Appendix A: Reagent MSDS Sheets

SAFETY DATA SHEET

NC00525
MICROC 2000

Preparation Date: 09/Mar/2018 Version: 1

1. IDENTIFICATION

Product identifier

Product Name MICROC 2000

Other means of identification

Product Code(s) NC00525

Synonyms none

Recommended use of the chemical and restrictions on use

Recommended Use Reducing agent for biological purposes

Restricted Uses No information available

Initial Supplier Identifier
Univar Canada Ltd.
9800 Van Horne Way
Richmond, BC V6X 1W5
Telephone: 1-866-686-4827

Emergency telephone number

24 Hour Emergency Phone Number (CANUTEC): 1-888-226-8832 (1-888-CAN-UTEC)

2. HAZARD IDENTIFICATION

Hazardous Classification of the substance or mixture

none

Label elements

Hazard pictograms None

Hazard statements

SAFETY DATA SHEET

SDS00221
Sodium Hypochlorite 12%

Preparation Date: 09/Feb/2018 Version: 4

1. IDENTIFICATION

Product identifier

Product Name Sodium Hypochlorite 12%

Other means of identification

Product Code(s) SDS00221

Synonyms Sodium oxychloride; Soda bleach liquor; Javel water; Clorox; Javex.

Recommended use of the chemical and restrictions on use

Recommended Use Chemical intermediate Bleaching agent Laboratory reagent. Pulp and paper. Water treatment. Disinfectant

Restricted Uses No information available

Initial Supplier Identifier
Univar Canada Ltd.
9800 Van Horne Way
Richmond, BC V6X 1W5
Telephone: 1-866-686-4827

Emergency telephone number

24 Hour Emergency Phone Number (CANUTEC): 1-888-226-8832 (1-888-CAN-UTEC)

2. HAZARD IDENTIFICATION

Hazardous Classification of the substance or mixture

Corrosive to metals	Category 1
Skin corrosion/irritation	Category 1
Sub-category B	
Serious eye damage/eye irritation	Category 1

Label elements

Hazard pictograms

Signal Word: Danger

Hazard statements
May be corrosive to metals
Causes severe skin burns and eye damage

Precautionary Statements

Prevention
Do not breathe dust/fume/gas/mist/vapors/spray
Wash face, hands and any exposed skin thoroughly after handling
Wear protective gloves/protective clothing/eye protection/face protection

Immediately call a POISON CENTER or doctor
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water or shower
Wash contaminated clothing before reuse
IF INHALED: Remove person to fresh air and keep comfortable for breathing
IF SWALLOWED: Rinse mouth. DO NOT induce vomiting

Storage
Store locked up
Store in a well-ventilated place. Keep container tightly closed

Disposal
Dispose of contents/container to an approved waste disposal plant

Very toxic to aquatic life with long lasting effects

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substance

Not applicable.

Mixture

Chemical Name	CAS No	Weight-%	Synonyms
Water	7732-18-5	80 - 90%	Water
Sodium Hypochlorite, Solution	7681-52-9	10 - 20%	Sodium Hypochlorite, Solution

4. FIRST AID

Description of first aid measures

General advice
Immediate medical attention is required. Show this safety data sheet to the doctor in attendance.

Inhalation
Remove to fresh air. If breathing has stopped, give artificial respiration. Get medical attention immediately. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, (trained personnel should) give oxygen. Delayed pulmonary edema may occur.

Eye contact
Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Keep eye wide open while rinsing. Do not rub affected area. Remove contact lenses, if present and easy to do. Continue rinsing. Get immediate medical advice/attention.

Skin contact
Wash off immediately with soap and plenty of water while removing all contaminated clothes and shoes. Get immediate medical advice/attention.

Ingestion
Do NOT induce vomiting. Clean mouth with water and drink afterwards plenty of water. Never give anything by mouth to an unconscious person. Get immediate medical advice/attention.

Self-protection of the first aider
Ensure that medical personnel are aware of the material(s) involved, take precautions to protect themselves and prevent spread of contamination. Avoid contact with skin, eyes or clothing. Avoid direct contact with skin. Use barrier to give mouth-to-mouth resuscitation. Wear personal protective clothing (see section 8).

Most important symptoms and effects, both acute and delayed:
Causes irritation of the mouth, nose and throat. Corrosive Causes burns to the mouth, throat and stomach. May cause severe skin irritation. Corrosive to the respiratory passage. Corrosive to eye tissue and may cause severe damage and blindness. Causes vomiting, nausea, and diarrhea. Repeated and/or prolonged exposures may cause productive cough, running nose, bronchopneumonia, pulmonary edema (fluid build-up in lungs) and reduction of pulmonary function. Coma, shock and death may occur. May cause whitening or bleaching of the skin. If mixed with acids or warmed to temperatures greater than 40 °Celsius, Sodium hypochlorite solutions release chlorine gas. This gas can cause severe irritation of the nose and throat. Exposures to high levels of chlorine gas may result in severe lung damage. Prolonged contact may lead to burns and blisters and may aggravate dermatitis.

Indication of any immediate medical attention and special treatment needed:

Note to physicians
Due to the severely irritating or corrosive nature of the material, swallowing may lead to ulceration and inflammation of the upper alimentary tract with hemorrhage and fluid loss. Also, perforation of the esophagus or stomach may occur, leading to mediastinitis or peritonitis and the resultant complications.

5. FIRE-FIGHTING MEASURES

Suitable Extinguishing Media
Use extinguishing media appropriate for surrounding fire.

Specific hazards arising from the substance or mixture
Closed containers may explode in fire. Keep containers cool to prevent rupture and release of material. Spilled material may cause floors and contact surfaces to become slippery.

Hazardous combustion products
Chlorine. Oxides of sodium. Oxygen. When heated to decomposition, it emits acrid smoke and irritating fumes.

Special protective equipment for fire-fighters
Firefighters should wear self-contained breathing apparatus and full firefighting turnout gear. Use personal protection equipment.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Attention! Corrosive material. Avoid contact with skin, eyes or clothing. Ensure adequate ventilation. Use personal protective equipment as required. Evacuate personnel to safe areas. Keep people away from and upwind of spill/leak.

Environmental precautions

Prevent further leakage or spillage if safe to do so. Should not be released into the environment. Do not allow to enter into soil/subsoil. Prevent product from entering drains.

Methods and materials for containment and cleaning up

Prevent further leakage or spillage if safe to do so.

7. HANDLING AND STORAGE

Precautions for safe handling

For industrial use only. Handle and open containers with care. Avoid contact with eyes, skin and clothing. Do not ingest. Avoid inhalation of chemical. Empty containers may contain hazardous product residues. Keep the containers closed when not in use. Protect against physical damage. Use appropriate personnel protective equipment. When diluting, add this product to water in small amounts to avoid spattering. Never add water to this material.

Conditions for safe storage, including any incompatibilities

Store in a cool, dry, well ventilated area, away from heat and ignition sources. Keep away from direct sunlight. Do not freeze. Store away from organic chemicals, strong bases, metal powders, carbides, sulfides, and any readily oxidizable material. Storage area should be equipped with corrosion-resistant floors, sumps and should have controlled drainage to a recovery tank. Store below 29 °C. Store in a sealed polyethylene lined container.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Exposure Limits This product, as supplied, does not contain any hazardous materials with occupational exposure limits established by the region specific regulatory bodies.

Chemical Name	Alberta OEL	British Columbia OEL	Ontario	Quebec OEL	Exposure Limit - ACGIH	Immediately Dangerous to Life or Health - IDLH
Water 7732-18-5	Not available	Not available	Not available	Not available	Not available	Not available
Sodium	Not available	Not available	Not available	Not available	Not available	Not available

Hypochlorite, Solution 7681-52-9						

Consult local authorities for recommended exposure limits

Appropriate engineering controls

Engineering controls
Local exhaust ventilation as necessary to maintain exposures to within applicable limits. Make up air should always be supplied to balance air exhausted (either generally or locally). Ventilation required when spraying or applying in a confined area. Ventilation should be explosion proof. Eliminate ignition sources.

Individual protection measures, such as personal protective equipment

Eye/face protection
Chemical safety goggles and/or full face shield to protect eyes and face, if product is handled such that it could be splashed into eyes.

Hand protection
Nitrile gloves. Neoprene gloves. Impervious gloves. Rubber gloves.

Skin and body protection
Neoprene coated apron or chemical resistant clothing. Impervious boots.

Respiratory protection
NIOSH approved supplied air respirator when airborne concentrations exceed exposure limits. Wear a NIOAH approved full facepiece respirator for acid gases or a self-contained breathing apparatus for air concentration levels up to 5 ppm.

General hygiene considerations
Avoid contact with skin, eyes or clothing. Wear suitable gloves and eye/face protection. Do not eat, drink or smoke when using this product. Remove and wash contaminated clothing and gloves, including the inside, before re-use. Contaminated work clothing should not be allowed out of the workplace. Regular cleaning of equipment, work area and clothing is recommended. Wash hands before breaks and immediately after handling the product.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Appearance

Physical state	Liquid
Color	Clear Green to yellow.
Odor	Chlorine
Odor threshold	No information available

PROPERTIES	Values	Remarks • Method
pH	11.5 - 13	
Melting point / freezing point	-25 °C / -13 °F	
Initial boiling point/boiling range	No data available	None known
Flash point	No data available	None known
Evaporation rate	No data available	None known
Flammability (solid, gas)	No data available	None known
Flammability Limit in Air		
Upper flammability limit:	No data available	
Lower flammability limit:	No data available	
Vapor pressure	17.5 mmHg	
Relative vapor density	No data available	None known

Specific Gravity	1.175	
Water solubility	Soluble in water	
Solubility in other solvents	No data available	
Partition coefficient	No data available	
Autoignition temperature	No data available	None known
Decomposition temperature	No data available	None known
Kinematic viscosity	No data available	None known
Dynamic viscosity	No data available	None known
Explosive properties	No information available.	
Oxidizing properties	No information available.	
Molecular weight	No information available	
VOC Percentage Volatility	No information available	
Liquid Density	No information available	
Bulk density	No information available	

10. STABILITY AND REACTIVITY

Reactivity/Chemical Stability
Unstable above 40°C / 104 °F.

Possibility of hazardous reactions
Hypochlorites may react with primary amines to form nitrogen trichloride which explodes spontaneously in air. Hypochlorite bleach reacts with urea to form nitrogen trichloride which explodes spontaneously in air. Some metals accelerate the decomposition of Sodium Hypochlorite. Nickel. Copper. Tin. Iron and its alloys. Manganese.

Hazardous polymerization
Will not occur.

Conditions to avoid
High temperatures. Exposure to light.

Incompatible materials
Strong oxidizers. Acids. Reducing agents. Ammonia. Metals.

Hazardous decomposition products
Chlorine. Oxides of sodium. Oxygen. When heated to decomposition, it emits acrid smoke and irritating fumes.

11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure

Inhalation
Causes irritation of the mouth, nose and throat. Corrosive to the respiratory passage. Repeated and/or prolonged exposures may cause productive cough, running nose, bronchopneumonia, pulmonary edema (fluid build-up in lungs) and reduction of pulmonary function. If mixed with acids or warmed to temperatures greater than 40 °Celsius, Sodium hypochlorite solutions release chlorine gas. This gas can cause severe irritation of the nose and throat. Exposures to high levels of chlorine gas may result in severe lung damage.

Eye contact
Corrosive to eye tissue and may cause severe damage and blindness.

Skin contact
Corrosive. May cause severe skin irritation. May cause whitening or bleaching of the skin. Prolonged contact may lead to burns and blisters and may aggravate dermatitis.

Ingestion
Causes burns to the mouth, throat and stomach. Corrosive. Causes vomiting, nausea, and diarrhea. Coma, shock and death may occur.

Information on toxicological effects

Symptoms
Corrosive effects on the skin and eyes may be delayed, and damage may occur without the sensation or onset of pain. Aspiration may cause lung damage.

Numerical measures of toxicity

Acute toxicity

The following values are calculated based on chapter 3.1 of the GHS document .

ATEmix (oral) 68,333.00 mg/kg
ATEmix (dermal) 83,417.00 mg/kg

Unknown acute toxicity No information available

Chemical Name	Oral LD50	Dermal LD50	Inhalation LC50
Water 7732-18-5	> 90 mL/kg (Rat)	Not available	Not available
Sodium Hypochlorite, Solution 7681-52-9	= 8.91 g/kg (Rat)	> 10000 mg/kg (Rabbit)	Not available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Skin corrosion/irritation
Corrosive. May cause severe skin irritation. May cause whitening or bleaching of the skin. Prolonged contact may lead to burns and blisters and may aggravate dermatitis.

Serious eye damage/eye irritation
Corrosive to eye tissue and may cause severe damage and blindness.

Respiratory or skin sensitization
No information available.

Germ cell mutagenicity
No information available.

Carcinogenicity
No information available.

The table below indicates whether each agency has listed any ingredient as a carcinogen.

Chemical Name	ACGIH	IARC	NTP	OSHA
Water 7732-18-5	Not available	Not available	Not available	Not available
Sodium Hypochlorite, Solution 7681-52-9	Not available	Group 3	Not available	Not available

Legend
IARC (International Agency for Research on Cancer)
Group 3 - Not Classifiable as to Carcinogenicity in Humans

Reproductive toxicity
No information available.

Specific target organ systemic toxicity - single exposure

No information available.

Specific target organ systemic toxicity - repeated exposure
No information available.

Aspiration hazard
No information available.

12. ECOLOGICAL INFORMATION

Ecotoxicity

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Chemical Name	Ecotoxicity - Freshwater Algae Data	Ecotoxicity - Fish Species Data	Toxicity to microorganisms	Crustacea
Water 7732-18-5	Not available	Not available	Not available	Not available
Sodium Hypochlorite, Solution 7681-52-9	Not available	0.06 - 0.11 mg/L LC50 (Pimephales promelas) 96 h flow-through 4.5 - 7.6 mg/L LC50 (Pimephales promelas) 96 h static 0.4 - 0.8 mg/L LC50 (Lepomis macrochirus) 96 h static 0.28 - 1 mg/L LC50 (Lepomis macrochirus) 96 h flow-through 0.05 - 0.771 mg/L LC50 (Oncorhynchus mykiss) 96 h flow-through 0.03 - 0.19 mg/L LC50 (Oncorhynchus mykiss) 96 h semi-static 0.18 - 0.22 mg/L LC50 (Oncorhynchus mykiss) 96 h static	Not available	EC50: 0.033 - 0.044mg/L (48h, Daphnia magna)

Persistence and degradability No information available.

Bioaccumulation No information available.

Chemical Name	Partition coefficient
Water 7732-18-5	Not available
Sodium Hypochlorite, Solution 7681-52-9	Not available

Other adverse effects No information available.

13. DISPOSAL CONSIDERATIONS

Waste treatment methods

Dispose of in accordance with local regulations. Dispose of waste in accordance with environmental legislation.

Do not reuse empty containers.

14. TRANSPORT INFORMATION

TDG (Canada):

UN Number	UN1791
Shipping name	HYPOCHLORITE SOLUTION
Class	8
Packing Group	III
Marine pollutant	Not available.

DOT (U.S.)

UN Number	UN1791
Shipping name	HYPOCHLORITE SOLUTION
Class	8
Packing Group	III
Marine pollutant	Not available

15. REGULATORY INFORMATION

Safety, health and environmental regulations/legislation specific for the substance or mixture

NSF International

Certified to NSF/ANSI 60

Additional information
Maximum use for potable water 95 mg/L. Only products bearing the NSF Mark on the product, product packaging, and/or documentation shipped with the product are Certified.

U.S. Regulatory Rules

Chemical Name	CERCLA/SARA - Section 302:	SARA (311, 312) Hazard Class:	CERCLA/SARA - Section 313:
Water - 7732-18-5	Not Listed	Not Listed	Not Listed
Sodium Hypochlorite, Solution - 7681-52-9	Not Listed	Listed	Not Listed

International Inventories

TSCA	Complies
DSL/NDSL	Complies

Legend:
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

16. OTHER INFORMATION, INCLUDING DATE OF PREPARATION OF THE LAST REVISION

NFPA:	**Health hazards** 3	**Flammability** 0	**Instability** 0	**Physical and chemical properties** -
HMIS Health Rating:	**Health hazards** 3	**Flammability** 0	**Physical hazards** 0	**Personal protection** X

Legend Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

TWA	TWA (time-weighted average)	STEL	STEL (Short Term Exposure Limit)
Ceiling	Maximum limit value	*	Skin designation

Prepared By: The Environment, Health and Safety Department of Univar Canada Ltd.

Preparation Date: 09/Feb/2018
Revision Date: 09/Feb/2018

Disclaimer

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Do not use ingredient information and/or ingredient percentages in this SDS as a product specification. For product specification information refer to a Product Specification Sheet and/or a Certificate of Analysis. These can be obtained from your local Univar Sales Office.

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End of Safety Data Sheet

The mixture does not meet the criteria for classification.

Prevention
Wash hands thoroughly after handling
Wear protective gloves/protective clothing/eye protection/face protection
In case of inadequate ventilation wear respiratory protection

Response
Read the label and safety data sheet before use.
Flush eyes with plenty amounts of water.
If eye irritation persists: Get medical advice/attention
Wash skin with plenty of water.
If skin irritation occurs: Get medical advice/attention
Move person to fresh air.
Do NOT induce vomiting. Never give anything by mouth to an unconscious or convulsing person. Seek immediate medical attention. If vomiting occurs spontaneously, keep head below hips to prevent aspiration of liquid into the lungs.

Storage
Store in accordance with good industrial practices.

Disposal
Disposal of all wastes must be done in accordance with municipal, provincial and federal regulations

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substance

Not applicable.

Mixture

Chemical Name	CAS No	Weight-%	Synonyms
Glycerine	56-81-5	70 - 80%	Glycerine
Water	7732-18-5	20 - 30%	Water
Sodium Chloride	7647-14-5	0 - 10%	Sodium Chloride
Methanol	67-56-1	0 - 10%	Methanol

4. FIRST AID

Description of first aid measures

Inhalation
Remove to fresh air.

Eye contact
Rinse thoroughly with plenty of water for at least 15 minutes, lifting lower and upper eyelids. Consult a physician.

Skin contact
Wash skin with soap and water.

Ingestion
Clean mouth with water and drink afterwards plenty of water.

Most important symptoms and effects, both acute and delayed:
May cause slight eye irritation Symptoms include pain, redness and tearing. May cause slight skin irritation. Prolonged or repeated contact may cause discomfort and local redness. High concentrations of mist or vapor may cause irritation of the respiratory tract. May be harmful if swallowed

Indication of any immediate medical attention and special treatment needed:

Note to physicians
Treatment based on sound judgment of physician and individual reactions of patient.

5. FIRE-FIGHTING MEASURES

Suitable Extinguishing Media
Use extinguishing agent suitable for type of surrounding fire. Water spray. Alcohol foam. Dry chemical or CO2. Water or Foam may cause frothing.

Specific hazards arising from the substance or mixture
No information available.

Hazardous combustion products
See section 10 for more information.

Special protective equipment for fire-fighters
Firefighters should wear self-contained breathing apparatus and full firefighting turnout gear. Use personal protection equipment.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Ensure adequate ventilation. Avoid breathing vapors or mists.

Environmental precautions

See Section 12 for additional Ecological Information.

Methods and materials for containment and cleaning up

Prevent further leakage or spillage if safe to do so. Eliminate all ignition sources.

7. HANDLING AND STORAGE

Precautions for safe handling

Handle in accordance with good industrial hygiene and safety practice. Avoid contact with skin, eyes or clothing. Avoid breathing vapors or mists. Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.

Conditions for safe storage, including any incompatibilities

Keep containers tightly closed in a cool, well-ventilated place. Keep away from sources of ignition.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Exposure Limits .

Chemical Name	Alberta OEL	British Columbia OEL	Ontario	Quebec OEL	Exposure Limit - ACGIH	Immediately Dangerous to Life or Health - IDLH
Glycerine 56-81-5	TWA: 10 mg/m^3	TWA: 10 mg/m^3 TWA: 3 mg/m^3	Not available	TWA: 10 mg/m^3	Not available	Not available
Water 7732-18-5	Not available	Not available	Not available	Not available	Not available	Not available
Sodium Chloride 7647-14-5	Not available	Not available	Not available	Not available	Not available	Not available
Methanol 67-56-1	TWA: 200 ppm TWA: 262 mg/m^3 STEL: 250 ppm STEL: 328 mg/m^3 Skin	TWA: 200 ppm STEL: 250 ppm Skin	TWA: 200 ppm STEL: 250 ppm Skin	TWA: 200 ppm TWA: 262 mg/m^3 STEL: 250 ppm STEL: 328 mg/m^3 Skin	250 ppm STEL 200 ppm TLV-TWA	6000 ppm

Consult local authorities for recommended exposure limits

Appropriate engineering controls

Engineering controls
Showers
Eyewash stations
Ventilation systems.

Individual protection measures, such as personal protective equipment

Eye/face protection
Chemical goggles; also wear a face shield if splashing hazard exists.

Hand protection
Use gloves chemically resistant to this material, examples of preferred glove barrier materials include:. Nitrile gloves.

Skin and body protection
Skin contact should be prevented through the use of suitable protective clothing, gloves and footwear, selected for conditions of use and exposure potential. Consideration must be given both to durability as well as permeation resistance.

Respiratory protection
If exposure exceeds occupational exposure limits, use an appropriate NIOSH-approved respirator.

General hygiene considerations
Handle in accordance with good industrial hygiene and safety practice.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Appearance

Physical state	Liquid
Color	Light brown

Odor	MUSTY to Sweet
Odor threshold	No information available

PROPERTIES	Values	Remarks • Method
pH	4 - 11	
Melting point / freezing point	No data available	None known
Initial boiling point/boiling range	No data available	None known
Flash point	No data available	None known
Evaporation rate	No data available	None known
Flammability (solid, gas)	No data available	None known
Flammability Limit in Air		
Upper flammability limit:	No data available	
Lower flammability limit:	No data available	
Vapor pressure	No data available	None known
Relative vapor density	No data available	None known
Specific Gravity	1.225@ 20°C	
Water solubility	Soluble in water	
Solubility in other solvents	No data available	None known
Partition coefficient	No data available	
Autoignition temperature	No data available	None known
Decomposition temperature	No data available	None known
Kinematic viscosity	45 cPs @ 20C	
Dynamic viscosity	No data available	None known
Explosive properties	No information available.	
Oxidizing properties	No information available.	

Molecular weight	No information available
VOC Percentage Volatility	No information available
Liquid Density	No information available
Bulk density	10.22 lbs/gal

10. STABILITY AND REACTIVITY

Reactivity/Chemical Stability
Stable under normal conditions

Possibility of hazardous reactions
None under normal processing.

Conditions to avoid
Heat, flames and sparks.

Incompatible materials
Oxidizing agents. Nitric acid. Peroxides. Chromates.

Hazardous decomposition products
Oxides of carbon.

11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure

Inhalation
High concentrations of mist or vapor may cause irritation of the respiratory tract.

Eye contact
May cause slight eye irritation.

Skin contact
May cause slight skin irritation.

Ingestion
May be harmful if swallowed.

Information on toxicological effects

Symptoms
Prolonged exposure may cause headaches, nausea, dizziness, eye, skin and respiratory irritation.

Numerical measures of toxicity

Acute toxicity

The following values are calculated based on chapter 3.1 of the GHS document .

ATEmix (oral) 13,548.00 mg/kg
ATEmix (dermal) 13,903.00 mg/kg

Unknown acute toxicity No information available

Chemical Name	Oral LD50	Dermal LD50	Inhalation LC50
Glycerine 56-81-5	= 12600 mg/kg (Rat)	> 10 g/kg (Rabbit)	> 570 mg/m^3 (Rat) 1 h
Water 7732-18-5	> 90 mL/kg (Rat)	Not available	Not available
Sodium Chloride 7647-14-5	= 3 g/kg (Rat)	Not available	> 42 g/m^3 (Rat) 1 h
Methanol 67-56-1	= 6200 mg/kg (Rat)	= 15840 mg/kg (Rabbit)	= 22500 ppm (Rat) 8 h

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Skin corrosion/irritation
May cause slight irritation with discomfort and local redness.

Serious eye damage/eye irritation
Symptoms include pain, redness and tearing.

Respiratory or skin sensitization
No information available.

Germ cell mutagenicity
No information available.

Carcinogenicity
No information available.

Chemical Name	ACGIH	IARC	NTP	OSHA
Glycerine 56-81-5	Not available	Not available	Not available	Not available
Water 7732-18-5	Not available	Not available	Not available	Not available
Sodium Chloride 7647-14-5	Not available	Not available	Not available	Not available
Methanol 67-56-1	Not available	Not available	Not available	Not available

Reproductive toxicity
No information available.

Specific target organ systemic toxicity - single exposure
No information available.

Specific target organ systemic toxicity - repeated exposure
No information available.

Aspiration hazard
No information available.

12. ECOLOGICAL INFORMATION

Ecotoxicity

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Chemical Name	Ecotoxicity - Freshwater Algae Data	Ecotoxicity - Fish Species Data	Toxicity to microorganisms	Crustacea
Glycerine 56-81-5	Not available	51 - 57 mL/L LC50 (Oncorhynchus mykiss) 96 h static	Not available	Not available
Water 7732-18-5	Not available	Not available	Not available	Not available
Sodium Chloride 7647-14-5	Not available	5560 - 6080 mg/L LC50 (Lepomis macrochirus) 96 h flow-through 12946 mg/L LC50 (Lepomis macrochirus) 96 h static 6020 - 7070 mg/L LC50 (Pimephales promelas) 96 h static 7050 mg/L LC50 (Pimephales promelas) 96 h semi-static 6420 - 6700 mg/L LC50 (Pimephales promelas) 96 h static 4747 - 7824 mg/L LC50 (Oncorhynchus mykiss) 96 h flow-through	Not available	EC50: =1000mg/L (48h, Daphnia magna) EC50: 340.7 - 469.2mg/L (48h, Daphnia magna)
Methanol 67-56-1	Not available	28200 mg/L LC50 (Pimephales promelas) 96 h flow-through 100 mg/L LC50 (Pimephales promelas) 96 h static 19500 - 20700 mg/L LC50 (Oncorhynchus mykiss) 96 h flow-through 18 - 20 mL/L LC50 (Oncorhynchus mykiss) 96 h static 13500 - 17600 mg/L LC50 (Lepomis macrochirus) 96 h flow-through	Not available	Not available

Persistence and degradability No information available.

Bioaccumulation No information available.

Component Information

Chemical Name	Partition coefficient
Glycerine 56-81-5	-1.76
Water 7732-18-5	Not available
Sodium Chloride 7647-14-5	Not available
Methanol 67-56-1	-0.77

Other adverse effects No information available.

13. DISPOSAL CONSIDERATIONS

Waste treatment methods

Dispose of in accordance with local regulations. Dispose of waste in accordance with environmental legislation.

Do not reuse empty containers.

14. TRANSPORT INFORMATION

TDG (Canada):

UN Number	Not applicable
Shipping name	Not regulated
Class	Not applicable
Packing Group	Not applicable
Marine pollutant	Not available.

DOT (U.S.)

UN Number	Not applicable
Shipping name	Not regulated
Class	Not applicable
Packing Group	Not applicable
Marine pollutant	Not available

15. REGULATORY INFORMATION

Safety, health and environmental regulations/legislation specific for the substance or mixture

U.S. Regulatory Rules

Chemical Name	CERCLA/SARA - Section 302:	SARA (311, 312) Hazard Class:	CERCLA/SARA - Section 313:
Glycerine - 56-81-5	Not Listed	Not Listed	Not Listed
Water - 7732-18-5	Not Listed	Not Listed	Not Listed
Sodium Chloride - 7647-14-5	Not Listed	Not Listed	Not Listed
Methanol - 67-56-1	Not Listed	Listed	Listed

International Inventories

TSCA	Complies
DSL/NDSL	Complies

Legend:
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory

DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

16. OTHER INFORMATION, INCLUDING DATE OF PREPARATION OF THE LAST REVISION

NFPA:	**Health hazards** 0	**Flammability** 0	**Instability** 0	**Physical and chemical properties** -
HMIS Health Rating:	**Health hazards** 0	**Flammability** 0	**Physical hazards** 0	**Personal protection** X

Legend Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

TWA	TWA (time-weighted average)	STEL	STEL (Short Term Exposure Limit)
Ceiling	Maximum limit value	*	Skin designation

Prepared By: The Environment, Health and Safety Department of Univar Canada Ltd.

Preparation Date: 09/Mar/2018
Revision Date: 09/Mar/2018

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End of Safety Data Sheet

SAFETY DATA SHEET

SDS00404
ALS Aluminum Sulphate

Preparation Date: 07/Nov/2017 Version: 3

1. IDENTIFICATION

Product identifier

Product Name ALS Aluminum Sulphate

Other means of identification

Product Code(s) SDS00404

Synonyms none

Recommended use of the chemical and restrictions on use

Recommended Use Water treatment (potable and waste water). Paper applications.

Restricted Uses No information available

Initial Supplier Identifier
Univar Canada Ltd.
9800 Van Horne Way
Richmond, BC V6X 1W5
Telephone: 1-866-686-4827

Emergency telephone number

24 Hour Emergency Phone Number (CANUTEC): 1-888-226-8832 (1-888-CAN-UTEC)

2. HAZARD IDENTIFICATION

Hazardous Classification of the substance or mixture

Corrosive to metals	Category 1
Serious eye damage/eye irritation	Category 1

Label elements

Hazard pictograms

Signal Word: Danger

Hazard statements
May be corrosive to metals
Causes serious eye damage

Precautionary Statements

Prevention
Wash face, hands and any exposed skin thoroughly after handling
Keep only in original container
Wear eye/face protection

Response

IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
If eye irritation persists: Get medical advice/attention
IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower
IF SWALLOWED: Call a POISON CENTER or doctor if you feel unwell
Rinse mouth

In case of fire: Use dry sand, dry chemical or alcohol-resistant foam to extinguish

Storage
Store locked up
Store in a well-ventilated place. Keep container tightly closed

Disposal
Disposal of all wastes must be done in accordance with municipal, provincial and federal regulations

Other Information
Unknown acute toxicity No information available

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substance

Chemical Name	CAS No	Weight-%	Synonyms
Sulfuric acid, aluminum salt	10043-01-3	20 - 30%	Sulfuric acid, aluminum salt

4. FIRST AID

Description of first aid measures

General advice
Show this safety data sheet to the doctor in attendance.

Inhalation
Remove to fresh air.

Eye contact
Rinse thoroughly with plenty of water for at least 15 minutes, lifting lower and upper eyelids. Consult a physician.

Skin contact
Wash with soap and water. Take off contaminated clothing and wash before reuse. Get medical attention if irritation develops and persists.

Ingestion
Do NOT induce vomiting. Clean mouth with water and drink afterwards plenty of water. Never give anything by mouth to an unconscious person. Call a physician.

Most important symptoms and effects, both acute and delayed:
May cause digestive tract irritation. May cause respiratory tract irritation May cause moderate skin irritation. Direct contact may cause moderate irritation.

Indication of any immediate medical attention and special treatment needed:

Note to physicians
Treatment based on sound judgment of physician and individual reactions of patient.

5. FIRE-FIGHTING MEASURES

Suitable Extinguishing Media
Use extinguishing media appropriate for surrounding fire.

Specific hazards arising from the substance or mixture
Use water spray to cool fire-exposed containers and structures. Under fire conditions, toxic, corrosive fumes are emitted.

Hazardous combustion products
Thermal decomposition: after completely dry and heated to decomposition will produce sulphur oxides and aluminum oxides.

Special protective equipment for fire-fighters
Firefighters should wear self-contained breathing apparatus and full firefighting turnout gear. Use personal protection equipment.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Use personal protective equipment as required. Wash thoroughly after handling.

Environmental precautions

Prevent further leakage or spillage if safe to do so. Prevent from entering into soil, ditches, sewers, waterways and/or groundwater. Consult local authorities.

Methods and materials for containment and cleaning up

Small spills: soak up with absorbent material and scoop into containers. Large spills : prevent contamination of waterways. Dike and pump into suitable containers. Clean up residual with absorbent material, place in appropriate container and flush with water. Neutralize with lime or limestone powder.

7. HANDLING AND STORAGE

Precautions for safe handling

Empty containers may contain hazardous product residues. Use appropriate personnel protective equipment. Wash thoroughly after handling. Avoid contact with eyes, skin and clothing.

Conditions for safe storage, including any incompatibilities

Place away from incompatible materials. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid). Suitable material: Stainless steel, rubber-coated steel, plastic, plastic with fiberglass reinforcement. Unsuitable material: Common metal. Do not store in aluminum, copper, copper alloys and galvanized containers. Shelf life: 12 months in original, sealed container. Keep at temperatures between 0 and 30 °C. Reason: Quality.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Exposure Limits .

Chemical Name	Alberta OEL	British Columbia OEL	Ontario	Quebec OEL	Exposure Limit - ACGIH	Immediately Dangerous to Life or Health - IDLH
Sulfuric acid, aluminum salt 10043-01-3	TWA: 2 mg/m^3	Not available	Not available	TWA: 2 mg/m^3	Not available	Not available

Consult local authorities for recommended exposure limits

Appropriate engineering controls

Engineering controls
Local exhaust ventilation as necessary to maintain exposures to within applicable limits.

Individual protection measures, such as personal protective equipment

Eye/face protection
Chemical goggles; also wear a face shield if splashing hazard exists.

Hand protection
Appropriate chemical resistant gloves should be worn.

Skin and body protection
Skin contact should be prevented through the use of suitable protective clothing, gloves and footwear, selected for conditions of use and exposure potential. Consideration must be given both to durability as well as permeation resistance.

Respiratory protection
If exposure exceeds occupational exposure limits, use an appropriate NIOSH-approved respirator.

General hygiene considerations
Handle in accordance with good industrial hygiene and safety practice.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Appearance

Physical state	Liquid
Color	Colorless Clear
Odor	Slight ACIDIC
Odor threshold	No information available

PROPERTIES	Values	Remarks • Method
pH	<2.5	
Melting point / freezing point	-13 °C / 9 °F	
Initial boiling point/boiling range	110 °C / 230 °F	None known
Flash point	No data available	None known
Evaporation rate	similar to water	
Flammability (solid, gas)	No data available	None known
Flammability Limit in Air		None known
Upper flammability limit:	No data available	
Lower flammability limit:	No data available	
Vapor pressure	40 mmHg @ 35°C	
Relative vapor density	No data available	None known
Specific Gravity	1.2 - 1.36	
Water solubility	Completely soluble	
Solubility in other solvents	No data available	
Partition coefficient	No data available	None known
Autoignition temperature	No data available	None known
Decomposition temperature	No data available	None known
Kinematic viscosity	No data available	None known
Dynamic viscosity	No data available	None known
Explosive properties	No information available.	
Oxidizing properties	Not oxidizing.	
Molecular weight	No information available	
VOC Percentage Volatility	No information available	
Liquid Density	No information available	
Bulk density	No information available	

10. STABILITY AND REACTIVITY

Reactivity/Chemical Stability
Stable under normal conditions

Possibility of hazardous reactions
No additional remark.

Conditions to avoid
Avoid contact with mineral acids, excessive heat and bases/alkalis.

Incompatible materials
Metals such as iron or steel which are subject to corrosion. Carbon steel, aluminum, carbon, brasses and nylon.

Hazardous decomposition products

Thermal decomposition: after completely dry and heated to decomposition will produce sulphur oxides and aluminum oxides. Decomposition : 650 °C/ 1202 °F.

11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure

Inhalation
May cause respiratory tract irritation.

Eye contact
Direct contact may cause moderate irritation.

Skin contact
May cause moderate skin irritation.

Ingestion
May cause digestive tract irritation.

Information on toxicological effects

Symptoms
No additional information available.

Numerical measures of toxicity

Acute toxicity

The following values are calculated based on chapter 3.1 of the GHS document .
ATEmix (oral) 1,930.00 mg/kg

Unknown acute toxicity No information available

Chemical Name	Oral LD50	Dermal LD50	Inhalation LC50
Sulfuric acid, aluminum salt 10043-01-3	= 1930 mg/kg (Rat)	Not available	Not available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Skin corrosion/irritation
May cause moderate skin irritation.

Serious eye damage/eye irritation
Direct contact may cause moderate irritation.

Respiratory or skin sensitization
No information available.

Germ cell mutagenicity
No information available.

Carcinogenicity
No information available.

Chemical Name	ACGIH	IARC	NTP	OSHA
Sulfuric acid, aluminum salt 10043-01-3	Not available	Not available	Not available	Not available

Reproductive toxicity
No information available.

Specific target organ systemic toxicity - single exposure
No information available.

Specific target organ systemic toxicity - repeated exposure
No information available.

Aspiration hazard
No information available.

12. ECOLOGICAL INFORMATION

Ecotoxicity
May lower pH of waterways and adversely effect aquatic life.

Chemical Name	Ecotoxicity - Freshwater Algae Data	Ecotoxicity - Fish Species Data	Toxicity to microorganisms	Crustacea
Sulfuric acid, aluminum salt 10043-01-3	Not available	Not available	Not available	Not available

Persistence and degradability No information available.

Bioaccumulation No information available.

Chemical Name	Partition coefficient
Sulfuric acid, aluminum salt 10043-01-3	Not available

Other adverse effects No information available.

13. DISPOSAL CONSIDERATIONS

Waste treatment methods

Dispose of in accordance with local regulations. Dispose of waste in accordance with environmental legislation.

Do not reuse empty containers.

14. TRANSPORT INFORMATION

TDG (Canada):

UN Number	UN3264
Shipping name	CORROSIVE LIQUID, ACIDIC, INORGANIC, N.O.S. (ALUMINUM SULPHATE)
Class	8
Packing Group	III
Marine pollutant	Not available.

DOT (U.S.)

UN Number	UN3264
Shipping name	CORROSIVE LIQUID, ACIDIC, INORGANIC, N.O.S. (ALUMINUM SULPHATE)
Class	8

Packing Group	III
Marine pollutant	Not available

15. REGULATORY INFORMATION

Safety, health and environmental regulations/legislation specific for the substance or mixture

NSF International

Additional information
Maximum use for potable water 400 mg/L. Only products bearing the NSF Mark on the product, product packaging, and/or documentation shipped with the product are Certified.

U.S. Regulatory Rules

Chemical Name	CERCLA/SARA - Section 302:	SARA (311, 312) Hazard Class:	CERCLA/SARA - Section 313:
Sulfuric acid, aluminum salt - 10043-01-3	Not Listed	Listed	Not Listed

International Inventories

TSCA	Complies
DSL/NDSL	Complies

Legend:
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

16. OTHER INFORMATION, INCLUDING DATE OF PREPARATION OF THE LAST REVISION

NFPA:	**Health hazards** 1	**Flammability** 0	**Instability** 0	**Physical and chemical properties** -
HMIS Health Rating:	**Health hazards** 1	**Flammability** 0	**Physical hazards** 0	**Personal protection** X

Legend Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

TWA	TWA (time-weighted average)	STEL	STEL (Short Term Exposure Limit)
Ceiling	Maximum limit value	*	Skin designation

Prepared By: The Environment, Health and Safety Department of Univar Canada Ltd.

Preparation Date: 07/Nov/2017
Revision Date: 07/Nov/2017

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End of Safety Data Sheet

SAFETY DATA SHEET

SDS00256
SODA ASH 58% DENSE

Preparation Date: 10/Jan/2018 Version: 2

1. IDENTIFICATION

Product identifier

Product Name SODA ASH 58% DENSE

Other means of identification

Product Code(s) SDS00256

Synonyms Sodium carbonate, anhydrous. Carbonic acid, disodium salt; Disodium carbonate; Soda ash

Recommended use of the chemical and restrictions on use

Recommended Use Soda salts. Manufacture of glass. Soap Cleaners and water softeners. Pulp and paper. Photographical agent. Water treatment. pH adjustment

Restricted Uses No information available

Initial Supplier Identifier
Univar Canada Ltd.
9800 Van Horne Way
Richmond, BC V6X 1W5
Telephone: 1-866-686-4827

Emergency telephone number

24 Hour Emergency Phone Number (CANUTEC): 1-888-226-8832 (1-888-CAN-UTEC)

2. HAZARD IDENTIFICATION

Hazardous Classification of the substance or mixture

Serious eye damage/eye irritation	Category 1
Specific target organ toxicity (single exposure)	Category 3

Label elements

Hazard pictograms

Signal Word: Danger

Hazard statements
Causes serious eye damage
May cause respiratory irritation

Precautionary Statements

Prevention
Do not breathe dust/fume/gas/mist/vapors/spray
Wash face, hands and any exposed skin thoroughly after handling
Wear protective gloves/protective clothing/eye protection/face protection

IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water or shower
IF INHALED: Remove person to fresh air and keep comfortable for breathing
IF SWALLOWED: Rinse mouth. DO NOT induce vomiting

Storage
Store locked up
Store in a well-ventilated place. Keep container tightly closed

Disposal
Disposal of all wastes must be done in accordance with municipal, provincial and federal regulations

Direct skin contact may cause slight or mild, transient irritation. Ingestion may cause gastrointestinal irritation, nausea, vomiting and diarrhea.

Unknown acute toxicity No information available

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substance

Chemical Name	CAS No	Weight-%	Synonyms
Sodium Carbonate	497-19-8	90 - 100%	Sodium Carbonate

4. FIRST AID

Description of first aid measures

General advice
Immediate medical attention is required. Show this safety data sheet to the doctor in attendance.

Inhalation
Remove to fresh air. If breathing has stopped, give artificial respiration. Get medical attention immediately. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, (trained personnel should) give oxygen. Delayed pulmonary edema may occur.

Eye contact
Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Keep eye wide open while rinsing. Do not rub affected area. Remove contact lenses, if present and easy to do. Continue rinsing. Get immediate medical advice/attention.

Skin contact
Wash off immediately with soap and plenty of water while removing all contaminated clothes and shoes. Get immediate medical advice/attention.

Ingestion
Do NOT induce vomiting. Clean mouth with water and drink afterwards plenty of water. Never give anything by mouth to an unconscious person. Get immediate medical advice/attention.

Self-protection of the first aider
Ensure that medical personnel are aware of the material(s) involved, take precautions to protect themselves and prevent spread of contamination. Avoid contact with skin, eyes or clothing. Avoid direct contact with skin. Use barrier to give mouth-to-mouth resuscitation. Wear personal protective clothing (see section 8).

Most important symptoms and effects, both acute and delayed:
May cause gastrointestinal irritation, nausea, vomiting and diarrhea. May cause severe eye irritation. Symptoms include redness, swelling, itching and pain. Material is irritating to mucous membrane and upper respiratory tract. Exposure can cause coughing, chest pains and difficulty in breathing Effects may include pain, marked redness and swelling.

Indication of any immediate medical attention and special treatment needed:

Note to physicians
Treatment based on sound judgment of physician and individual reactions of patient.

5. FIRE-FIGHTING MEASURES

Suitable Extinguishing Media
Use extinguishing media appropriate for surrounding fire. Does not burn.

Specific hazards arising from the substance or mixture
Not flammable.

Hazardous combustion products
Carbon dioxide. Decomposition temperature: >400°C / 752 °F.

Special protective equipment for fire-fighters
Firefighters should wear self-contained breathing apparatus and full firefighting turnout gear. Use personal protection equipment.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Attention! Corrosive material. Avoid contact with skin, eyes or clothing. Ensure adequate ventilation. Use personal protective equipment as required. Evacuate personnel to safe areas. Keep people away from and upwind of spill/leak.

Environmental precautions

Prevent further leakage or spillage if safe to do so. Should not be released into the environment. Do not allow to enter into soil/subsoil. Prevent product from entering drains.

Methods and materials for containment and cleaning up

Stop leak if you can do it without risk. Shovel, sweep up or use industrial vacuum cleaner to pick up. Sweep up and place in an appropriate closed container. Avoid raising dust.

7. HANDLING AND STORAGE

Precautions for safe handling

Use good personal hygiene. Avoid prolonged contact with eyes or prolonged skin contact. Avoid breathing in dust. When dissolving, add to water cautiously while stirring; solutions can get hot.

Conditions for safe storage, including any incompatibilities

Store in a cool, dry, well ventilated area. Prolonged storage may cause product to cake and become damp from atmospheric moisture. Store away from acids.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Exposure Limits This product, as supplied, does not contain any hazardous materials with occupational exposure limits established by the region specific regulatory bodies.

Chemical Name	Alberta OEL	British Columbia OEL	Ontario	Quebec OEL	Exposure Limit - ACGIH	Immediately Dangerous to Life or Health - IDLH
Sodium Carbonate 497-19-8	Not available	Not available	Not available	Not available	Not available	Not available

Consult local authorities for recommended exposure limits

Appropriate engineering controls

Engineering controls
Local exhaust ventilation as necessary to maintain exposures to within applicable limits.

Individual protection measures, such as personal protective equipment

Eye/face protection
Safety glasses with side shields or chemical goggles.

Hand protection
Appropriate chemical resistant gloves should be worn. Break through time >8 hours. Butyl rubber gloves. Natural rubber gloves. Neoprene gloves. Nitrile gloves. Polyvinylchloride (PVC) gloves. Viton gloves. Silver Shield (R). NOTICE: The selection of a specific glove for a particular application and duration of use in a workplace should also take into account all relevant workplace factors such as, but not limited to: Other chemicals which may be handled, physical requirements (cut/puncture protection, dexterity, thermal protection), potential body reactions to glove materials as well as the instructions/specifications provided by the glove supplier.

Skin and body protection
As a minimum, wear long-sleeve shirts, trousers, and gloves for routine product use.

Respiratory protection
For dusty or misty conditions, wear NIOSH-approved dust or mist respirator.

General hygiene considerations
Avoid contact with skin, eyes or clothing. Wear suitable gloves and eye/face protection. Do not eat, drink or smoke when using this product. Remove and wash contaminated clothing and gloves, including the inside, before re-use. Contaminated work clothing should not be allowed out of the workplace. Regular cleaning of equipment, work area and clothing is recommended. Wash hands before breaks and immediately after handling the product.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Appearance	
Physical state	Solid
Color	White
Odor	Odorless
Odor threshold	No information available

PROPERTIES	Values	Remarks • Method
pH	11.3-11.4 (1% solution), 11.6 (5% solution), 11.7 (10% solution) @ 20°C	
Melting point / freezing point	851 °C / 1563.8 °F	
Initial boiling point/boiling range	No data available	None known
Flash point	No data available	None known
Evaporation rate	No data available	None known
Flammability (solid, gas)	No data available	None known
Flammability Limit in Air		
Upper flammability limit:	No data available	
Lower flammability limit:	No data available	
Vapor pressure	No data available	None known
Relative vapor density	No data available	None known
Specific Gravity	2.533 @ 20°C	
Water solubility	Soluble in water	
Solubility in other solvents	No data available	
Partition coefficient	No data available	
Autoignition temperature	No data available	None known
Decomposition temperature	>400°C/752°F	
Kinematic viscosity	No data available	None known
Dynamic viscosity	No data available	None known
Explosive properties	No information available.	
Oxidizing properties	No information available.	

Molecular weight	105.99
VOC Percentage Volatility	No information available
Liquid Density	No information available
Bulk density	No information available

10. STABILITY AND REACTIVITY

Reactivity/Chemical Stability
Stable

Possibility of hazardous reactions
Contact with acids will release carbon dioxide gas. Can react violently with red hot aluminum metal; fluorine gas; lithium; and 2,4,6-trinitrotoluene.

Hazardous polymerization
Will not occur.

Conditions to avoid
Hygroscopic (absorbs moisture from the air). Simultaneous exposure to soda ash and lime dusts (CaO). In the presence of moisture (i.e. perspiration) the two materials combine to form corrosive caustic soda (NaOH) which may cause burns.

Incompatible materials
Acids. Soda Ash is corrosive to aluminum, lead, and zinc and zinc brasses when in solution and to aluminum when high humidity is present. Silver nitrate. Magnesium. Fluorine. Lithium. Calcium hypochlorite.

Hazardous decomposition products
Carbon dioxide. Decomposition temperature: >400°C / 752 °F.

11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure

Inhalation
Material is irritating to mucous membrane and upper respiratory tract. Exposure can cause coughing, chest pains and difficulty in breathing.

Eye contact
Causes serious eye damage. Effects may include pain, marked redness and swelling.

Skin contact
Symptoms include redness, swelling, itching and pain.

Ingestion
May cause gastrointestinal irritation, nausea, vomiting and diarrhea.

Information on toxicological effects

Symptoms
Excessive contact may produce "soda ulcers" on hands and perforation of the nasal septum. Sensitivity reactions may occur from prolonged and repeated exposure.

Numerical measures of toxicity

Acute toxicity

The following values are calculated based on chapter 3.1 of the GHS document .
ATEmix (oral) 4,098.00 mg/kg

Unknown acute toxicity No information available

Chemical Name	Oral LD50	Dermal LD50	Inhalation LC50
Sodium Carbonate 497-19-8	= 4090 mg/kg (Rat)	Not available	= 2300 mg/m^3 (Rat) 2 h

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Skin corrosion/irritation
Symptoms include redness, swelling, itching and pain.

Serious eye damage/eye irritation
Causes serious eye damage. Effects may include pain, marked redness and swelling.

Respiratory or skin sensitization

No information available.

Germ cell mutagenicity
No information available.

Carcinogenicity
No information available.

Chemical Name	ACGIH	IARC	NTP	OSHA
Sodium Carbonate 497-19-8	Not available	Not available	Not available	Not available

Reproductive toxicity
No information available.

Specific target organ systemic toxicity - single exposure
May cause respiratory irritation.

Specific target organ systemic toxicity - repeated exposure
No information available.

Aspiration hazard
No information available.

12. ECOLOGICAL INFORMATION

Ecotoxicity

.

Chemical Name	Ecotoxicity - Freshwater Algae Data	Ecotoxicity - Fish Species Data	Toxicity to microorganisms	Crustacea
Sodium Carbonate 497-19-8	Not available	310 - 1220 mg/L LC50 (Pimephales promelas) 96 h static 300 mg/L LC50 (Lepomis macrochirus) 96 h static	Not available	EC50: =265mg/L (48h, Daphnia magna)

Persistence and degradability No information available.

Bioaccumulation No information available.

Chemical Name	Partition coefficient
Sodium Carbonate 497-19-8	Not available

Other adverse effects No information available.

13. DISPOSAL CONSIDERATIONS

Waste treatment methods

Disposal of all wastes must be done in accordance with municipal, provincial and federal regulations.

Do not reuse empty containers.

14. TRANSPORT INFORMATION

TDG (Canada):

UN Number	Not applicable
Shipping name	Not regulated
Class	Not applicable
Packing Group	Not applicable
Marine pollutant	Not available.

DOT (U.S.)

UN Number	Not applicable
Shipping name	Not regulated
Class	Not applicable
Packing Group	Not applicable
Marine pollutant	Not available

15. REGULATORY INFORMATION

Safety, health and environmental regulations/legislation specific for the substance or mixture

NSF International

Certified to NSF/ANSI 60

Additional information
Only products bearing the NSF Mark on the product, product packaging, and/ordocumentation shipped with the product are Certified. Maximum use of potable water 100 mg/L.

U.S. Regulatory Rules

Chemical Name	CERCLA/SARA - Section 302:	SARA (311, 312) Hazard Class:	CERCLA/SARA - Section 313:
Sodium Carbonate - 497-19-8	Not Listed	Not Listed	Not Listed

International Inventories

TSCA	Complies
DSL/NDSL	Complies

Legend:
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

16. OTHER INFORMATION, INCLUDING DATE OF PREPARATION OF THE LAST REVISION

NFPA:	**Health hazards** 3	**Flammability** 0	**Instability** 0	**Physical and chemical properties** -
HMIS Health Rating:	**Health hazards** 3	**Flammability** 0	**Physical hazards** 0	**Personal protection** X

Legend Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

TWA	TWA (time-weighted average)	STEL	STEL (Short Term Exposure Limit)
Ceiling	Maximum limit value	*	Skin designation

Prepared By: The Environment, Health and Safety Department of Univar Canada Ltd.

Preparation Date: 10/Jan/2018
Revision Date: 10/Jan/2018

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End of Safety Data Sheet

MATERIAL SAFETY DATA SHEET

Revision date: *06/15/2011* **Revision number:** *3*

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name BioRemove 5895

Contact Manufacturer

Novozymes Biologicals Inc.
5400 Corporate Circle
Salem, VA, USA 24153

Information Telephone Number 1-540-389-9361

Emergency Telephone Number 1-800-424-9300 (Chemtrec) 24 hours every day

Health Hazard	1
Fire Hazard	0
Reactivity	0

2. HAZARDS IDENTIFICATION

CAUTION

Emergency Overview

Contact may cause eye and skin irritation

Appearance Opaque **Physical State** Liquid **Odor** Slight fermentation odor

Potential Health Effects

Principle Routes of Exposure Eye contact, Skin contact, Inhalation

Acute Effects

Eyes May cause slight irritation
Skin Substance may cause slight skin irritation
Inhalation May cause irritation of respiratory tract
Ingestion Ingestion may cause gastrointestinal irritation, nausea, vomiting and diarrhoea

Chronic Effects

Chronic Toxicity No information available

See Section 11 for additional Toxicological information.

Aggravated Medical Conditions No information available

Potential Environmental Effects There is no known ecological information for this product
See Section 12 for additional Ecological information

3. COMPOSITION/INFORMATION ON INGREDIENTS

Hazardous Components

Chemical Name	CAS-No	Weight %
Water	7732-18-5	95-100%
Viable Bacteria Cultures	Not Applicable	1-5%

Ingredients not listed are either non-hazardous or under reportable concentrations

4. FIRST AID MEASURES

Eye Contact Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician

Skin Contact Wash off immediately with soap and plenty of water

Inhalation Move to fresh air

Ingestion Clean mouth with water and afterwards drink plenty of water

Notes to Physician Treat symptomatically

5. FIRE-FIGHTING MEASURES

Flammable Properties	Slightly flammable according to HMIS criteria
Suitable Extinguishing Media	Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.
Unsuitable Extinguishing Media	None
Hazardous Combustion Products	None
Specific Hazards Arising from the Chemical	May cause allergic respiratory reaction.
Protective Equipment and Precautions for Firefighters	Self-contained breathing apparatus and standard turn-out apparel

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions	For personal protection see section 8
Environmental Precautions	Spilled preparation should be removed immediately to avoid formation of dust from dried preparation. Take up by mechanical means preferably by a vacuum cleaner equipped with a high efficiency filter. Flush remainder carefully with plenty of water. Avoid splashing and high pressure washing (avoid formation of aerosols). Ensure sufficient ventilation. Wash contaminated clothing. .
Methods for cleaning up	Avoid formation of dust and aerosols Spilled preparation should be removed immediately to avoid formation of dust from dried preparation. Take up by mechanical means preferably by a vacuum cleaner equipped with a HEPA (High Efficiency Particulate Air) filter. Flush remainder carefully with plenty of water. Avoid splashing, high pressure washing or compressed air cleaning to avoid formation of aerosols. Ensure sufficient ventilation. Wash contaminated clothing.

For personal protection see section 8

7. HANDLING AND STORAGE

Handling	Avoid formation of dust and aerosols Ensure adequate ventilation
General Precautions	The Substance should be handled under conditions of good industrial hygiene and in conformity with any local regulations in order to avoid unnecessary exposure..
Storage	Keep tightly closed in a dry and cool place.
Temperature	Keep in a dry, cool and well-ventilated place.
Storage Conditions	In unbroken packaging - dry and protect from the sun. The product has been formulated for optimal stability. Extended storage or adverse conditions such as higher temperatures or higher humidity may lead to a higher dosage requirement.
Conditions To Avoid	Avoid Temperatures above 45 C to preserve biological stability. Avoid freezing temperatures. Strong Acids or alkali compounds may inactivate biological cultures. Avoid strong oxidizing agents.
Incompatible Materials	Strong acids or alkali compounds may inactivate biological cultures

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Occupational exposure controls

Engineering Controls	Ensure adequate ventilation, especially in confined areas Maintain good conditions of industrial hygiene. Some processes may require enclosures, local exhaust ventilation, or other engineering controls to control airborne levels. Additional handling and healthy/safety information is available upon request

Personal Protective Equipment

Respiratory Protection	In case of insufficient ventilation wear suitable respiratory equipment that meets HEPA/P100 specifications
Eye Protection	Safety glasses with side-shields
Skin Protection	Long sleeved clothing
Hand Protection	Protective gloves
General Hygiene Considerations	Handle in accordance with good industrial hygiene and safety practices
Environmental exposure controls	Local authorities should be advised if significant spillages cannot be contained

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	Opaque
Physical State	Liquid
Odor	Slight fermentation odor
pH	7.0-8.0
Boiling Point/Range	No information available
Melting Point/Range	No information available
Flash Point	No information available
Flammability (solid, gas)	No information available
Explosive Properties	No information available
Oxidizing Properties	No information available
Vapor Pressure	No information available
Relative density	No data available
Solubility	No information available
Partition Coefficient (n-octanol/water)	No information available

The physical data presented above are typical values and should not be construed as a specification

10. STABILITY AND REACTIVITY

Chemical stability	Stable under recommended storage conditions
Conditions to Avoid	Stable under normal conditions Excessive temperature variations below 32F or above 155F
Materials to avoid	None
Hazardous Decomposition Products	None
Possibility of Hazardous Reactions	None

11. TOXICOLOGICAL INFORMATION

Acute Toxicity

Ingestion, LD50 Rat Oral (mg/kg):	Not Determined
Inhalation, LC50 Rat inhalation (mg/l/4hr)	Not Determined
Skin, LD50 Rat Dermal (mg/kg)	Not Determined
Eye Irritation	Not Determined

Chronic Toxicity

Sensitization	According to our experience and to the information provided to us, the product does not have any harmful effects if it is used and handled as specified

This product is formulated using a range of microorganisms specially selected from the natural environment

12. ECOLOGICAL INFORMATION

Ecotoxicity

This product is not expected to pose an environmental hazard. No Toxicity Data is available specifically for soil organisms, plants and terrestrial animals.

Environmental Effects	The data available do not support any environmental hazard
Persistence/Degradability	The organic components of the product are biodegradable.
Bioaccumulative Potential	According to experience not expected
Mobility	Not available
Other adverse effects	No known effect

13. DISPOSAL CONSIDERATIONS

Waste Disposal Method	Dispose of contents/container in accordance with local regulation.
Contaminated Packaging	Dispose of wastes in an approved waste disposal facility.

14. TRANSPORT INFORMATION

Transport Regulations	Not dangerous goods
IMDG/IMO	Not regulated
RID	Not regulated
ADR	Not regulated
ICAO	Not regulated
IATA	Not regulated
DOT	Not regulated

15. REGULATORY INFORMATION

International Inventories

TSCA	Complies
PICCS	Complies
KECL	Complies
ENCS	Complies
CHINA	Complies
AICS	Complies
DSL/NDSL	Complies

USA, Federal Regulations

SARA 313
Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product does not contain any chemicals which are subject to the reporting requirements of the Act and 40 CFR Part 372.

SARA 311/312 Hazardous Categorization

Acute Health Hazard	No
Chronic Health Hazard	No
Fire Hazard	No
Sudden Release of Pressure Hazard	No
Reactive Hazard	No

USA, State Regulations

California Proposition 65 This product contains the following Proposition 65 chemicals:

Canada

WHMIS Hazard Class Controlled product hazard class D2 A (respiratory sensitizer)

WHMIS Statement This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the SDS contains all the information required by the CPR.

16. OTHER INFORMATION

Disclaimer

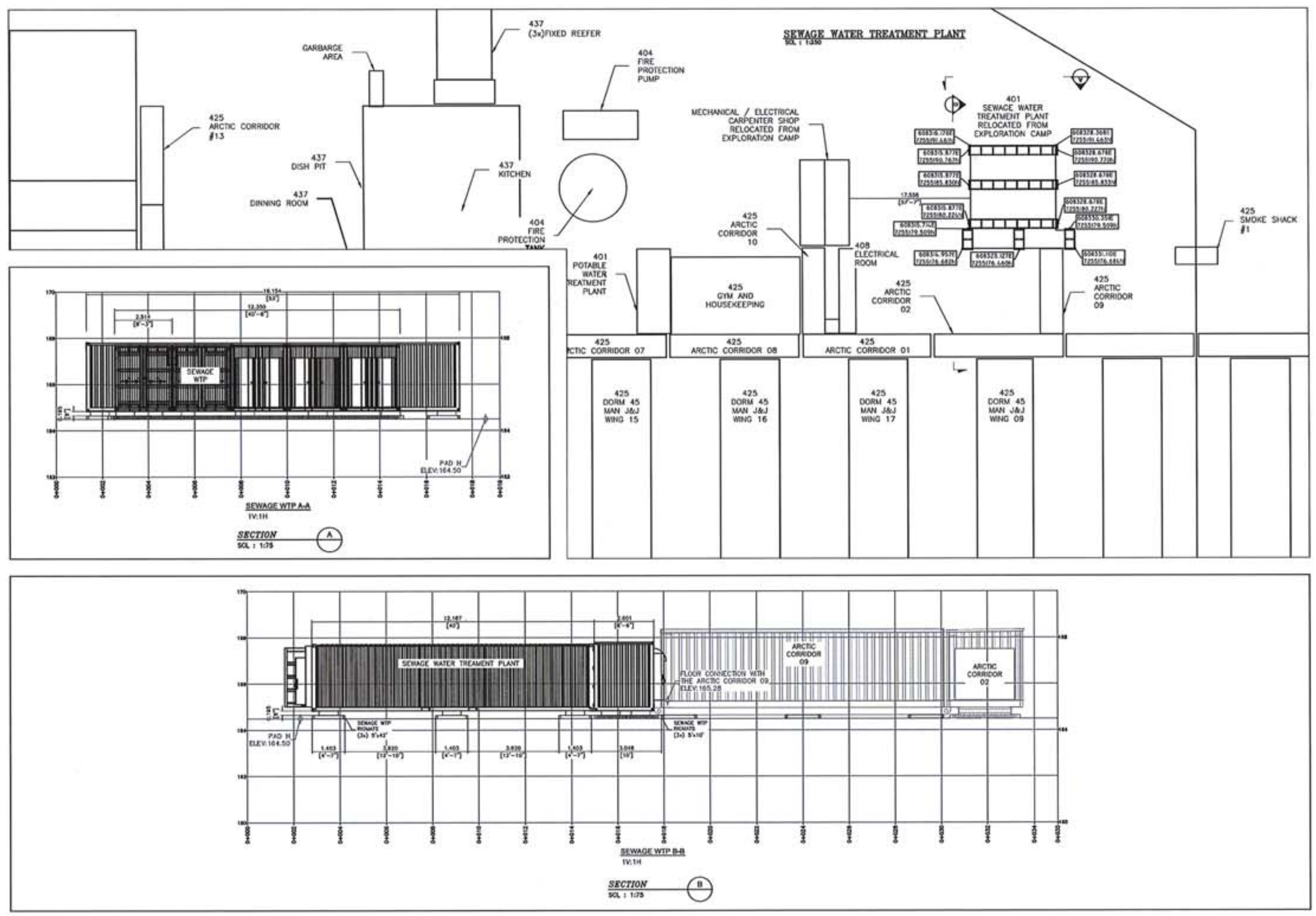
The information provided on this MSDS is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guide for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered as a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other material or in any process, unless specified in the text. Furthermore, as the conditions of use are beyond the control of Novozymes, it is the responsibility of the customer to determine the conditions of safe use of these products.

Report version 1 / ANSI / English

End of Material Safety Data Sheet

Appendix B: Drawings

61-401-230-003_R0



NOTES GÉNÉRALES / GENERAL NOTES

- VALIDATE THE LOCATION OF THE SEWAGE WTP DOORS IN RELATION WITH THE ARCTIC CORRIDOR 09.

POUR CONSTRUCTION
FOR CONSTRUCTION
DATE : 2018-12-13

DESSINS EN RÉFÉRENCE / REFERENCE DRAWINGS

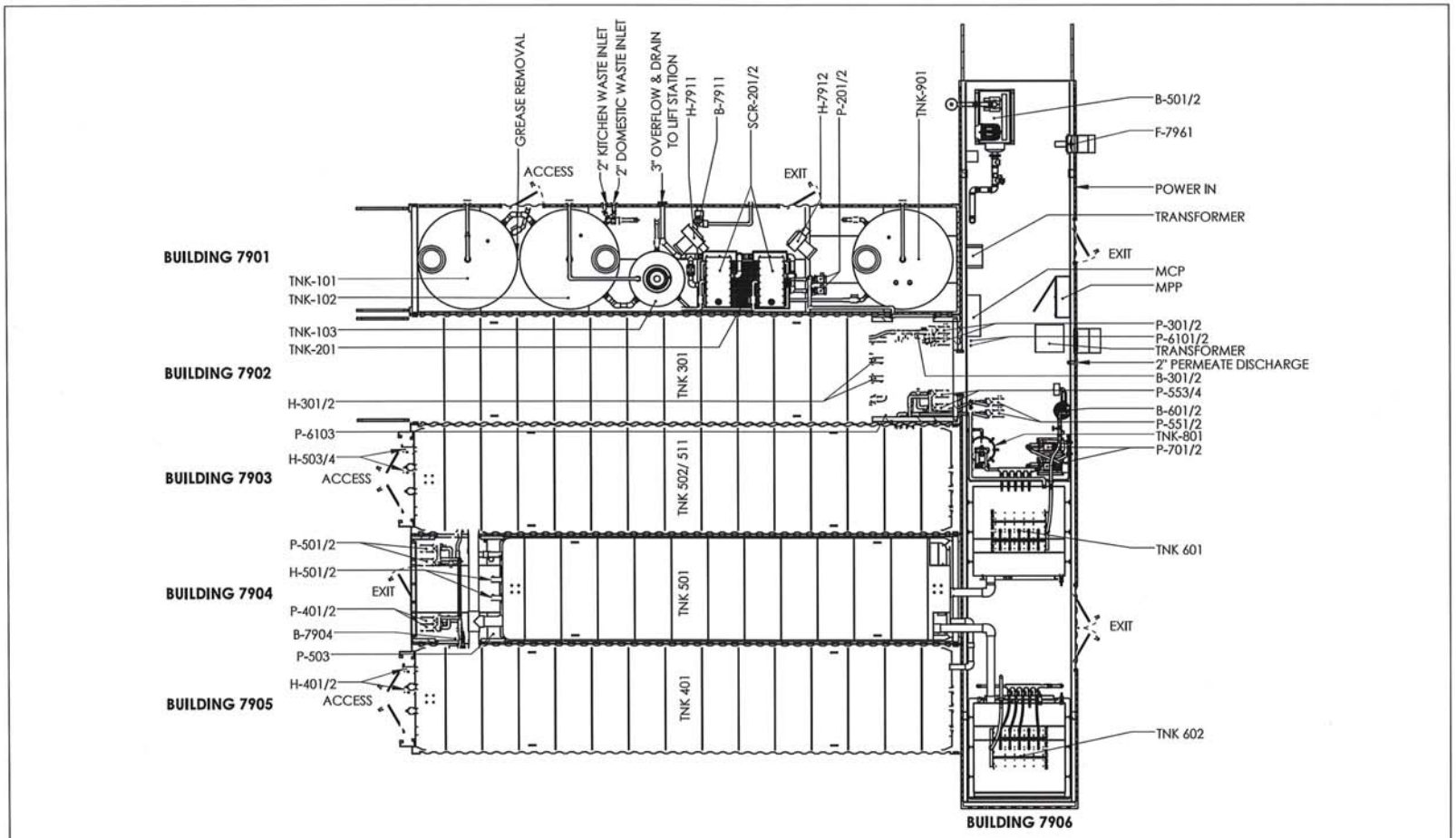
AGNICO EAGLE

REVISIONS

AMARUQ PROJECT

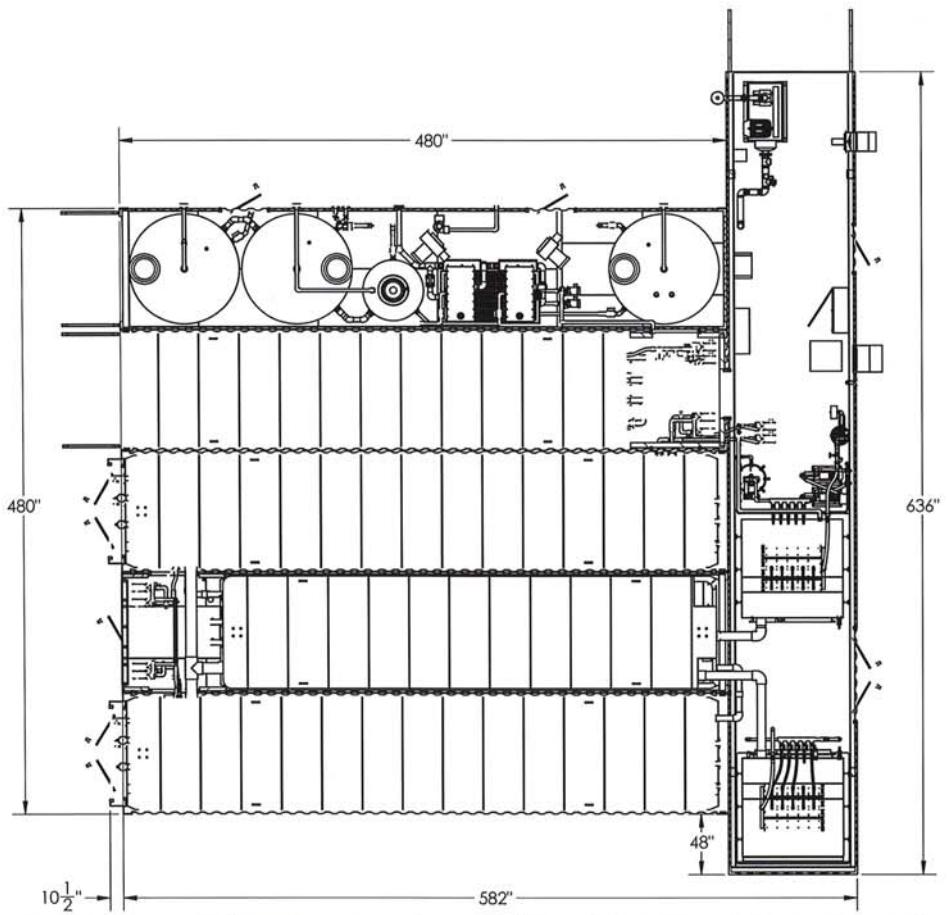
AGNICO EAGLE – MEADOWBANK DIVISION
401 – WATER
230 – GENERAL EARTH WORKS
PLAN
OPERATION CAMP – SEWAGE WATER TREATMENT PLANT
2018 INSTALLATION PLAN

DRAWN BY	L. R. FRENETTE	DATE	2018-11-19
CHECKED BY	D. LAFLAMME		2018-11-19
APPROVED BY	D. LAFLAMME		2018-11-19
SCALE	AS SHOWN	DATE	2018-11-19
DRAWING NO.	61-401-230-003		
PROJECT NO.	6115	REVISION 0	1/1



GENERAL TOLERANCES .XX ± 1/8" .XXX ± 1/16" UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES				DWG. NO:	1704432
	C1	11/08/17	AH	AS BUILT	
	B1	07/06/17	GH	FOR PRODUCTION	TITLE: SYSTEM LAYOUT
	B	06/06/17	GH	FOR PRODUCTION	
	A2	25/05/17	GH	REVISED LAYOUT	CUSTOMER: AGNICO EAGLE
	A	19/05/2017	GH	FOR REVIEW	DRAWN BY: GH
	LEVEL	DATE	BY	REVISION	DATE: 19/05/17

SHEET 1 OF 4

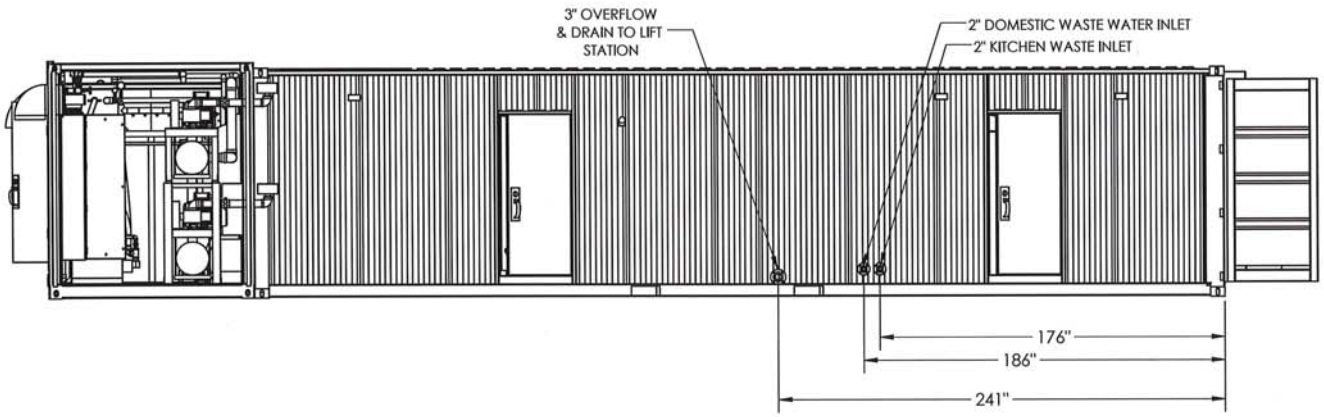


GENERAL TOLERANCES
.XX ± 1/8"
.XXX ± 1/16"
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES

newterra

LEVEL	DATE	BY	REVISION
C1	11/08/17	AH	AS BUILT
B1	07/06/17	GH	FOR PRODUCTION
B	06/06/17	GH	FOR PRODUCTION
A2	25/05/17	GH	REVISED LAYOUT
A	19/05/2017	GH	FOR REVIEW

DWG. NO:
PROJECT NUMBER: 1704432
TITLE: SYSTEM LAYOUT
CUSTOMER: AGNICO EAGLE
DRAWN BY: GH
DATE: 19/05/17
SHEET 2 OF 4

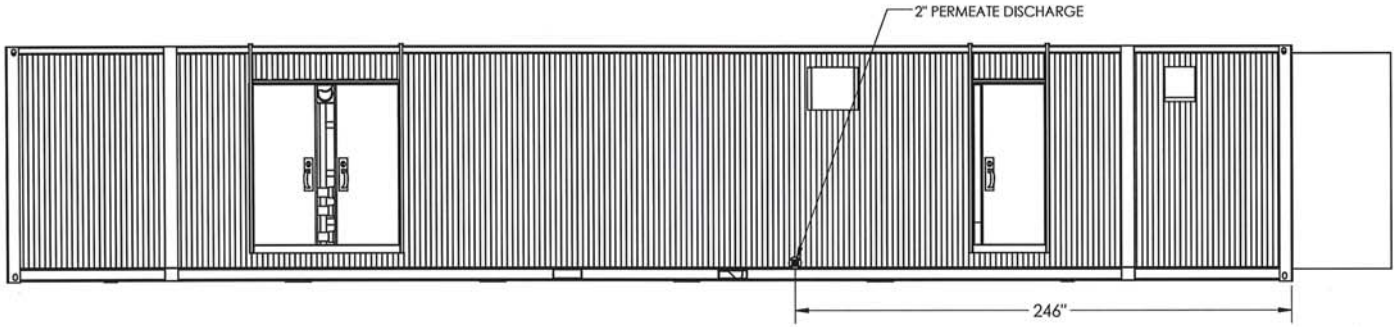


GENERAL TOLERANCES
.XX ± 1/8"
.XXX ± 1/16"
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES

newterra

LEVEL	DATE	BY	REVISION
C1	11/08/17	AH	AS BUILT
B1	07/06/17	GH	FOR PRODUCTION
B	06/06/2017	GH	FOR PRODUCTION

DWG. NO:
PROJECT NUMBER: 1704432
TITLE: SYSTEM LAYOUT
CUSTOMER: AGNICO EAGLE
DRAWN BY: GH
DATE: 06/06/17



GENERAL TOLERANCES
.XX ± 1/8"
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UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES

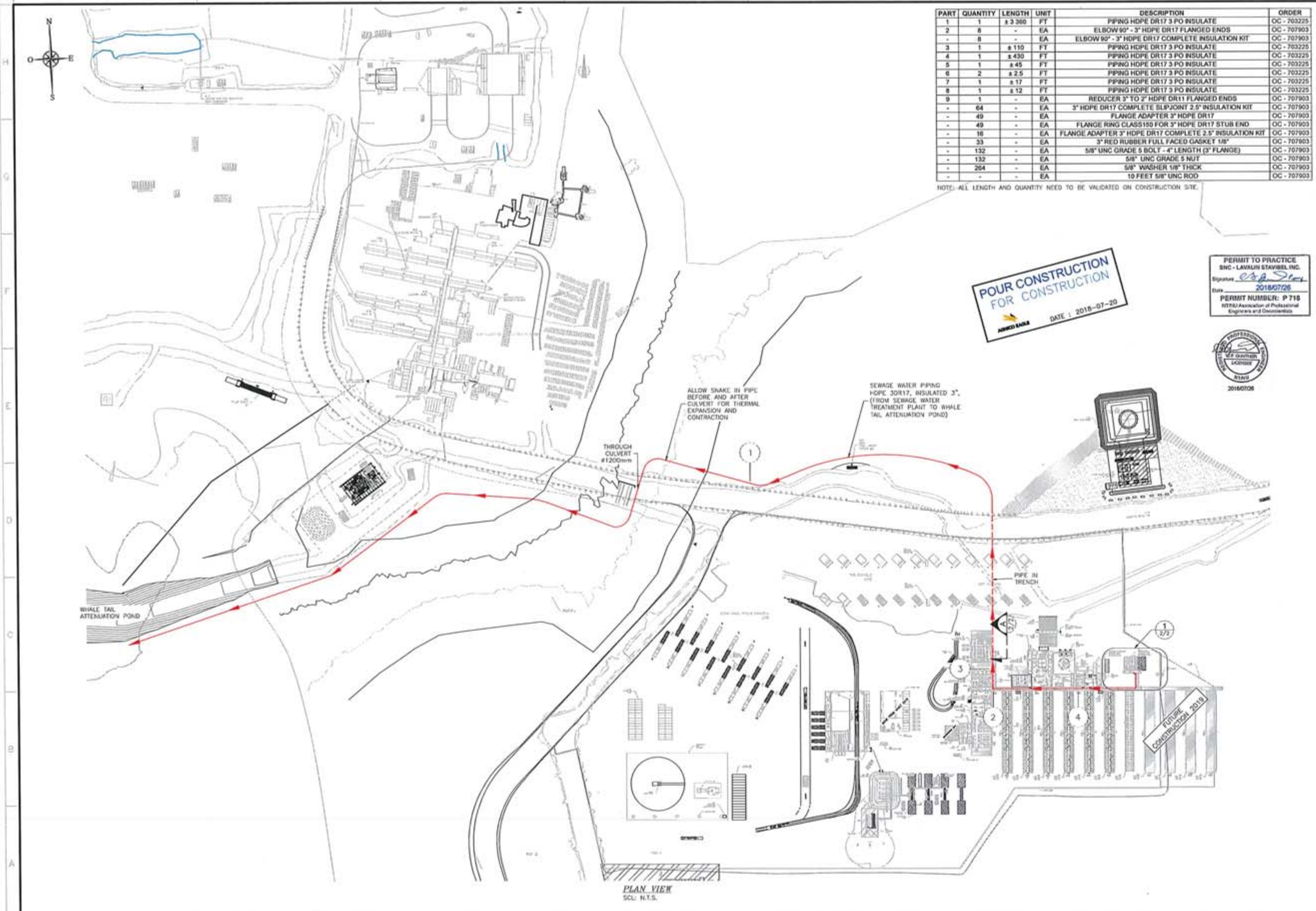
LEVEL	DATE	BY	REVISION
C1	11/08/17	AH	AS BUILT
B1	07/06/17	GH	FOR PRODUCTION
B	06/08/2017	GH	FOR PRODUCTION

DWG. NO:
PROJECT NUMBER: 1704432
TITLE: SYSTEM LAYOUT
CUSTOMER: AGNICO EAGLE
DRAWN BY: GH
DATE: 06/06/17
SHEET 4 OF 4

NO. DESSIN / DRAWING NO. 61-460-270-201-1_R0

PART	QUANTITY	LENGTH	UNIT	DESCRIPTION	ORDER
1	1	± 3 360	FT	PIPING HDPE DR17 3 PO INSULATE	OC - 703225
2	8	-	EA	ELBOW 90° - 3" HDPE DR17 FLANGED ENDS	OC - 707903
-	8	-	EA	ELBOW 90° - 3" HDPE DR17 COMPLETE INSULATION KIT	OC - 707903
3	1	± 110	FT	PIPING HDPE DR17 3 PO INSULATE	OC - 703225
4	1	± 430	FT	PIPING HDPE DR17 3 PO INSULATE	OC - 703225
5	1	± 45	FT	PIPING HDPE DR17 3 PO INSULATE	OC - 703225
6	2	± 2.5	FT	PIPING HDPE DR17 3 PO INSULATE	OC - 703225
7	1	± 17	FT	PIPING HDPE DR17 3 PO INSULATE	OC - 703225
8	1	± 12	FT	PIPING HDPE DR17 3 PO INSULATE	OC - 703225
9	1	-	EA	REDUCER 3" TO 2" HDPE DR11 FLANGED ENDS	OC - 707903
-	64	-	EA	3" HDPE DR17 COMPLETE SLIPJOINT 2.5" INSULATION KIT	OC - 707903
-	49	-	EA	FLANGE ADAPTER 3" HDPE DR17	OC - 707903
-	49	-	EA	FLANGE RING CLASS150 FOR 3" HDPE DR17 STUB END	OC - 707903
-	16	-	EA	FLANGE ADAPTER 3" HDPE DR17 COMPLETE 2.5" INSULATION KIT	OC - 707903
-	33	-	EA	3" RED RUBBER FULL FACED GASKET 1/8"	OC - 707903
-	132	-	EA	5/8" UNC GRADE 5 BOLT - 4" LENGTH (3" FLANGE)	OC - 707903
-	132	-	EA	5/8" UNC GRADE 5 NUT	OC - 707903
-	264	-	EA	5/8" WASHER 1/8" THICK	OC - 707903
-	-	-	EA	10 FEET 5/8" UNC ROD	OC - 707903

NOTE: ALL LENGTH AND QUANTITY NEED TO BE VALIDATED ON CONSTRUCTION SITE.



PLAN VIEW
SCL: N.T.S.

POUR CONSTRUCTION
FOR CONSTRUCTION
AGNICO EAGLE DATE : 2018-07-20

PERMIT TO PRACTICE
SNC - LAVALIN STAVIBEL INC.
Signature [signature]
Date 2018/07/26
PERMIT NUMBER: P 718
NT/NU Association of Professional Engineers and Geoscientists

2018/07/26

PLAN CLÉ / KEY PLAN

WORK AREA

NOTES GÉNÉRALES / GENERAL NOTES

1. ALL LENGTH AND QUANTITY NEED TO BE VALIDATED ON CONSTRUCTION SITE.

PIPING ON GROUND
PIPING IN TRENCH

THE DESIGN AND MATERIALS ON THIS DRAWING ARE ASSUMED BY AGNICO EAGLE.

SNC-LAVALIN

Project # : 644819-0000

DESSINS EN RÉFÉRENCE / REFERENCE DRAWINGS

AGNICO EAGLE

0	2018-07-20	ISSUED FOR CONSTRUCTION	N.B.G.	C.I.G.	K.P.M.

REVISIONS

TITRE / TITLE
AGNICO EAGLE – WHALE TAIL (AMARUQ)
460 – SEWAGE WATER TREATMENT PLANT
270 – PIPING
PLAN VIEW
SEWAGE WATER PIPING (ROUTING)
FROM TREATMENT PLANT TO ATTENUATION POND

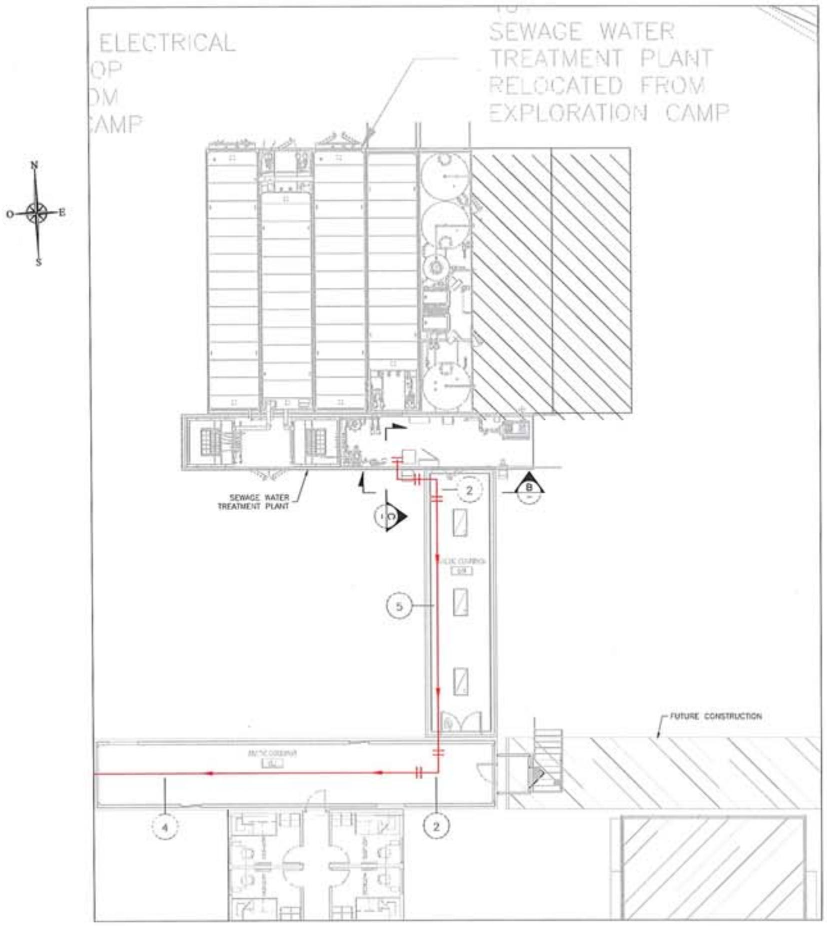
DESSINÉ PAR / DRAWN BY	NICOLAS BORDELEAU G., TECH.	2018-06-12
VÉRIFIÉ PAR / CHECKED BY	KEVEN PLANTE-MARQUIS, ING.	2018-07-20
APPROUVÉ PAR / APPROVED BY	CHRISTIANN IAN GUNTHER, ING.	2018-07-20
ÉCHELLE / SCALE	N.T.S.	DATE 2017-12-01

NO. DESSIN / DRAWING NO. 61-460-270-201

NO. PROJET / PROJECT NO. 6115 | RÉVISION 0 | FEUILLE / SHT 1/2

61-460-270-201-1_R0

POUR CONSTRUCTION
FOR CONSTRUCTION
AGNICO EAGLE DATE : 2018-07-20



DETAIL 1/2
SCALE: N.T.S.

PART	QUANTITY	LENGTH	UNIT	DESCRIPTION	ORDER
1	1	± 3 360	FT	PIPING HDPE DR17 3 PO INSULATE	OC - 703225
2	8	-	EA	ELBOW 90° - 3" HDPE DR17 FLANGED ENDS	OC - 707903
-	8	-	EA	ELBOW 90° - 3" HDPE DR17 COMPLETE INSULATION KIT	OC - 707903
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5	1	± 45	FT	PIPING HDPE DR17 3 PO INSULATE	OC - 703225
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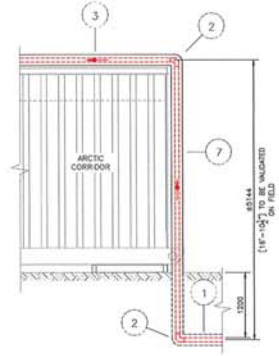
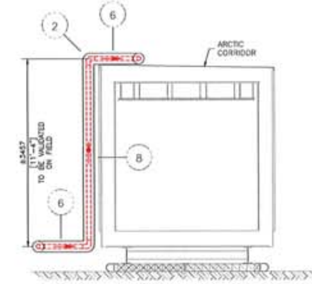
-	-	-	EA	10 FEET 5/8" UNC ROD	OC - 707903

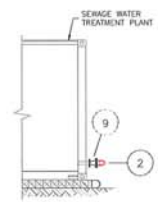
NOTE: ALL LENGTH AND QUANTITY NEED TO BE VALIDATED ON CONSTRUCTION SITE.



SECTION A 1/2
SCL. N.T.S.



SECTION B
SCL. N.T.S.



SECTION C
SCL. N.T.S.

PERMIT TO PRACTICE
SNC - LAVALIN STAVIBEL INC.
Signature
Date 2018/07/26
PERMIT NUMBER: P 719
NT/NU Association of Professional Engineers and Geoscientists

2018/07/26

PLAN CLÉ / KEY PLAN

NOTES GÉNÉRALES / GENERAL NOTES

1. ALL LENGTH AND QUANTITY NEED TO BE VALIDATED ON CONSTRUCTION SITE.

PIPING ON GROUND
PIPING IN TRENCH

THE DESIGN AND MATERIALS ON THIS DRAWING ARE ASSUMED BY AGNICO EAGLE.

SNC-LAVALIN

Project # : 644819-0000

DESSINS EN RÉFÉRENCE / REFERENCE DRAWINGS

AGNICO EAGLE

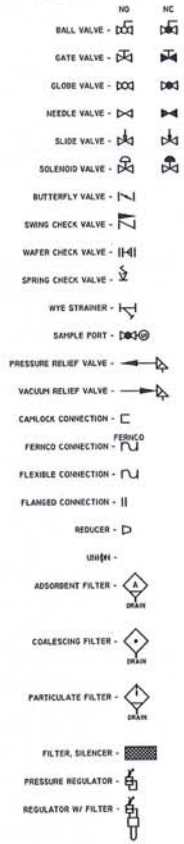
REV.	DATE	DESCRIPTION	PAR/BY	APP.	CLIENT
0	2018-07-20	ISSUED FOR CONSTRUCTION	N.B.G.	C.V.G.	K.P.M.

REVISIONS

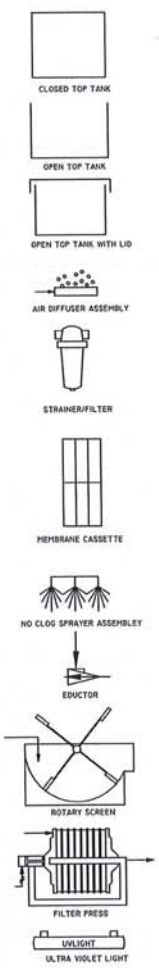
TITRE / TITLE
AGNICO EAGLE – WHALE TAIL (AMARUQ)
460 – SEWAGE WATER TREATMENT PLANT
270 – PIPING
DETAILS & SECTIONS
SEWAGE WATER PIPING (ROUTING)
FROM TREATMENT PLANT TO ATTENUATION POND

DESSINÉ PAR / DRAWN BY	NICOLAS BORDELEAU G., TECH.	DATE 2018-06-12
VÉRIFIÉ PAR / CHECKED BY	KEVEN PLANTE-MARQUIS, ING.	2018-07-20
APPROUVÉ PAR / APPROVED BY	CHRISTIAN VAN GUNTHER, ING.	2018-07-20
ÉCHELLE / SCALE	N.T.S.	DATE 2017-12-01
NO. DESSIN / DRAWING NO.	61-460-270-201	
NO. PROJET / PROJECT NO. 6115	RÉVISION 0	FEUILLE / SHT 2/2

VALVES AND PIPING



EQUIPMENT



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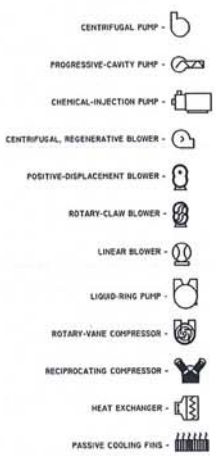
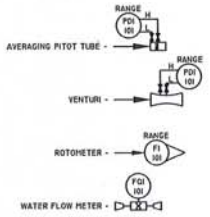


EQUIPMENT

AV - ACTUATED VAVLE
B - BLOWER
F - FAN
H - HEATER
MBR - MEMBRANE BIOLOGICAL REACTOR
MV - MODULATED VALVE
P - PUMP
SV - SOLENOID VALVE
TNK - TANK
UV - ULTRA VIOLET LIGHT
VFD - VARIABLE FREQUENCY DRIVE

FLOW MEASUREMENT



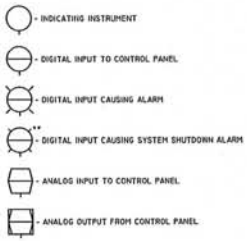
INSTRUMENT DESIGNATION

	INPUT	1ST MODIFIER	2ND MODIFIER	3RD MODIFIER	OUTPUT	1ST MODIFIER	
A							A
B						BLOWER	B
C	CYCLE					COMPRESSOR	C
D		DIFFERENTIAL				AIR DRYER	D
E							E
F	FLOW					FAN	F
G	GAS (LEL)		GAUGE				G
H				HIGH	HAND	HEATER	H
I	CURRENT		INDICATOR				I
J							J
K							K
L	LEVEL			LOW			L
M					MOTORIZED		M
N							N
O							O
P	PRESSURE				PNEUMATIC	PUMP	P
Q		QUANTITY					Q
R							R
S	SPEED		SWITCH		SOLENOID		S
T	TEMPERATURE		TRANSMITTER				T
U							U
V						VALVE	V
W							W
X							X
Y							Y
Z	POSITION						Z

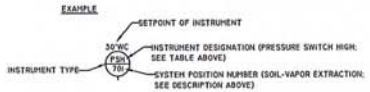
SYSTEM POSITION DESIGNATION

1000 - LIFT STATION
2000 - INLET SCREEN
3000 - EQUALIZATION TANK
4901 - SCREEN DISCHARGE PUMP TANK
5000 - AERATION TANK
5500 - SLUDGE HOLDING TANK
6000 - MBR TANK
6100 - CHEMICAL INJECTION
7000 - PERMEATE
7500 - UV LIGHT
7900 - BUILDING,TRAILER OR SKID
8000 - DISCHARGE TANK
8200 - CONTROL PANEL
8300 - TELEMETRY
9900 - EXTRAS

INSTRUMENT IDENTIFICATION



EXAMPLE



NOTES

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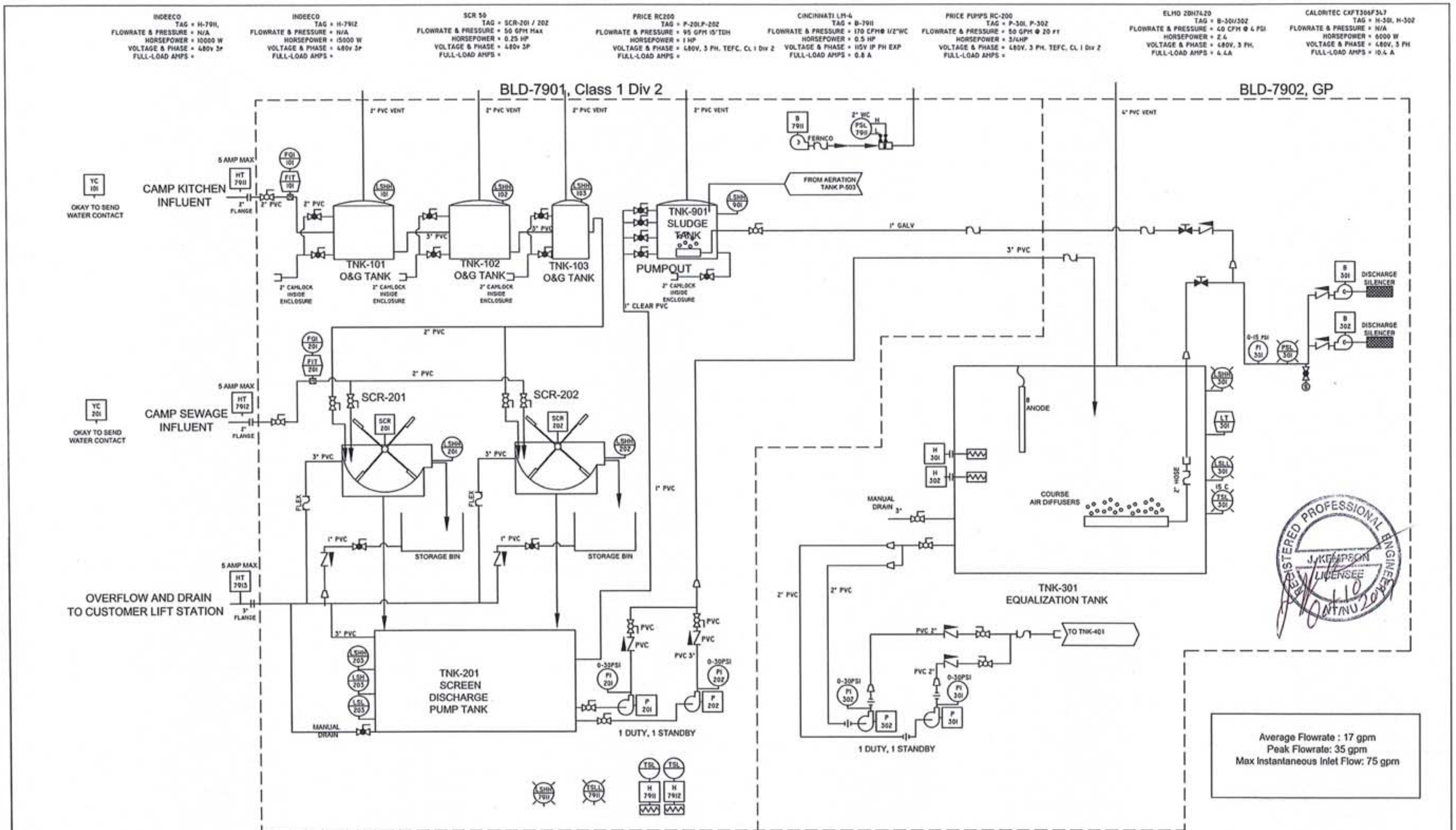
LEVEL	REVISION	DATE (mm/dd/yy)	BY
D	T-401 MIX PIPE SIZE	10/10/17	JJK
C	AS-BUILT	13/08/17	JJK
B	PRODUCTION	06/06/17	JJK
A2	SUBMITTAL REVISIONS	26/05/17	JJK
A	SUBMITTAL	23/05/17	JJK

PROJECT NUMBER: 1704432

TITLE AND LOCATION: P&ID AMARUQ MINE

CUSTOMER: AGNICO EAGLE MINE

DRAWN BY: MH | DATE: | SHEET: 4 | SHEETS: 4



Average Flowrate : 17 gpm
Peak Flowrate: 35 gpm
Max Instantaneous Inlet Flow: 75 gpm

NOTES

IS INPUT WIRING TO BE WIRED FOR OUTDOORS, ACCORDING CEC FOR HAZARDOUS LOCATIONS.

WIRING TO BE CLASS I DIVISION 2, AS PER THE CEC.

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D	T-401 MIX PIPE SIZE	10/10/17	JJK
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A	SUBMITTAL	23/05/17	JJK

PROJECT NUMBER: 1704432

TITLE AND LOCATION: P&ID AMARUQ MINE

CUSTOMER: AGNICO EAGLE MINE

DRAWN BY: MH | DATE: | SHEET 1 | SHEETS 4

PRICE PUMPS RC-200
TAG = P-601,602
FLOWRATE & PRESSURE = 300 GPM @ 60 FT
HORSEPOWER = 5HP
VOLTAGE & PHASE = 480V, 3 PH, TEFC, CL 1 Div 2
FULL-LOAD AMPS =

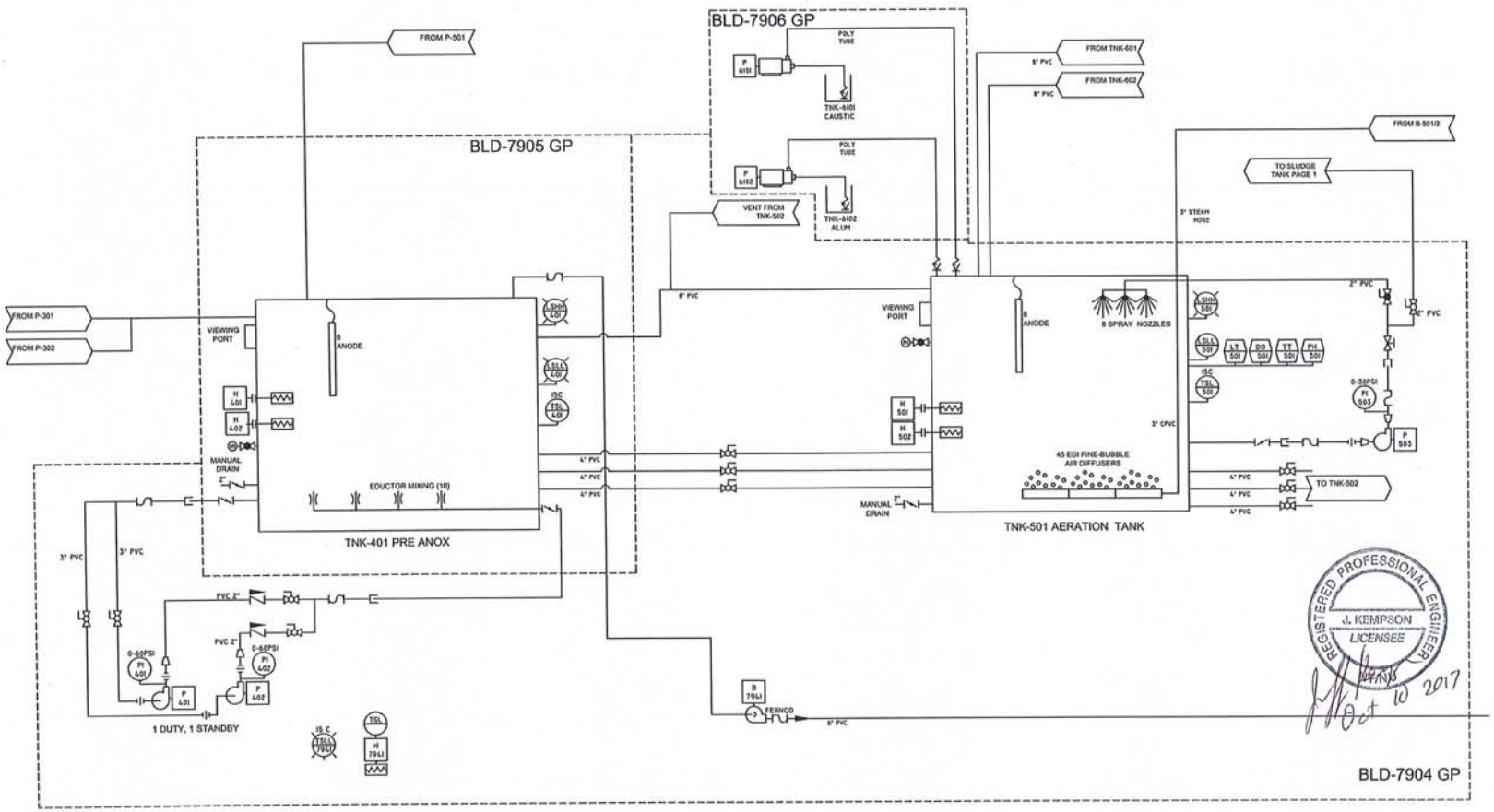
CALORITEC CXFT306F347H83
TAG = H-601,602,501,502
FLOWRATE & PRESSURE = N/A
HORSEPOWER = 6000 W
VOLTAGE & PHASE = 480V, 3 PH
FULL-LOAD AMPS = 10.4 A

CINCINNATI LM6
TAG = B-794I
FLOWRATE & PRESSURE = 700 CFM@ 2"WC
HORSEPOWER = 1.5 HP
VOLTAGE & PHASE = 480V 3P PH
FULL-LOAD AMPS =

OMELLET OAC649088L
TAG = H-794I
FLOWRATE & PRESSURE = N/A
HORSEPOWER = 4800 W
VOLTAGE & PHASE = 480 V, 1 PH
FULL-LOAD AMPS = 8.34

PRICE PUMPS RC-200
TAG = P-503
FLOWRATE & PRESSURE = 50 GPM @ 10 FT
HORSEPOWER = 1/4 HP
VOLTAGE & PHASE = 480V, 3 PH, TEFC, CL 1 Div 2
FULL-LOAD AMPS =

PROMINENT BETA 4
TAG = P-610I, 610Z
FLOWRATE & PRESSURE = 3.2 GPH@58PSI
HORSEPOWER = N/A
VOLTAGE & PHASE = 120 V, 1 PH
FULL-LOAD AMPS = N/A



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J. KEMPSON
LICENSEE
Oct 10 2017

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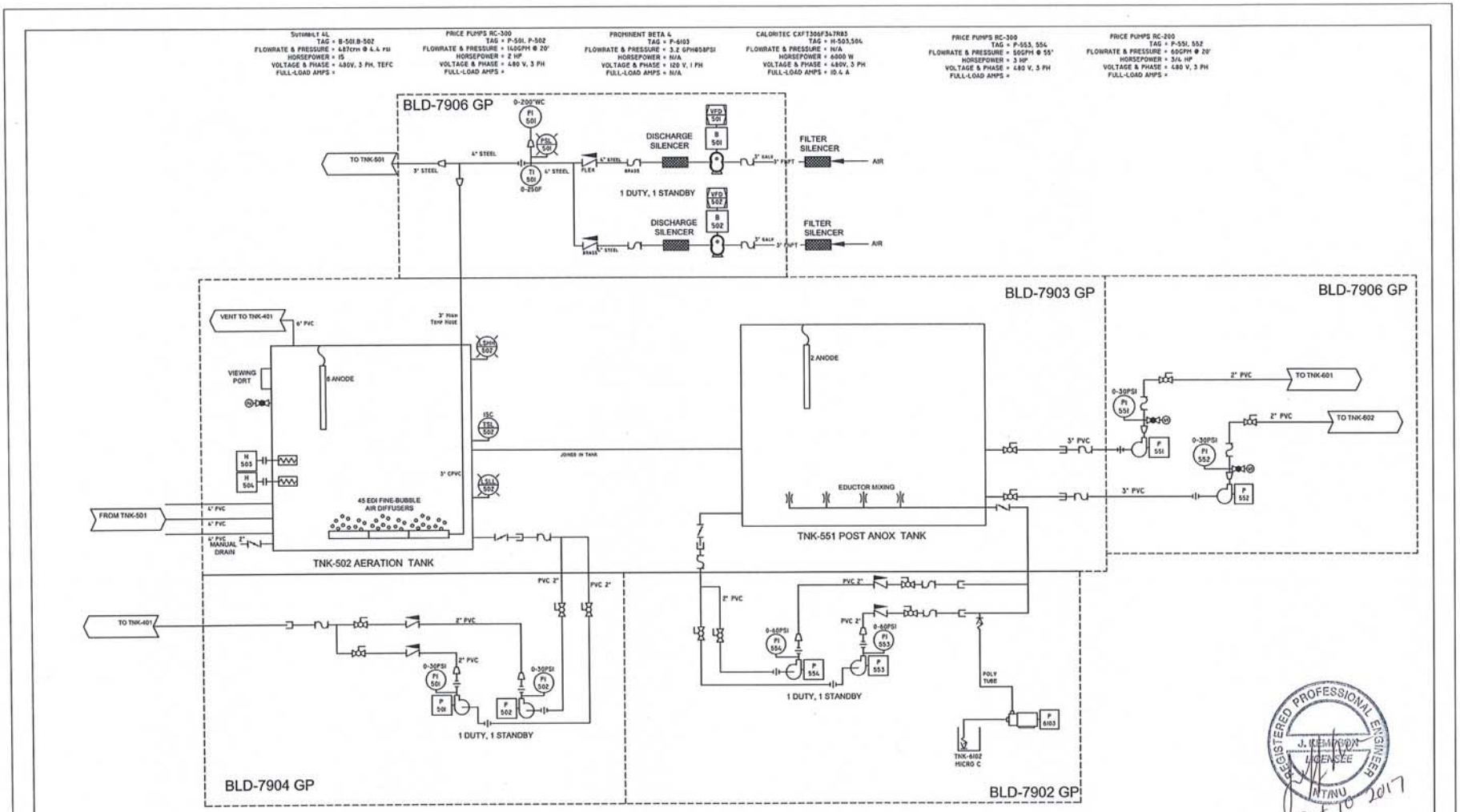
LEVEL	REVISION	DATE (mm/dd/yy)	BY
D	T-401 MIX PIPE SIZE	10/10/17	JJK
C	AS-BUILT	13/08/17	JJK
B	PRODUCTION	06/06/17	JJK
A2	SUBMITTAL REVISIONS	26/05/17	JJK
A	SUBMITTAL	23/05/17	JJK

PROJECT NUMBER: 1704432
TITLE AND LOCATION: P&ID AMARUQ MINE
CUSTOMER: AGNICO EAGLE MINE
DRAWN BY: MH
DATE:
SHEET: 2
SHEETS: 4



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NT/NU
Oct 10 2017

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D	T-401 MIX PIPE SIZE	10/10/17	JJK
C	AS-BUILT	13/08/17	JJK
B	PRODUCTION	06/06/17	JJK
A2	SUBMITTAL REVISIONS	26/05/17	JJK
A	SUBMITTAL	23/05/17	JJK

PROJECT NUMBER: 1704432

TITLE AND LOCATION: P&ID AMARUQ MINE

CUSTOMER: AGNICO EAGLE MINE

DRAWN BY: MH | DATE: | SHEET: 3 | SHEETS: 4

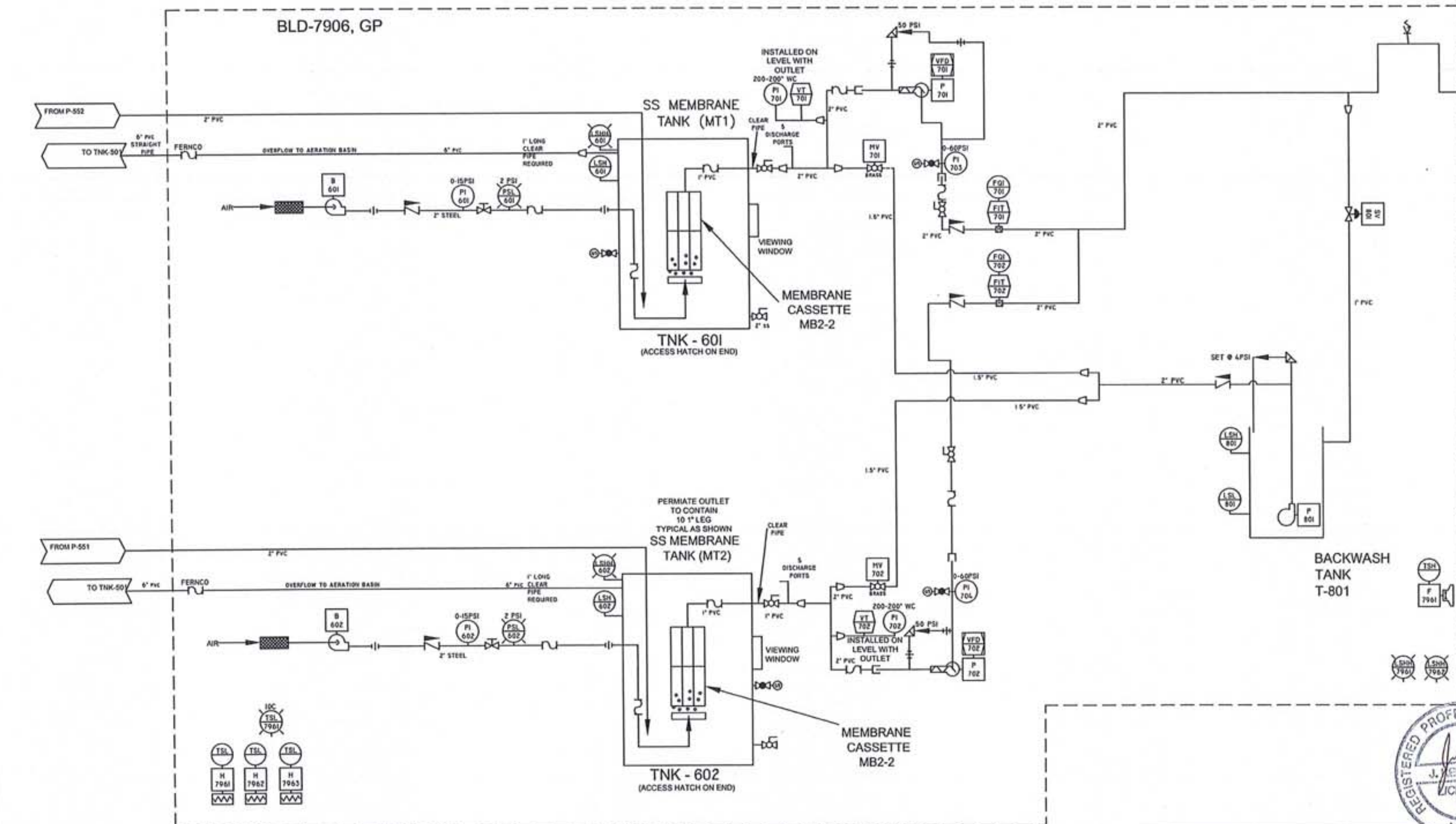
ELMO RIETCHLE 2BH-1510
TAG = B-601,B-602
FLOWRATE & PRESSURE = 95SCFM @ 4.4 PSI
HORSEPOWER = 6.2
VOLTAGE & PHASE = 480 V, 3 PH, TEFC
FULL-LOAD AMPS = 9.9

OUELLET OAC04808BL
TAG = H-7961,H-7962,H-7963
FLOWRATE & PRESSURE = N/A
HORSEPOWER = 4800 W
VOLTAGE & PHASE = 480V, 1 PH
FULL-LOAD AMPS = 8.34

MOYNO 356
TAG = P-701, P-702
FLOWRATE & PRESSURE = 0-20 GPM
HORSEPOWER = 2HP
VOLTAGE & PHASE = 480 V, 3 PH, TEFC
FULL-LOAD AMPS =

ZOELLER M72
TAG = P-801
FLOWRATE & PRESSURE = 0-40 GPM
HORSEPOWER = 1/2HP
VOLTAGE & PHASE = 115 V, 1 PH, TEFC
FULL-LOAD AMPS =

CAN ARM 518-F1
TAG = F-7961
FLOWRATE & PRESSURE =
HORSEPOWER = 1/3
VOLTAGE & PHASE = 115V 1 Phase
FULL-LOAD AMPS = 6.6A



NOTES

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PROJECT NUMBER: 1704432
TITLE AND LOCATION: P&ID AMARUQ MINE
CUSTOMER: AGNICO EAGLE MINE
DRAWN BY: MH
DATE:
SHEET 4 SHEETS 4

REGISTERED PROFESSIONAL ENGINEER J. KEMPSON LICENSEE NT/NU
2017

Appendix C: Newterra Operation and Maintenance Manual

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newterra MBR Wastewater Treatment Plant

OPERATION AND MAINTENANCE MANUAL

System:	**newterra MBR WWTP**
Location:	**Amaruq mine, Kivalliq District of Nunavut**
Client:	**Agnico Eagle**
Project:	**1704432**
Rev.:	**1**
Date:	**August 2017**

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List of Appendices

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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 Wastewater 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***.

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.***

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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. These are sample MSDS sheets and need to be replaced by the actual vendor MSDS sheets.
Information and guidelines outlined in this manual **must** be followed at all times prior to system installation and during operation and maintenance.

ESSENTIAL FOR SAFE OPERATION:

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

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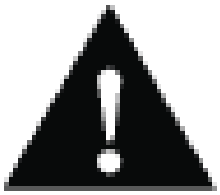

WARNING

CRITICAL WARNING SIGN

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

2.2 Personal Protective Equipment (PPE)

Personal protective equipment (PPE) refers to protective clothing, gloves, helmets, goggles, or other garments or equipment designed to protect the wearer's body from injury or infection. The hazards addressed by protective equipment include physical, electrical, heat, chemicals, biohazards, and airborne particulate matter. ”Protective clothing" is applied to traditional categories of clothing, and "protective gear" applies to items such as pads, guards, shields, masks, and others.

The purpose of personal protective equipment is to reduce employee exposure to hazards when engineering and administrative controls are not feasible or effective to reduce these risks to acceptable levels. PPE is needed when there are hazards present. PPE has the serious limitation that it does not eliminate the hazard at source and may result in employees being exposed to the hazard if the equipment fails.
The following list includes the minimum scope of PPE that should be available to system operators:

2.2.1 Head protection

Hard hats, bump caps, or helmets are types of protection that should be considered if there is a hazard of head injury. Head injuries can occur under various circumstances including as the result of a slip or fall, working in confined areas or where there are low ceilings, where there may be falling objects. Hard hats should be worn at all times when overhead work is being conducted.

2.2.2 Eye and Face Protection

Eye protection with side shields should be used at all times while inside the newterra system as there may be a danger of flying objects, particles, liquids, sprays or other matter entering the eyes. Protection can take many forms including:

- safety glasses,
- goggles, or
- full face protection. This should be used if handling chemicals, waste product or working around pressurized lines (air of liquid).

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2.2.3 Foot Protection

Foot protection should be used at all times within the newterra system. Foot protection is usually in the form of steel-toed work boots, with a steel shank to protect the bottom of the foot from puncture wounds. In wet environments, steel-toed boots that are waterproof and slip-resistant may be necessary.

2.2.4 Hand Protection

Hand protection should be worn within the newterra system. The workplace can create many hazards for hands, whether from chemicals, cuts or burns. No single glove can provide appropriate protection for every work situation, so it is important to assess the risk for each task and select a glove that provides specialized protection.

The following is a list of gloves and their suggested appropriate application:

- Coated fabric gloves: This type of glove can provide protection against some moderate concentrated chemicals. They can be used in laboratory work provided they are strong enough to protect against the specific chemical being handled.
- Rubber, plastic or synthetic gloves: These types of glove can be used when cleaning or working with oils, solvents and other chemicals.
- Leather gloves: These should be used when welding, as the leather can resist sparks and moderate heat. The risk of cuts and abrasions also can be minimized by wearing leather gloves.
- Kevlar gloves: These have a wide variety of industrial applications. They are cut- and abrasion-resistant and provide protection against both heat and cold.
- Chemical/liquid-resistant gloves: Several types of gloves help protect against specific chemicals:
    - Butyl rubber gloves: nitric acid, sulfuric acid, hydrochloric acid and peroxide
    - Natural latex/rubber gloves: water solutions or acids, alkalis, salts, and ketones
    - Neoprene gloves: hydraulic fluids, gasoline, alcohols and organic acids
    - Nitrile rubber gloves: chlorinated solvents

2.2.5 Body Protection

Body protection may be required in various situations including dusty environments or when spraying liquid pesticides or handling dangerous chemicals. The hazard to be controlled will determine the type of protection that is most appropriate, for example, an apron, coveralls or a full rain suit. As a minimum, the operator should be wearing work coveralls.

2.2.6 Hearing Protection

Hearing protection should be worn in work environments where noise levels exceed 85 decibels – such as around blowers and air compressors. There are many types of hearing protection, including earplugs or muffs. Hearing protection that is suitable for the work environment and provides adequate noise reduction should be chosen. Disposable ear plugs or headset style are acceptable.

2.3 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!

2.4 Chemical Safety

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

- **Sodium Carbonate (Soda Ash)** is used for pH adjustment, in case there is a deficiency in alkalinity in influent sewage and pH drops. It is hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation (lung irritant).
- **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).

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- **Aluminium Sulphate ($Al_2(SO_4)_3$)** is used for Phosphorus Removal. Mild to moderate irritation can occur from unprotected contact. Aluminum is very poorly absorbed through the skin and toxic effects would not be expected following short-term skin contact. Inhalation of mists can be irritating to the respiratory tract and lungs.

- **MicroC 2000** is used for nitrate removal.
  - Exposure to eyes may cause slight irritation
  - Exposure to Skin may cause slight irritation
  - Inhalation of high mist concentrations may cause irritation of respiratory tract.

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 above descriptions are preliminary warnings only. The MSDSs for each of the chemicals should be consulted prior to using or handling any of the chemicals.
Sample MSDSs for chemicals used in the PWTP process can be found in Appendix F of this Manual.

WARNING

Mixing chemicals can result in dangerous reactions, including violent splashing, fires, explosions and release of toxic gases!
Chemicals should only be used for their intended uses!

2.5 Electrical Safety

Power may be supplied to control panels from various sources. Even if the disconnect is in the OFF position, certain electrical components inside the panel may be energized and servicing should not be conducted unless all incoming power is disconnected. Refer to the electrical drawings in Appendix A of this manual.

Ensure that the system is properly grounded before applying power to the system. Installation and servicing is only to be performed by **qualified authorized personnel**.

2.5.1 Lockout Procedures

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. The person who locked out the device, should be the only person to remove the lockout.

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When equipment is to be locked out, employers, supervisors and workers should follow accepted lockout principles, including:

- Pre-planning for the lockout by identifying all energy sources, switches, etc.
- Where lockout is complex, a written sequence in checklist form should be prepared for equipment access, lockout/tagout, clearance, release and start-up.
- All workers affected by the lockout should be notified.
- Equipment should be shut down by normal means by turning of switches and closing valves etc.
- Equipment should be isolated from energy sources by disconnecting or blocking the sources of energy.
- Lockout and tag the energy isolating devices by padlock or some other locking device that the worker has control over as well as a tag indicating that the equipment has been shut down.
- Verify that all energy sources have been isolated by attempting to cycle the equipment prior to working on it.
- When work is completed, release equipment from lockout.
- Test equipment

2.6 Confined Spaces

"**confined space**" means a fully or partially enclosed space:

- that is not both designed and constructed for continuous human occupancy, and
- in which atmospheric hazards may occur because of its construction, location or contents or because of work that is done in it.

If you have a space that is fully or partially enclosed, the two conditions – (a) and (b) above – must both apply before the space can be considered a "confined space".

"**atmospheric hazards**" means:

- the accumulation of flammable, combustible or explosive agents,
- an oxygen content in the atmosphere that is less than 19.5 per cent or more than 23 per cent by volume, or
- the accumulation of atmospheric contaminants, including gases, vapours, fumes, dusts or mists, that could,
    - result in acute health effects that pose an immediate threat to life, or
    - interfere with a person's ability to escape unaided from a confined space.

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

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If a workplace includes a confined space that workers may enter to perform work, it is highly recommended that written program for the confined space is developed and maintained in accordance with this local regulations and policies before a worker enters the confined space. A confined space program is a written document that would include: a method for recognizing each confined space to which the program applies; a method for assessing the hazards to which workers may be exposed; a method for the development of confined space entry plans; a method for training workers; and, an entry permit system.

2.7 Fire Safety

Exposed hot surfaces can create potential burn/ignition hazards. Blowers and air compressors compress ambient air, causing heat to be generated. This heat can bring the temperature of the air compressor head and blower piping to a level that can cause burns to exposed flesh.
Follow local laws and regulations with respect to Fire Safety and regulations.

2.8 Responsibility for Safety

2.8.1 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.

2.8.2 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!!!

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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

2.8.3 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.
- 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.

2.9 Hazard Warning Signs/Symbols

Below is a sample of possible hazard warning signs/symbols that may be provided with the newterra system. It is recommended that the operator become familiar with the warning signs in the system.

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2.10 First aid

First aid is emergency care given immediately to an injured person. The purpose of first aid is to minimize injury and future disability. In serious cases, first aid may be necessary to keep the victim alive.

It often consists of a one-time, short-term treatment and requires little technology or training to administer. First aid can include cleaning minor cuts, scrapes, or scratches; treating a minor burn; applying bandages and dressings; drinking fluids to relieve heat stress, etc.

Operators must know the location of emergency telephone number(s), First Aid Kits, emergency eye wash stations and first aid attendant(s).

In over 98% of locations in the United States and Canada, dialing "9-1-1" from any telephone will link the caller to an emergency dispatch office—called a Public-Safety Answering Point (PSAP) by the telecom industry—which can send emergency responders to the caller's location in an emergency. In approximately 96 percent of the U.S., the Enhanced 9-1-1 system automatically pairs caller numbers with a physical address.

Follow local laws and regulations with respect to First Aid procedures and reporting.

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2.10.1 CPR Poster

CPR for an Adult or Child

1

- Check the scene to ensure it is safe. If it is safe to do so, check the person and the person's ABCs (Airway, Breathing, Circulation).
- Call EMS/9-1-1 and get an AED or have someone else do this.

2

- Place the heel of one hand on the middle of the chest. Place the other hand on top.
- Do 30 compressions. Push hard, push fast.

3

- Open the airway by tilting the head back and lifting the chin. Pinch the nostrils closed and give 2 breaths.
- Repeat the cycle of 30 compressions and 2 breaths.
- Continue CPR until an AED arrives or more advanced care takes over.

The information on this poster does not replace formal First Aid & CPR training.

To find a Red Cross First Aid course in your area scan the QR code, or:
redcross.ca/firstaid | 1.877.356.3226

CANADIAN RED CROSS

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3.0 WASTEWATER TREATMENT PLANT DESIGN BASIS

This section presents the design basis of the newterra MicroClear™ Membrane Bioreactor (MBR) Wastewater Treatment Plant (WWTP), including the influent constituent loading rates, hydraulic capacity and specifications for the membrane module and cassettes used. This section also includes a list of prohibited chemicals that should not be added to the influent wastewater and chemicals that should not come in contact with the membranes. The system is designed to meet effluent discharge criteria presented in this section below.

3.1 newterra MicroClear™ MBR Process Specification

Design loading	**SI Units**
Design Hydraulic Load	96 m^3/d
Organic Load	87.1 kgBOD/d
TKN Load	12.5 kgTKN/d
Phosphorus Load	1.15 kgTP/d
Process Tanks	**SI Units**
Three (3) Oil & Grease Tanks (TNK-101/TNK-102/TNK-103) with a total volume	12 m^3
One (1) Equalization Tank (TNK-301) with effective volume	40 m^3
One (1) Pre-Anoxic Tank (TNK-401) with effective volume	46 m^3
Two (2) Aeration Tanks (TNK-501/TNK-502) with total effective volume	76.5 m^3
One (1) Post-Anoxic Tank (TNK-401) with effective volume	8.6 m^3
Two (2) Membrane Tanks (TNK-601/TNK-602) each with effective volume	8.0 m^3
Two (2) Sludge Holding Tank (TNK-901) each with effective volume	7.0 m^3
Membrane Bioreactor (MBR) including anoxic tanks, aeration tanks and membrane tanks - total effective volume	**147.1 m^3**
Design Hydraulic Retention Time (HRT)	36.8 h
Sludge Age	26.5 d
Mixed Liquor Return Ratio - from Membrane Tank to Aerobic Tanks	5 x
Mixed Liquor Return Ratio - from Aerobic Tanks to Pre-Anoxic Tank	8 x
Design net flux (average)	13 LMH
Design Sludge Wasting Rate	5.36 m^3/d
Minimum design operating temp	**10 °C**

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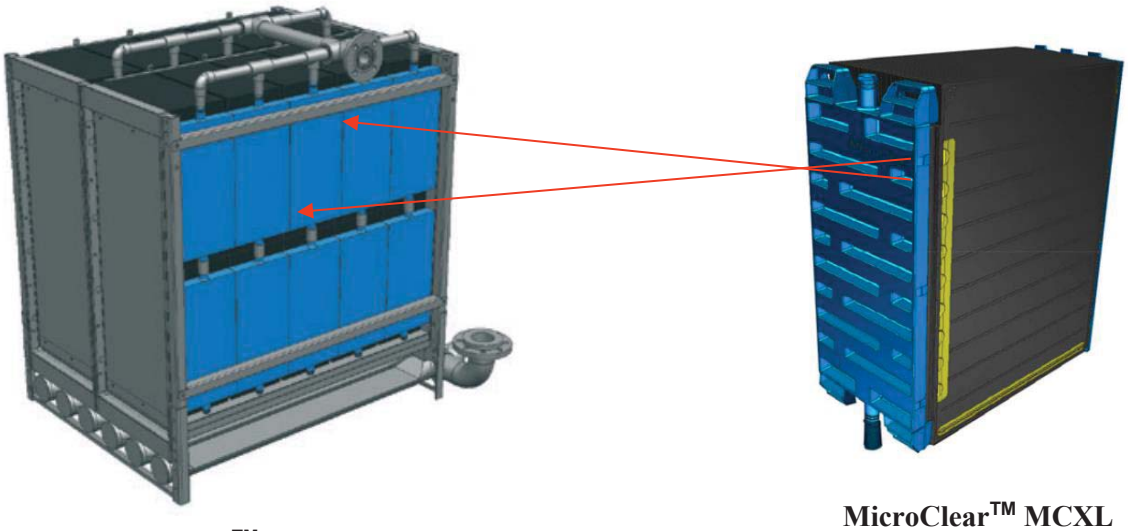
3.2 MicroClear™ MB2-2 Membrane Module Characteristics

MicroClear™ MB2-2 membrane module	SI Units
MB2-2 modules in MBR	2
MCXL cassettes in MB2-2 module	20
Total Area of MB2-2 module	160 m^2
MB2-2 Module Dimensions (L x W x H)	1.302 m x 1.124 m x 1.379 m
Housing materials	Stainless steel

3.3 MicroClear™ MCXL Membrane Cassette Characteristics

MicroClear™ MCXL membrane cassette	
Membrane Material	Polyethersulfone (PES)
Individual Cassette Area	8 m^2
Pore Size	0.04 µm
Cut Off	150 kDalton
Filtration Pressure	0.1 – 0.25 bar
Backwash Pressure	0.07 – 0.1 bar
Cassette Dimension	0.416 m x 0.209 m x 0.490 m



MicroClear™ MB2-2 membrane module

MicroClear™ MCXL membrane cassette

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3.4 Influent/Effluent Wastewater Characteristics

The newterra MBR shall treat wastewater from the mine camp with the following characteristics upon entering the newterra MBR.

Parameters	Unit	Influent*	Effluent
pH	s.u.	6 - 9	6.5 – 8.5
Fat, Oil, Grease (FOG)	mg/L	< 30	< 5
Biological Oxygen Demand (BOD)	mg/L	907.5	< 25
Total Suspended Solids (TSS)	mg/L	262.5	< 25
Total Kjeldahl Nitrogen (TKN)	mgN/L	130	-
Unionized Ammonia Nitrogen (NH_3-N)	mgN/L	-	< 1.25
Nitrate Nitrogen (NO_3-N)	mgN/L	-	< 5
Total Phosphorus (TP)	mgP/L	12	< 0.5
Fecal Coliform	CFU/100mL	-	< 200**
Total Residual Chlorine	mg/L	-	< 0.02
Alkalinity (assumed)	mg/L as $CaCO_3$	471	-
Total Dissolved Solids(TDS)	mg/L	< 1,200	-

3.5 Estimated Chemical Consumption

Consumable		Usage Rate			
Purpose	Name	Value	Unit	Value	Unit
Supplemental Alkalinity	**Dry Soda Ash**	6.28	kg/d	2292	kg/year
Phosphorus Removal	**Liquid Alum, 48%**	14.6	L/d	5346	L/year
Nitrate Removal	**MicroC 2000**	16.5	L/d	6025	L/year
Membrane Cleaning	**Sodium Hypochlorite, 12%**	-	L/d	150	L/year

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3.6 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!

3.7 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.

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

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3.8 MicroClear™ Membrane Compatibility Chart

Group	Substances	Compatibility
Chlorinated solvents	Methylene Chloride, Chloroform, Carbon Tetrachloride, Chlorobezene, Trichloroethane (<1%)	**Not recommended**
Esters	Ethyl Acetate, Butyl Acetate, Butyl Acrylate (<1%)	**Not recommended**
Ethers	Ethyl Ether, Polyethylene Oxide (<1%)	**Not recommended**
H_2O_2	<2000 ppm	Very good
Inorganic acids	HF, HCl, H_2SO_4	pH 0 - 14
Ketones	Acetone, Methyl Ethyl Ketone	**Not recommended**
NaOCl	100,000 ppm x h	Very good
Organic acids	Sulfamic Acid, Formic Acid, Oleic Acid, Sulfonic Acid, Acetic Acid, Acrylic Acid, Lactic Acid	pH 0 - 14
Phenols		**Not recommended**
Silicones		**Not recommended**
Alcohols	Ethanol, Butanol, Isopropranol (<50%)	Good
Aldehydes	Formaldehyde (<1%)	Very good
Alkali		pH 0 - 14
	Dimethyl Formamide, Dimethyl, Acetamid Dioxane, N-Methyl, Pyrrolidone, Tetramethyl Acetamide	**Not recommended**
Aprotic Solvents	Benzene, Toluene, Xylene, Anthracene, Naphatalene, Gasoline	**Not recommended**
Aromatic hydrocarbon	Methoxyethanol, Ethoxyethanol, Buthoxyethanol	unknown

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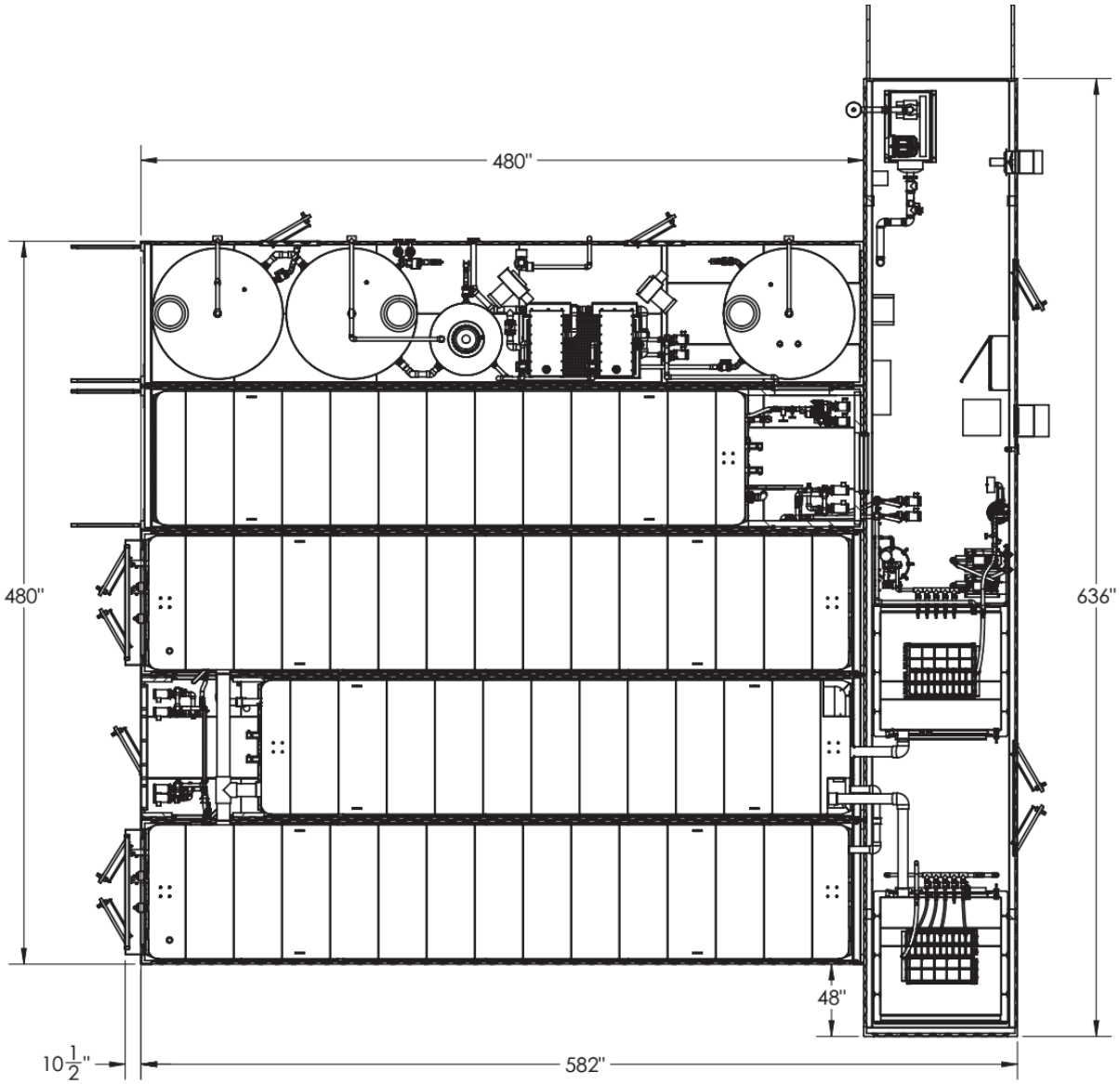
4.0 PLANT INSTALLATION, INSPECTION, AND TESTING

4.1 System Overview

The **newterra** MicroClear™ MBR WWTP is 96m3/day MBR for for the Amaruq Mine located in Nunavut. The system consists of five (5) modified 40 foot High Cube ISO shipping containers and one (1) modified 53 foot High Cube ISO shipping container. See below. .



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4.2 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 Appendices B-F).
- 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 are recommended.

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.***

4.3 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 enclosures and factory tested. Upon receiving the system, please perform the following:

- Place the container onto the prepared firm base to avoid sagging, equipment vibration, and shifting. When lifting the containers, 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.

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- Inspect the containers to ensure that no components or parts are missing (refer to the Packing List – see Appendix B). 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.**

4.4 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.***

4.4.1 Installation Checklist

At Appendix C is the installation and commissioning checklist for the system. Below is a summary of installation activities.

4.4.1.1 Customer's Scope List

- Placement and anchoring (if required) of equipment
- Interconnecting piping supply and installation
- Interconnecting electrical and controls supply and installation including connection inside newterra's control panel
- Electrical power supply to our electrical panel, lightning, grounding, etc.
- Permitting
- Potable water supply to the plant site for plant hydraulic test during startup
- Seed sludge
- Wastewater testing
- Chemicals supply and storage
- Treated effluent and waste sludge disposal
- All site civil work including design

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4.4.1.2 Civil Checklist

- Ensure that a potable water supply is available (used for hydraulic testing during start-up, membrane cleaning, washing hands and for performing onsite testing).
- Ensure availability of on-site emergency eyewash station and personal protection equipment.
- Remove hatch covers from the interconnecting ports.
- All doors are closing, latching and locking
- Weather stripping has been installed around each door
- Door sweeps have been installed on each door
- Louvers and hoods have been installed and sealed
- Install Liquid Rubber Container Seal as per drawing at Appendix C.

4.4.1.2 Electrical Checklist

- Connect electrical power to the Main Disconnect from available source ensuring correct phase rotation (See Electrical Drawings at Appendix A for power source specifications).
- Connect electrical power to the Control Panel (See System Layout drawing in Appendices A for locations)
- Ensure that proper electrical grounding and lightning protection is available.
- Switch Main Switch Panel's isolator to the ON position.
- Check all internal lighting and heating for correct operation.
- Install packed external lighting into brackets above the doorways.
- All internal electrical connections have been terminated
- Confirm Phase Monitor is not in alarm
- Site voltage measured:
    - L1/L2 - L2/L3 - L3/L1 - L1/GRD - L2/GRD - L3/GRD:
- Check field wiring and piping as per drawings
- Check panel for loose wiring, Correct as required
- Check voltage on AC transformer
- Check voltage on DC transformer
- Check I.S. barrier is grounded as per input drawing

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4.4.1.3 Mechanical Checklist

- All hoses and mechanical connections have been hooked up
- Ensure all unions and fittings are tight, as some are loosened to prevent stress in shipping
- Check alignment of motors, Correct as required
- Check all motor belt tensions, Correct as required
- Check alignment of pulleys for all belt driven blowers
- Verify membrane modules are secure within the membrane tanks – 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 tanks.
- Confirm Tank Diffusers and Educators have not moved during shipping
- Calibrate pH sensor

4.4.2 System Electrical Specifications

Verify site power per system design criteria. Additional detail is at Appendix A.

ELECTRICAL SPECIFICATIONS	
VOLTAGE	600V
PHASE	3Ø
FREQUENCY	60 Hz
FULL LOAD AMPS	172A
MAIN DISCONNECT SIZE	400A - FUSED @ 250A
SCCR SYMMETRICAL (kAMPS)	10
SYSTEM APPROVAL AND CLASSIFICATION	cMET - CL1Div2
PANEL APPROVAL AND CLASSIFICATION	cMETus to UL698A

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

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

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4.5 Plant Initial Testing

The newterra MicroClear™ 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 initial testing on the plant after installation, including **dry and hydraulic tests.**

The following subsection is presented for one single process train; if multiple trains are provided, performing the dry test and hydraulic test for each train is identical.

4.5.1 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(s) and the aeration tank(s) 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 Commissioning Checklist presented in Appendix H).
- Confirm heater/fan and air conditioner operations

4.5.2 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.
- Perform clean water test on the chemical distribution system.

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4.5.2.1 EQ, Anox and Aeration Tanks

- Fill the tanks in order - TNK-301, 401, 501, 502, 551, 601, 602 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 blower(s) for the blower(s) for aeration tank(s), 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(s) and 2 - 3 mg/L for aeration tank(s); 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 tanks (i.e. turn off transfer pump(s) from aeration tank(s) to membrane tank(s) and turn of recirculation pump(s) from membrane tank(s) to aeration tank(s), if included), and record blower ON/OFF duration.

4.5.2.2 Membrane Tank

- Enable membrane operation using the HMI
- Start the transfer pump(s) from the aeration tank(s) to the membrane tank(s) and fill the membrane tank(s) with potable water.
- Start the air blowers for the membrane tank(s) and check for an even distribution of air across the membrane filter area and air bubble uniformity above the membrane module/cassette.
- Check hydraulic flow pattern through the membranes and between membrane module/ cassette and tank wall.
- Make a clean copy of the **Clean Water Testing Sheet** presented in **Appendix J** of this O&M Manual.
- Record all checked parameters in the **Clean Water Testing Sheet.**
- Start the permeate (vacuum) pumps.
- Record the vacuum (TMP) on the gauge(s) on the permeate line [for clean water could be 0.05 to 0.07 bar (20” to 29” WC)].
- Record 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.

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4.5.2.3 O&G and 901 Tanks

- Fill the tanks in order - TNK-101, 102, 103 and 901 with potable water, run the pumps and check for any signs of leakage.
- Confirm diffuser operation in TNK-901. Adjust as necessary.

5.0 OPERATION of newterra MicroClear™ MBR

MBR (Membrane Bioreactor) treatment technology is an effective combination of an activated sludge biological treatment process with MicroClear MBR membrane filtration technology.

This section provides a description of the treatment process and how it is controlled. For a more complete understanding, review the **Process & Instrumentation Diagram** and **System Layout** provided in **Appendix A** of this manual as well. The detailed Control Narrative with factory setpoints, alarms and logic, please see **Appendix K**.

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.

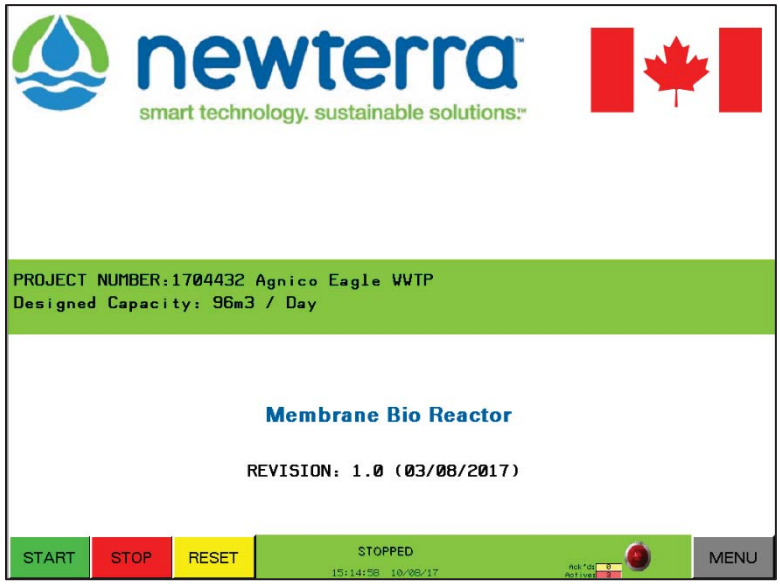
5.1 Control System – Main SCADA Control, PLCs and HMIs

The **newterra** MicroClear™ MBR is controlled by a PLC (Programmable Logic Controller). The system is programmed to:

- Receive analog and digital input signals from the switches and transmitters being controlled;
- Process the information using the structure and rules entered into the program;
- Generate outputs that control the equipment - turn equipment OFF or ON.
- Generate alarms if critical conditions are present
- Provide a HMI (Human Machine Interface) touch-screen for ease of operator process monitoring and control.

5.1.2 HMI Control Screen

An example of an HMI Control Screen is provided below:



System Operation

- (RUNNING/STOPPED) Indicates whether the system is currently in the **RUN** mode or turned off
- **START** button puts the system in **RUN** mode as long as there are no alarms preventing the start up of the system
- **STOP** button stops the system operation
- **RESET** button is used to clear alarms after they have been addressed
- Clarifier blowers, equalization tank blowers and the building fan if on, continue to run even after the **STOP** button has been pressed

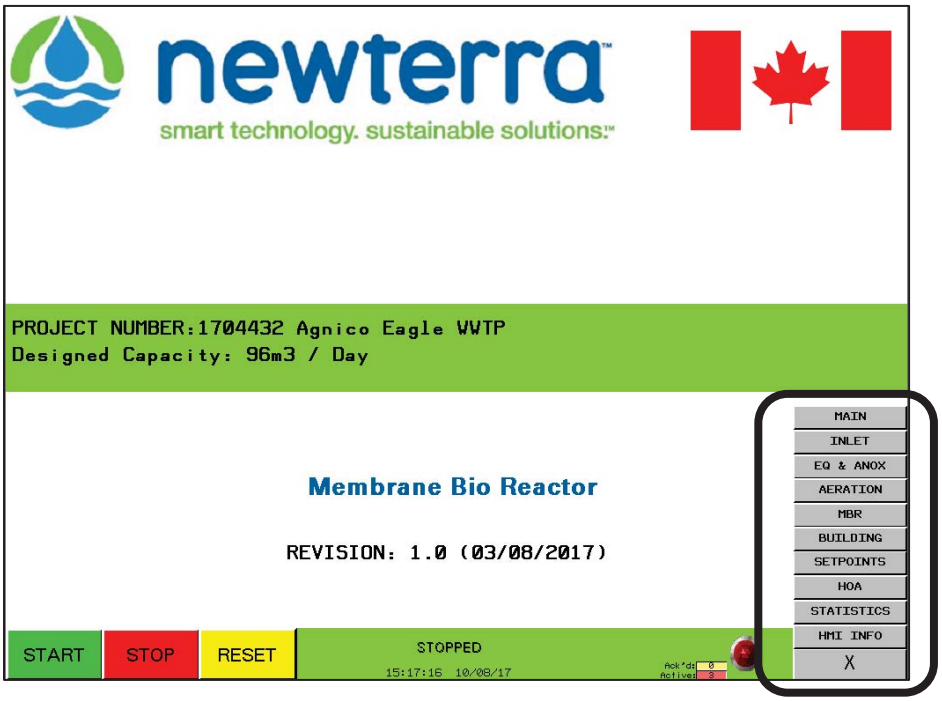
The MBR will always remain in auto run mode, unless the kill switch is pressed or power is down.

The MBR will automatically restart after power failure.

A menu to navigate through the process and data information screens is provided at the bottom right corner of the HMI screen.

When the **MENU** button is pressed, it shows a list of individual screens with a scroll bar.

- To go to any of the listed screens, touch the icon.
- To go back to the main screen, touch the **X** button.



Screen-shots presented in this manual are for example only and may not be representative of ideal operation.

5.1.3 HOA (Hand/Off/Auto) Screen

This screen displays all devices controlled by the PLC. Under normal operation (auto mode), all devices are set in the AUTO position.

- Each PLC controlled motor or valve in the system has a Hand/Off/Auto (HOA) Switch to control its operation.
- 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 turn OFF and revert to the (O) position. Operators must be present when equipment is operated in the manual mode.

5.1.4 Process Screens

The main process screens are accessed from the main menu of the HMI control screen. These process screens are:

- Inlet
- EQ & Anox
- Aeration
- MBR

Note: In the following sections are the detailed descriptions of the main processes.

Switches are indicated on the HMI as follows:

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

Status of the switches are indicated as follows:

Grey when **OFF**
Green when **ON**
RED when in Alarm

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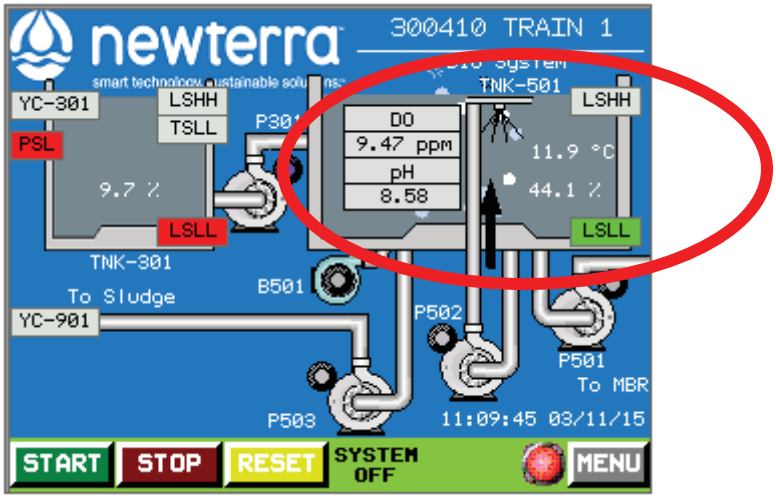
Tank levels are indicated by level switch positions and percent full values where level transmitters are provided. For example, the following screen shows LSLL as green, LSHH as grey and the percent full as 44.1% in TNK-501. This indicates that the tank is 44.1% full, and the water level is above LSLL and below LSHH.



NOTE: Touching a device on the process screen will open an HOA popup for that device.

- The device status indicator color coding is as follows:

Indicator Color	Operational Status
Yellow	Manual operation
Orange	Interlock
Red	Failure
Green	ON / OK
Purple	Interlock / Communication failure
Pink	Unknown
Black	Faulty contactor
Grey	Off

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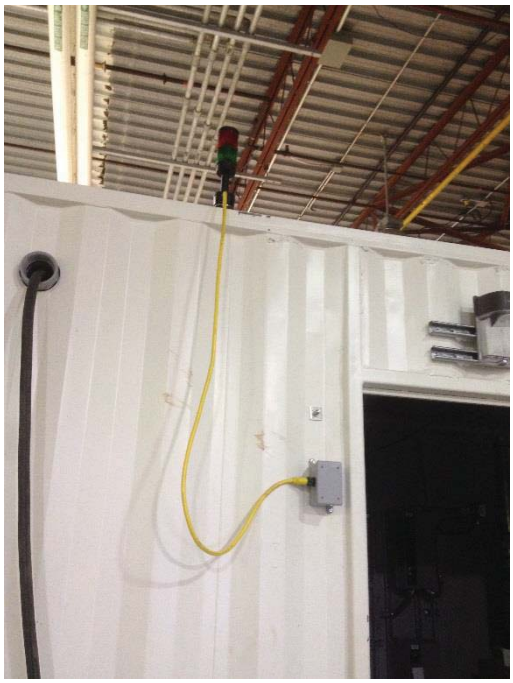
5.1.5 HMI Alarm Screen

- When the **ALARMS** button is flashing red, it indicates an alarm is present in the system. Press the **ALARMS** button to be routed to the Active Alarms Screen.
- To clear alarms, first press the yellow **RESET** button then press the flashing **ALARMS** button to verify that the condition causing the alarm has been cleared.

All alarms are visually indicated on a beacon stack on the roof of the exterior of the container and an alarm light on the system control panel:

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



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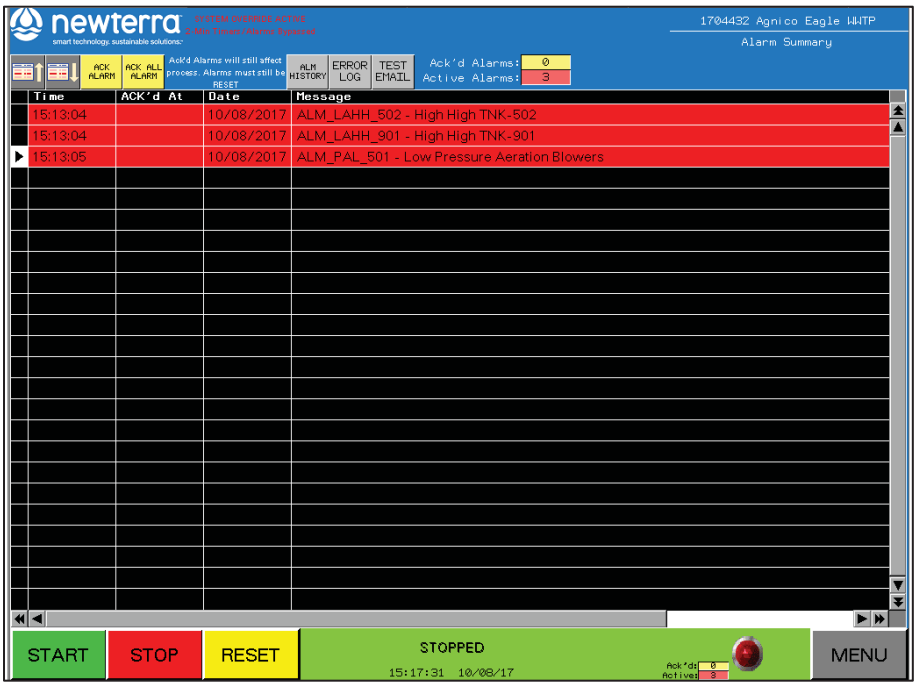

NOTE: All high level alarms (identified as LSHH on P&ID and HMI) indicate a critical situation for imminent tank overflow and could result in pump(s) shutting off to avoid overflow situations.

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5.2 WWTP Buildings/Utilities

5.2.1 Power Supply

A power monitor has been installed in the main power distribution panel to ensure proper power and phase rotation is delivered to the system.

Alarms

Alarm	Alarm Description	Actuation Control	Delay	Self Resetting (Y)
ESA-8201	Emergency Stop Alarm	ESA-8201 = Active	Immediate	Y
PWR-FAIL	Power Failure		Immediate	Y
PLC FLT	PLC Fault Detected		Immediate	Y
PWR FLT	Phase Monitor Fault	JA-8201 = Active	Immediate	Y

5.2.2 E-Stop

Emergency stop buttons are located:

- On the Main Control Panel in each of the Screen Buildings
- On the Control Panel installed in each process train
- On the Main Control Panel in the Sludge Building
- Main Control Panel in each of the Receiving Stations
- There is an E-Stop PLC alarm if pressed.

5.2.3 Building Temperature Control

The electric heaters respond to the temperature set point set on the individual heater TSL temperature switches. If the building temperature falls below the temperature switch settings, electric heaters will turn on.

5.2.3.1 Logic

TAG	Description	Control Logic	Output Type
H-7911	Building Heater	Always on internally controlled	Direct (not PLC controled)
H-7912	Building Heater	Always on internally controlled	Direct (not PLC controled)
H-7941	Building Heater	Always on internally controlled	Direct (not PLC controled)
H-7961	Building Heater	Always on internally controlled	Direct (not PLC controled)
H-7962	Building Heater	Always on internally controlled	Direct (not PLC controled)
H-7963	Building Heater	Always on internally controlled	Direct (not PLC controled)

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5.2.3.2 Alarms

Alarm	Alarm Description	Actuation Control	Delay	Self Resetting (Y)
TALL-7911	Temperature Alarm Low Low	TSLL-7911 = Active	5s	Y
TALL-7941	Temperature Alarm Low Low	TSLL-7941 = Active	5s	Y
TALL-7961	Low Low Temp Aalrm	LSLL-7961 = Active		

5.2.4 Ventilation

A single fan (F-7963) located in the MBR Process container acts to exhaust the container during the warmer months. Temperature is monitored by the temperature sensor and a high setpoint turns the exhaust fan on. There are also exhaust blowers to de-rate classified areas.

5.2.4.1 Logic

Tag / Mode	Description	Control Logic	Output Type	HOA Control
B-7911	Ventilation Blower	The continuous ventilation blower will always be ON. This blower is used as means to de-rate the screen building to a Class 1 Division 2 area. Air exchanges must be a minimum of 12 per hour,	Direct (not PLC controled)	
B-7941	Aeration Exhaust Blower	On when B-501/502 is on OR B-601/602 is on	Discrete	Auto
F-7963	Building Fan	Always on controlled by Wall Mount Termostat	Direct (not PLC controled)	

5.2.4.2 Alarms

Alarm	Alarm Description	Actuation Control	Delay	Self Resetting (Y)	Notes
PAL-7911	Pressure Alarm Low	PSL-7911 = InActive	5s	Y	Alarm indicates possible continuous ventilation failure, indicating risk that the room may become Class 1 Division 1 rated.

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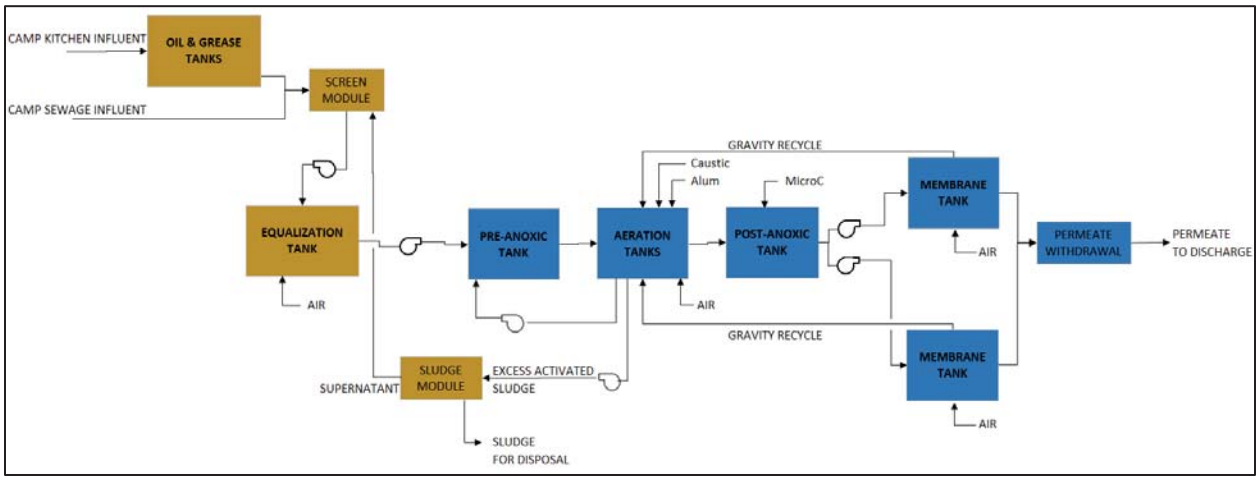
5.3 Process Narrative



The wastewater treatment plant receives two streams of wastewater. The first source is domestic wastewater, which is fed directly to the fine to remove any fibers or debris that might damage the membranes. The second source is kitchen wastewater which is pre-treated in the oil and grease tanks to remove oil and grease prior to being fed into the fine screens. The combined screened wastewater is pumped to the equalization tank (TNK-301). The equalization tank buffers variability in the influent flow rate and concentrations of influent constituents, maintaining a consistent flow rate and wastewater strength through the MBR system. Wastewater is then pumped from the equalization tank to the pre-anoxic tank (TNK-401) for denitrification.

In the pre-anoxic tank screen wastewater containing organics is combined with recycled mixed liquor from the aeration tank containing nitrates. Bacteria use some of the organics to drive the denitrification process, converting nitrate into nitrogen gas. This process occurs in an anoxic environment where there is minimal oxygen. As such a pump and eductors are used to mix the tank to prevent addition of oxygen. The denitrification process is used to meet the effluent nitrate limit, reduce oxygen requirements and to recover alkalinity, thus reducing chemical consumption.

Mixed liquor from the anoxic tank flows by gravity to the first aerobic tank (TNK-501) followed by the second aeration tank (TNK-502) for aerobic biological degradation of the influent constituents (organics and ammonia). In the aerobic tanks the nitrification process converts ammonia to nitrate in order to meet the effluent ammonia limit. This process consumes alkalinity, so a caustic dosing pump is used to control the pH. Additionally, liquid alum is dosed into the anoxic zone to precipitate phosphorus in order to meet the effluent phosphorus limit. Mixed liquor flows by gravity from the second aeration tank to the post-anoxic tank (TNK-551) for final denitrification polishing. In the post-anoxic tank there are minimal dissolved influent organics to drive the denitrification process. As such, an external carbon source in the form of Micro C is dosed to supplement the organics and drive the denitrification process.

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Mixed liquor is pumped from the post-anoxic tank to the membrane tanks (TNK-601 and TNK-602). The membrane tanks serve as additional volume for aerobic biological treatment to remove any excess MicroC (which would other cause BOD in the effluent) and house the membrane filters used for solid-liquid separation. Treated effluent is drawn through the membranes by vacuum pumps.

Since the solid-liquid separation process results in an accumulation of solids in the membrane tank, the mixed liquor (containing both solids and filtrate) is continuously recycled to the first aeration tank (TNK-501). This prevents excessive solids build-up in the membrane tank, and maintains sufficient biomass in the anoxic and aeration tanks. The solids that accumulate in the system consist of biomass that have grown from the influent organics and ammonia, as well as non-biodegradable solids from the influent wastewater. In order to maintain an optimal concentration of mixed liquor suspended solids (MLSS) (typically 10 g/L), a portion of the mixed liquor is periodically wasted by pumping from the Aeration Tank (TNK-501) to the sludge holding tank (TNK-901). Wasted sludge in the sludge holding tank is thickened by decanting supernatant back to the screen tank. Thickened sludge accumulates in the sludge holding tanks until it is eventually pumped out for disposal.

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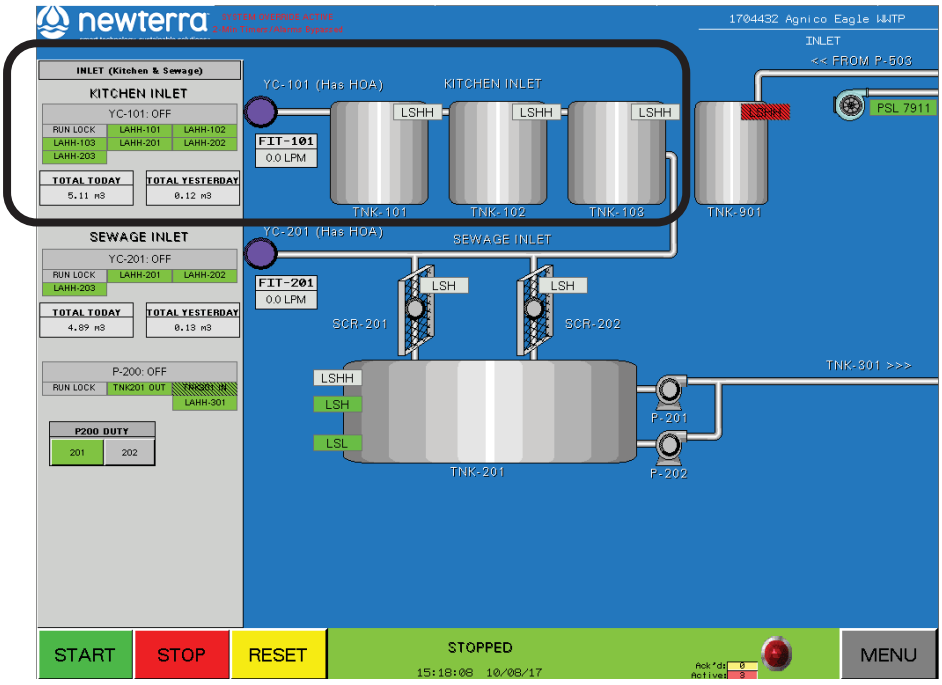
5.4 Kitchen Inlet Module (TNK-101/2/3) Module

A schematic of the Kitchen Inlet Module is located on the INLET HMI screen and shown below.



5.4.1 Function

The Waste Water Treatment Plant accepts waste water from the local kitchen which contains kitchen oils and greases. These need to be removed prior to being fed into the fine screens. This is done by using TNK-101/2/3 as grease traps. The kitchen waste water enters TNK-101, the solid food particles sink to the bottom, while lighter grease and oil floats to the top. The relatively grease-free water is then fed into TNK-102 where the process is repeated to further separate the oils and greases from the waste water. The same applies to TNK-103. The waste water is then fed to the fine screens.

5.4.2 Inputs

TAG	Description	Input Type	HMI Display Units	Device Range and Units	Device Span/PLC Scale	Datalog (Y)	Trending (Y)
FIT-101	Flow Indicating Transmitter	Analog	GPM	0-760lpm	0-760lpm	Y	Y
FQI-101	Flow Totalizer	Discrete N.O.	Pulse/Gal	1 liter/ Pulse			
LSHH-101	Level Switch High High	Discrete N.C.					
LSHH-102	Level Switch High High	Discrete N.C.					
LSHH-103	Level Switch High High	Discrete N.C.					

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5.4.3 Setpoints

Tag	Description	Factory Setpoint	Setpoint Range and Units	Setpoint Change Control	Alarm setpoint (Y/N)
FTAH-101-SP	Flow Transmitter Alarm High Setpoint	75	0-200 GPM	Open	Y

5.4.4 Logic

TAG	Description	Control Logic	Alarm Interactions	HOA Control
YC-101	Ready Contact	On when LSHH-101 / 102 / 103 and LSHH-201 / 202 and LSHH-203 are not ON	All LSHH's in the inlet area	HOA

5.4.5 Alarms

Alarm	Alarm Description	Actuation Control	Delay	Self Resetting (Y)
FTAH-101	Flow Transmitter Alarm High	FIT-101 > FTAH-101-SP	60s	
LAHH-101	Level Alarm High High	LSHH-101 = Active	5s	Y
LAHH-102	Level Alarm High High	LSHH-102 = Active	5s	Y
LAHH-103	Level Alarm High High	LSHH-103 = Active	5s	Y

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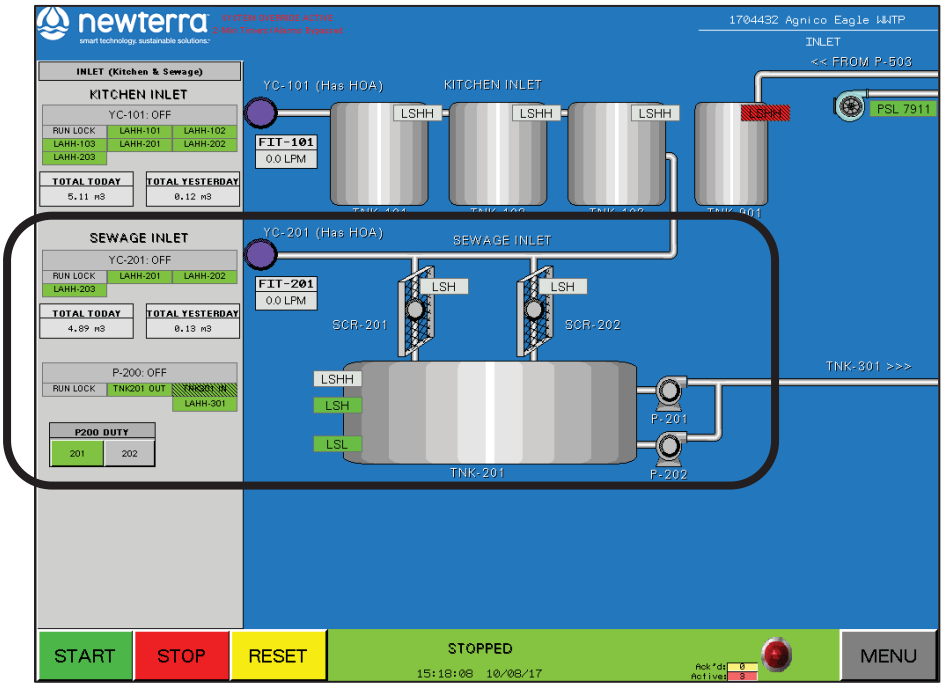
5.5 Fine Screens (SCR-201/202) Module

A schematic of the Fine Screens are located on the INLET HMI screen and shown below.



5.5.1 Function

Camp domestic and kitchen wastewater is into the fine screens (SCR-201/202). The screening process is provided to remove hair, and fibrous materials from the supplied wastewater that might damage the membranes. The screening are collected in burlap bags that need to be removed daily. The waste water is then pumped to the EQ Tank.

5.5.2 Inputs

TAG	Description	Input Type	HMI Display Units	Device Range and Units	Device Span/PLC Scale	Datalog (Y)	Trending (Y)
FIT-201	Flow Indicating Transmitter	Analog	GPM	0-760lpm	0-760lpm	Y	Y
FQI-201	Flow Totalizer	Discrete N.O.	Pulse/Gal	1 liter/ Pulse			
LSHH-201	Level Switch High High	Discrete N.C.					
LSHH-202	Level Switch High High	Discrete N.C.					
LSHH-203	Level Switch High High	Discrete N.C.					
LSH-203	Level Switch High	Discrete N.C.					
LSL-203	Level Switch Low Low	Discrete N.O.					

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5.5.3 Setpoints

TAG	Description	Factory Setpoint	Setpoint Range and Units	Setpoint Change Control	Alarm setpoint (Y/N)
FTAH-201-SP	Flow Transmitter Alarm High Setpoint	75	0-200 GPM	Open	Y

5.5.4 Logic

TAG	Description	Control Logic	Alarm Interactions	Output Type	Hour Meter	HOA Control
YC-201	Ready Contact	On when LSH-201 / 202 and LSHH-203 are not ON				HOA
SCR-201	Inlet Screen	The inlet screen will be ON when influent flow is detected via flow transmitter FIT-201. The screen will run for 1 minute after influent flow has stopped via flow transmitter FIT-201. If the high high level switch LSHH-201 on the screen is ON then the inlet screen SCR-201 will be ON.		Discrete	Y	HOA
SCR-202	Inlet Screen	Same as SCR-201		Discrete	Y	HOA
P-201	Screen Transfer Pump	The pump will be ON when the LSH-203 turn on as long as LT-301 < LTH-301-sp setpoint the pump will turn off when the LSL-201 turns off	LAHH-301	Discrete	Y	HOA
P-202	Screen Transfer Pump	This pump runs duty standby with P-201 with a 5:1 rato	LAHH-301	Discrete	Y	HOA

5.5.5 Alarms

Alarm	Alarm Description	Actuation Control	Delay	Self Resetting (Y)
FTAH-201	Flow Transmitter Alarm High	FIT-201 > FTAL-201-SP	60s	
LAHH-201	Level Alarm High High	LSHH-201 = Active	5s	Y
LAHH-202	Level Alarm High High	LSHH-202 = Active	5s	Y
LAHH-203	Level Alarm High High	LSHH-203 = Active	5s	Y

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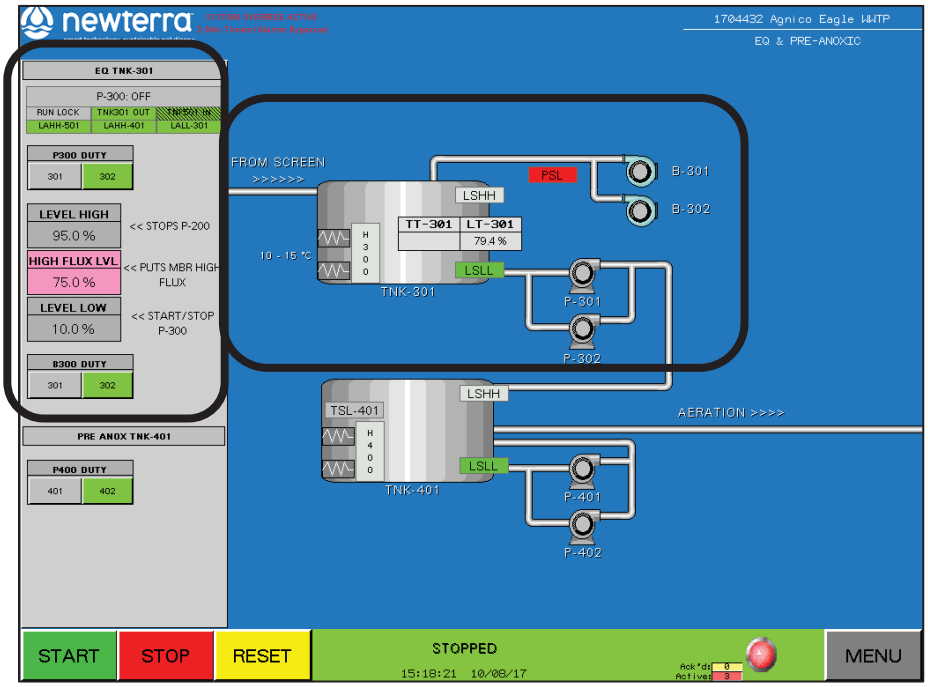
5.6 Equalization Tank (TNK-301) Module

A schematic of the Equalization Tank (TNK-301) is located on the EQ & PRE-ANOXIC HMI screen and shown below.



5.6.1 Function

The EQ Tank (TNK-301) buffers variability in the influent flow rate to maintain a consistent flow rate through the membranes and to reduce concentration fluctuations of influent constituents (i.e. BOD, TSS etc.) through the MBR treatment system. Wastewater entering the newterra MBR will first have undergone pre-treatment by fine screens and grease traps (kitchen waste). The waste water is then pumped to the Pre-Anox Tank.

5.6.2 Inputs

Tag	Description	Input Type	HMI Display Units	Device Range and Units	Device Span/PLC Scale	Datalog (Y)	Trending (Y)	Notes
LSHH-301	Level Switch High High	Discrete N.C.						
LT-301	Level Transmitter	Analog	%	0-10 ftWC	0-10 ftWC	Y	Y	
TT-301	Temperature Transmitter	Analog	°C	0-100c	0-100c	n	n	Added to System
LSLL-301	Level Switch Low Low	Discrete N.O.						Must be above all immersion heaters in Tank
PSL-301	Pressure Switch Low	Discrete N.C.		9-85"WC				

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5.6.3 Setpoints

Tag	Description	Factory Setpoint	Setpoint Range and Units	Setpoint Change Control	Alarm setpoint (Y/N)	Notes
LTL-301-SP	Level Transmitter Low Setpoint	10%	0-100%	Open		
LTHFLUX-301-SP	High Flux Level Setting	50%	0-100%			Puts the MBR Permeate pumps into High Flux Mode
LTH-301-SP	Level Transmitter High Setpoint	80%	50-100%	Open		

5.6.4 Logic

Tag	Description	Control Logic	Alarm Interactions	Output Type	Hour Meter	HOA Control
H-301	Tank Heater	On when TT-301 < 10C Off when TT-301 >15C	LALL-301	Discrete		
H-302	Tank Heater	Same as H-301	LALL-301	Discrete		
P-301	EQ Transfer Pump	The EQ pump will be ON when the EQ level transmitter LT-301 > LTL-301-SP and the aeration tank level transmitter LT-501 < LTH-501-SP The EQ pump will be OFF when the EQ level transmitter LT-301 < LTL-301-SP OR LSLL-301 = InActive OR the aeration tank level transmitter LT-501 > LTH-501-SP OR LSHH-401 is active Runs Duty with P-302 as Standby	Turns OFF LAHH-501 LAHH-401 LALL-301	Discrete	Y	HOA
P-302	EQ Transfer Pump	This pump runs duty standby with P-201 with a 5:1 rato		Discrete	Y	HOA
B-301	EQ Blower	The EQ blower will be ON when the System is in Run & LSLL-301 is active.		Discrete	Y	HOA
B-302	EQ Blower	Runs Duty standby with B-301 switching every 120 hours		Discrete	Y	HOA

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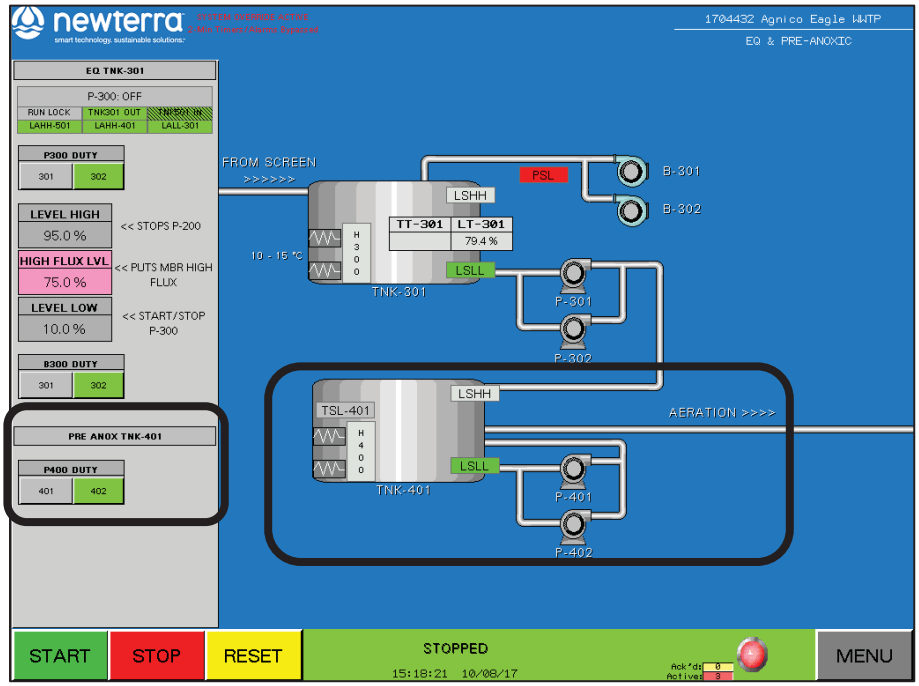
5.6.5 Alarms

Alarm	Alarm Description	Actuation Control	Delay	Self Resetting (Y)
LAHH-301	Level Alarm High High	LSHH-301 = Active	5s	Y
LALL-301	Level Alarm Low Low	LSLL-301 = Off	5s	Y

5.7 Pre-Anox Tank (TNK-401) Module

A schematic of the Pre-Anox Tank (TNK-401) is located on the EQ & PRE-ANOXIC HMI screen and shown below.



5.7.1 Function

In the pre-anoxic tank (TNK-401), the wastewater containing organics is combined with recycled mixed liquor from the aeration tank containing nitrates. Bacteria use some of the organics to drive the denitrification process, converting nitrate into nitrogen gas. This process occurs in an anoxic environment where there is minimal oxygen. As such, a pump and eductors are used to mix the tank to prevent addition of oxygen. The denitrification process is used to meet the effluent nitrate limit, reduce oxygen requirements and to recover alkalinity, thus reducing chemical consumption.

5.7.2 Inputs

Tag	Description	Input Type
LSHH-401	Level Switch High High	Discrete N.C.
TSL-401	Temperature Switch Low	Discrete N.C.
LSLL-401	Level Switch Low Low	Discrete N.O.

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5.7.3 Setpoints

None

5.7.4 Logic

Tag	Description	Control Logic	Alarm Interactions	Output Type	Hour Meter	HOA Control
P-401	Pre-Anox Mixing Pump	The pump will be ON when the System is in Run & LSLL-401 is active.	LALL-401 PUMP IS OFF	Discrete	Y	HOA
P-402	Pre-Anox Mixing Pump	Runs Duty standby with P-401 switching every 120 hours		Discrete	Y	HOA
H-401	Tank Heater	On when TSL-401 is OFF	LALL-401	Discrete		
H-402	Tank Heater	On when TSL-401 is OFF	LALL-401	Discrete		

5.7.5 Alarms

Alarm	Alarm Description	Actuation Control	Delay	Self Resetting (Y)
LAHH-401	Level Alarm High High	LSHH-401 = Active	5s	Y
LALL-401	Level Alarm Low Low	LSLL-401 = OFF	5s	Y

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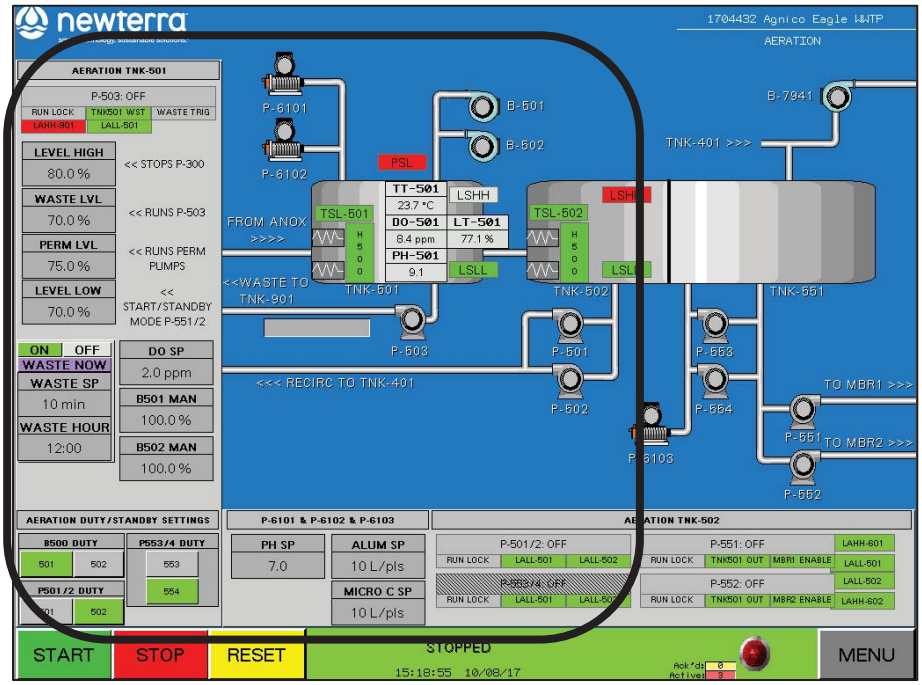
5.8 Aeration Tanks (TNK-501/502) - Biological Treatment Module

The schematic of the Aeration Tanks (TNK-501/502) is located on the AERATION HMI screen and shown below.



5.8.1 Function

Mixed liquor from the anoxic tank (TNK-401) flows by gravity to the first aerobic tank (TNK-501) followed by the second aeration tank (TNK-502) for aerobic biological degradation of the influent constituents (organics and ammonia). In the aerobic tanks (TNK-501/502), the nitrification process converts ammonia to nitrate in order to meet the effluent ammonia limit. This process consumes alkalinity, so caustic is dosed into TNK-501 (by pump P-6101) to control the pH. Additionally, liquid alum is dosed (by pump P-6102) into the anoxic zone to precipitate phosphorus in order to meet the effluent phosphorus limit.

pH measured by a pH probe (PH-501) in TNK-501.

Blowers (B-501/502) supply air to the submerged fine-bubble diffusers to ensure sufficient dissolved oxygen (DO) is available for biological oxidation and to keep solids in the water suspended. Dissolved Oxygen (DO) is measured by a DO Probe (DO-501) in TNK-501.

In order to maintain an optimal concentration of mixed liquor suspended solids (MLSS) (typically 10 g/L), a portion of the mixed liquor is periodically wasted by pumping from the Aeration Tank (TNK-501) to the sludge holding tank (TNK-901) by P-503.

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5.8.2 Inputs

Tag	Description	Input Type	HMI Display Units	Device Range and Units	Datalog (Y)	Trending (Y)
LSHH-501	Level Switch High High	Discrete N.C.				
LSLL-501	Level Switch Low Low	Discrete N.O.				
PH-501	pH Transmitter	Analog		0-14 pH	Y	Y
DO-501	Dissolved Oxygen Transmitter	Modbus	ppm	0-10	Y	Y
TT-501	Temperature Transmitter	Modbus	°C	0-100		
LT-501	Level Transmitter	Analog	%	0-10 ft	Y	Y
PSL-501	Pressure Switch Low	Discrete N.C.		9-85"WC		
LSHH-502	Level Switch High High	Discrete N.C.				
LSLL-502	Level Switch Low Low	Discrete N.O.				
TSL-502	Temperature Switch Low	Discrete N.C.				

5.8.3 Setpoints

Tag	Description	Factory Setpoint	Setpoint Range and Units	Setpoint Change Control	Alarm setpoint (Y/N)
LTL-501-SP	Level Transmitter Low Setpoint	70%	0-100%	Open	
LTH-501-SP	Level Transmitter High Setpoint	80%	0-100%	Open	
LT501-SLUDGE-SP	Waste Level for P-503	75%	0-100%	Open	
LT501-PERM-SP	Level Control for Permeate Pumps	75%	0-100%	Open	
P503 WASTE HOUR	When P-503 will waste	12pm	0-23		
P503 WASTE SP	Time that P-503 wastes for	10min	0-99		
PH-501-SP	pH Normal Setpoint	7 pH	6-8pH	Open	
PHAH-501-SP	pH Alarm High Setpoint	8 pH	7 - 14 pH	Open	Y

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Tag	Description	Factory Setpoint	Setpoint Range and Units	Setpoint Change Control	Alarm setpoint (Y/N)
PHAL-501-SP	pH Alarm Low Setpoint	6 pH	0-7 pH	Open	Y
DO-501-SP	Dissolved Oxygen Normal Setpoint	2 ppm	0-6 ppm	Open	
B500 I SP	Integral Gain setting DO PID Loop	10s	0-99		
B500 P SP	Proportional Gain setting DO PID Loop	100%	0-99		
B501 MAN SP	Manual Speed B-501	50%	0-100		
B502 MAN SP	Manual Speed B-502	50%	0-100		
DOAL-501-SP	Dissolved Oxygen Alarm Low Setpoint	0.5 ppm	0-6 ppm	Open	Y
ALUM DOSE	Alum Dose setting (xGal per Pulse)	10 Gallons	0-99 Gallons	Open	
MICROC DOSE	Micro C Dose setting (xGal per Pulse)	10 Gallons	0-99 Gallons	Open	
TALL-501-SP	Temperature Alarm Low Low	10 deg C	5 - 25 deg C	Password	Y
TTL-501-SP	Temperature Transmitter Low Setpoint	15 deg C	5-25 deg C	Open	
PAL-501-SP	Pressure Alarm Low Setpoint	28"WC (1PSIG)		On Device	Y
TALL-502-SP	Temperature Alarm Low Low	10 deg C	5 - 25 deg C	Password	Y

5.8.4 Logic

Tag	Description	Control Logic	Alarm Interactions	Output Type	Hour Meter	HOA Control
P-6102	Alum Dosing Pump	Alum Dosing Pump P-6102 be ON when FIT-701 has reached a user adjustable volume of permeate via FT-701-DOSE setpoint. P-6102 will be ON for one pulse.		Discrete		HOA
P-6101	Caustic Dosing Pump	Caustic Dosing Pump P-6101 will be ON when PH-501 < PH-501-SP. The pump will be ON for 30s and OFF for 30s and will operate in pause mode		Discrete		HOA
H-501	Tank Heater	On when TSL-501 is OFF	LALL-501	Discrete		

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Tag	Description	Control Logic	Alarm Interactions	Output Type	Hour Meter	HOA Control
H-502	Tank Heater	On when TSL-501 is OFF	LALL-501	Discrete		
P-503	Waste Activated Sludge Pump	The waste activated sludge pump will be ON at time of day setting SLUDGE-WASTE-TOD IF level switch LT501-SLUDGE-SP	LAHH-901: Pump will be OFF	Discrete		HOA
H-503	Tank Heater	On when TSL-502 is OFF	LALL-502	Discrete		
H-504	Tank Heater	On when TSL-502 is OFF	LALL-502	Discrete		
P-501	Aeration Recirc Pump	The pump will run as long as LSLL-501 is Active	LALL-502: Pump will be OFF	Discrete	Y	HOA
P-502	Aeration Recirc Pump	Runs Duty standby with p-501 switching every 120 hours		Discrete	Y	HOA
B-501	Aeration Tank Aeration Blower	ON - AlwaysRuns via PID loop to maintain DO-501-SPRuns Duty/Standby 120 hours with B-502.		Direct	Y	HOA
B-502	Aeration Tank Aeration Blower	Runs via same logic as B-501. Runs Duty/Standby every 120 hours with B-501.		Direct	Y	HOA

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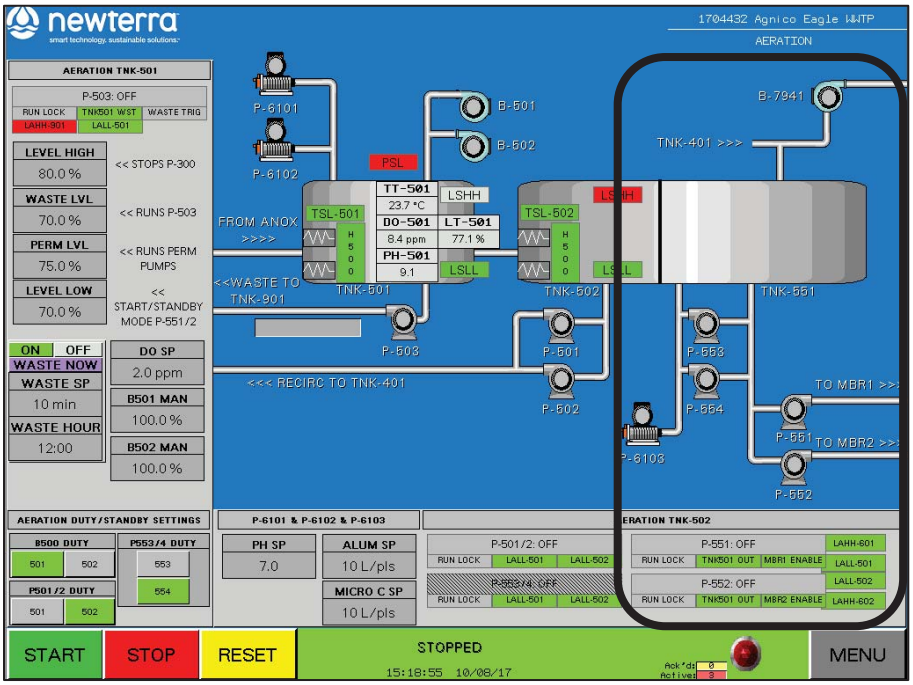
5.8.5 Alarms

Alarm	Alarm Description	Actuation Control	Delay	Self Resetting (Y)
LAHH-501	Level Alarm High High	LSHH-501 = Active	5s	Y
LAHH-502	Level Alarm High High	LSHH-501 = Active	5s	Y
PHAH-501	pH Alarm High	pH-501 > PHAH-501-SP	60s	
PHAL-501	pH Alarm Low	pH-501 < PHAL-501-SP	60s	
DOAL-501	Dissolved Oxygen Alarm Low	DO-501 < DOAL-501-SP	15m	
DOALL-501	Dissolved Oxygen Alarm Low Low	DO-501 < DOAL-501-SP	4hrs	
TTAL-501	Low Temp TNK-501	TT-501<TTAL-501-SP		
PAL-501	Pressure Alarm Low	PSL-501 = InActive	5s	Y
VFDA-501	VFD Fault			
VFDA-502	VFD Fault			
LALL-501	Low Low Level TNK-501	LSLL-501 = OFF		
LALL-502	Low Low Level TNK-502	LSLL-502 = OFF		

5.9 Post-Anox Tank (TNK-551) Module

The schematic of the Post-Anox Tank (TNK-551) is located on the AERATION HMI screen and shown below.



5.9.1 Function

Mixed liquor flows by gravity from the second aeration tank (TNK-502) to the post-anoxic tank (TNK-551) for final denitrification polishing. In the post-anoxic tank, there are minimal dissolved influent organics to drive the denitrification process. As such, an external carbon source in the form of Micro C is dosed (by P-6103) to supplement the organics and drive the denitrification process.

5.9.2 Inputs

None

5.9.3 Setpoints

None

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5.9.4 Logic

Tag	Description	Control Logic	Alarm Interactions	Output Type	Hour Meter	HOA Control
P-553	Post Anox Mix Pump	The pump will run as long as LSLL-501 is Active	LALL-501: Pump will be OFF	Discrete	Y	HOA
P-554	Post Anox Mix Pump	Runs Duty standby with p-501 switching every 120 hours		Discrete	Y	HOA
P-6103	Micro C Dosing Pump	Dosing Pump will be ON when FIT-701 or FT-702 has reached a user adjustable volume of permeate via DOSE setpoint.		Discrete		HOA
P-551	Aeration Transfer Pump Feed to MBR-1	The aeration pump will feed MBR tank T-601. The pump will be ON when level transmitter LT-501 > LTL-501-SP and LSLL-501 = Active and LSLL-502 = Active and MBR-1 is Enabled. The aeration pump will be cycle ON/OFF when LT-501 < LTL-501-SP and be OFF if LSLL-501 = InActive OR LSLL-502 = InActive	LAHH-601: Pump will be OFF MBR-1 Disabled	Discrete	Y	HOA
P-552	Aeration Transfer Pump Feed to MBR-2	The aeration pump will feed MBR tank T-602. The pump will be ON when level transmitter LT-501 > LTL-501-SP and LSLL-501 = Active and LSLL-502 = Active and MBR-2 is Enabled. The aeration pump will cycle ON/OFF when LT-501 < LTL-501-SP and be OFF if LSLL-501 = InActive OR LSLL-502 = InActive	LAHH-602: Pump will be OFF MBR-2 Disabled	Discrete	Y	HOA

5.9.5 Alarms

None

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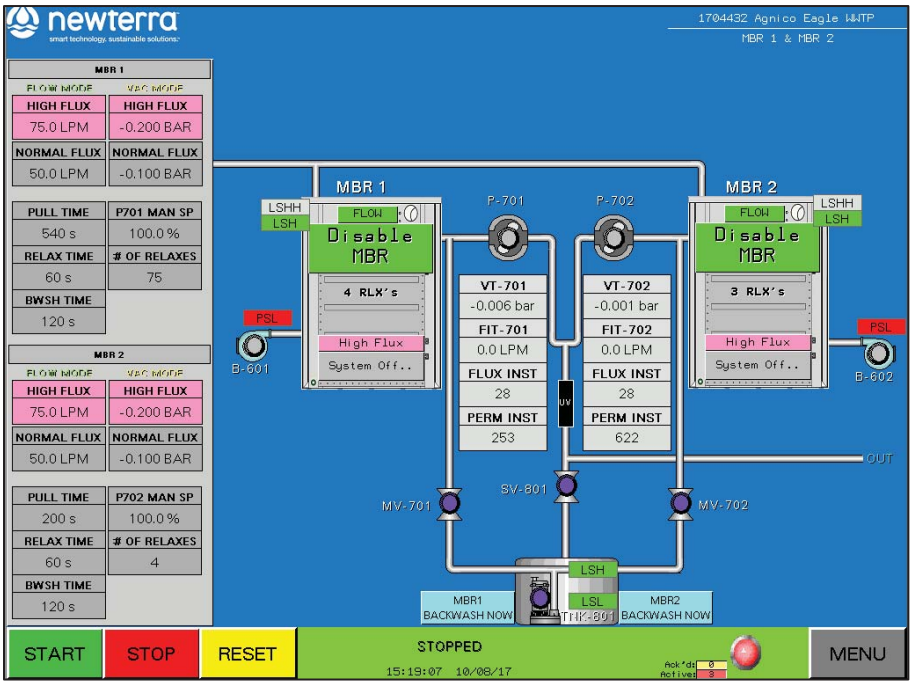
5.10 Membrane and Permeate Module

The schematic of the Membrane (TNK-601/602) and Permeate (P-701/702) Module is located on the MBR 1 & MBR 2 HMI screen and shown below.



5.10.1 Function

Mixed liquor filtration and supplemental biological oxidation.

Since the solid-liquid separation process results in an accumulation of solids in the membrane tank, the mixed liquor (containing both solids and filtrate) is continuously recycled to the first aeration tank (TNK-501). This prevents excessive solids build-up in the membrane tank, and maintains sufficient biomass in the anoxic and aeration tanks. The solids that accumulate in the system consist of biomass that have grown from the influent organics and ammonia, as well as non-biodegradable solids from the influent wastewater.

Vacuum pumps (P-701 and P-702) draw the water through the membranes under a low vacuum of 0.07 to 0.25 bar.

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5.10.2 Inputs

Tag	Description	Input Type	HMI Display Units	Device Range and Units	Datalog (Y)	Trending (Y)
LSHH-601	Level Switch High High	Discrete N.C.				
LSH-601	Level Switch High	Discrete N.O.				
LSHH-602	Level Switch High High	Discrete N.C.				
LSH-602	Level Switch High	Discrete N.O.				
PSL-601	Pressure Switch Low	Discrete N.C.		9-85"WC		
PSL-602	Pressure Switch Low	Discrete N.C.		9-85"WC		
VT-701	Vacuum Transmitter	Analog	Bar	-1.0 - 1.0 Bar	Y	Y
VT-702	Vacuum Transmitter	Analog	Bar	-1.0 - 1.0 Bar	Y	Y
VFD-701	VFD Status	Communcation				
VFD-702	VFD Status	Communcation				
FIT-701	Flow Indicating Transmitter	Analog	GPM	0-300lpm	Y	Y
FQI-701	Flow Totalizer	Discrete N.O.	Pulse/Gal	1liter / Pulse		
FIT-702	Flow Indicating Transmitter	Analog	GPM	0-300lpm	Y	Y
FQI-702	Flow Totalizer	Discrete N.O.	Pulse/Gal	1liter / Pulse		
LSH-801	Level Switch High	Discrete N.C.				
LSL-801	Level Switch Low Low	Discrete N.O.				

5.10.3 Setpoints

Tag	Description	Factory Setpoint	Setpoint Range and Units	Setpoint Change Control	Alarm setpoint (Y/N)	Notes
VT-701-SP	MBR-1 Vac Mode Permeate Setpoint	-0.1 bar	-0.2 - 0 bar	Open		
VT-701-HFSP	MBR-1 Vac Mode Permeate High Flux Setpoint	-0.15 bar	-0.2 - 0 bar	Open		
VTAH-701-SP	MBR-1 Vacuum Transmitter Alarm High	-0.3 bar	-0.3 - 0 bar	Open	Y	
VT-702-SP	MBR-2 Vac Mode Permeate Setpoint	-0.1 bar	-0.2 - 0 bar	Open		
VT-702-HFSP	MBR-2 Vac Mode Permeate High Flux Setpoint	-0.15 bar	-0.2 - 0 bar	Open		

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Tag	Description	Factory Setpoint	Setpoint Range and Units	Setpoint Change Control	Alarm setpoint (Y/N)	Notes
VTAH-702-SP	MBR-2 Vacuum Transmitter Alarm High	-0.3 bar	-0.3 - 0 bar	Open	Y	
FT-701-SP	MBR-1 Flow Mode Permeate Setpoint	60 GPM	0-200	Open		
FT-701-HFSP	MBR-1 Flow Mode Permeate High Flux Setpoint	75%	0-200	Open		
FTAH-701-SP	MBR-1 Flow Transmitter Alarm High Setpoint	100	0-200	Open	Y	
FTAL-701-SP	MBR-1 Flow Transmitter Alarm Low Setpoint	10	0-200	Open	Y	
FT-702-SP	MBR-2 Flow Mode Permeate Setpoint	60 GPM	0-200	Open		
FT-702-HFSP	MBR-2 Flow Mode Permeate High Flux Setpoint	75GPM	0-200	Open		
FTAH-702-SP	MBR-2 Flow Transmitter Alarm High Setpoint	100	0-200	Open	Y	
FTAL-702-SP	MBR-2 Flow Transmitter Alarm Low Setpoint	10	0-200	Open	Y	
BKWSH-TIME-SP	Backwash Time Setpoint	120s	0-999 s	Open		
RELAX-SP	Number of Relaxes Before Backwash	6	0-999	Open		
PERM-PULL-TIME	Permeate Pull Time	9m	0-30m	Open		
RELAX-TIME	Membrane Relax Time	60s	0-999 s	Open		
FLUX-SP	High Flux Setpoint	75%	50-100%	Open		Reading based on LT-301
SLUDGE-WASTE-TOD	Time of Day to Start Sludge Wasting	23hr	0-23 hr	Open		
SLUDGE-WASTE-TIME	Duration of Sludge Wasting	60m	0-1000m	Open		

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5.10.4 Logic

Tag	Description	Control Logic	Alarm Interactions	Output Type	Hour Meter
B-601	MBR Tank Blower	The membrane tank blower will be ON when the System is in Run. And the MBR 1 is enabled	MBR-1 Disabled	Discrete	Y
B-602	MBR Tank Blower	The membrane tank blower will be ON when the System is in Run. And the MBR 2 is enabled	MBR-2 Disabled	Discrete	Y
P-701	Permeate Transfer Pump	The permeate pump will be ON when MBR-1 is Enabled & level switch LSH-601 = Active & LT-501 > LT501-PERM-SP The Pump will perform a PULL/RELAX Cycle. The pump will be ON for the duration specified by the PERM-PULL-TIME setpoint and then be OFF for the duration of the RELAX-TIME setpoint. This will generate one PULL/RELAX Cycle. The VFD Speed of the pump will operate based on the following: In FLOW MODE: The VFD Speed will operate based on a PID loop to maintain the flowrate setpoint FT-701-SP. IF the vacuum transmitter VT-701 > -0.25 bar then the pump will switch to VAC MODE. IF the level transmitter LT-301 > FLUX-SP, the pump will run via PID loop to maintain a high flow setpoint FT-701-HFSP In VAC MODE: The VFD Speed will operate based on a PID loop to maintain the vacuum setpoint VT-701-SP. IF the level transmitter LT-301 > FLUX-SP, the pump will run via PID loop to maintain a high flow setpoint VT-701-HFSP P-701 will be OFF if P-501 is OFF.	VFDA-701: Pump Will be Off	Communication	Y

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Tag	Description	Control Logic	Alarm Interactions	Output Type	Hour Meter
P-702	Permeate Transfer Pump	The permeate pump will be ON when MBR-2 is Enabled & level switch LSH-602 = Active & & LT-501 > LT501-PERM-SP The Pump will perform a PULL/RELAX Cycle. The pump will be ON for the duration specified by the PERM-PULL-TIME setpoint and then be OFF for the duration of the RELAX-TIME setpoint. This will generate one PULL/RELAX Cycle. The VFD Speed of the pump will operate based on the following: In FLOW MODE: The VFD Speed will operate based on a PID loop to maintain the flowrate setpoint FT-702-SP. IF the vacuum transmitter VT-702 > -0.25 bar then the pump will switch to VAC MODE. IF the level transmitter LT-301 > FLUX-SP, the pump will run via PID loop to maintain a high flow setpoint FT-702-HFSP In VAC MODE: The VFD Speed will operate based on a PID loop to maintain the vacuum setpoint VT-702-SP. IF the level transmitter LT-301 > FLUX-SP, the pump will run via PID loop to maintain a high flow setpoint VT-702-HFSP P-702 will be OFF if P-502 is OFF.	VFDA-703: Pump Will be Off	Communication	Y
SV-801	Clean In Place Tank Fill Solenoid Valve	The Solenoid Valve SV-801 will be Open (Energized) when level switch LSH-801 is InActive and MBR-1 OR MBR-2 are not in Backwash. The Solenoid Valve SV-801will be Closed (De-Engergized) when LSH-801 is Active or IF MBR-1 OR MBR-2 are in Backwash.		Discrete	
MV-701	Backwash Actuated Valve	A Backwash is enabled once the permeate pumps for MBR-1 reach the number of PULL/RELAX cycles designated by the RELAX-SP on the HMI.the The actuated valve will be OPEN when MBR-1 is in Backwash and level switch LSH-801 is Active. If MBR-2 is already in backwash, MBR-1 will complete 1 additional PULL/RELAX Cycle before starting a Backwash Cycle.		Discrete	
MV-702	Backwash Actuated Valve	A Backwash is enabled once the permeate pumps for MBR-2 reach the number of PULL/RELAX cycles designated by the RELAX-SP on the HMI. the The actuated valve will be OPEN when MBR-2 is in Backwash and level switch LSH-801 is Active. If MBR-2 is already in backwash, MBR-1 will complete 1 additional PULL/RELAX Cycle before starting a Backwash Cycle.		Discrete	

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Tag	Description	Control Logic	Alarm Interactions	Output Type	Hour Meter
P-801	Backwash Transfer Pump	The backwash transfer pump will be ON when MBR-1 OR MBR-2 are in Backwash and level switch LSH-801 is Active The backwash transfer pump will be OFF after the duration of BKWSH-TIME-SP OR level switch LSL-801 becomes InActive.		Discrete	

5.10.5 Alarms

Alarm	Alarm Description	Actuation Control	Delay	Email Notification (Y)	Self Resetting (Y)
LAHH-601	Level Alarm High High	LSHH-601 = Active	5s		Y
LAHH-602	Level Alarm High High	LSHH-602 = Active	5s		Y
PAL-601	Pressure Alarm Low	PSL-601 = InActive	5s		Y
PAL-602	Pressure Alarm Low	PSL-602 = InActive	5s		Y
VTAH-701	Vacuum Transmitter Alarm High	VT-701 < VTAH-701-SP	5s		Y
VTAH-702	Vacuum Transmitter Alarm High	VT-702 < VTAH-702-SP	5s		Y
VFDA-701	VFD Fault				
VFDA-702	VFD Fault				
FTAH-701	Flow Transmitter Alarm High	FIT-701 > FTAH-701-SP	60s		
FTAL-701	Flow Transmitter Alarm Low	FIT-701 < FTAL-701-SP	60s		
FTAH-702	Flow Transmitter Alarm High	FIT-702 > FTAH-702-SP	60s		
FTAL-702	Flow Transmitter Alarm Low	FIT-702 < FTAL-702-SP	60s		

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5.10.6 Blower Control

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

5.10.7 CIP Cleaning

Note: At design flow when the membrane discharge vacuum exceeds 0.2 bar (80" WC), as transmitted by VT-701, VT-702 and indicated locally at PI-701, PI-702, it is necessary to take the membrane tank offline for CIP cleaning. See **Section 7** for instructions on CIP cleaning.

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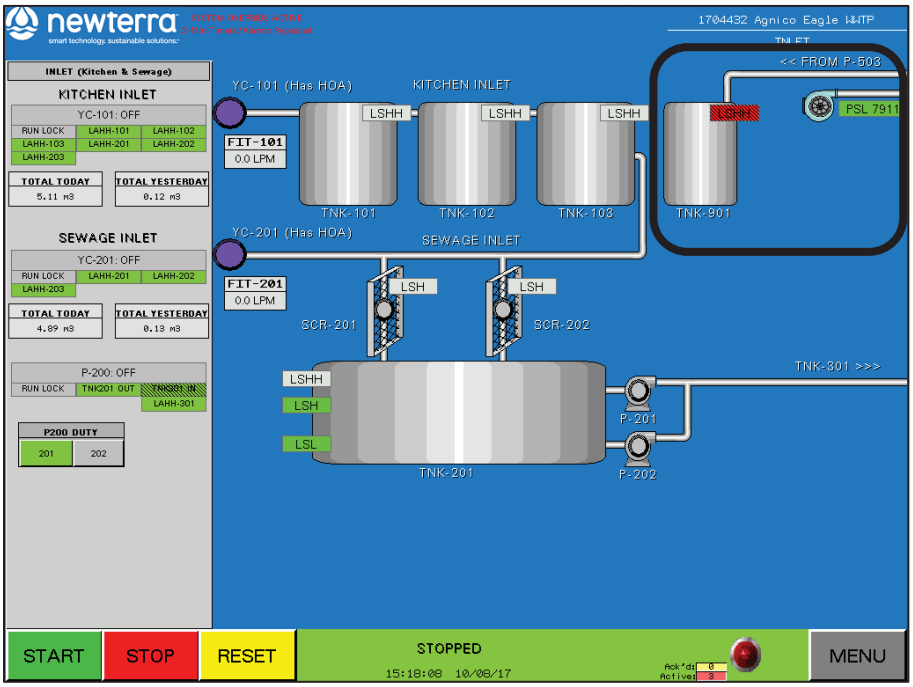
5.11 Sludge Holding Tank Module (TNK-901)

A schematic of the Sludge Holding Tanks is located on the INLET HMI screen is shown below.



5.11.1 Function

To store and thicken waste activated sludge for later disposal off site.

In order to maintain an optimal concentration of mixed liquor suspended solids (MLSS) (typically 10 g/L), a portion of the mixed liquor is periodically wasted by pumping from the Aeration Tank (TNK-501) to the sludge holding tank (TNK-901). Wasted sludge in the sludge holding tank is thickened by decanting supernatant back to the screen tank. Thickened sludge accumulates in the sludge holding tanks until it is eventually pumped out for disposal.

5.11.2 Inputs

Tag	Description	Input Type
LSHH-901	Level Switch High High	Discrete N.C.

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5.11.3 Setpoints

Tag	Description	Factory Setpoint	Setpoint Range and Units	Setpoint Change Control	Alarm setpoint (Y/N)
P503 WASTE HOUR	When P-503 will waste	12pm	0-23		
P503 WASTE SP	Time that P-503 wastes for	10min	0-99		

5.11.4 Logic

Tag	Description	Control Logic	Alarm Interactions	Output Type	Hour Meter	HOA Control
P-503	Waste Activated Sludge Pump	The waste activated sludge pump will be ON at time of day setting SLUDGE-WASTE-TOD IF level switch LT501-SLUDGE-SP	LAHH-901: Pump will be OFF	Discrete		HOA

5.11.5 Alarms

Alarm	Alarm Description	Actuation Control	Delay	Self Resetting (Y)
LAHH-901	Level Alarm High High	LSHH-901 = Active	5s	Y

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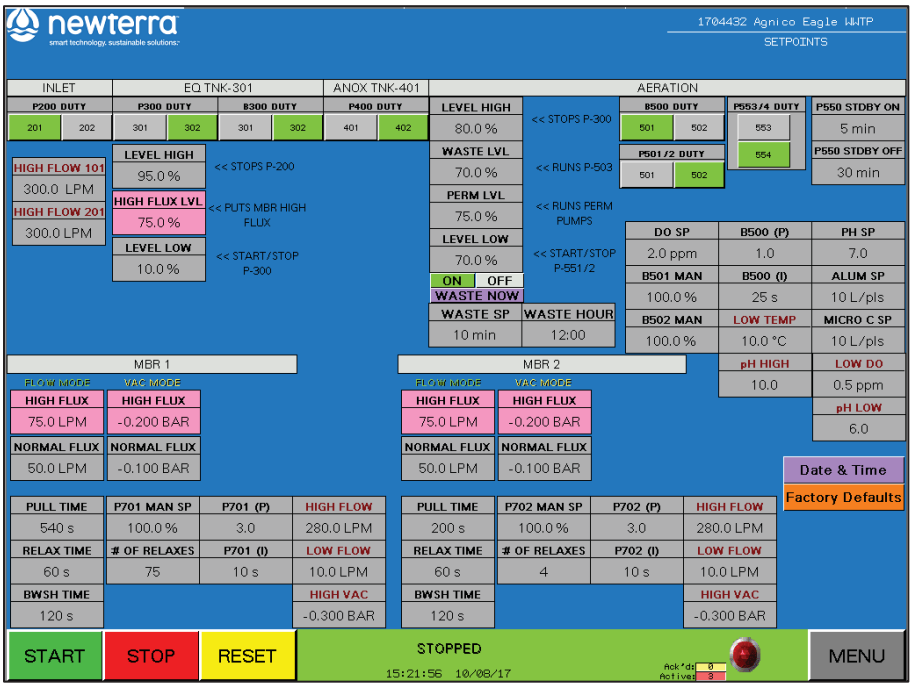
5.12 Setpoints

The system Setpoints can be accessed from the SETPOINTS menu option.



5.12.1 PLC Date & Time

The PLC Time and Date can be adjusted from the SETPOINTS HMI screen. Below is an example of the screen that will appear for the operator.

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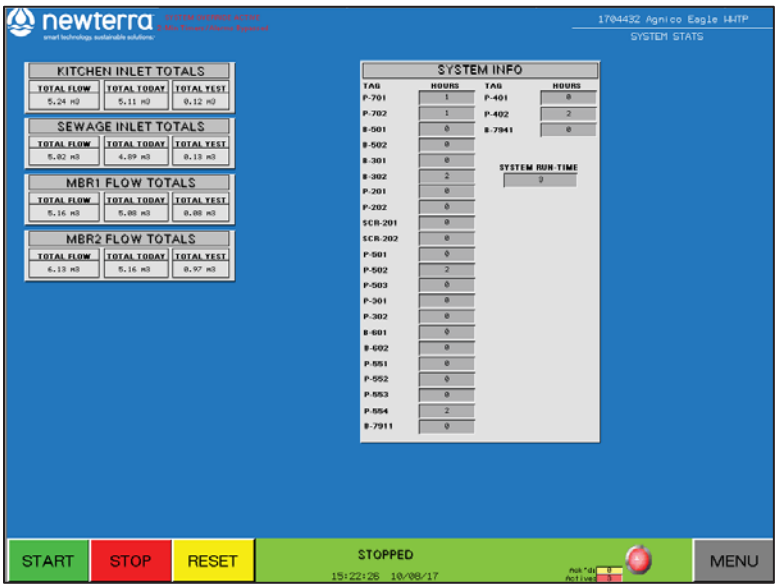
5.12.2 Factory Defaults

The Factory Defaults (setpoints) can be restored to the WWTP by pressing the Factory Default button from the SETPOINTS HMI screen. A confirmation screen will appear to the operator. See below. A listing of WWTP Factory Default values (setpoints) are at Appendix K.

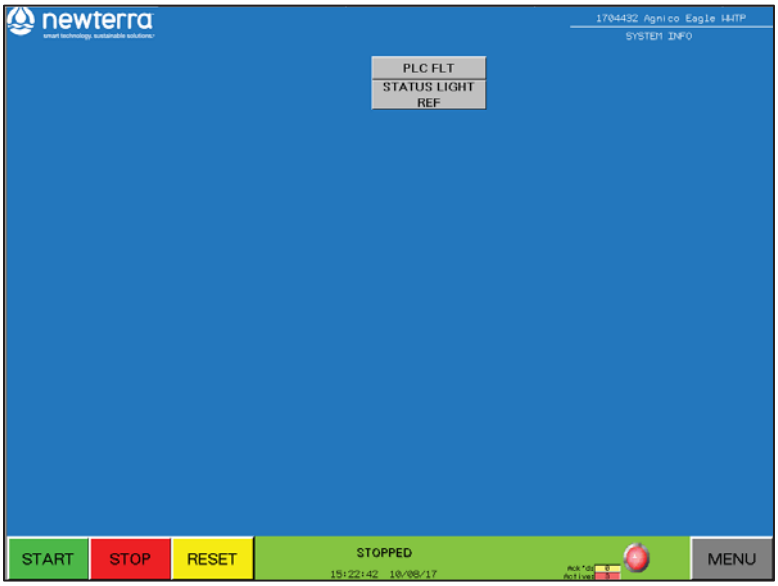
5.13 Statistics

The system statistics can be accessed from the STATS menu option. Influent and Process Flow totals as well as motor run times are provided at this screen.



5.14 PLC Status

The system PLC status can be accessed from the SYSTEM INFO menu option.



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6.0 PLANT START-UP, OPERATING GUIDELINES AND MONITORING

6.1 MBR Plant Start-Up

6.1.1 Mechanical & Electrical Start-up Procedure

- If the system is being started for the first time, work your way through the **newterra Commissioning 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.

6.1.2 Process Start-up

NOTE: Sludge from a nearby wastewater treatment plant can be used to start up another system if the treatment process is similar (i.e. nitrification, de-nitrification etc.).

1. Introduce the seed bacteria and fill the aeration tank according to one of the following two methods specific to the type of seed used:

Sludge Seed

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

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

Vs: Total volume of seed sludge for MBR system (m3)
Vt: Total effective volume of process tanks in MBR system (see section 3 of the manual) (m3)
MLSSs: MLSS concentration of seed sludge from a treatment system with similar processes (nitrification, de-nitrification etc.) (mg/L)

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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 similar wastewater and operated with similar processes (nitrification etc).

b. If possible drain the water used for clean water testing from the aeration tank. This will minimize dilution of the seed bacteria.

c. Pump seed sludge through the screen module to remove any debris that might damage the membranes. This can usually be done by slowly dumping the seed into the closest lift station. Ensure screen process and feed pumps to aeration tank are in “AUTO” mode.

d. If a primary clarifier is included and there is a screen between the aeration tank and membrane tank: Add seed sludge directly to the aeration tank.

e. Once aeration tank liquid level has filled above 30% with seed sludge, turn aeration tank blowers to “AUTO” mode.

f. Continue adding remaining seed sludge.

g. Once all seed sludge has been pumped into the aeration tank take note of the liquid level. If the aeration tank is full then continue to Step 2. If the aeration tank is not full then continue to fill the aeration tank 15% of its total volume per day using raw wastewater. This is to avoid shocking the bacteria with excess BOD, reducing the risk of forming foam causing bacteria and reducing the impact of un-metabolized BOD on the membranes.

Dry Seed

a. If possible drain the water in the aeration tank used for clean water test. This will minimize dilution of the seed bacteria.

b. Turn screen module and feed pump(s) to aeration tank to “AUTO”.

c. Allow aeration tank to fill to 30% with raw wastewater, and then turn off screen module and feed pump(s).
d. Remove the access cover from the aeration tank.

e. Adjust the DO probe and pH probe positioning in the aeration tank until both probes are submerged in the wastewater.

f. Turn aeration tank blowers to “HAND” to ensure vigorous mixing when adding dry seed bacteria. Note: When set to “HAND” the blowers will only run for 2 minutes. If this time runs out before all the dry bacteria have been added, then the blowers must be set to “OFF” and then back to “HAND”.

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g. Slowly add 25% of the supplied heterotrophic dry seed bacteria through the view port). The following quantities in Table 1 are typically shipped with standard camp systems, if the current system is not on this list please consult with a Process Engineer:

Table 1 - Seed bacteria quantities per standard camp model

Standard Camp Model	Dry Bacteria (Bioremove 5190) (lbs)	Nitrifying Bacteria (Bioremove 5895) (lbs)
50 Man	50	10
100 Man	50	10
300 Man	75	20
600 Man	75	20
1000 Man	100	30

h. Turn aeration tank blowers to “AUTO”.

i. Continue adding raw wastewater and dry seed bacteria according to the schedule outlined in Table 2 below:

Table 2 - Dry seed and wastewater dosing schedule

Day	Daily Wastewater Flowrate (% of Aeration Tank Volume)	Aeration Tank Fill Level (%)	Dry (heterotrophic) Seed to be Added (% of Total Supplied)
1	30%	30%	25%
2	10%	40%	20%
3	10%	50%	15%
4	15%	65%	10%
5	15%	80%	10%
6	15%	95%	10%
7	5%	100%	10%

j. As the aeration tank fills, continue to adjust the positioning of the DO and pH probes accordingly.

2. Once the aeration tank is full (liquid level >80%) the remaining equipment in the system can be started. Turn all equipment (except sludge wasting/processing equipment) to “AUTO”. Set the permeate flow rate at a value to achieve a flux of 6.5 lmh initially.

   Convert flux (lmh) to flow rate (lpm) as follows:

$$Flow\ rate\ (lpm) = \frac{Flux\ (lmh) * membrane\ surface\ area\ (m^2)}{60\ \left(\frac{min}{h}\right)}$$

   **** Verify the membrane cassette model – MCXL2 = 8 m^2 of surface area

3. Continue increasing the flux rate everyday according to the schedule in below.

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NOTE: Day 1 refers to the day that the aeration tank is full. If dry seed was used this will be day 7. If nitrifying bacteria were provided begin dosing into the aeration tank according to the schedule in below.

Flux and nitrifying bacteria dosing schedule

Day	Flux (lmh)	Nitrifying Bacteria to be Added (% of Total Provided) [If Provided]
1	6.5	20%
2	6.9	20%
3	7.4	20%
4	7.9	20%
5	8.4	20%
6	9.0	-
7	9.6	-
8	10.2	-
9	10.9	-
10	11.6	-
11	12.4	-
12	13.2	-
13	14.1	-
14	15.1	-
15	16.1	-
16	17.1	-
17	18.0	-
18	18.0	-
19	18.0	-
20	18.0	-
21	18.0	-
22	18.0	-
23	18.0	-

4. Foaming may occur during start-up, which is normal. Foaming can be caused by a number of factors. Typically during start-up foaming is a result of a high food (BOD) to microorganism (F/M) ratio. This promotes the growth of long chained filamentous bacteria that increases the surface tension resulting in strong, long lasting foam. As the quantity of biomass builds, and the sludge age increases the normal non-filamentous bacteria will dominate, and the foam should subside. In the meantime foaming can be addressed by spraying water, food based defoamer (silicone based defoamer is strictly prohibited) addition, or aeration minimization in the aeration tank. Check for signs of toxicity and excessive fat, oil and grease.

5. If a defoamer is required, consult with a process engineer for recommendation of an acceptable antifoaming agent and dosing quantities.

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6. Monitor the pH throughout the start-up process. An observed decline in pH is an indication that the nitrifying bacteria are beginning to remove ammonia. It is important, however, that the pH does not drop too low, as this can cause biological activity to be inhibited, which can then result in severe membrane fouling. During start-up it is beneficial to operate at a pH between 7.0 and 7.5 to ensure optimal performance and growth of bacteria.

   The pH should be maintained between 6.5 and 8.0 during normal operation.

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

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

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6.2 MBR System Operating Guidelines and Monitoring

6.2.1 Operating Guidelines

This section outlines the operating conditions that are required for proper wastewater treatment, and longevity of the membranes. For instructions on how to control the system using the touch screen HMI, see **Section 5**. 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:

- The MBR system is designed to treat wastewater with specified influent characteristics.
- 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.
- Always supply the required amount of air for scouring to the membrane module.
- Always filter wastewater at or below design flow rate.
- 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 1 min).
- Always operate the MBR in accordance with the parameters listed in the following tables.
- Clean the membranes in-place with a dilute chemical in accordance with **Section 7** of the O&M Manual.

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6.2.1.1 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
Backwashing	48 cycles	Built-in backwash mode during relaxation mode
In-situ Chemically Enhanced Backwash (CEB)	500 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.
TMP	< 0.2 bar (2.9 psi)	Membranes to be cleaned once the TMP exceeds 0.2 bar (2.9 psi)

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6.2.1.2 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	–
Aeration Tank to Anoxic Tank Recirculation	400%	200 – 500%*	Only applies if an anoxic tank is included. *The recycle ratio is a function of effluent NO_3-N/TN limit
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 Section 7 of this O&M Manual.

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6.2.2 Sampling

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

Monitoring and Testing Requirements

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

Legend: D = daily; W = weekly; TW = three times weekly; M = monthly; AR = as required.
* If MLVSS /MLSS ratio of a minimum of 0.7 is detected, MLVSS testing can be done periodically, on an “as required” basis.

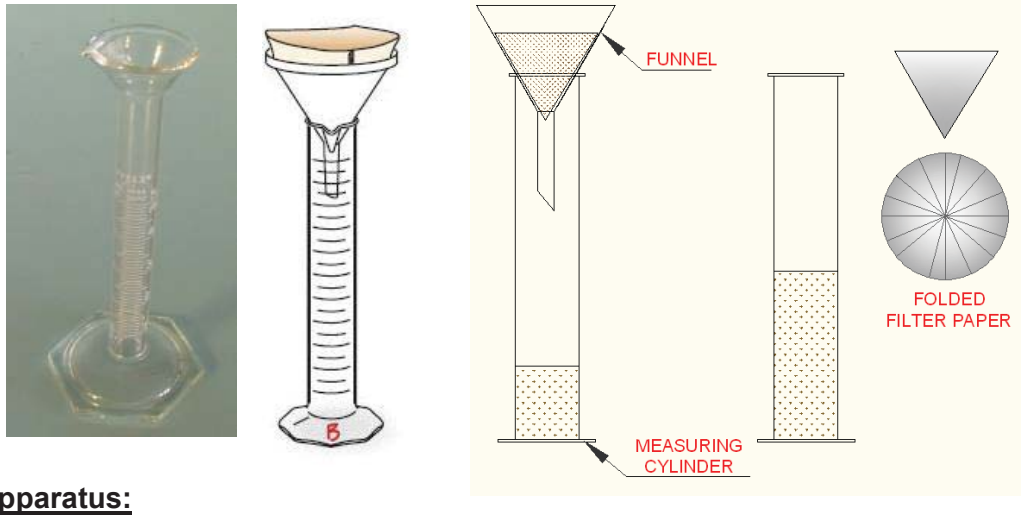
**The effluent should be routinely checked for any signs of problem. Normally, the effluent is reasonably clear, colourless, and odourless. If the effluent becomes turbid, testing should be carried out required.

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

6.2.2.1 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. See the Membrane Fouling Troubleshooting Guidelines table in Section 7.6.1 to determine the cause of the low filterability and how to correct operation to improve the filterability.

Laboratory Glassware and Filter Paper



Apparatus:

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

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.

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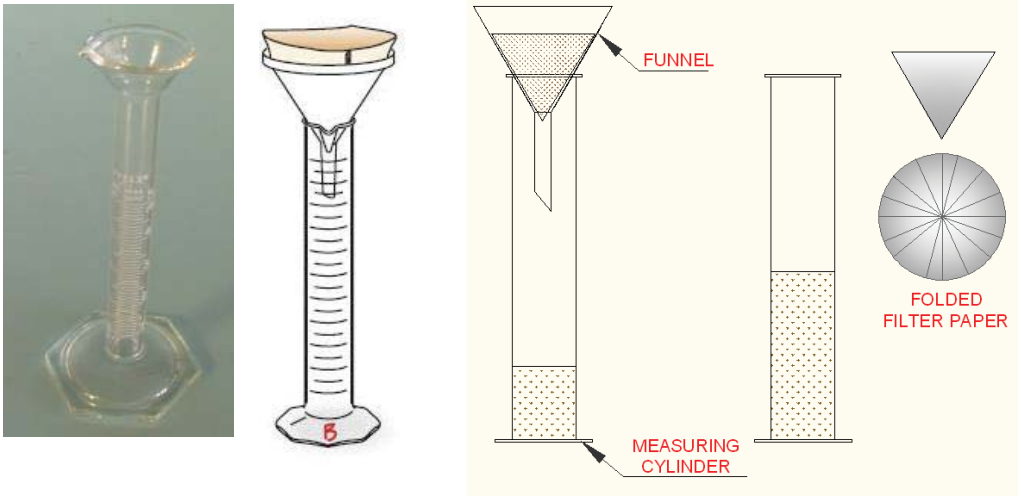
Filterability (FT)	Action	State of urgency
> 10 ml	Excellent, no action req'	
5 - 10 ml	Tweak process operation	
< 5 ml	Process adjustment req	**Contact newterra ltd.**

6.2.3 Suggested Test Equipment for Monitoring

The following test equipment's will assist in the monitoring of the MWWTP but are not provided with the system.

6.2.3.1 Filterability - Laboratory Glassware and Filter Paper



Apparatus:

- Filter paper - AMD Manufacturing, Part Number NO5C 18.5CM or equivalent;
- Funnel (75 mm diameter recommended);
- 50 mL graduated cylinder - Cole-Parmer Graduated Cylinder, Part Number RK-06134-67 or equivalent;
- Beaker (min 100 ml size) and stir rod
- Watch with seconds display or equivalent

6.2.3.2 Turbidity, Phosphorus - Hach DR900 (and reagents)

The hand-held DR 900 allows quick and easy access to most-used testing methods. This colorimeter is waterproof, dustproof and field durable. With an intuitive user interface, easy data transfer abilities, and the ability to test up to 90 of the most commonly tested water methods.

6.2.3.3 DO and pH - Hach HQ40d with probe or Equivalent

Designed for water applications, the Hach HQ40d portable meter is an advanced meter. HQd™ meters connect with smart probes that automatically recognize the testing parameter, calibration history, and method settings to minimize errors and setup time.
Portable meter measures critical water quality parameters - without the need for multiple instruments.
Intuitive user interface for simple operation and accurate results.
Meter kit includes field case, 4 AA batteries, protective meter glove, power adapter, USB/DC power adapter for data transfer, quick-start guide, user manual, and documentation CD.
DO and pH probes required.

6.2.3.4 Sludge Settling - Settleometer

The ability to observe and measure the rate and characteristics of solids separation is essential to control biological treatment processes that produce sludge.

6.2.3.5 TSS - Aysix model 3150 hand held TSS meter or Equivalent

Portable Suspended Solids Analyser

6.2.3.6 Hach CEL Advanced Wastewater Laboratory

Includes the DR 900 Colorimeter, HQd multi-meter with pH probe, reagent sets, apparatus, illustrated instrument and procedures manuals, and a rugged carrying case

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6.2.4 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.

6.2.5 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

	**ATTENTION: MAINTENANCE SHOULD BE PERFORMED ONLY BY TRAINED PERSONNEL!** **When providing maintenance or cleaning the plant, avoid direct contact with wastewater, organic materials, etc.** **Always wear protective clothing, e.g. waterproof, protective gear, boots, and gloves to keep these materials from body. Wear face and eye protection as required by health & safety protocols and standards, especially when handling chemicals.**

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

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

7.1 Plant Visual Checks

Noise	During normal operation, there is a uniform humming sound at the plant. In case of an unusual noise, it could be an indication that the blower needs maintenance or repairs.
Smell	The MicroClear™ 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 scouring is effective across all membrane plates.**

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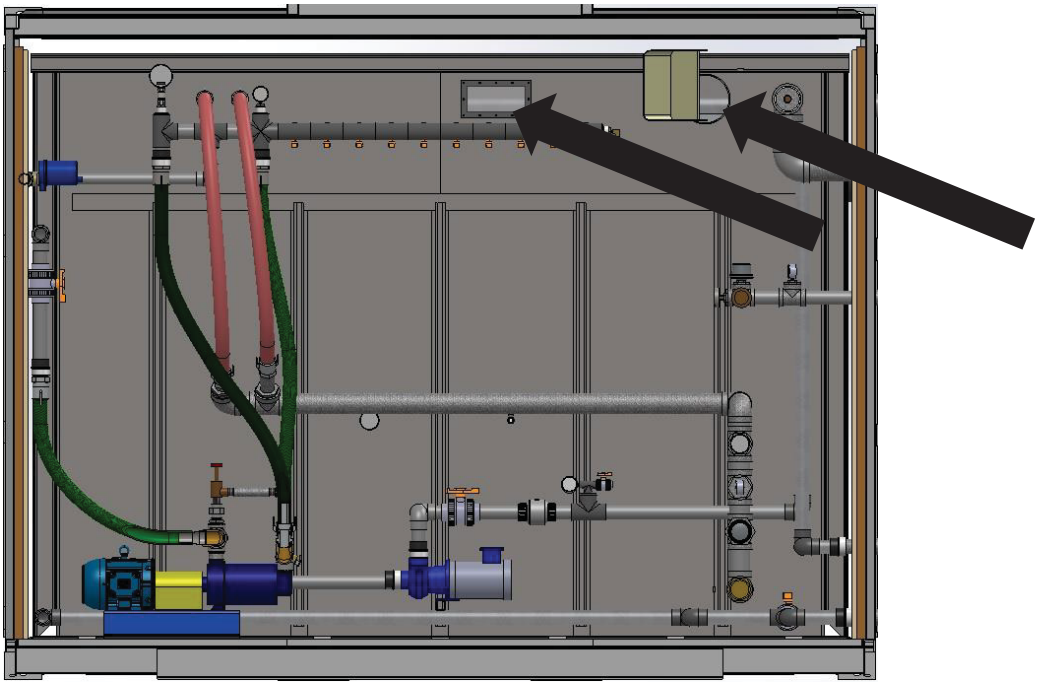
7.1.1 Air Scouring Patterns in Membrane Tanks

Membrane air scouring check is an essential routine maintenance procedure for **newterra** MBR WWTP to ensure membranes are receiving effective physical cleaning. Air scouring 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 top row of membranes and looking thru the tank viewport or inspection opening (see below).

Proper air scouring in membrane tank

Uneven aeration in membrane tank



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It is easy to observe aeration patterns through the clear window in the membrane tank(s). Operator should note any unusual patterns of air distribution. The visual inspection should also be performed before any membrane cassettes are removed from the membrane tank(s). Operator has to check for:

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

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

7.2 Schedule for Routine Operation and Maintenance Checkups

Location	Item	Day	Week	Month	Quarter	Year	Comments
Grease Traps	**TNK-101/102/103** **Grease traps must be cleaned whenever the grease film is approx. 1 foot thick in any tank. An unmaintained grease trap does not stop any grease waste from entering the WWTP system.**						Remove vac out grease film from top of tanks and any food particles from the bottom of tanks.
PROCESS	**Perform visual check**	X					Refer to Plant Visual Checks
	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 – 0.25 bar (28” -100” WC)
Note: When the vacuum at the membranes reaches 0.25 bar/3.5 psig/100" WC), it may be necessary to stop the permeation and perform recovery cleaning (please see Section 7.6.1 for membrane fouling troubleshooting and subsection 7.3 for membrane cleaning procedures)							
MECHANICAL & PROCESS	**Inspect membranes and permeate withdrawal system**		**X**				1 hour
	Clean the DO sensor – DO-501 Replace DO probe every second year in accordance with vendor manual.		**X**				In accordance with vendor manual in Appendix E
	Clean and calibration (as required) PH-501					X	In accordance with vendor manual in Appendix E

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Location	Item	Day	Week	Month	Quarter	Year	Comments
MECHANICAL & PROCESS	**Inspect and maintain valves & fittings for leaks.**		**X**				
	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)
	Remove, inspect and maintain diffusers in aeration and membrane tanks					X	This involves a complete draining of tanks (1-2 days). In accordance with vendor manual in Appendix E
	P-201/202, 301/302, 401/402, 501/502, 553/554, 551/552 – Price Pumps **-General Condition (Temperature, Unusual Noises or Vibrations, Cracks, Leaks, Loose Hardware, Etc.)** **- Pump Performance (Gauges, Speed, Flow)** **-Clean electrical motor and keep ventilation openings clear**				**X**		See vendor manual at Appendix E.
	P-701/702 – Permeate Pumps **-General Condition (Temperature, Unusual Noises or Vibrations, Cracks, Leaks, Loose Hardware, Etc.)** **- Pump Performance (Gauges, Speed, Flow)** **-Clean electrical motor and keep ventilation openings clear** **-Do Not let the pump run dry!**				**X**		See vendor manual at Appendix E.

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Location	Item	Day	Week	Month	Quarter	Year	Comments
MECHANICAL & PROCESS	**P-801 – Backwash Pump** **-General Condition (Temperature, Unusual Noises or Vibrations, Cracks, Leaks, Loose Hardware, Etc.)** **- Pump Performance (Gauges, Speed, Flow)**						Submersible pumps contain oils which becomes pressurized and hot under operating conditions - allow 2½ hours after disconnecting before attempting service.
	B-301/302 , 601/602 – EQ and Membrane Tank Blowers **-Clean electrical motor and keep ventilation openings clear** **-Check inlet filter. Clean or replace as necessary.**			**X** **X**			In accordance with vendor manual in Appendix E
	B-501/502 – Aeration Tank Blowers **-Clean electrical motor and keep ventilation openings clear** **- Check V-belts for tightness** **- Check and add fresh oil as required to maintain proper level.** **- Change blower oil.** **-Check inlet filter. Clean or replace as necessary.**		**X** **X**	**X** **X**		**X**	In accordance with vendor manual in Appendix E Semi-annual
	SCR-101/102 **-Inspect inspecting the unit for blockages and general cleaning. Inspection doors are located on the cover guard and screen body. Washing the screen with high water pressure may be necessary.**	**X**					

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Location	Item	Day	Week	Month	Quarter	Year	Comments
	-Check for wear on the brushes and give the unit a thorough cleaning each week will ensure maximum efficiency. **-Check the oil level in the motor. Grease the bearings with the appropriate grease. Making adjustments to the brushes to maximize contact with perforated sheet.**		**X**	**X**			
	P-6101/6102/6103 – Dosing Pumps **-Check the metering diaphragm for damage** **-Check that the hydraulic lines are fixed firmly to the liquid end.** **-Check that the suction valve and discharge valve are fitted tightly.** **-Check the tightness of the entire liquid end - particularly around the leakage hole** **-Check that the flow is correct: Allow the pump to prime briefly - turn the multifunctional switch briefly to "Test"** **-Check that the electrical connections are intact.** **-Check the integrity of the housing.** **-Check that the dosing head screws are tight.**				**X**		In accordance with vendor manual in Appendix E
	Container Fans **-Dust and dirt on the exterior surface of the motor, fan panel and the entire fan wheel should be removed.** **-Inspect of all fasteners to ensure they have not loosened due to vibration.**					**X**	In accordance with vendor manual in Appendix E

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Location	Item	Day	Week	Month	Quarter	Year	Comments
	Container Heaters **Once a year, remove the dust accumulation inside the heater using a vacuum cleaner or compressed air. Cleaning should be done while the heater is disconnected from the supply circuit.**					**X**	In accordance with vendor manual in Appendix E
ELECTRICAL	**Check electrical leads**				X		
	Check panel fan filter and replace/clean as necessary.			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 condition with no leaks.

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7.3 MBR 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 0.25 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 backflush 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)

7.3.1.1 Procedure – Backwash Solution Preparation

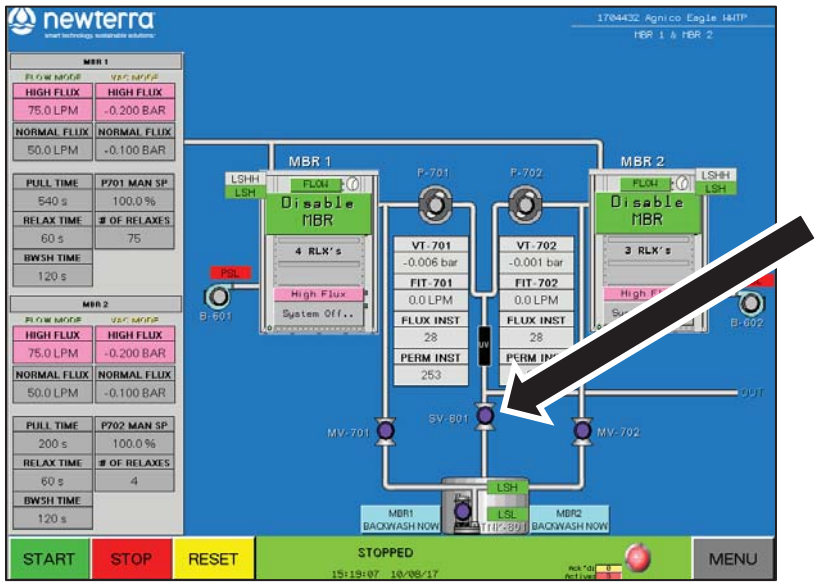
Note: It is recommended that only one membrane module at a time be cleaned (backwash).

Prepare the backwash solution as follows:

1) If backwash tank TNK-801 is empty:

   a. Ensure membrane is enabled and pulling, and turn SV-801 solenoid valves on hand ("H") until backwash tank is filled with required volume for chemical backwash (3L per cassette X 20 cassettes per module = 60 L OR approx. 1/4 capacity of TNK-801). Note TNK-801 capacity is 272L.

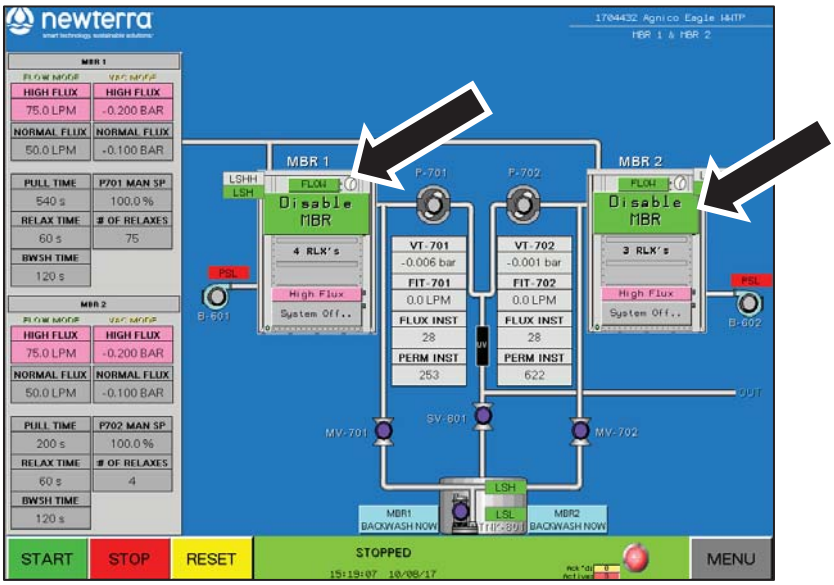
   b. Turn SV-801 series solenoid valves off ("O")



   c. Skip to step 3

2) If backwash tank TNK-801 is full:

   a. Disable membrane by holding down the disable membrane button for about 5 seconds



   b. Turn SV-801 solenoid valves to off ("O")

   c. Turn MV-701/702 (depending on the membranes to be cleaned) motorized valves to hand ("H")

   d. Turn pump P-801 to hand ("H") until the backwash tank has drained to the required volume for chemical backwash (3L per cassette X 20 cassettes per module = 60 L OR approx. 1/4 capacity of TNK-801) – the exact volume can be determined by backwash tank level drop. Note TNK-801 capacity is 272L.

   e. Turn P-801 to off ("O")

7.3.1.2 Procedure – Organic Fouling Solution

Organic Fouling - NaOCl: 500 mg/L solution (acceptable range of 200 to 1000 mg/L). Used for removal of organic fouling, which is the most common type of fouling in MBRs.

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

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

$\boldsymbol{V_m}$: Volume of the solution (Gallon, or Litre), equal to 3 L multiplying the number of MCXL cassettes 20 (60L per module);
$\boldsymbol{C_s}$: Concentrated NaOCl concentration (%)
$\boldsymbol{V_x}$: Volume of concentrated NaOCl required (Gallon, or Litre)

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7.3.1.3 Procedure – Organic Fouling Solution

Inorganic Fouling - Citric Acid: 2 g/L solution (up to 20 g/L). Used for removal of inorganic fouling. This is typically only required for systems treating water with a high hardness.

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

7.3.1.4 Procedure

1) Ensure MV-701/2 series motorized valves and SV-801 solenoid valve are set to off (“O”). The system is now ready for a chemical backwash. Note: only one membrane module should be backwashed at a time. The modules can be isolated by closing the permeate valves (there are valves per module)

2) Turn off all blowers in the membrane tank to be backwashed (B-601)
3) Turn the MV-701/702 motorized valve to hand (“H”) then turn pump P-801 to hand (“H”) until the backwash tank has drained.
4) Turn pump P-801 to off (“O”) and then turn the MV-701/702 motorized valve to off (“O”).
5) Let membranes soak for 45 mins or so.
6) After soaking membranes, turn the blowers back on (B-601) and allow blowers to scour for ~15 minutes.
7) After the 15 minute scour turn all valves and pump back to auto (“A”)
8) Turn SV-801 solenoid valves to off (“O”)

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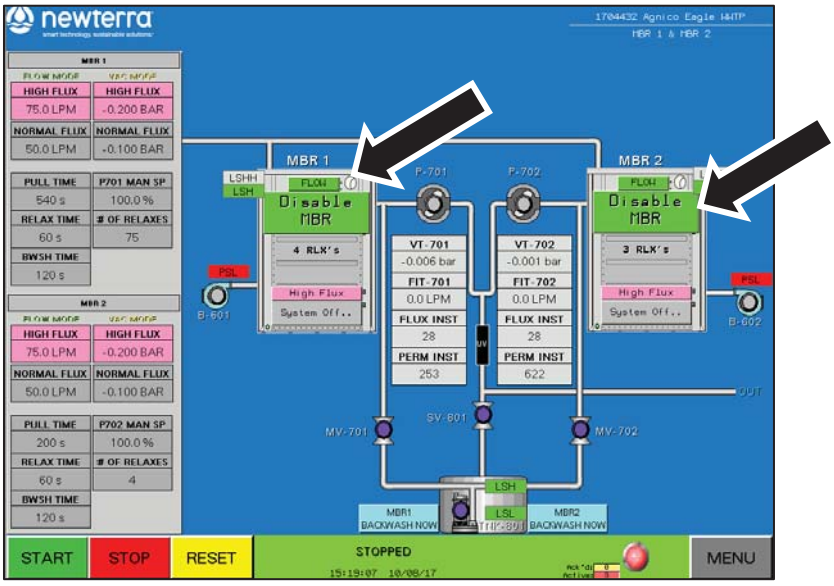
9) Enable membranes by holding down the enable membrane button for about 5 seconds
10) Allow membranes to permeate for 5 minutes, and then turn SV-801 solenoid valves back to auto (“A”)
11) Record TMP and flux, and ensure that the permeability has recovered
12) Repeat procedure for the second membrane module.

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 membrane tank 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)

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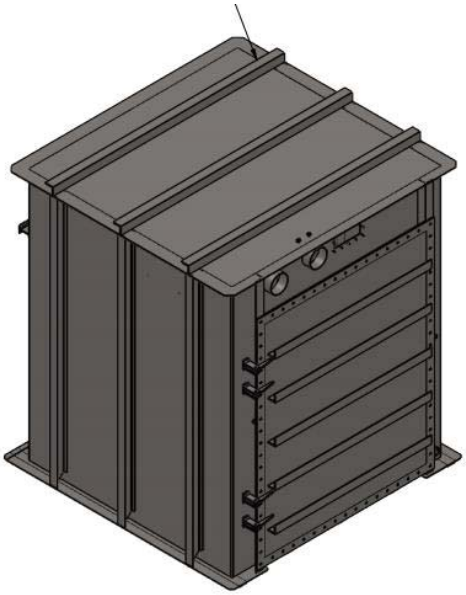
7.3.2.1 Step 1 - Preparation

1. Turn off air scour – B-601/602

2. Drain all mixed liquor from the membrane.

3. Open the MBR tank hatch. Clean (wash down) the membrane tank with water and vacuum out the dirty liquid. Close the MBR tank hatch.



4. Fill the membrane tank with potable water until the membranes are completely covered. The membrane tank (TNK-601/2) holds approx. 8.0 m3 / 6000L.

7.3.2.2 Step 2 – Cleaning with High pH Solution

This step is to be done if membrane fouling is a result of high FOG. Note: FOG in influent wastewater should be maintained below 30 mg/L.

5. Confirm that the membrane tank (TNK-601/2) has been cleaned and refilled with water (Section 7.3.2.1).

6. Add a suitable chemical – normally caustic soda (Sodium hydroxide (NaOH)) - to the membrane tank to raise the pH to 12.

    a. Volume of NaOH required can be calculated as follows. A starting dose for NaOH would be 400 mg/L. For example: if using a 50% solution of sodium hydroxide, approximately 0.5 L of solution would be required per m3 of membrane tank. Additional NaOH may be required depending on the alkalinity of the water. The operator should measure pH after addition of 400 mg/L and add more until the pH is 12.

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b. TNK-601 holds approx. 8 m3 or 8000L.

7. Turn on air scour for 2 min to mix the solution and turn it off during membrane soak.

8. Allow membranes to soak for 1 to 2 hours.

9. Drain spent solution.

7.3.2.3 Step 3 - Cleaning with Sodium Hypochlorite (NaOCl)

1. Turn off air scour

2. Confirm that the membrane tank (TNK-601) has been cleaned and refilled with water (Section 7.3.2.1).

3. 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 2 min to mix the solution and turn it off during membrane soak.

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

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

   $\boldsymbol{V_m}$: Volume of membrane tank - TNK-601 holds approx. 8.0 m3 / 8000L.
   $\boldsymbol{C_s}$: NaOCl concentration (%)
   $\boldsymbol{V_x}$: Volume of NaOCl required (m3 or Litre)

4. Keep the membranes soaked for 8 to 12 hours in the NaOCl solution (longer soak time required if severe fouling is evident).

5. Drain spent NaOCl solution.

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

7. Repeat step 6 to ensure all NaOCl has been thoroughly removed.

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7.3.2.4 Step 4 - Cleaning with Citric Acid

This step is only required in case of inorganic fouling caused by the high hardness. The recommended concentration is 2 g/L solution (up to 20 g/L).

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. Turn off air scour
2. Confirm that the membrane tank (TNK-601) has been cleaned and refilled with water (Section 7.3.2.1).
3. Add Critic Acid into the membrane tank to a concentration of 2 g/L solution (up to 20 g/L) – reducing the membrane tank to a pH of 2.0.
    a. Volume of Critic Acid required can be calculated as follows. A starting dose for Critic Acid would be 2g/L (up to 20g/L). For example: if using a 50% solution of Critic Acid, approximately 3.2 L of solution would be required per m3 of membrane tank. Additional Critic Acid may be required depending on the alkalinity of the water. The operator should measure pH after addition of 2g/L and add more until the pH is 2.
    b. TNK-601 holds approx. 8 m3 or 6000L.
4. Keep the membranes soaked in the citric acid solution for 2 hours (longer soak time required if severe fouling is evident).
5. 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.

7.3.2.5 Step 5 - Resume normal operation

Turn all equipment back to Automatic mode “A”, and enable the membranes.

7.3.2.6 Step 6 - Checking Permeability

Normal permeability after cleaning: 200 to 300 LMH/bar.

Repeat the cleaning procedures If normal permeability is not achieved.

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Note: Membrane maintenance (CEB) and recovery cleaning has to be recorded according to Membrane Cleaning Log Sheet presented in Appendix J 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 removing 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 membranes DO NOT DRY OUT OR FREEZE during this procedure.

1. Confirm that the eStop switch on the main panel is pushed in. Confirm that the Main Disconnect is ON. Stop the system operations by using the HMI screen button.

2. Empty the MBR tank (TNK-601) via the tank drain valve or recycle back to Aeration Tank using P-601.

3. Open the MBR tank hatch.

4. Wash remainder of waste water in the tank with reuse water and vacuum out.

5. Install the cassette rails and Disconnect the permeate hoses from the top of the membranes.

6. Slide out the cassette and further clean the membranes.

Membrane module replacement - ***If membranes require changing*** verify membrane modules are secured within the membrane tanks after re-installing the new 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.

7. Remove the membranes from the cassette. NOTE. The membranes are triple stacked. The bottom membrane has a plug in the bottom opening. Do not remove this plug. Note the membrane orientations for re-installation. The membranes are joined together with either a PVC union with two O-Rings on each side OR clear PVC hose and hose clamps.

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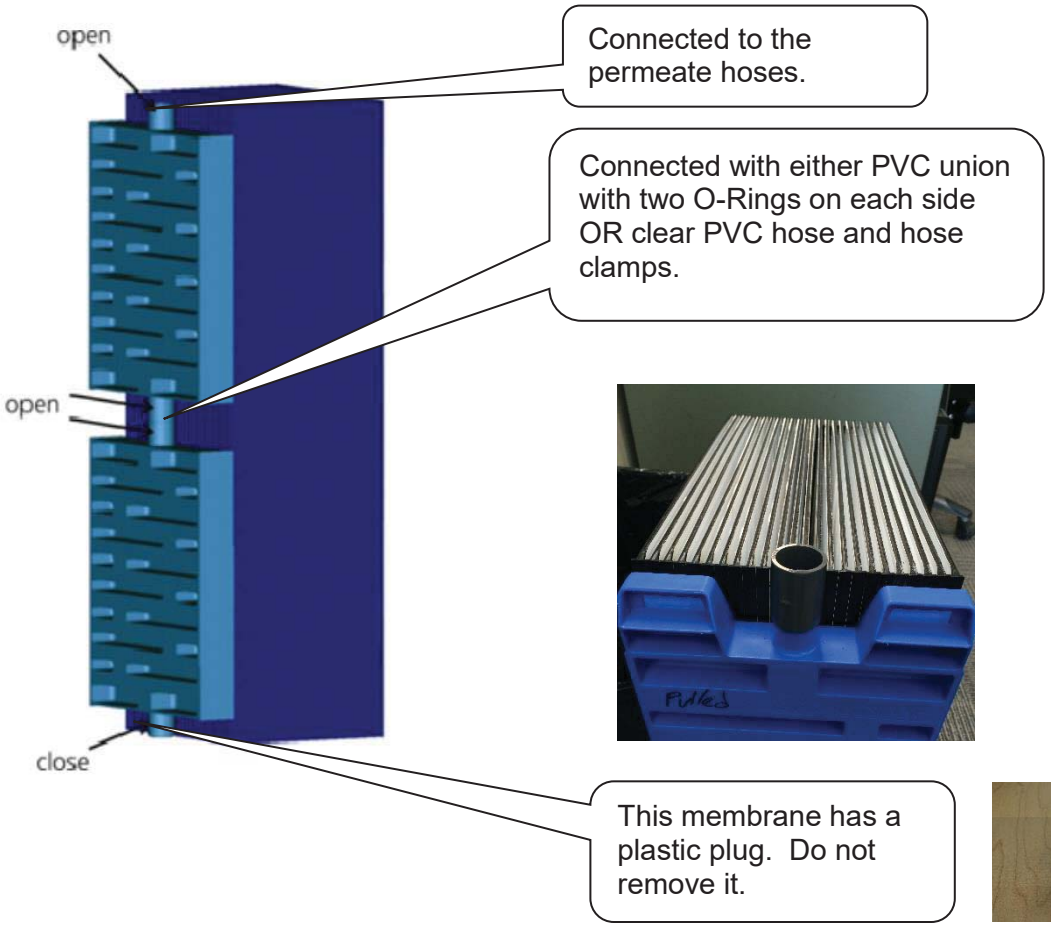

8. After membranes are separated, wash with clean water. Remove the blue backing plate and gently separate the membrane plates and clean with water to remove any debris. Replace backing plate.

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9. Place bottom membrane cassettes in the MBR tank and then integrate top membranes into the triple stack configuration. Slide in the cassette and reconnect the permeate hoses. Close the MBR tank door and start system operation.

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7.4 Sludge Decanting (TNK-901)

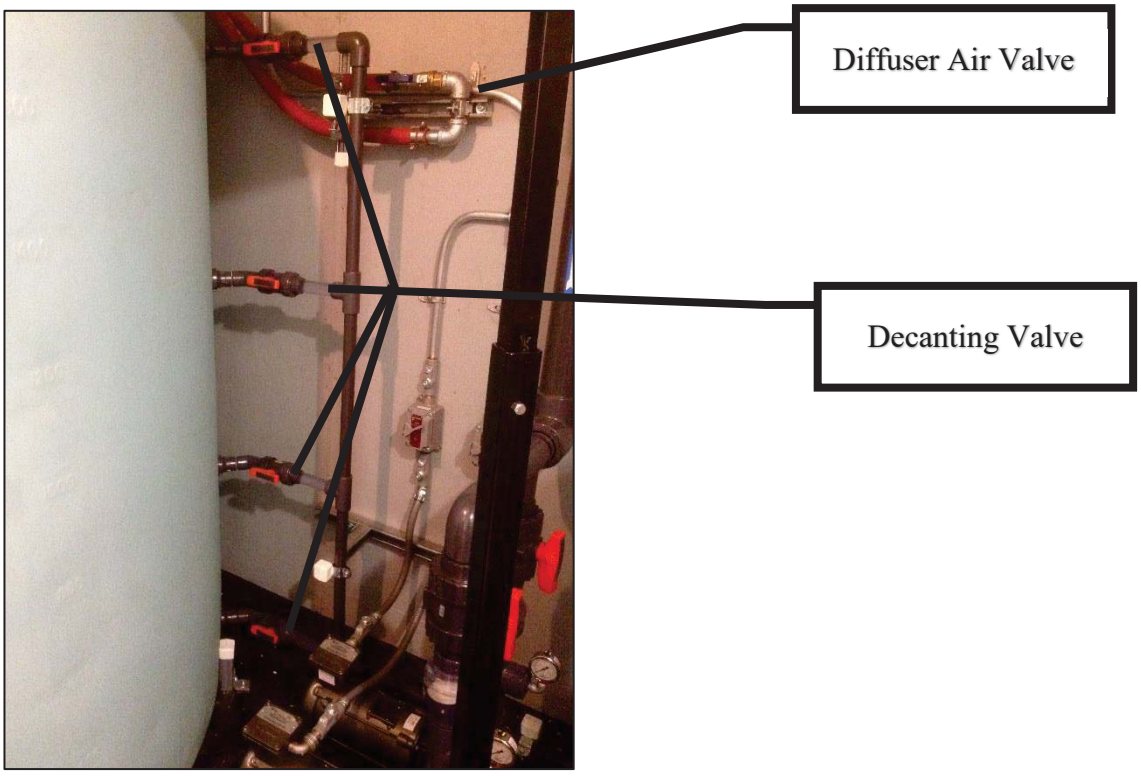
In order to maintain an optimal concentration of mixed liquor suspended solids (MLSS) (typically 10 g/L), a portion of the mixed liquor is periodically wasted by pumping from the Aeration Tank (TNK-501) to the sludge holding tank (TNK-901). Wasted sludge in the sludge holding tank is thickened by decanting supernatant back to the screen tank. Thickened sludge accumulates in the sludge holding tanks until it is eventually pumped out for disposal.

Excess sludge will be wasted by P-503 from the Aeration Tank (TNK-501) every 10 mins at noon. See below.

Tag	Description	Factory Setpoint	Setpoint Range and Units
P503 WASTE HOUR	When P-503 will waste	12pm	0-23
P503 WASTE SP	Time that P-503 wastes for	10min	0-99

In order to decant the water from the sludge, the air to TNK-901 diffuser must be turned off. See valve location below.

After the sludge has settled, that the operator would open the appropriate valve on TNK-901 to decent off the water.



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7.5 Trouble Shooting

7.5.1 MBR Membrane Fouling

Introduction

MBR operation relies critically on the ability of the membrane unit to pass all flow incoming to the plant. If membrane permeability is impaired, the MBR plant cannot process all flow with potentially catastrophic results even though effluent quality remains consistently high. This contrasts with typical operation of activated sludge system where the plant hydraulic capacity is rarely exceed but effluent quality is much more variable. Hence, membrane fouling (and associated reduction of flux or increase of TMP) remains as an operational challenge.

Membrane Fouling in MBR is a result of the interaction between the incoming water quality, mixed liquor filterability, system operation condition, and membrane material. There are four categories of membrane fouling. They are microbial fouling, particle/colloids fouling, inorganic fouling, and organic fouling. A brief description on the nature of fouling and control measures is summarized below.

7.5.1.1 Microbial/Biological Fouling

Microbial fouling is a result of formation of biofilms on membrane surfaces. Living materials, such as bacteria, fungus and algae, or soluble microbial products (SMP) and extracellular polymetric substances (EPS) bound to the activated sludge attach to the membrane; they start to multiple and produce EPS to form a viscous, slimy, hydrated gel. EPS typically consists of heteropolysaccharides and have high negative charge density. This gel structure protects bacterial cells from hydraulic shearing and from chemical attacks of biocides such as chlorine.

7.5.1.2 Particulate/colloid Fouling

This type of fouling may be associated with high concentrations of colloidal solids present in mixed liquor. In most cases, particles and colloids do not really foul the membrane because the flux decline caused by their accumulation on the membrane surface is largely reversible by hydraulic cleaning measures such as backwash and air scouring. However, the accumulation of solids between the membranes can create increased membrane resistance to permeation and permanent physical membrane damage.

To distinguish the different fouling phenomena, particles and colloids here are referred to biologically inert particles and colloids that are inorganic in nature.

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7.5.1.3 Inorganic Fouling

Inorganic fouling or precipitative fouling is caused by the accumulation of inorganic precipitates such as metal hydroxides, and “scales” on membrane surface or within pore structure. Precipitates are formed when the concentration of chemical species exceeding their saturation concentrations. Scale can be caused by high pH and extremely hard feed water. For the ultrafiltration (UF) membranes in our MBR system, inorganic fouling can exist most likely due to interactions between ions and other fouling materials (i.e., organic polymers) via chemical bonding.

7.5.1.4 Organic Fouling

Organic fouling is the attachment of materials such as oil or grease to the membrane surface. It is common in MBR systems used for treating industrial effluent. Organic fouling often leads to surface and internal pore fouling. More importantly, organic fouling progressively leads to biological fouling (i.e., biofilm growth/build up on membrane surface). Sometimes the adsorption process is irreversible when the organic substances are hydrophobic or positively charged polymers with high molecular weight. Such organic substances including organics present as an emulsion must be removed in the pretreatment.

The following pictures are examples of clean membranes

The following pictures are examples of fouled membranes