATCH™ Baffinland Iron Mines Corporation

DESIGNED BY: R. KAPADIA Date: 12/21/2011	DRAWN BY: R. KAPADIA Date: 12/21/2011
CHECKED BY: R. RADAKOVIC Date: 12/21/2011	DISCIP ENGR.: R. KAPADIA Date: 12/21/2011
PROJ. DES. COORD.	PROJ. ENGR.: J. CASSON Date: 12/21/2011
PROJECT MANAGER: H. CHARALAMBU Date: 12/21/2011	

STEENSBY - MARY RIVER PROJECT
BLOCK FLOW DIAGRAM
PERMANENT CAMP - WATER SUPPLY BALANCE

Drawing No. H337697-4510-10-002-0001
SHEET 3 OF 5

Rev. F



NOTES:

1) The peak flows from the accommodation facilities were determined using a peaking factor.
2) The division of trucked and piped facilities is based upon the proximity of the various facilities as indicated on layouts prepared by Hatch.
3) Sewage will be drained from a local collection tank at each remote location
4) Effluent reuse is optional. To be reviewed in detailed engineering.
5) Miscellaneous refers to potential oily water flow from the bermed tank farm areas and fuel refilling station run-off only if sampling indicates that additional treatment of this run-off is necessary.
6) The explosives plant will come complete with it's own evaporation system such that no liquid waste will be generated.

Stream No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Stream Description	BACKWASH WASTE FROM PWTP	SEWAGE FROM ACC. COMPLEX	SEWAGE FROM POWER PLANT	SEWAGE FROM VEHICLE MAINTENACE SHOP	SEWAGE FROM ADMIN. BLDG.	SEWAGE FROM FREIGHT DOCK OP.	SEWAGE FROM ORE DOCK OP.	SEWAG E FROM TERTIARY CRUSHER BLDG.	SEWAGE FROM SCREENING BLDG.	FROM NEXT PAGE	SEWAGE FROM COCKBURN SOUTH	SEWAGE FROM MAINT. & CARGO BLDG.	PIPED SEWAGE	TRUCKED SEWAGE	FEED TO STP
Construction Phase - Design (m^3/h)	0.003	22.3	0.0	3.8	3.8	42.9	42.9	42.9	42.9	42.9	42.9	42.9	30.0	42.9	17.5
Construction Phase - Nominal (m^3/h)	0.002	2.5	0.0	1.5	1.3	0.19	0.19	0.05	0.05	0.67	7.50	0.03	5.33	8.67	14.00
Operation Phase - Design (m^3/h)	0.003	20.4	0.5	1.9	1.4	42.9	42.9	42.9	42.9	42.9	0.00	42.9	24.2	42.9	3.8
Operation Phase - Nominal (m^3/h)	0.002	1.6	0.1	0.7	0.4	0.04	0.04	0.05	0.05	0.00	0.00	0.00	2.82	0.18	3.00

Stream No.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Stream Description	STP EFFLUENT	SOLIDS TO DISPOSAL	VEHICHLE MAINT. SHOP OILY WASTE	BOILER PLANT OILY WASTE	POWER PLANT OILY WASTE	MISCELLANE OUS	WASH WATER FROM INCIN. PLANT	WASH WATER FROM STP.	WASH WATER FROM PWTP	TOTAL FEED TO WWTP	OILY WASTE	OILY SOLIDS TO DISPOSAL	RECYCLED WWTP EFFLUENT	WWTP EFFLUENT TO OCEAN	REUSE	STP EFFLUENT TO OCEAN
Construction Phase - Design (m^3/h)	17.4	0.1	-	42.9	42.9	42.9	42.9	42.9	42.86	42.86	0.0004	n/a	0.2	0.05	42.9	17.4
Construction Phase - Nominal (m^3/h)	13.9	0.1	-	0.01	0.1	0.01	0.04	0.04	0.01	0.25	0.0004	0.04	0.2	0.04	2.5	11.3
Operation Phase - Design (m^3/h)	3.7	0.03	11.0	42.9	42.9	42.9	42.9	42.9	42.86	42.86	0.0015	n/a	0.9	0.23	42.9	3.7
Operation Phase - Nominal (m^3/h)	3.0	0.02	0.65	0.01	0.1	0.1	0.04	0.0	0.01	0.96	0.0015	0.04	0.7	0.18	-	3.0

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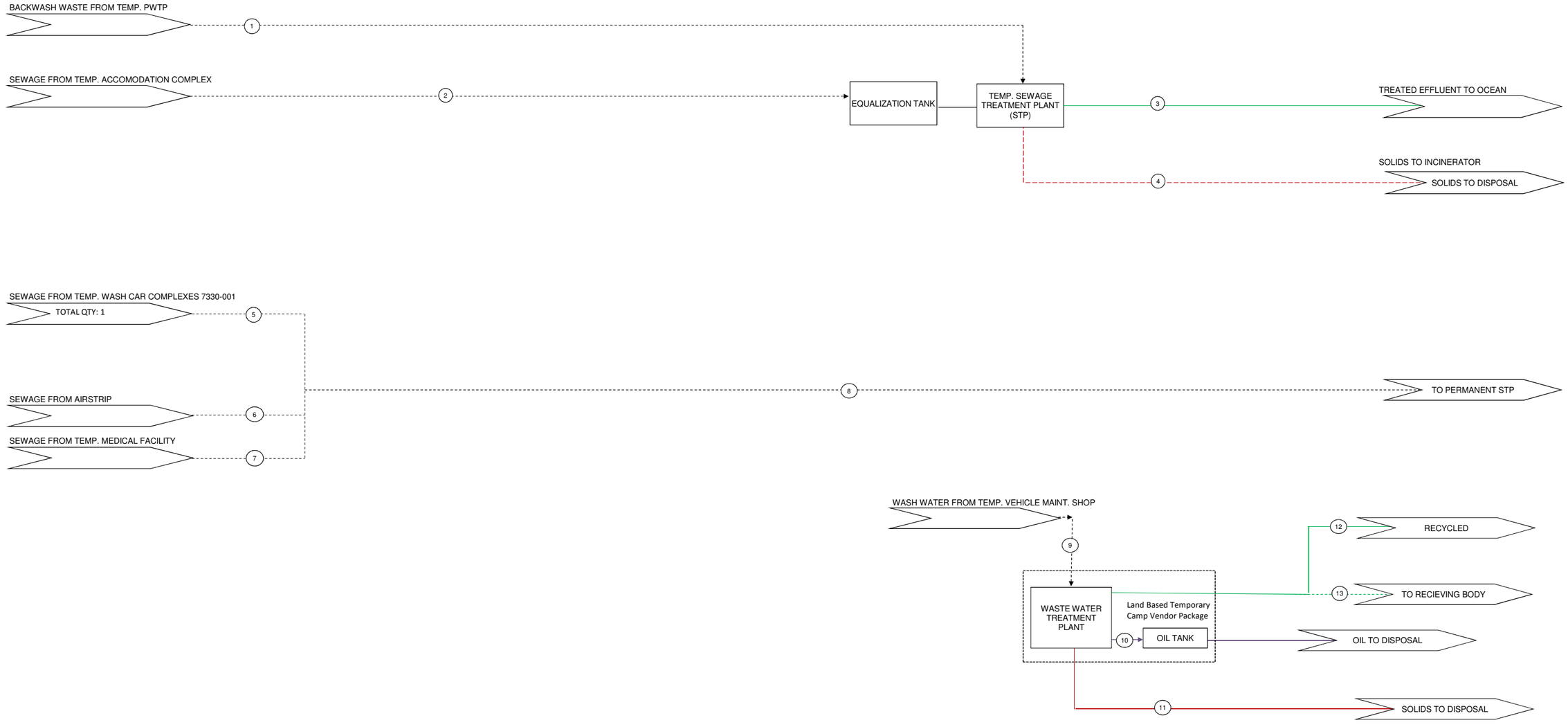
DESIGNED BY R. KAPADIA Date: 12/21/2011	DRAWN BY R. KAPADIA Date: 12/21/2011
CHECKED BY R. RADAKOVIC Date: 12/21/2011	DISCIP ENGR. R. KAPADIA Date: 12/21/2011
PROJ. DES. COORD.	PROJ. ENGR. J. CASSON Date: 12/21/2011
PROJECT MANAGER H. CHARALAMBU Date: 12/21/2011	

STEENSBY - MARY RIVER PROJECT
BLOCK FLOW DIAGRAM
PERMANENT CAMP - WASTE WATER BALANCE

Drawing No. H337697-4510-10-002-0001
SHEET 4 of 5

Rev. F



NOTES:

1) The peak flows from the accommodation facilities were determined using a peaking factor.
2) The division of trucked and piped facilities is based upon the proximity of the various facilities as indicated on layouts prepared by Hatch.
3) Sewage will be drained from a local collection tank at each remote location
4) Effluent reuse is optional. To be reviewed in detailed engineering.

Stream No.	1	2	3	4	5	6	7	8	9	10	11	12	13
Stream Description	WASTE FROM TEMP. PWTP	SEWAGE FROM TEMP. ACC. COMPLEX	TEMP. STP EFFLUENT	TEMP. STP SOLIDS	SEWAGE FROM TEMP. CAR WASH	SEWAGE FROM AIRSTRIP	SEWAGE FROM TEMP. MEDICAL FACILITY	TRUCKED SEWAGE TO STP	WATER FROM TEMP. VEHICLE SHOP	OIL WASTE	WWTP SOLIDS WASTE	RECYCLED EFFLUENT	WWTP EFFLUENT TO OCEAN
Construction Phase - Design (m^3/h)	0.003	27.0	27.0	0.04	42.9	42.9	42.9	42.86	42.86	0.00	n/a	1.18	-
Construction Phase - Nominal (m^3/h)	0.002	4.5	4.46	0.04	0.1	0.05	0.5	0.6740	1.1426	0.0018	0.2000	0.9408	-
Operation Phase - Design (m^3/h)	0.000	0.0	0.0	0.00	-	42.9	-	42.9	-	-	-	-	-
Operation Phase - Nominal (m^3/h)	0.000	0.0	0.0	0.00	-	0.001	-	0.001	-	-	-	-	-

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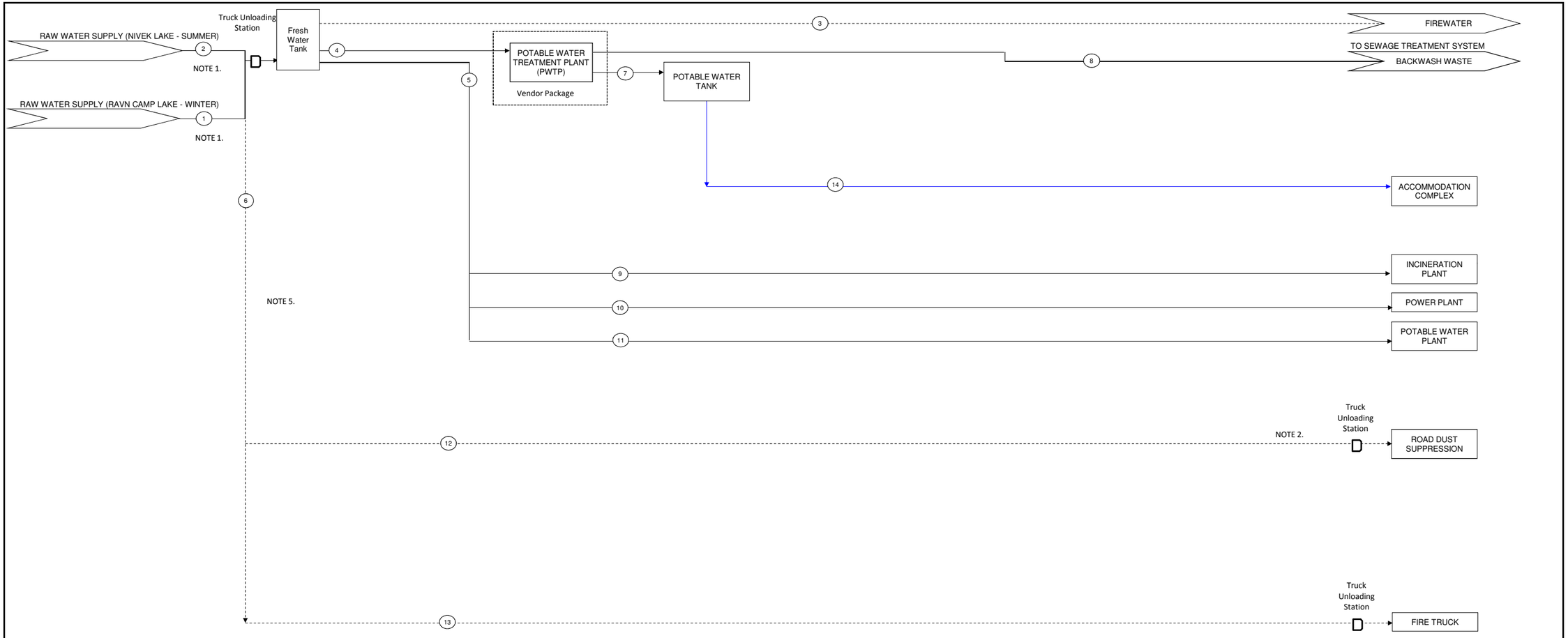
CHECKED BY R. RADAKOVIC Date: 12/21/2011	DISCIP ENGR. R. KAPADIA Date: 12/21/2011
PROJ. DES. COORD.	PROJ. ENGR. J.I. CASSON Date: 12/21/2011
PROJECT MANAGER H. CHARALAMBU Date: 12/21/2011	Drawing No. H337697-4510-10-002-0001 SHEET 5 of 5

STEENSBY - MARY RIVER PROJECT
BLOCK FLOW DIAGRAM
TEMPORARY CAMP - WASTE WATER BALANCE

Rev. F



NOTES:

1) The system will have a different raw water source for winter from summer. As such the flows for these two streams are indicative of the summer or winter period only.
2) The flows for these streams will occur in the summer time only.
3) The flow values on this water balance have been derived from previous consultants documentation produced during the earlier phase of the project. Where values were missing Hatch estimations are used.
4) The peak flows for the accommodation facilities were determined using a peaking factor.
5) The division of trucked and piped facilities is based upon the proximity of the various facilities as indicated on layouts prepared by Hatch.
6) Potable water will be supplied from the accommodation complex to the STP, Incineration Plant, Power Plant and PWTP using bottles.

LEGEND:

CONTINUOUS FLOW.

INTERMITTENT FLOW.

Stream No.	1	2	3	4	5	6	7
Stream Description	WINTER RAW WATER SUPPLY	SUMMER RAW WATER SUPPLY	FIREWATER	FEED TO POTABLE TREATMENT SYSTEM	PIPED FRESH WATER	TRUCKED FRESH WATER	POTABLE SYSTEM PRODUCT FLOW
Construction Phase - Design (m^3/h)	42.9	42.9	300.0	2.8	10.2	42.9	2.8
Construction Phase - Nominal (m^3/h)	3.3	3.3	-	2.8	0.4	0.1	2.8
Operation Phase - Design (m^3/h)	-	-	-	-	-	-	-
Operation Phase - Nominal (m^3/h)	-	-	-	-	-	-	-
Stream No.	8	9	10	11	12	13	14
Stream Description	POTABLE SYSTEM WASTE FLOW	WASH WATER TO INCIN. PLANT	WASH WATER TO POWER PLANT	WASH WATER TO PWTP	ROAD DUST SUPPRESS	FIRETRUCK WATER	POTABLE WATER TO ACC. COMPLEX
Construction Phase - Design (m^3/h)	0.002	3.4	3.4	3.4	42.9	42.9	21.3
Construction Phase - Nominal (m^3/h)	0.001	0.1	0.1	0.1	0.1	-	2.8
Operation Phase - Design (m^3/h)	-	-	-	-	-	-	-
Operation Phase - Nominal (m^3/h)	-	-	-	-	-	-	-

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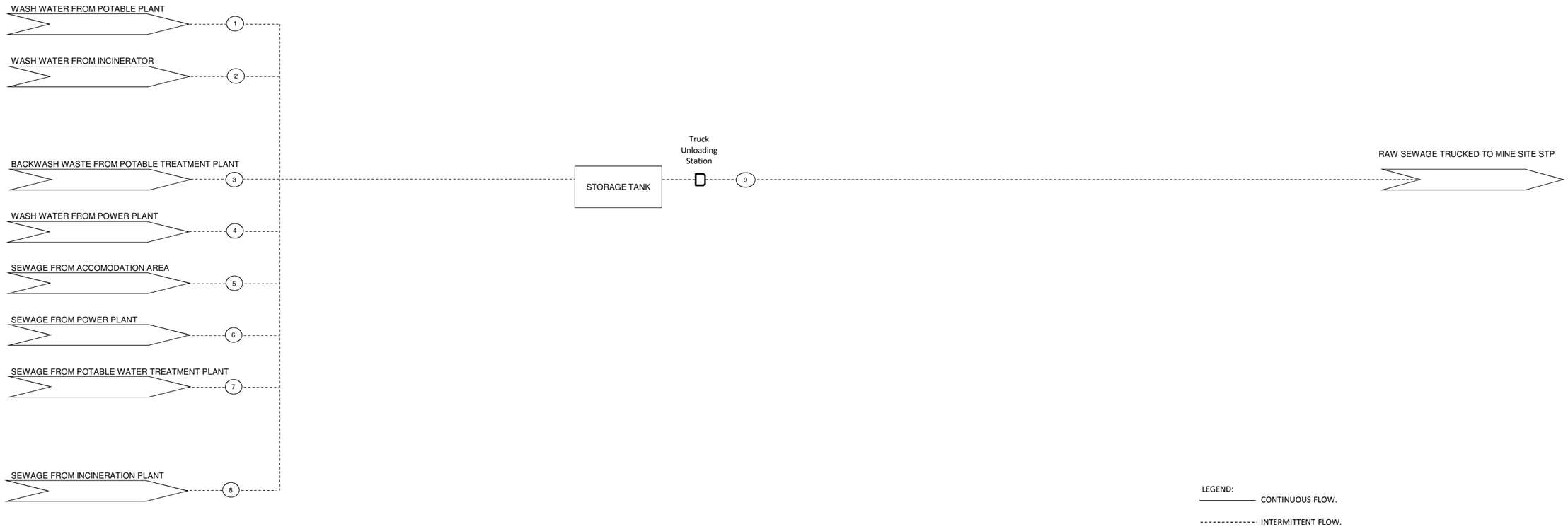
DESIGNED BY R. KAPADIA Date: 8/22/2011	DRAWN BY R. KAPADIA Date: 8/22/2011
CHECKED BY A. ZLATIC Date: 8/22/2011	DISCIP ENGR. A. ZLATIC Date: 8/22/2011
PROJ. DES. COORD.	PROJ. ENGR. J. CASSON Date: 8/22/2011
PROJECT MANAGER H. CHARALAMBU Date: 8/22/2011	

MID-RAIL CAMP - MARY RIVER PROJECT
BLOCK FLOW DIAGRAM
WATER SUPPLY BALANCE

Drawing No. H337697-7000-10-002-0004
SHEET 1 OF 2

Rev. E



Stream No.	1	2	3	4
Stream Description	WASH WATER FROM POTABLE PLANT	WASH WATER FROM INCIN.	PWTP BACKWASH WASTE STREAM	WASH WATER FROM POWER PLANT
Construction Phase - Design (m^3/h)	3.4	3.4	0.002	3.407
Construction Phase - Nominal (m^3/h)	0.1	0.1	0.001	0.142
Operation Phase - Design (m^3/h)	-	-	-	-
Operation Phase - Nominal (m^3/h)	-	-	-	-

Stream No.	5	6	7	8	9
Stream Description	SEWAGE FROM ACC. COMPLEX	SEWAGE FROM POWER PLANT	SEWAGE FROM PWTP	SEWAGE FROM INCIN. PLANT	RAW SEWAGE TO MINE SITE STP
Construction Phase - Design (m^3/h)	24.40	0.02	0.02	0.01	42.9
Construction Phase - Nominal (m^3/h)	2.39	0.02	0.02	0.01	2.9
Operation Phase - Design (m^3/h)	-	-	-	-	-
Operation Phase - Nominal (m^3/h)	-	-	-	-	-

NOTES:

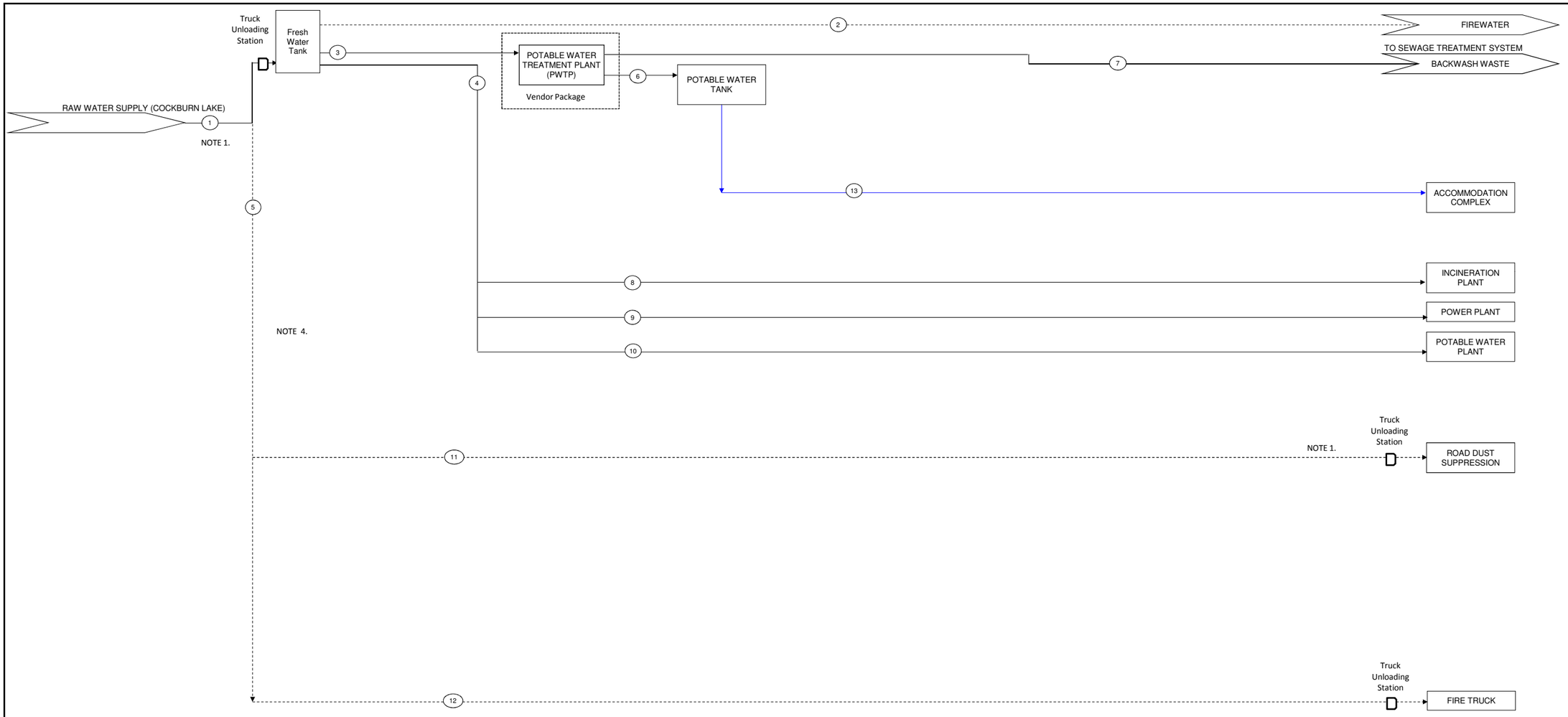
1) The flow values on this water balance have been derived from previous consultants documentation produced during the earlier phase of the project. Where values were missing Hatch estimations are used.
2) The peak flows for the accommodation facilities were determined using a peaking factor.
3) The division of trucked and piped facilities is based upon the proximity of the various facilities as indicated on layouts prepared by Hatch.
4) It has been assumed that relative sewage flows will be distributed through different facilities in the same proportions as the relative potable water flows.

HATCH™ Baffinland Iron Mines Corporation

DESIGNED BY R. KAPADIA Date: 8/22/2011	DRAWN BY R. KAPADIA Date: 8/22/2011
CHECKED BY A. ZLATIC Date: 8/22/2011	DISCIP ENGR. A. ZLATIC Date: 8/22/2011
PROJ. DES. COORD.	PROJ. ENGR. J. CASSON Date: 8/22/2011
PROJECT MANAGER H. CHARALAMBU Date: 8/22/2011	Drawing No. H337697-7000-10-002-0004 SHEET 2 OF 2

MID-RAIL CAMP - MARY RIVER PROJECT
BLOCK FLOW DIAGRAM
WASTE WATER BALANCE

Rev. E



NOTES:

1) The flows for these streams will occur in the summer time only.
2) The flow values on this water balance have been derived from previous consultants documentation produced during the earlier phase of the project. Where values were missing Hatch estimations are used.
3) The peak flows for the accommodation facilities were determined using a peaking factor.
4) The division of trucked and piped facilities is based upon the proximity of the various facilities as indicated on layouts prepared by Hatch.
5) Potable water will be supplied from the accommodation complex to the STP, Incineration Plant, Power Plant and PWTP using bottles.

Stream No.	1	2	3	4	5	6
Stream Description	RAW WATER SUPPLY	FIREWATER	FEED TO POTABLE TREATMENT SYSTEM	PIPED FRESH WATER	TRUCKED FRESH WATER	POTABLE SYSTEM PRODUCT FLOW
Construction Phase - Design (m^3/h)	42.9	300.0	4.1	10.2	42.9	4.1
Construction Phase - Nominal (m^3/h)	4.7	0.0	4.1	0.4	0.1	4.1
Operation Phase - Design (m^3/h)	-	-	-	-	-	-
Operation Phase - Nominal (m^3/h)	-	-	-	-	-	-

Stream No.	7	8	9	10	11	12	13
Stream Description	POTABLE SYSTEM WASTE FLOW	WASH WATER TO INCIN. PLANT	WASH WATER TO POWER PLANT	WASH WATER TO PWTP	FRESHWATER TRUCK	FIRETRUCK WATER	POTABLE WATER TO ACC. COMPLEX
Construction Phase - Design (m^3/h)	0.0	3.4	3.4	3.4	42.9	42.9	23.3
Construction Phase - Nominal (m^3/h)	0.0	0.1	0.1	0.1	0.1	0.0	4.1
Operation Phase - Design (m^3/h)	-	-	-	-	-	-	-
Operation Phase - Nominal (m^3/h)	-	-	-	-	-	-	-

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DESIGNED BY R. KAPADIA Date: 11/10/2011	DRAWN BY R. KAPADIA Date: 11/10/2011
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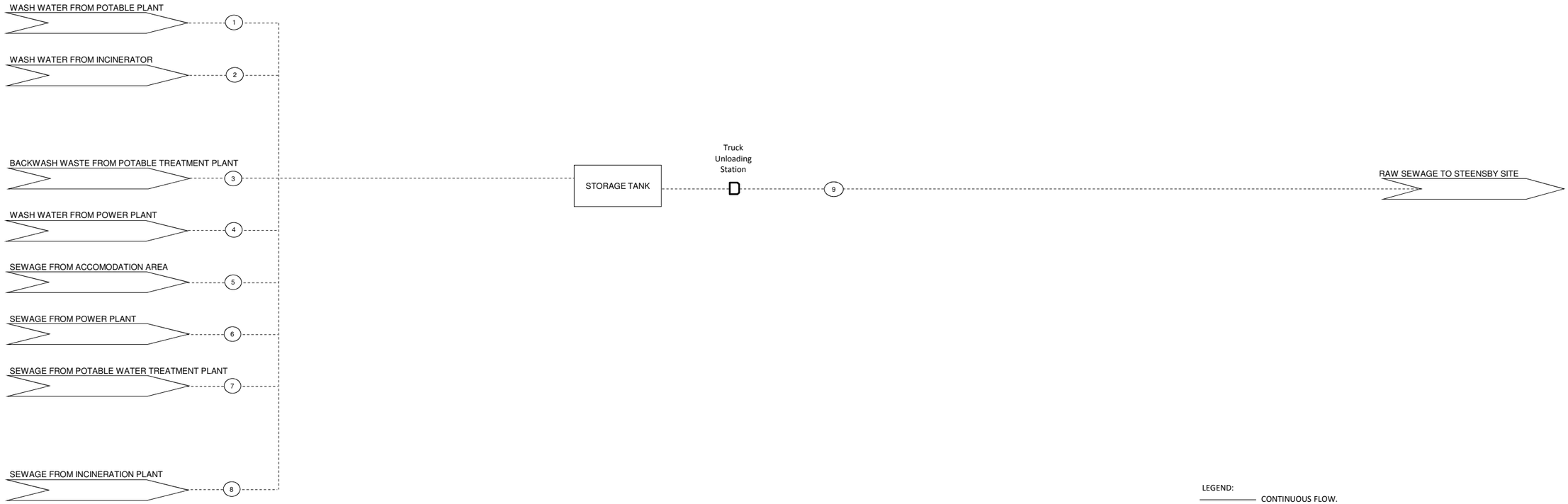
PROJ. DES. COORD.	PROJ. ENGR. J. CASSON Date: 11/10/2011
PROJECT MANAGER H. CHARALAMBU Date: 11/10/2011	

COCKBURN SOUTH CAMP - MARY RIVER PROJECT
BLOCK FLOW DIAGRAM
WATER SUPPLY BALANCE

Drawing No. H337697-7000-10-002-0006
SHEET 1 OF 2

Rev. E



Stream No.	1	2	3	4
Stream Description	WASH WATER FROM POTABLE PLANT	WASH WATER FROM INCIN.	PWTP BACKWASH WASTE STREAM	WASH WATER FROM POWER PLANT
Construction Phase - Design (m^3/h)	3.4	3.4	0.001	3.4
Construction Phase - Nominal (m^3/h)	0.1	0.1	0.001	0.1
Operation Phase - Design (m^3/h)	-	-	-	-
Operation Phase - Nominal (m^3/h)	-	-	-	-

Stream No.	5	6	7	8	9
Stream Description	SEWAGE FROM ACC. COMPLEX	SEWAGE FROM POWER PLANT	SEWAGE FROM PWTP	SEWAGE FROM INCIN. PLANT	RAW SEWAGE TO STEENSBY
Construction Phase - Design (m^3/h)	26.70	0.04	0.04	0.02	42.9
Construction Phase - Nominal (m^3/h)	3.78	0.04	0.04	0.02	4.3
Operation Phase - Design (m^3/h)	-	-	-	-	-
Operation Phase - Nominal (m^3/h)	-	-	-	-	-

NOTES:

1) The flow values on this water balance have been derived from previous consultants documentation produced during the earlier phase of the project. Where values were missing Hatch estimations are used.
2) The peak flows for the accommodation facilities were determined using a peaking factor.
3) The division of trucked and piped facilities is based upon the proximity of the various facilities as indicated on layouts prepared by Hatch.
4) It has been assumed that relative sewage flows will be distributed through different facilities in the same proportions as the relative potable water flows.
5) Effluent reuse is optional. To be reviewed in detailed engineering.

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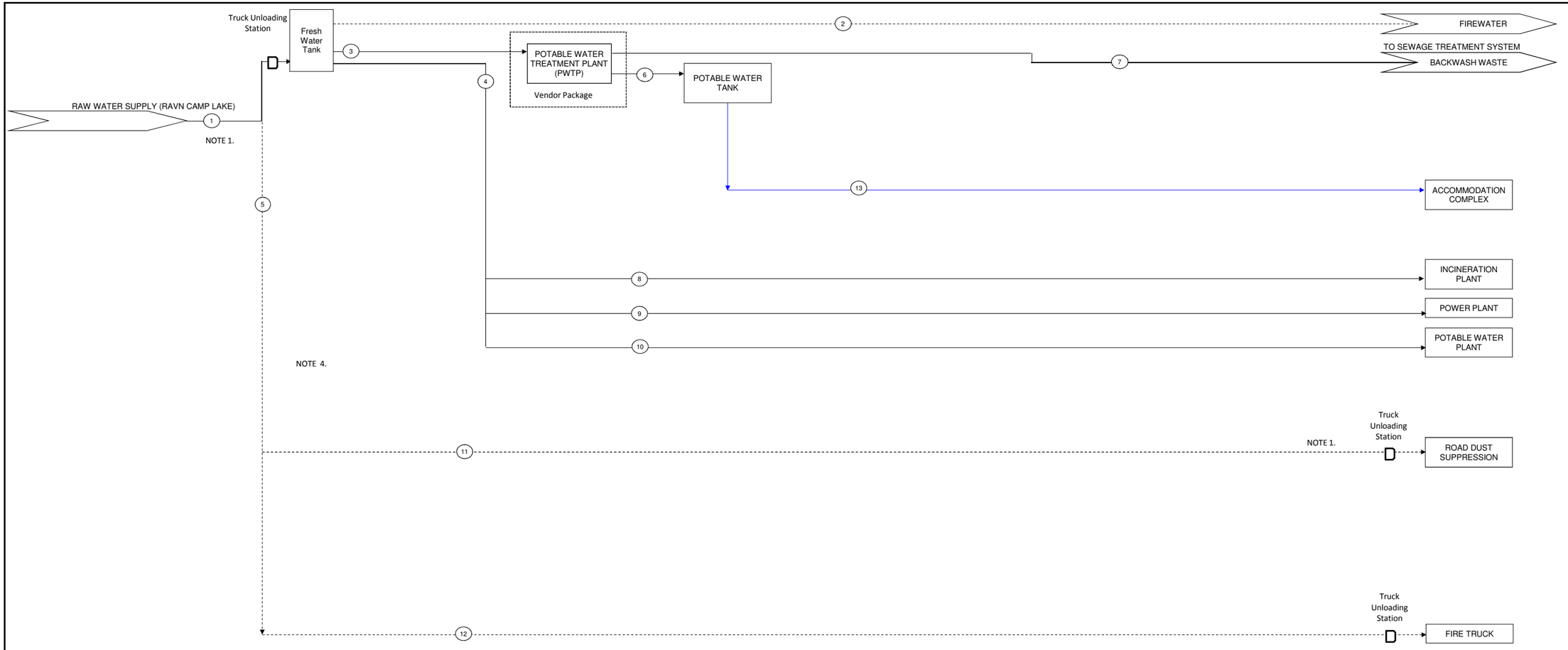
CHECKED BY R. RADAKOVIC Date: 11/10/2011	DISCIP ENGR. R. KAPADIA Date: 11/10/2011
PROJ. DES. COORD.	PROJ. ENGR. J. CASSON Date: 11/10/2011
PROJECT MANAGER H. CHARALAMBU Date: 11/10/2011	

COCKBURN SOUTH TUNNELS CAMP - MARY RIVER PROJECT
BLOCK FLOW DIAGRAM
WASTE WATER BALANCE

Drawing No. H337697-7000-10-002-0006
SHEET 2 OF 2

Rev. E



NOTES:

1) The flows for these streams will occur in the summer time only.
2) The flow values on this water balance have been derived from previous consultants documentation produced during the earlier phase of the project. Where values were missing Hatch estimations are used.
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5) Potable water will be supplied from the accommodation complex to the STP, Incineration Plant, Power Plant and PWTP using bottles.

LEGEND:

CONTINUOUS FLOW.

INTERMITTENT FLOW.

Stream No.	1	2	3	4	5	6
Stream Description	RAW WATER SUPPLY	FIREWATER	FEED TO POTABLE TREATMENT SYSTEM	PIPED FRESH WATER	TRUCKED FRESH WATER	POTABLE SYSTEM PRODUCT FLOW
Construction Phase - Design (m^3/h)	42.9	300.0	5.5	10.2	42.9	5.5
Construction Phase - Nominal (m^3/h)	6.1	-	5.5	0.4	0.1	5.5
Operation Phase - Design (m^3/h)	-	-	-	-	-	-
Operation Phase - Nominal (m^3/h)	-	-	-	-	-	-

Stream No.	7	8	9	10	11	12	13
Stream Description	POTABLE SYSTEM WASTE FLOW	WASH WATER TO INCIN. PLANT	WASH WATER TO POWER PLANT	WASH WATER TO PWTP	ROAD DUST SUPPRESS	FIRETRUCK WATER	POTABLE WATER TO ACC. COMPLEX
Construction Phase - Design (m^3/h)	0.002	3.4	3.4	3.4	42.9	42.9	31.1
Construction Phase - Nominal (m^3/h)	0.001	0.1	0.1	0.1	0.1	-	5.5
Operation Phase - Design (m^3/h)	-	-	-	-	-	-	-
Operation Phase - Nominal (m^3/h)	-	-	-	-	-	-	-

HATCH™ Baffinland Iron Mines Corporation

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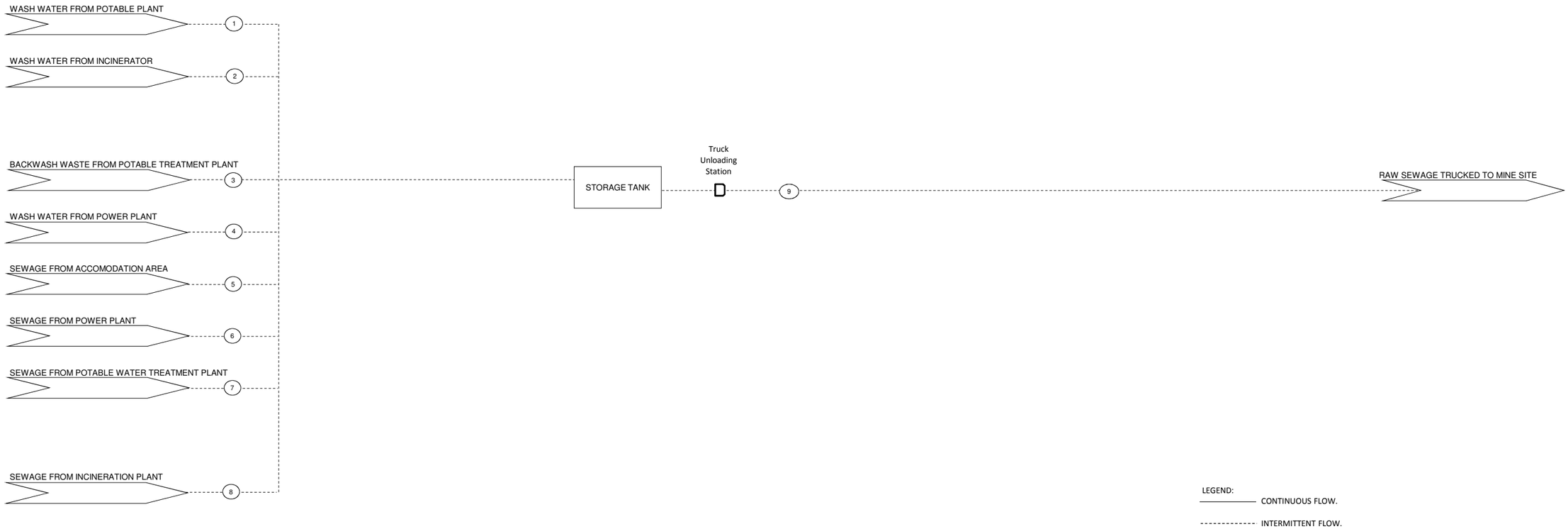
PROJ. DES. COORD.	PROJ. ENGR. J. CASSON Date: 11/10/2011
PROJECT MANAGER H. CHARALAMBU Date: 11/10/2011	Drawing No. H337697-7000-10-002-0003 SHEET 1 OF 2

RAVN RIVER CAMP - MARY RIVER PROJECT
BLOCK FLOW DIAGRAM
WATER SUPPLY BALANCE

Rev. E



Stream No.	1	2	3	4
Stream Description	WASH WATER FROM POTABLE PLANT	WASH WATER FROM INCIN.	PWTP BACKWASH WASTE STREAM	WASH WATER FROM POWER PLANT
Construction Phase - Design (m^3/h)	3.4	3.4	0.0017	3.4
Construction Phase - Nominal (m^3/h)	0.1	0.1	0.0014	0.1
Operation Phase - Design (m^3/h)	-	-	-	-
Operation Phase - Nominal (m^3/h)	-	-	-	-

Stream No.	5	6	7	8	9
Stream Description	SEWAGE FROM ACC. COMPLEX	SEWAGE FROM POWER PLANT	SEWAGE FROM PWTP	SEWAGE FROM INCIN. PLANT	RAW SEWAGE TO MINE SITE
Construction Phase - Design (m^3/h)	35.60	0.05	0.05	0.03	42.9
Construction Phase - Nominal (m^3/h)	5.76	0.05	0.05	0.03	6.3
Operation Phase - Design (m^3/h)	-	-	-	-	-
Operation Phase - Nominal (m^3/h)	-	-	-	-	-

NOTES:

1) The flow values on this water balance have been derived from previous consultants documentation produced during the earlier phase of the project. Where values were missing Hatch estimations are used.
2) The peak flows for the accommodation facilities were determined using a peaking factor.
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PROJ. DES. COORD.	PROJ. ENGR. J. CASSON Date: 11/10/2011
PROJECT MANAGER H. CHARALAMBU Date: 11/10/2011	Drawing No. H337697-7000-10-002-0003 SHEET 2 OF 2

RAVN RIVER CAMP - MARY RIVER PROJECT
BLOCK FLOW DIAGRAM
WASTE WATER BALANCE

Rev. E

Appendix D
Sewage Treatment Plant O & M Manual

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1325 California Avenue • P.O. Box 1517 • Brockville, ON • K6V 5W

HATCH VENDOR DATA REVIEW

Doc Number	E349000-PM009-00-118-0001	Sub	01
Date Received			

Review Grade	Next Submittal Status
☐ C1 – Proceed to next submission & status	☐ Internal Review ☐ Certified Final ☐ Final ☐ As-Built
☐ C2 – Proceed with exceptions as noted to next submission & status	Next Submittal Date:
☐ C3 – Do not proceed, revise as noted & resubmit	
No further submission required - Complete ☐	
☐ C4 – No further submission required - Cancelled ☐	
No further submission required - Superseded ☐	

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Sewage Treatment Plant

Operations & Maintenance Manual

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(800) 420-4056 / www.newterra.com

newterra MicroClear™ 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**

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MANUAL OVERVEW

Section	Section Title	Section Description
1	**Introduction**	Introduction to **newterra** 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**	**newterra** 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 **newterra** 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.

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APPPENDICES:

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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:

1. Installation and operation of the newterra MBR WWTP **must** only be carried out by **trained and qualified** personnel.
2. 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.
3. 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.

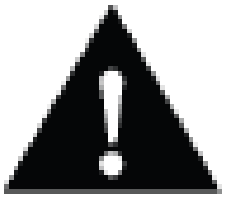
DEFINITION OF SAFETY AND WARNING SIGNS USED IN THE MANUAL

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.



WARNING

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 (NaOCl)** and **Citric Acid ($C_6H_8O_7$)** are used for cleaning the membranes.

  √ **Sodium hypochlorite (NaOCl)** 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 ($C_6H_8O_7$)** 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

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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.

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Hazard Warning Signs/Symbols

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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^3/d and 175-m Milne Port camp with an average design flow of 63 m^3/d. The wastewater treatment plants have been designed to meet the required effluent quality.

newterra MicroClear™ MBR Process Specification

Parameters	Unit	Value	
		Mine Site WWTP	Milne Port WWTP
Design Hydraulic Load			
Average Daily Flow (ADF)	m^3/d	72	63
Selected Design Flow (Q_h)	m^3/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^3	43.5	43.5
Hydraulic Retention Time (HRT_{EQ})	h	14.5	16.5
One (1) Aeration Tank			
Effective volume	m^3	48	48
$HRT_{AEROBIC}$	h	16	18.3
Two (2) Membrane Tanks			
Total Effective Volume	m^3	5.0	5.0
$HRT_{MEMBRANE}$	h	1.7	1.9

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Parameters	Unit	Value	
		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)	m^3/d	3.8	2.93
Minimum / maximum design operating temperature	°C	10 / 35	

MicroClear™ MB3-1 membrane module		
MCXL cassettes in each MB3-1 module	nr	15
Individual MB3-1 module filtration area	m^2	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
Housing materials	-	Stainless steel 1.4571 (316 Ti)

Sludge Treatment System	**Unit**	**Value**
One (1) Mixing Tank		
Effective Volume	m^3 (gal)	0.9 (240)
One (1) 6 ft^3 (expandable to 10 ft^3) 630 mm filter press		
Feed from aeration tank		
Sludge volume	m^3	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
Construction materials	-	Heavy duty steel skeleton, panted with two part epoxy
Polymer consumption (40 mg/L addition ratio of polymer at 0.25%)	L/d	150

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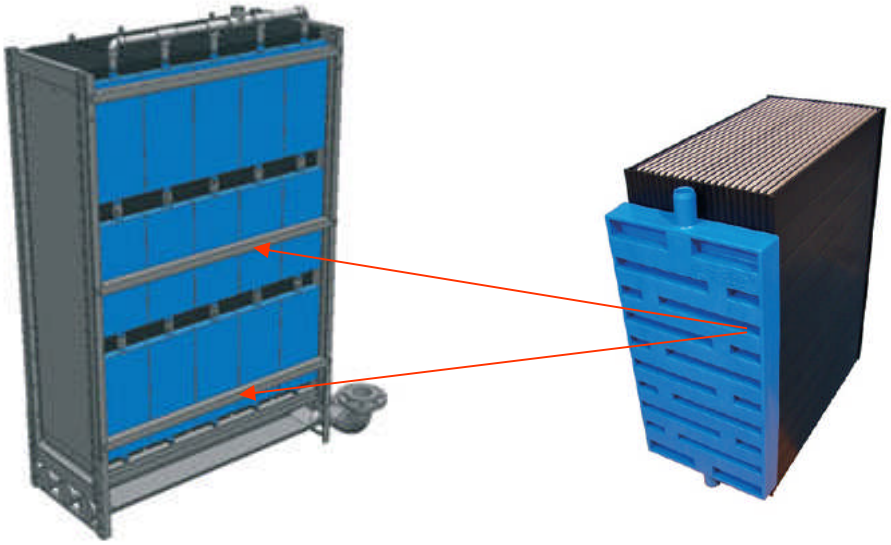

MicroClear™ MB3-1 membrane module

MicroClear™ 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_5)	mg/L	530	< 10	< 20
Total Suspended Solids (TSS)	mg/L	570	< 10	< 20
Total Kjeldahl Nitrogen (TKN)	mg/L	75		-
Ammonia Nitrogen (NH_3-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 $CaCO_3$	10 – 14	-	-

After UV disinfection

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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™ Membrane Compatibility Chart

Group	Substances	SP-Type Membrane
Chlorinated solvents	Methylene Chloride, Chloroform, Carbon Tetrachloride, Chlorobezene, Trichloroethane (<1%)	--
Esters	Ethyl Acetate, Butyl Acetate, Butyl Acrylate (<1%)	--
Ethers	Ethyl Ether, Polyethylene Oxide (<1%)	--
H_2O_2	<2000 ppm	++
Inorganic acids	HF, HCI, H_2SO_4	pH 0 - 14
Ketones	Acetone, Methyl Ethyl Ketone	--
NaOCI	100,000 ppmxh	++

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Organic acids	Sulfamic Acid, Formic Acid, Oleic Acid, Sulfonic 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	--
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™ 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™ 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.

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 death.***

4.2 Inspection upon Delivery

The **newterra** MicroClear™ 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.***

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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
	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)
Enclosures Dimensions	All enclosures are 40-ft high-cube modified shipping 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')
Inlet pipes	3" steel FNPT for wastewater from lift station; 3" steel with female camlock from sewage truck
Discharge pipe	2" steel pipe with 2" flange

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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.

	**Only trained and certified electricians should make the electrical connections.**

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 start-up, 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™ 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

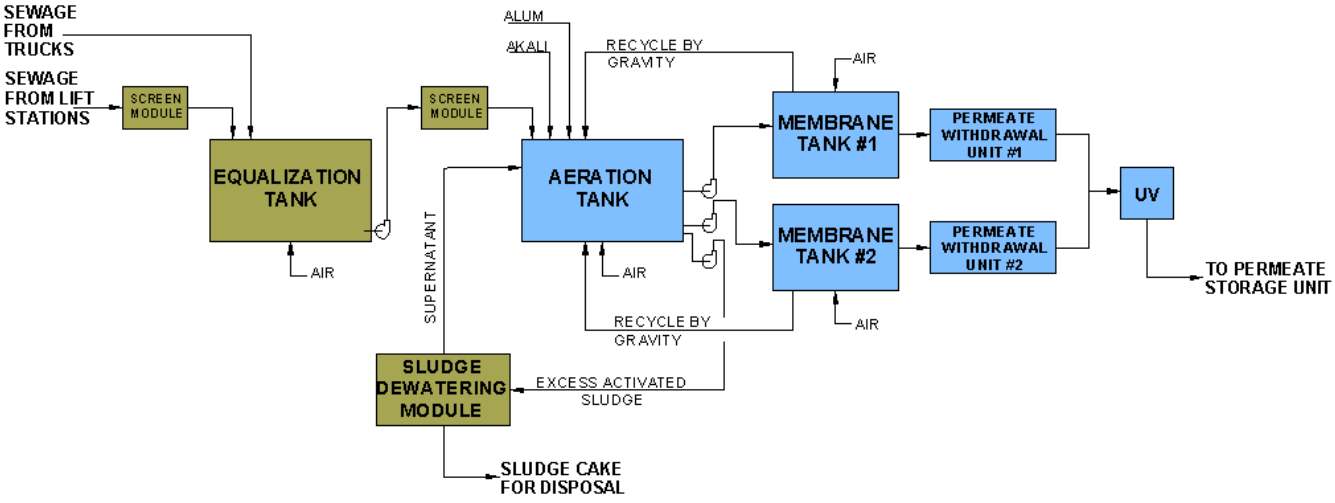
The manual mode of operation is provided for maintenance purposes and for emergency operation of the plant in the unlikely event of a failure of the automatic control system (default operation mode). Operators **must be present when equipment is operated in the manual mode.**

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 ^{o}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 ^{o}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 ^{o}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 ^{o}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 ^{o}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 ^{o}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 m^3, 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

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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^{o}C to 15^{o}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.

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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_3-N).

One (1) aeration tank (TNK-501) located in BLD-7902 has an overall effective volume of 48 m^3, 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)

<u>Temperature Control</u>

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

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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_2CO_3) 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™ 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.

	**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/cm^2 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 [$Ca(ClO)_2$] 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.

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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.

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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

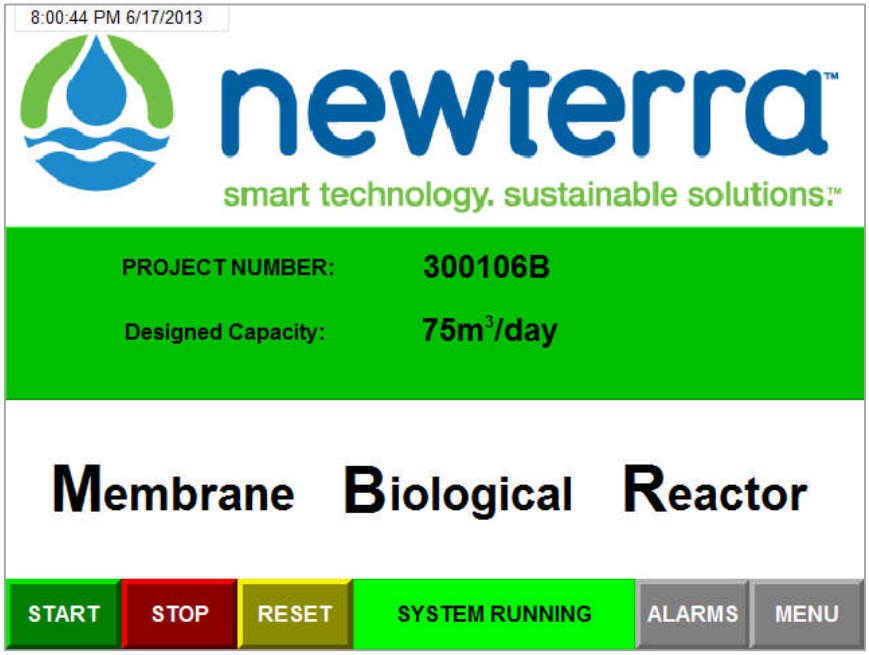
Alarms

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

5.2 Process Control System Touchscreen Operation

The MicroClear™ 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.

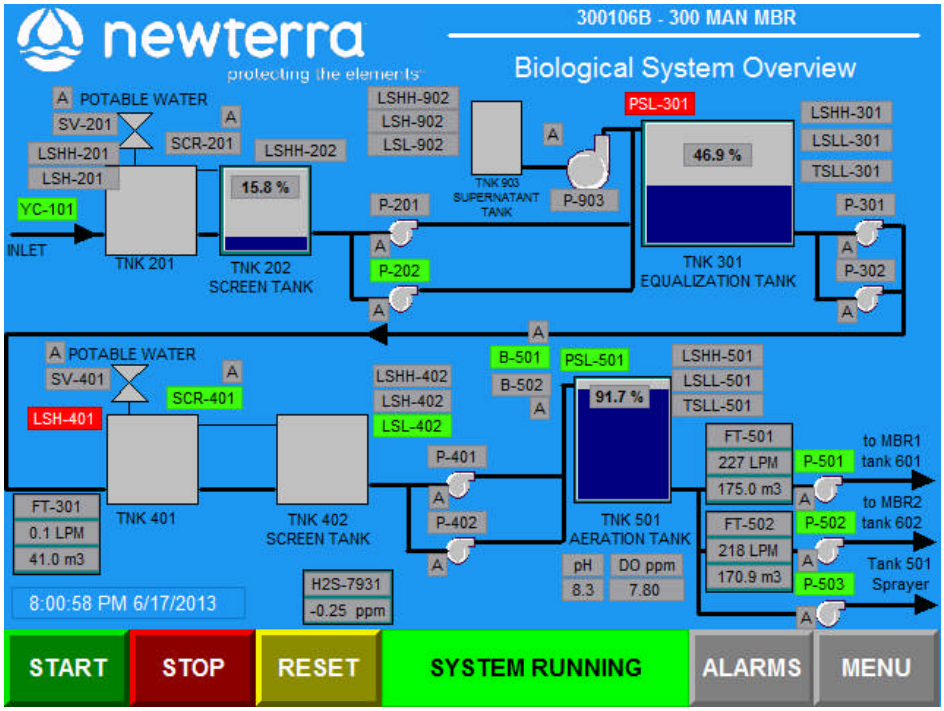
On the main process screens, switches are displayed as **Grey** when **OFF,** **Green** when **ON** and **Red** when in alarm condition.

- 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

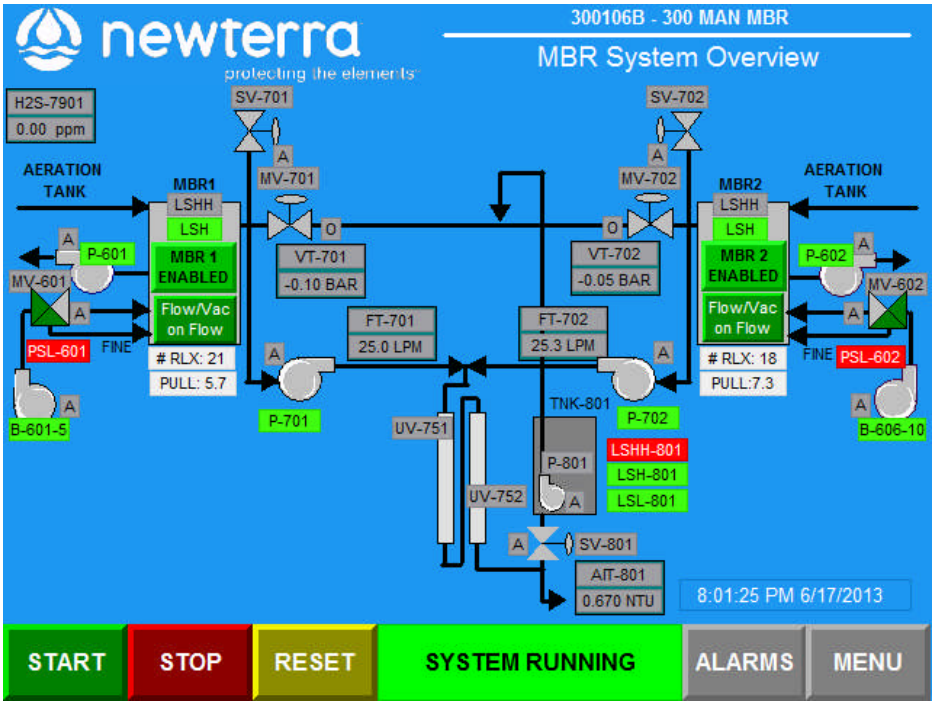
5.2.2.1 Biological System Overview Screen



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_2S detector are displayed

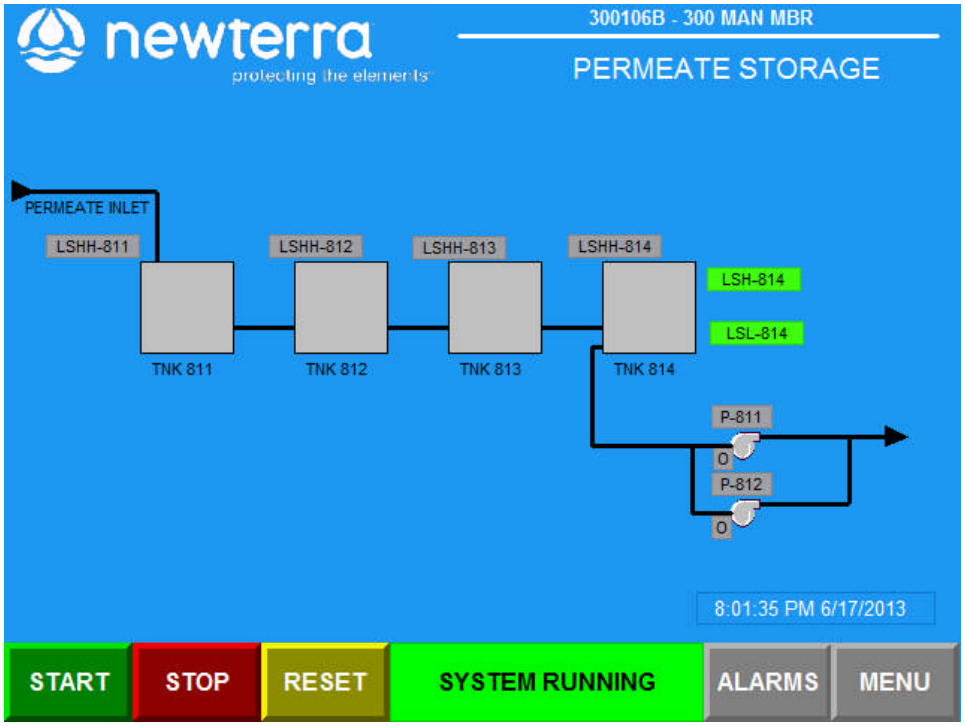
5.2.2.2 Membrane Filtration System (MBR) Overview Screen



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_2S detector are displayed
- The time on the current pull cycle

5.2.2.3 Permeate Storage Module Overview Screen

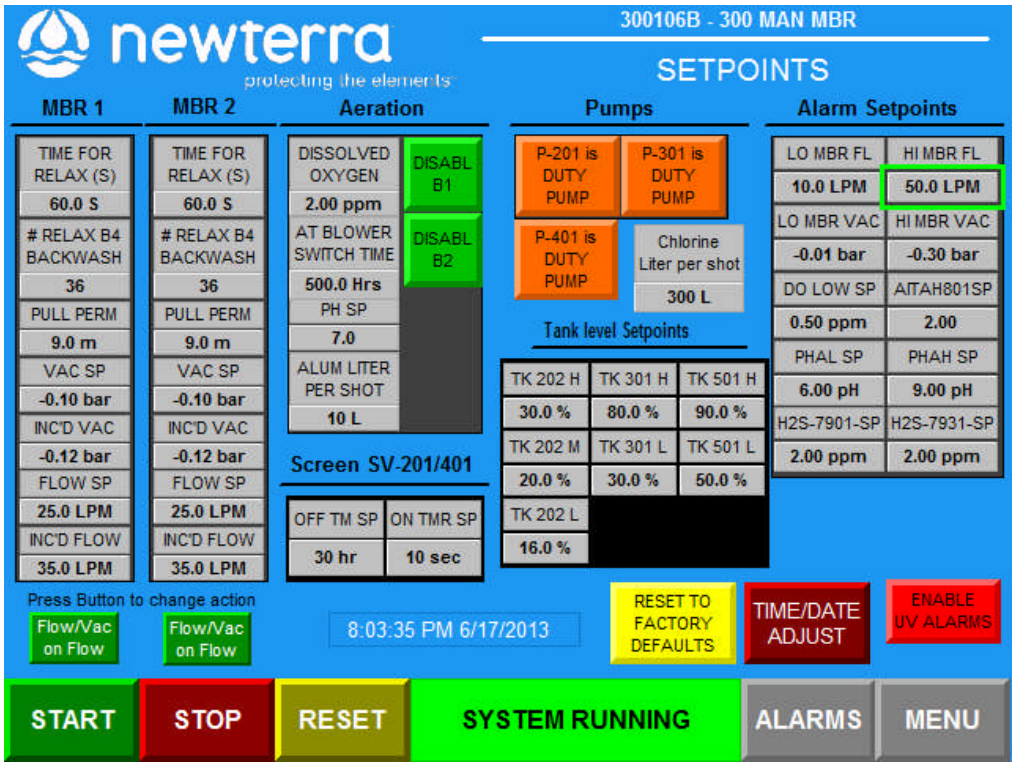


On this screen the following equipment and parameters are displayed:

- 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.

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newterra MBR Operational Setpoints Description

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

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

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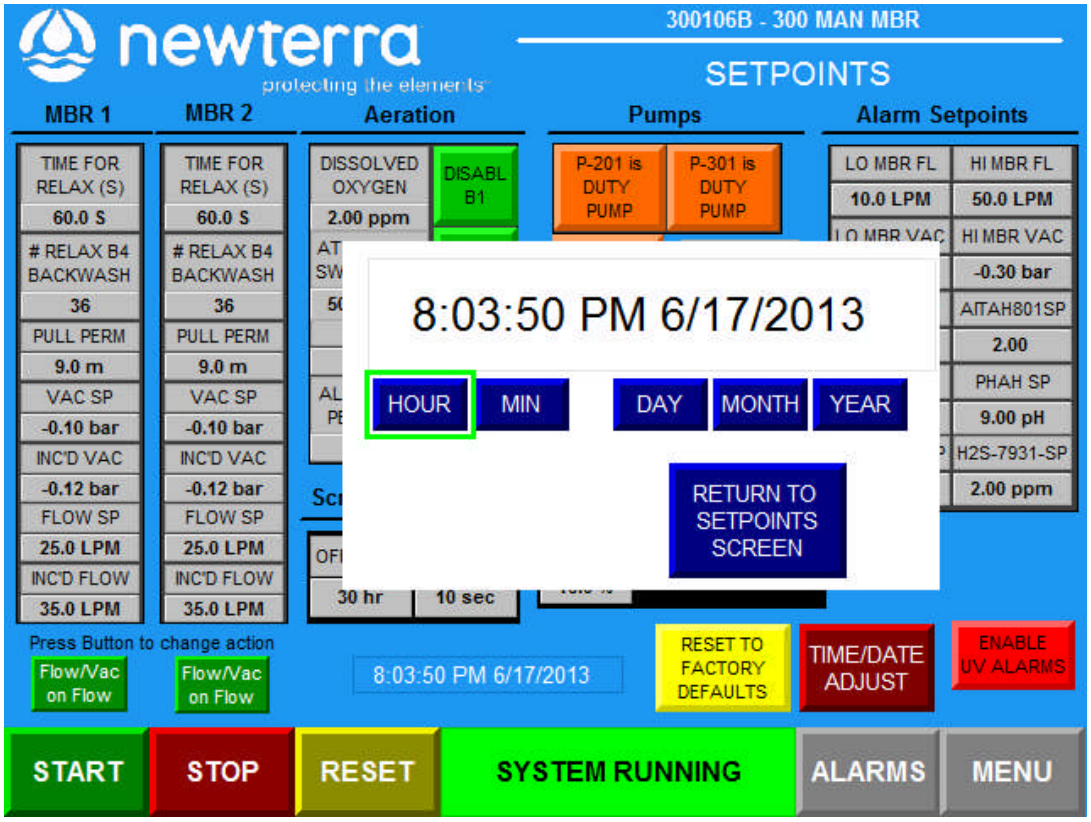
newterra MBR Alarm Setpoints Description

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

ATTENTION

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

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



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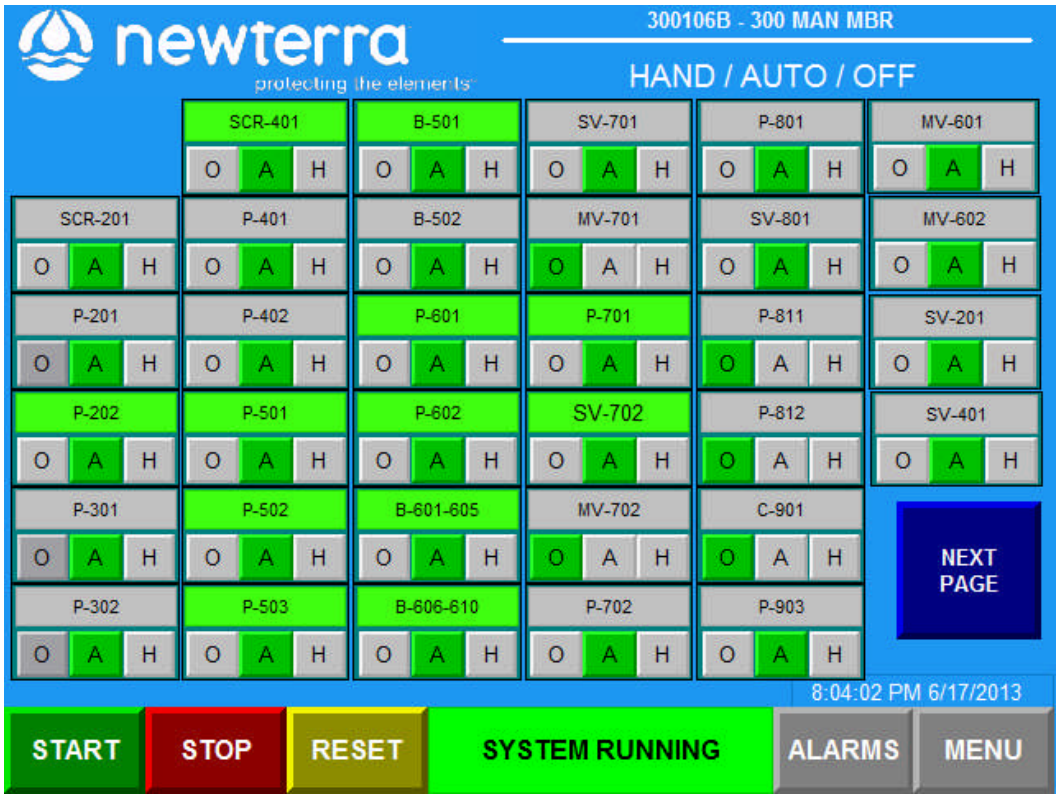
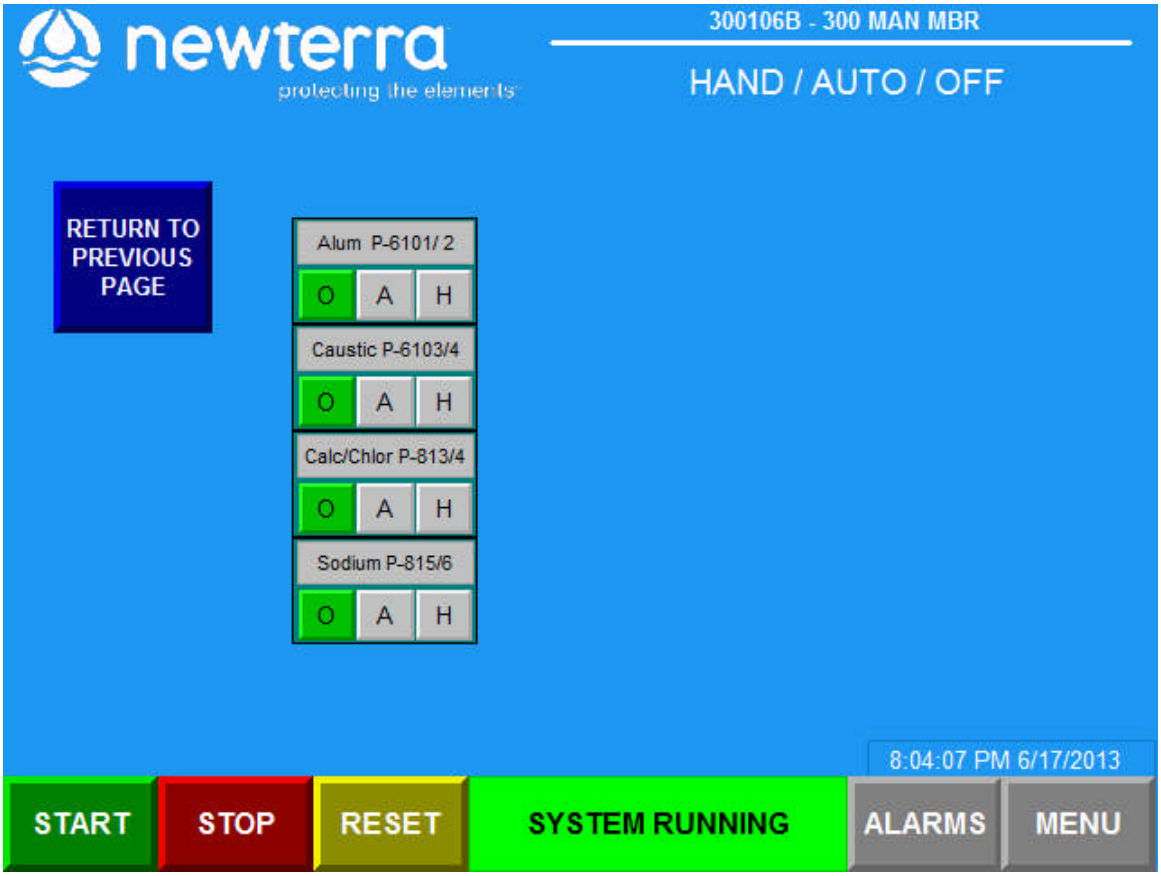
5.2.4 System HAO's (HAND /AUTOs/ OFF)

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

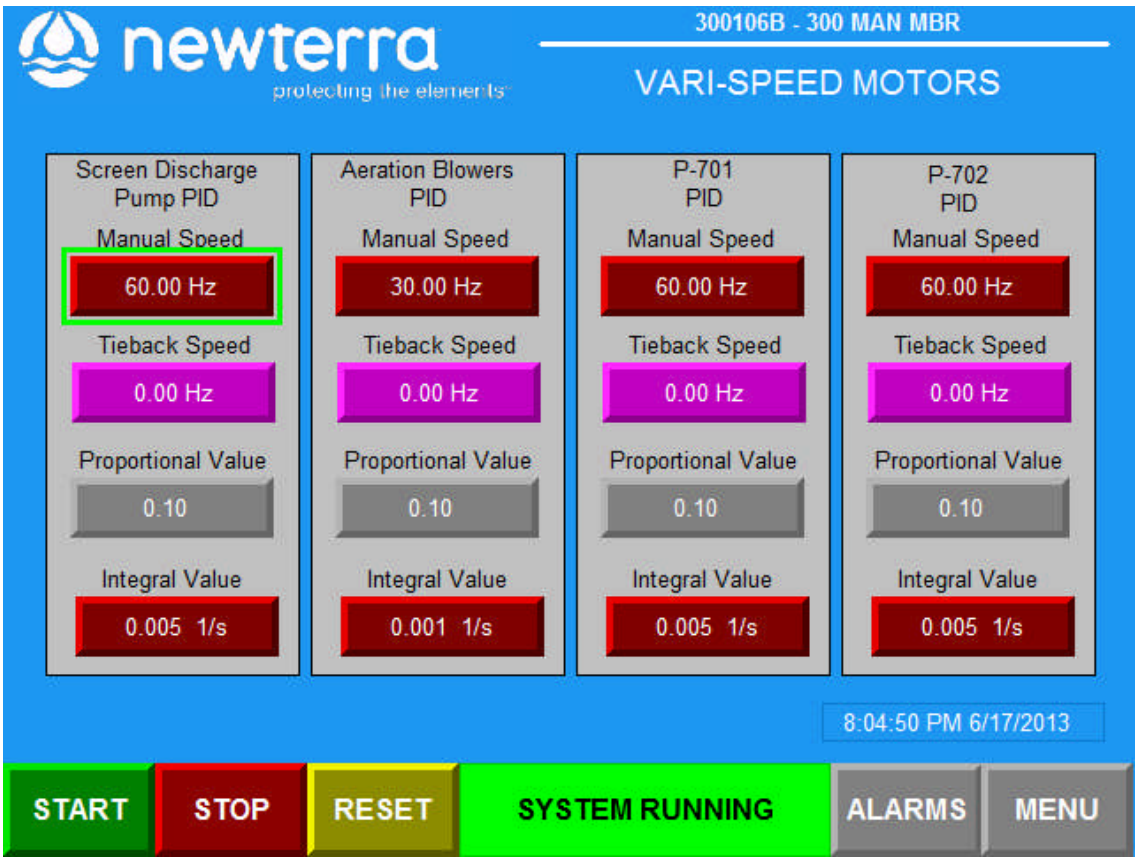


- Each PLC controlled motor or valve in the system has **a Hand/Auto/Off (HAO)** Switch to control its operation. This screen displays all the system HAO's
- For normal operation, all switches should be in the **AUTO (A)** position
- The **HAND (H)** position of a switch is used for testing and troubleshooting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



5.2.5 Motor Info Control Screen

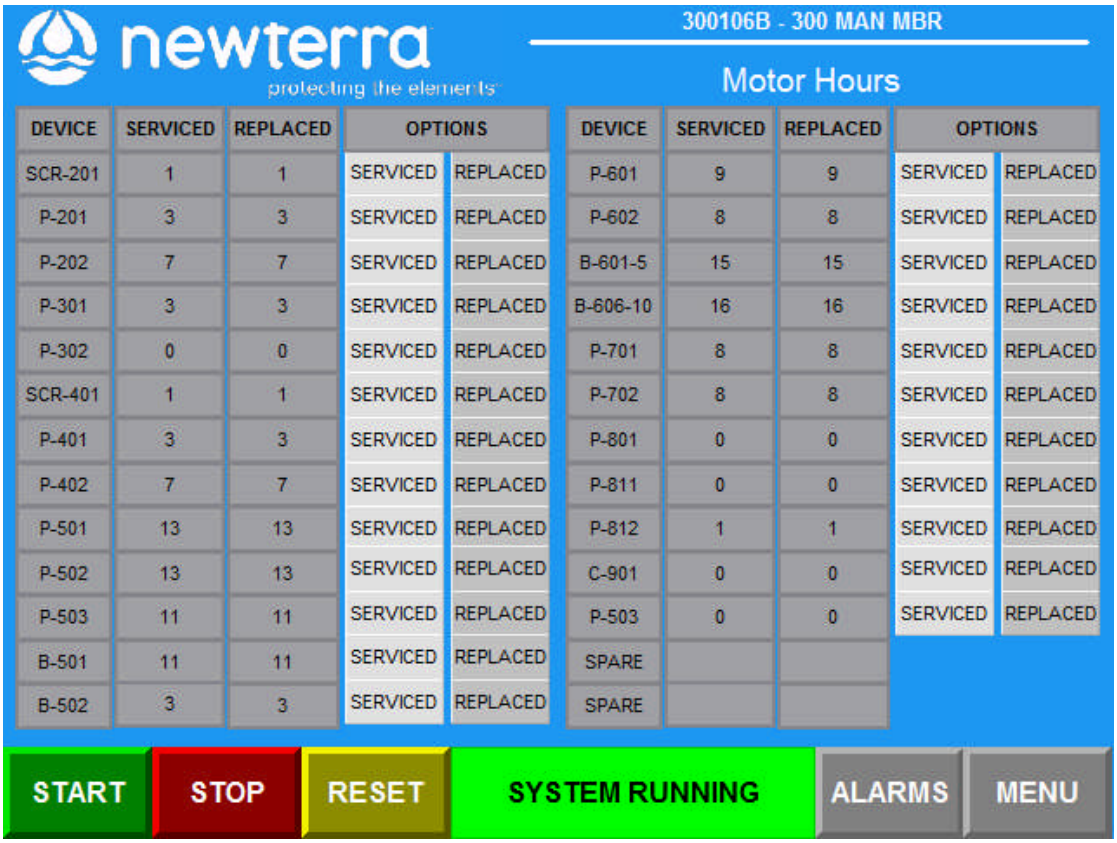
The following screen shows the status of the VFD's and their PID control values.



5.2.6 Moto Hours Control Screen

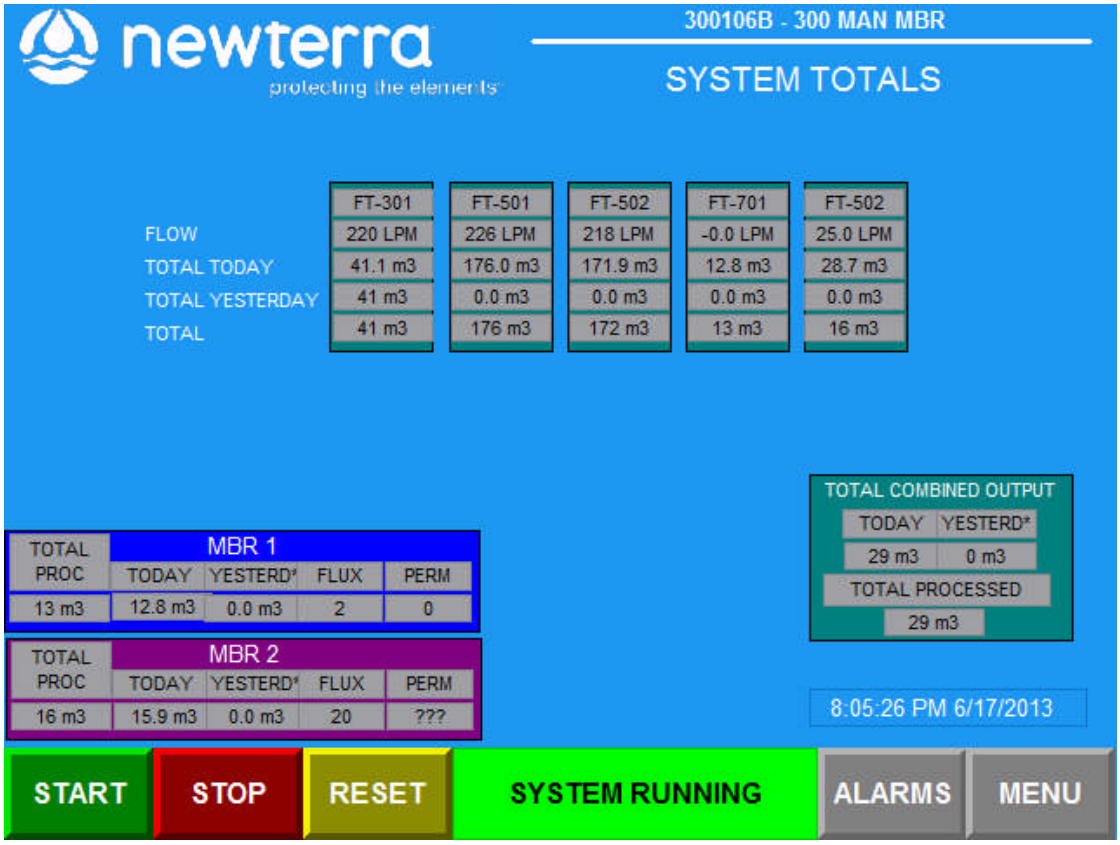
Motor Hours screen is accessed from the main menu by pressing the “Motor Hours” This screen shows the total number of hours that each motor can run.

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



5.2.7 System Totals

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

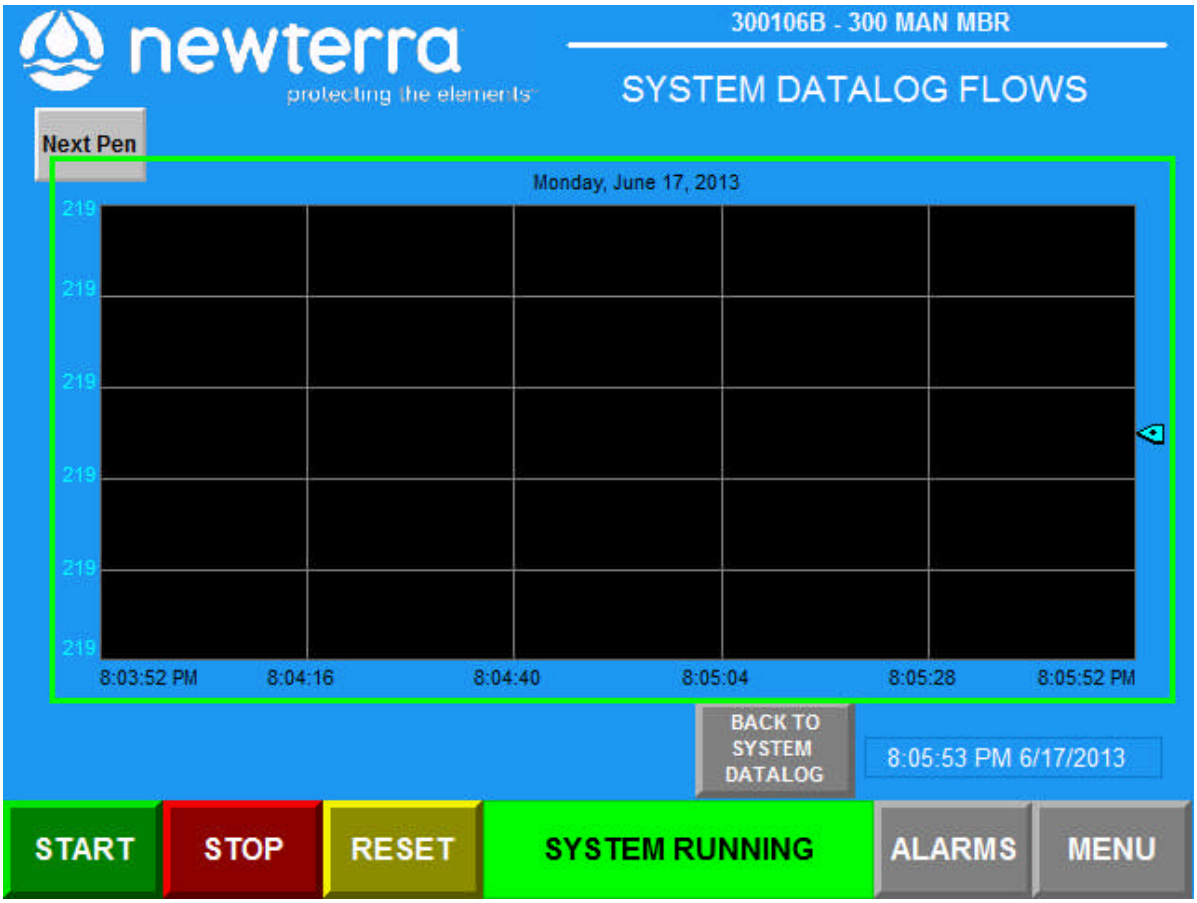


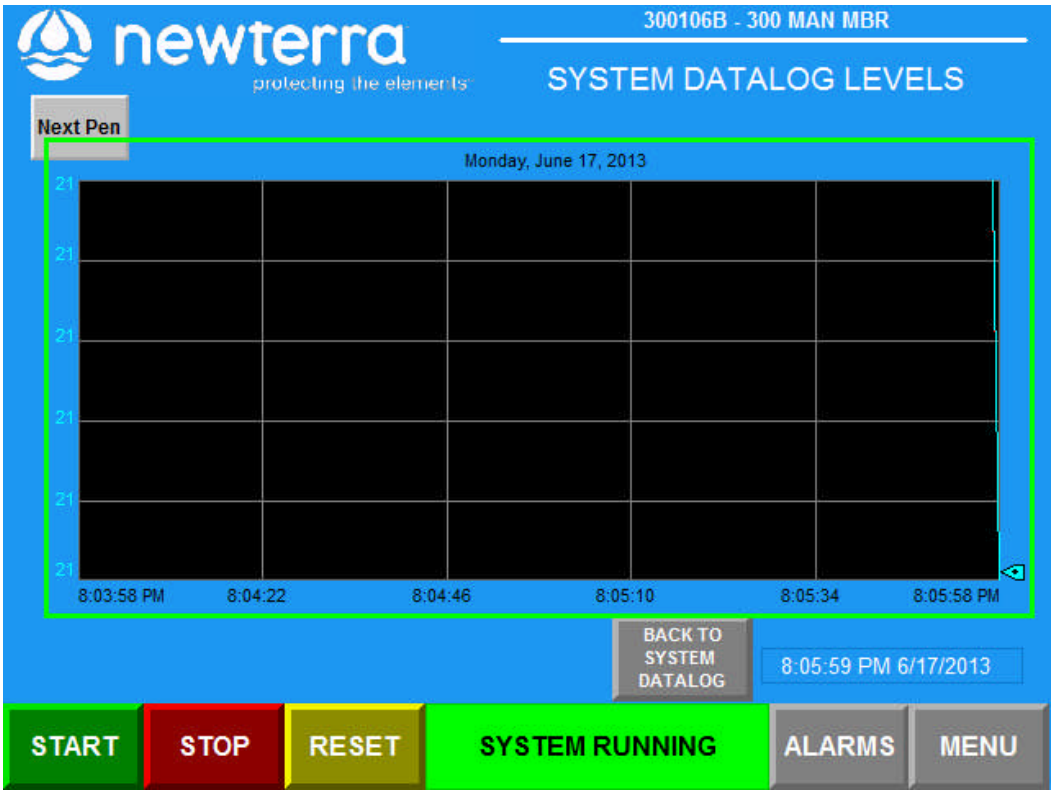
This screen is used to show:

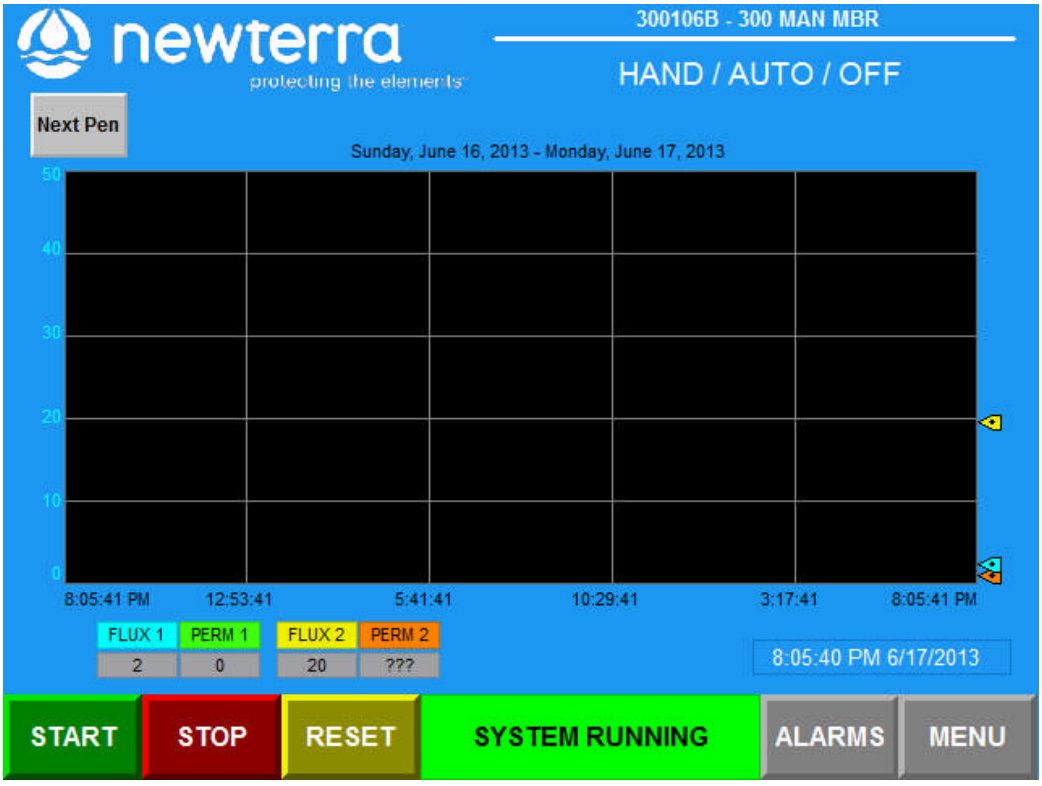
- The total amount of water processed through the process train, and also current (today) amount and amount of water processed yesterday
- Flux (**J)** for membrane unit expressed in **LMH (L/m²·h)**
- Permeability **(K)** for membrane unit expressed in **LMH/bar**

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

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

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

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

5. Remove grit from the screen if required.

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

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

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

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

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

	**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.**

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6.2 System Operating Guidelines and Monitoring

6.2.1 Operating Guidelines

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

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

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

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

Membrane Filtration Operational Conditions

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

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

MBR – Recommended Biological Operational Conditions

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

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

6.2.2 Sampling

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

Monitoring and Testing Requirements

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

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

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

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

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

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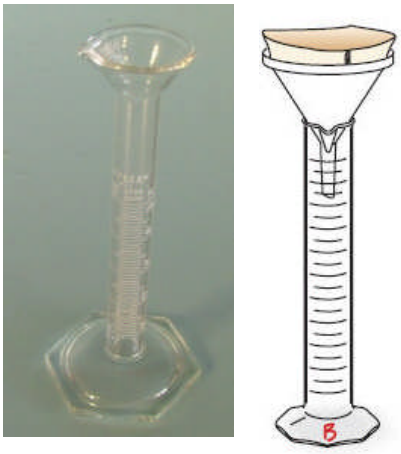
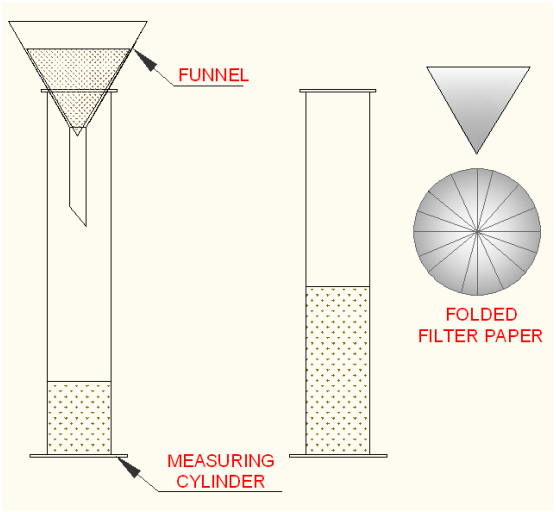
Filterability Test

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

Laboratory Glassware and Filter Paper





Apparatus:

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

Filterability Kit includes:

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

Stop watch

Measurement Procedure:

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

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

6.2.3 Record Keeping

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

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

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

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

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

6.2.4 Process Trending

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

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

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

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7.0 SYSTEM MAINTENANCE

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

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

7.1 Plant Visual Checks

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

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7.1.1 Air Scouring Patterns in Membrane Tanks

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

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

Proper air scouring in membrane tank

Uneven aeration in membrane tank

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

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

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

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

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

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

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

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™ MCXL filter is 0.1 bar or equivalent to a 100 cm water line. Only use gravity force to perform the backflush.

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

For better cleaning performance, it is recommended:

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

Procedure

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

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

1) Press the disable membrane button on the screen.

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

3) Close valve (SV-801).

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

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

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

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

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

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

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

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

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

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

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

7.3.2 Membrane Recovery Cleaning

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

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

For better cleaning performance, it is recommended:

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

Procedure

Step 1: Cleaning with Sodium Hypochlorite (NaOCl)

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

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

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

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

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

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

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

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

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

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

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

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

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

Step 4: Checking Permeability on Clean Water

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

Repeat the cleaning procedures If normal permeability is not achieved.

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

7.3.3 Membrane Physical Check

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

To remove membrane module from membrane tank

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

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

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

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

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

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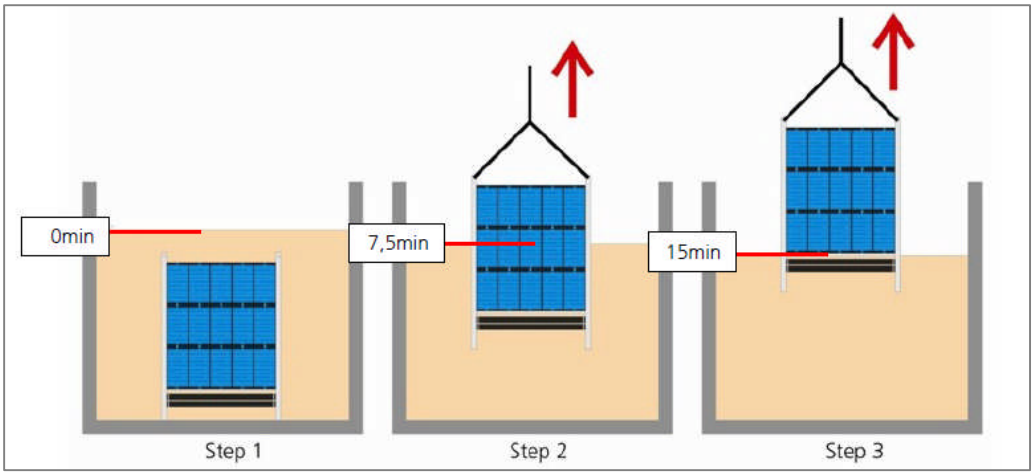

Schematic of MicroClear™ membrane module lifting / emptying of the membrane tank

Membrane module replacement

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

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

Glycerine Solution Solution Components and Solution Make-Up

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

2. Solution make-up procedure:

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

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

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

Membrane preservation procedure

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

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

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

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9.0 SERVICE & SUPPORT

Commissioning and Start-up

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

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

Post commissioning Services

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

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

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

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

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

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

There will be no construction and development of Steensby and the Rail camps during 2013 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). 1

E.1 Freshwater

E.1.1 Freshwater System Process Description

E.1.1.1 Steensby Port Site

During 2013, 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.

E.1.1.2 Mid-Rail Site

During 2013, 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 2013, 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.

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

During 2013, 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 2013, 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.

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 2013.

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.

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 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.

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 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.