H353004-10000-270-252-0002-0001
DWG. No.

LEGEND

(hexagon)	IMPACTED WATERSHED
(rectangle)	DEVELOPMENT AREAS
(dotted rectangle)	DEVELOPMENT AREAS SUBJECT TO APPROVAL
(rounded rectangle)	STORMWATER PONDS
(solid arrow)	CONTINUOUS OR WATERSHED FLOW
(dashed arrow)	INTERMITTENT FLOW
A/AA 100,000	ANNUAL VOLUME (m³/a)
MAUR	MEAN ANNUAL UNIT RUNOFF (l/s/km²)
MSC	MINE SITE COMPLEX
DA	DRAINAGE AREA (km²)

NOTES:

1. SITE LAYOUT PER DRAWING H353004-00000-220-272-0005-0001. (1)
2. REFER TO PROCESS FLOW DIAGRAM H353004-10000-270-282-0001-0001, FOR MORE DETAILED WATER SUPPLY AND WASTE WATER ~~TREATMENT~~.
3. RAW WATER SUPPLY FLOW RATE CAMP LAKE IS EQUAL TO OR LESS THAN TYPE A WATER LICENCE 2AM-MRY1325 FLOW RATE LIMIT OF 657.5m³/day (240,000m³/year) TOTAL.
4. USE OF POLISHING WASTE STABILIZATION POND PRIOR TO MARY RIVER DISCHARGE WILL OCCUR ON A CONTINGENCY BASIS ONLY, IN THE EVENT OF OFF-SPEC TREATED SEWAGE EFFLUENT.
5. USE OF POLISHING WASTE STABILIZATION POND AND SHEARDOWN LAKE DISCHARGE WILL OCCUR ON A CONTINGENCY BASIS ONLY, SHOULD CAPACITY BE EXCEEDED THROUGH THE SEWAGE TREATMENT SYSTEM DISCHARGING TO MARY RIVER.
6. BULK FUEL STORAGE AREA RUNOFF DRAINED TO ENVIRONMENT IF QUALITY SATISFIES DISCHARGE REQUIREMENTS; OTHERWISE IS CONVEYED TO MOBILE OIL/WATER SEPARATOR FOR TREATMENT PRIOR TO DISCHARGE.
7. PLANT SITE RECEIVES ONLY PRECIPITATION-RUNOFF AND NO SURFACE WATER RUNOFF FROM SURROUNDING AREAS.
8. REFER ERP SURFACE WATER AND AQUATIC ECOSYSTEM MANAGEMENT FROM H349000-1000-07-126-0005, REV 1.
9. MSC STP MOVED TO PORT.

PERMIT TO PRACTICE
HATCH LTD.
Signature 2019.04.17 12:22:11 -04'00'
Date
PERMIT NUMBER: P 512
The Association of Professional Engineers, Geologists and Geophysicists of NWT/NU

FOR USE

DRAWING No.	DRAWING TITLE
H349000-4000-10-002-0002	MINE SITE - WATER BALANCE - BLOCK FLOW DIAGRAM

REFERENCE DRAWINGS

REG. PROFESSIONAL: REGISTERED PROFESSIONAL ENGINEER J.M. WIKSTON LICENSEE NT/NU

No.	DESCRIPTION	BY	CHK'D	DATE
1	MSC DORMITORIES AND STP MOVED TO PORT	LS	PC	10-04-2019
0	APPROVED FOR USE	HV	PC	12-09-2018

REVISIONS

HATCH

ROLE	NAME	SIGNATURE	DATE
DRAFTSPERSON	H VINCENT	NR	24-08-2018
DESIGNER		NR	
CHECKER	P CHERRY	[signature]	2019-04-16
DESIGN COORD.	R GOOSEN	[signature]	2019-04-16
RESP. ENG.	J WIKSTON	[signature]	2019.04.17 12:21:48 -04'00'
LEAD DISC. ENG.	P CHERRY	[signature]	2019-04-16
AREA LEAD	M HAAKSMA	[signature]	2019-04-16
ENG. MANAGER	R GOOSEN	[signature]	2019-04-16
AREA MANAGER	T ATIBA	[signature]	19-04-17

DRAWING APPROVAL STATUS: Approved for Use

Baffinland

BAFFINLAND IRON MINES LP
MARY RIVER EXPANSION PROJECT

MINE SITE
AREA WATER BALANCE
BLOCK FLOW DIAGRAM

SCALE	DWG. No.	REV
NTS OR AS NOTED	H353004-10000-270-252-0002-0001	1

SHEET SIZE: D

jdc_pwservice 16-APR-2019 09:24
\\DCPWPDF03\PDFtemp\73967\115106_528\H353004-10000-270-252-0002-0001.dgn

Appendix D
Sewage Treatment Plant O & M Manual

newterra
smart technology, sustainable solutions.
1325 California Avenue • P.O. Box 1517 • Brockville, ON • K6V 5W1 • T: 800.420.4056 • F: 613.345.7623

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	
☐ C4 – No further submission required - Complete ☐ No further submission required - Cancelled ☐ No further submission required - Superseded ☐	

Package Coordinator: Name, signature and Date:

REVIEWED ONLY FOR GENERAL CONFORMITY WITH THE SPECIFICATIONS. ACCEPTANCE BY THE ENGINEER DOES NOT WARRANT OR REPRESENT THAT THE INFORMATION CONTAINED ON THIS DRAWING/DOCUMENT IS EITHER ACCURATE OR COMPLETE. THE SOLE RESPONSIBILTY FOR CORRECT DESIGN, DETAILS & DIMENSIONS SHALL REMAIN WITH THE PARTY SUBMITTING THE DRAWING/DOCUMENT.

E349000-PM-009-00-118-0001

Sewage Treatment Plant

Operations & Maintenance Manual

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(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**

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

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.

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

APPPENDICES:

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

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

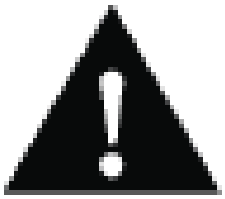
ATTENTION SYMBOL

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

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

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

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

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).

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

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

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

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.

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

Hazard Warning Signs/Symbols

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
744 Gordon Baker Road, Toronto, ON M2H 3B4
(800) 420-4056 / www.newterra.com

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

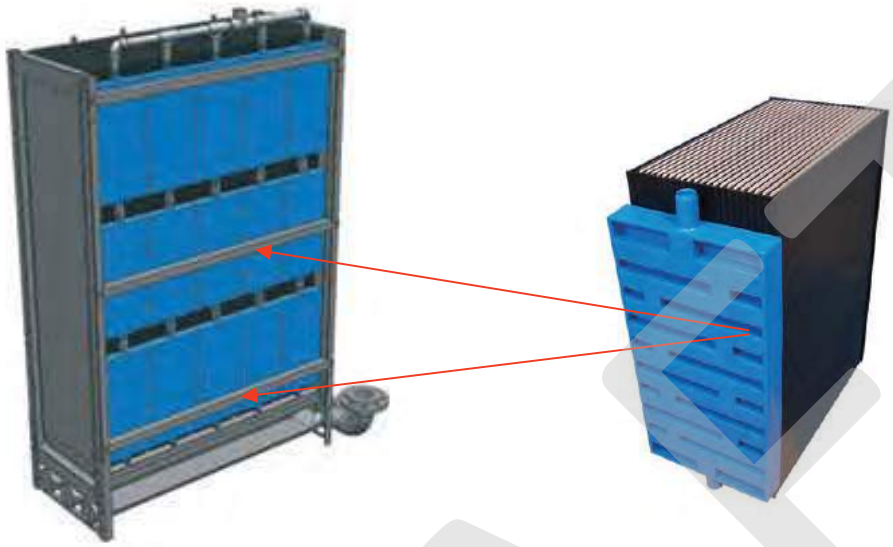
newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
744 Gordon Baker Road, Toronto, ON M2H 3B4
(800) 420-4056 / www.newterra.com

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

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
744 Gordon Baker Road, Toronto, ON M2H 3B4
(800) 420-4056 / www.newterra.com



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*

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
744 Gordon Baker Road, Toronto, ON M2H 3B4
(800) 420-4056 / www.newterra.com

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, HCl, H_2SO_4	pH 0 - 14
Ketones	Acetone, Methyl Ethyl Ketone	--
NaOCl	100,000 ppmxh	++

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
744 Gordon Baker Road, Toronto, ON M2H 3B4
(800) 420-4056 / www.newterra.com

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.

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
744 Gordon Baker Road, Toronto, ON M2H 3B4
(800) 420-4056 / www.newterra.com

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.***

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
744 Gordon Baker Road, Toronto, ON M2H 3B4
(800) 420-4056 / www.newterra.com

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.***

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
744 Gordon Baker Road, Toronto, ON M2H 3B4
(800) 420-4056 / www.newterra.com

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

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
744 Gordon Baker Road, Toronto, ON M2H 3B4
(800) 420-4056 / www.newterra.com

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.

ATTENTION	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).

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
744 Gordon Baker Road, Toronto, ON M2H 3B4
(800) 420-4056 / www.newterra.com

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;

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
744 Gordon Baker Road, Toronto, ON M2H 3B4
(800) 420-4056 / www.newterra.com

- 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.

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
744 Gordon Baker Road, Toronto, ON M2H 3B4
(800) 420-4056 / www.newterra.com

- 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.

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

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.

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

Manual Operation

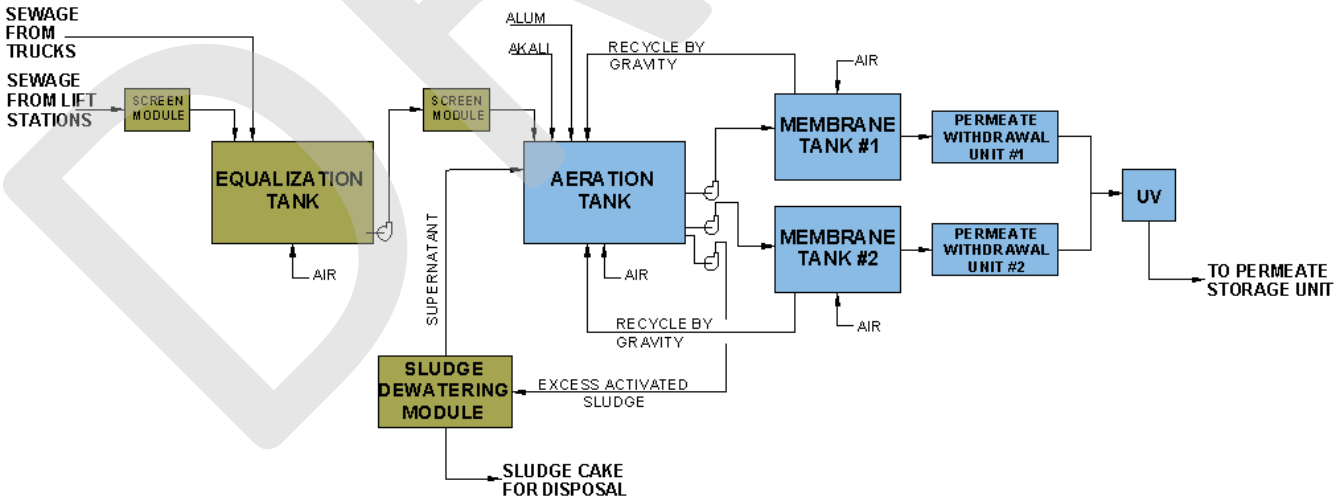
The manual mode of operation is provided for maintenance purposes and for emergency operation of the plant in the unlikely event of a failure of the automatic control system (default operation mode). Operators **must be present when equipment is operated in the manual mode.**

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.



newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

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

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

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.

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

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.

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

Alarms

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

5.1.1.6 EFFLUENT STORAGE BLD-7905

Temperature control

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

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

CAUTION: The temperature switch units are in °F.

Alarms

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

5.1.1.6 SLUDGE BLD-7904

Ventilation

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

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

Temperature control

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

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

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).

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

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.

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

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

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

Alarms

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

Screen Cleaning:

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

5.1.2.2 Equalization Tank (TNK-301)

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

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

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

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

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

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

Air Diffusers Control

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

Alarms

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

Temperature Control

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

Alarms

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

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

Transfer Pumps/Level Control

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

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

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

Alarms

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

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

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.

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

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)

Temperature Control

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

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

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

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

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.

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

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).

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

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.

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

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.

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

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.

.

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

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.

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

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.

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

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.

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

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.

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

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

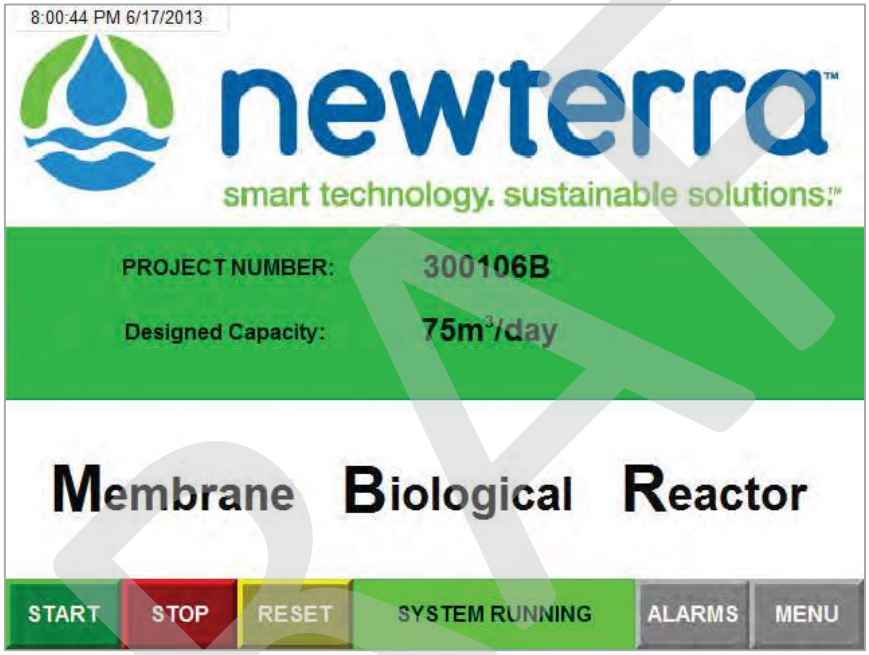
Alarms

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

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

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.

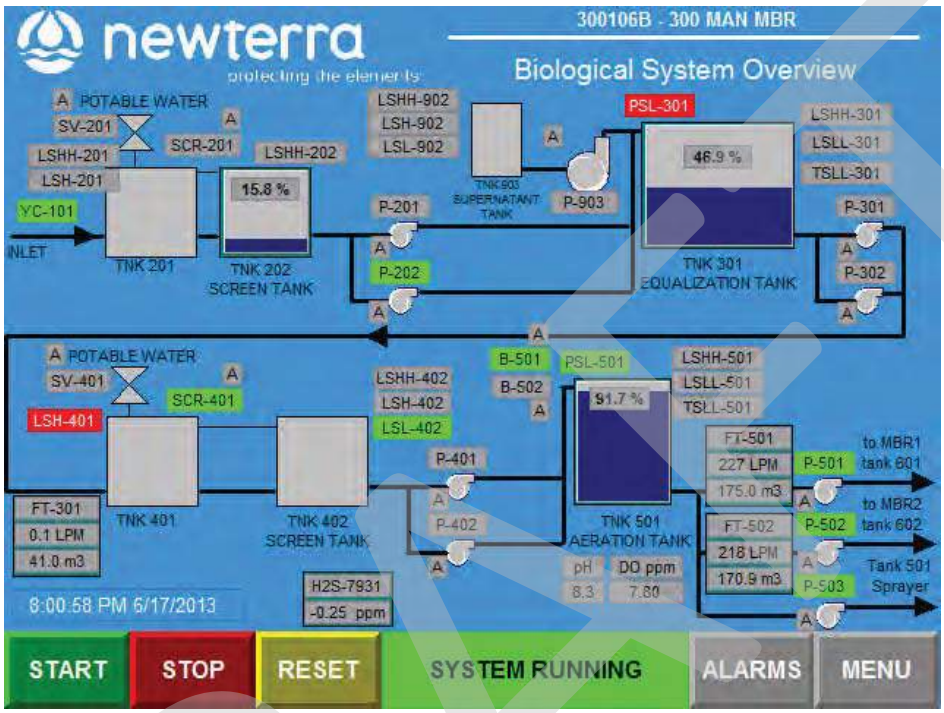
- LSHH – level switch high high
- LSH – level switch high
- LSLL – level switch low low
- TSHH – temperature switch high high
- LSL – level switch low
- PSL – pressure switch low

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

newterra ltd.
1325 California Avenue, Brockville, ON K6V 5Y6
200 555 11th Ave SW, Calgary, AB, T2R 1P6
(800) 420-4056 / www.newterra.com

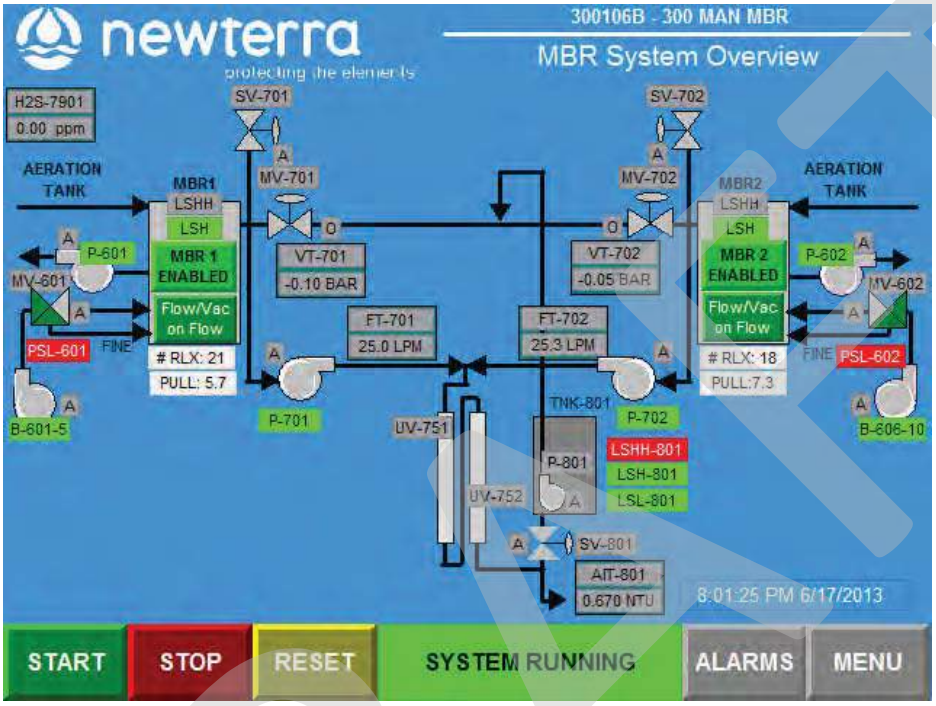
5.2.2.1 Biological System Overview Screen



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

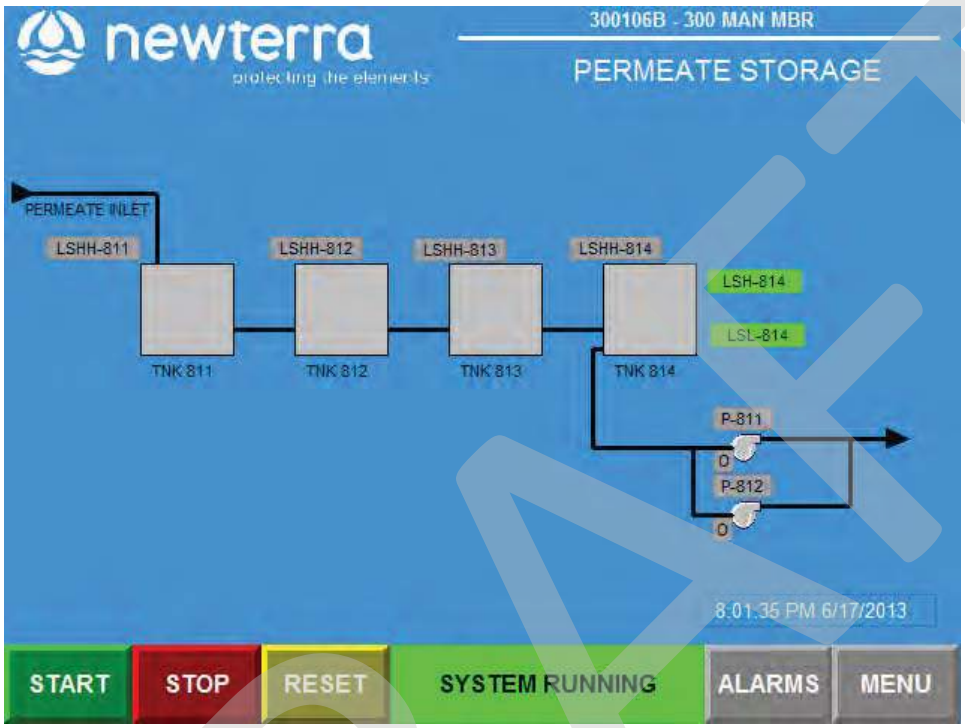
5.2.2.2 Membrane Filtration System (MBR) Overview Screen



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