Committee Bay Project

Waste Water Treatment System Management Plan

Revision 1

North Country Gold Corp.
November 2014

1.0 **Table of Contents**

List of Appendices

2.0 **DOCUMENT CONTROL**

Version	Date	Section	Pages	Revision
1	23/Nov/2014	all	all	Re-write of existing NCGC Waste Water Treatment System Plan

3.0 COMPANY AND PROJECT BACKGROUND

North Country Gold Corp. ('NCGC') is a publically listed, Canadian based exploration company conducting mineral exploration within the Committee Bay area in eastern portion of the Kitikmeot Region, Nunavut Territory, Canada.

The Committee Bay Project ('CBP') comprises mineral claims and leases located on both Crown Land and Inuit owned (surface rights) land pursuant to the Nunavut Land Claims Agreement. The project encompasses NCGC's flagship Three Bluffs gold deposit, numerous gold occurrences, four exploration camps and a number of fuel and equipment caches.

Exploration work programs are generally undertaken as seasonal campaigns occurring between March and October in any given year, largely dictated by market conditions. Work activities comprise claim and lease staking, prospecting, geological mapping, rock, till and soil sampling, airborne and ground geophysics and drilling. Supplies, including fuel are airlifted to the CBP from various towns and cities in Nunavut, Manitoba and the Northwest Territories.

In 2011, NCGC initiated an upgrade of its Hayes Camp. These upgrades were designed to increase Hayes camp capacity to 100 people and improve the overall safety, working conditions and environmental impacts of ongoing work at the Three Bluffs gold deposit. Upgrades completed in 2011 comprised construction of additional camp accommodation, the installation of new washroom facilities, quonset structures, a dual chambered incinerator, waste water treatment system, and initiation of the construction of a 3000' airstrip. NCGC intends to continue these camp upgrades and to construct an all-weather road from Hayes camp to, and within the Three Bluffs drilling area in coming years.

NCGC has the following permits and licences in place to support advanced exploration activity at the CBP.

Organization	Description	Permit/Licence #
Nunavut Impact Review Board	Project Reference Number	07EN021
Aboriginal Affairs and Northern Development Canada (AANDC)	Land Use Permit (Bullion camp)	N2014C0002
	Land Use Permit (Hayes camp)	N2014C0005
Kitikmeot Inuit Association	Land Use Licence for IOL (Ingot /Crater camps)	KTL314C003
Nunavut Water Board (NWB)	Water Licence	2BE-CRA1015
Aboriginal Affairs and Northern Development Canada (AANDC)	Commercial Leases	Lease 065J/11-1-2
		Lease 065J/12-1-2

4.0 **BACKGROUND**

As part of the 2011 Hayes Camp infrastructure upgrades, NCGC commissioned Sanitherm Inc. (Sanitherm) to design and construct a Membrane BioReactor (MBR) Waste Water Treatment System (WWTS) to process greywater and sewage generated from toilets, showers, laundries and kitchens at a 100 person remote arctic camp.

Sanitherm designed and constructed a MBR system in April 2011 which utilized an external membrane to filter and separate effluent during the treatment process. The Sanitherm MBR plant was mobilized to Hayes Camp in May 2011 and was installed by JDS Energy and Mining Inc. between June and August 2011. During initial testing of the plant, it was recognized that the external membrane design would require excessive maintenance and was not well suited for the intended application. Discussions were held with Sanitherm and it was agreed that the plant be retrofitted to accommodate a submerged internal membrane. Sanitherm initiated modifications to the MBR in July 2012.

The modifications completed by Sanitherm do not change alter the treatment process or effluent quality of the initial MBR plant design.

5.0 **INTRODUCTION**

NCGC recognizes that for any waste water treatment system to work effectively, a minimum quantity of waste must be generated on a regular basis and over a number of weeks to enable the build-up of sufficient biomass for the treatment process to occur. NCGC therefor intends to only operate the WWTS when Hayes camp is used to support a minimum population over a minimum length of time. NCGC will only operate its sea containerized wash-car/washroom facilities when the WWTS is operational.

During small scale operations NCGC intends to process greywater through conventional grease traps and sumps and to utilize pacto toilets for collection of raw sewage at Hayes Camp. Sewage will be processed in accordance with the NCGC Comprehensive Waste Management Plan.

This document has been developed by NCGC (in conjunction with Sanitherm) to outline the waste sewage and greywater treatment process using Sanitherm's Sanibrane MBR WWTS at NCGC's Hayes Camp, when utilized. Training of staff and detailed operating plans and procedures will be developed by NCGC and Sanitherm upon commissioning of the WWTS.

This document is designed to meet all regulatory requirements. This document forms part of NCGC's 2015 Nunavut Water Board ('NWB') Water Licence renewal application. Once approved, this document will remain in effect for the duration of NCGC's water licence. NCGC will conduct annual reviews of this document to address changes in technology and operational practises. Changes will be implemented upon approval from the NWB.

6.0 WASTEWATER COLLECTION

During the normal course of operations all wastewater including greywater and sewage will be directed to the WWTS for processing. All wastewater plumbing lines will be insulated and heat traced to ensure year round operability. NCGC will ensure that all employees, contractors and visitors are made aware of the limitations of the WWTS and that plastics, rubber, sanitary supplies, non-biodegradable materials and chemicals are not disposed in sinks of toilets.

6.1 Grey water

Waste water from the kitchen, camp and drillers dry/shower facilities and NCGC's sea containerized wash-cars will be plumbed and piped to a central grease trap for grease separation before collection in an above ground transfer station.

6.2 Black water (Sewage)

All black water (sewage) will be collected in conventional flush toilet facilities within the containerized wash-cars/washroom and transferred to an above ground transfer station.

6.3 Influent

Grey water and sewage will be pumped from the above ground transfer station to the MBR WWTS for treatment.

7.0 WASTEWATER TREATMENT

The Sanitherm MBR WWTS comprises a 40 foot sea container housing the main components of the waste water treatment system. The sludge handling system is contained within a separate 20 foot sea container. The WWTS consists of a fine screen, flow equalization tank, anoxic tank, aeration tank, membrane module, sludge filter press and associated equipment and instruments. The system is controlled by a Programmable Logic Computer (PLC).

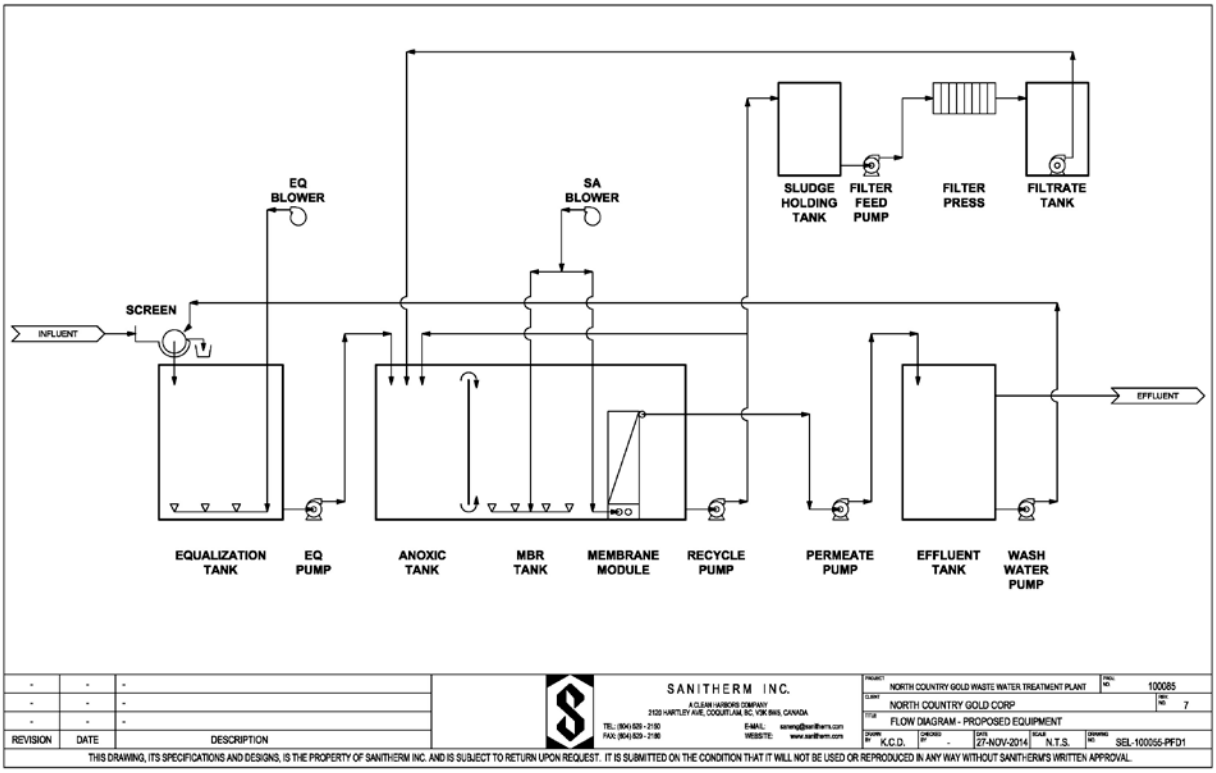


Figure 1 – Process Flow Diagram

8.0 **TREATMENT PROCESS**

Treatment of wastewater is undertaken as a number of processes: Pre-Treatment, Biological Treatment and Effluent Separation and discharge. UV disinfection[1] may also be undertaken prior to effluent release (Figure1). No chemicals are used during the treatment process.

8.1 Pre-Treatment

8.1.1 Filter

Incoming effluent received from transfer stations initially passes through an automatic filtration system where debris and large particles are removed. Debris and large particles are collected in a bagger system for periodic manual disposal.

[1] Present Sanitherm MBR plant design can meet required effluent quality standards without UV disinfection. A UV disinfection module can be added to treat effluent if required.

8.1.2 Influent Flow Equalization

Screened effluent is then transferred to a flow equalization (EQ) tank. This tank is designed to regulate variations in influent flow into the system and provide a constant flow of influent to the downstream process (e.g. showering at the end of day). Coarse bubble diffusers aerate and agitate the contents of the EQ tank to provide odour control. Aeration blowers provide aeration to this tank as necessary based on air flow sensors.

Wastewater within the EQ tank is pumped to the Anoxic Tank for treatment depending on the anticipated rate of wastewater generation. The plant is designed for a maximum of 23 cubic metres per day. This flow rate can be regulated manually for smaller camp populations and less wastewater.

8.2 Treatment

The treatment process is designed to substantially degrade the biological content of the sewage, derived from human waste, food waste, soaps and detergent. Treatment of wastewater occurs primarily within an anoxic/reactor tank. Within this tank different microoganisms are cultured to breakdown various biodegradable components of the wastewater. The anoxic/reactor tank is separated by a baffle wall into an anoxic tank and a reactor tank.

8.2.1 Anoxic Tank

Conditions within the anoxic tank enable the growth of specific bacteria responsible for biological treatment (anaerobic digestion) and removal of nitrogen. Process water overflows from the anoxic tank into the reactor tank.

8.3 Reactor Tank

In the reactor tank coarse bubble diffusers provide aeration and enable aerobic digestion whereby bacteria rapidly consume organic matter and remove the Biochemical Oxygen Demand (BOD). Two aeration blowers provide process aeration as necessary to facilitate biological breakdown within the reactor tank based on air flow sensors.

8.4 Effluent Separation (Membrane Filtration)

Effluent within the reactor tank is drawn through a submerged membrane system by permeate pumps. Bubble diffusers under the membrane remove biomass from the membrane and ensure the membrane remains clean. Filtrate from the membrane is transferred into an effluent tank, whilst biomass (microoganisms) remains within the reactor tank. Effluent from the effluent tank is periodically discharged to a small lake west of Hayes Camp.

8.5 Ultraviolet Treatment

The Sanitherm MBR WWTS plant is designed to meet all effluent quality guidelines outlined in the Guidelines for Discharge of Treated Municipal Wastewater in the NWT, without the use of a final UV disinfection system. A UV disinfection module may be added to the system upon commissioning and testing to ensure effluent is well below guidelines. UV light is used to disinfect water by destroying any micro-organisms ability to reproduce.

9.0 **SLUDGE PROCESSING**

Biomass in the WWTS is periodically removed by pumping it to a sludge holding tank, where it is mixed, agitated and aerated to provide odour control and to aid in flocculation. Sludge is then pumped from the holding tank to a filter press where it is dewatered. Pressed sludge is discharged into a sludge hopper, whilst filtrate is pumped to the sludge filtrate tank and then back into the anoxic tank.

Pressed (dry) sludge is collected in bags and disposed of in the Incinerator in accordance with the NCGC's *Comprehensive Waste Management Plan.*

10.0 **OPERATION**

The MBR WWTS is controlled by a Programmable Logic Computer (PLC). This computer monitors tank levels, flow rates and controls the operation of primary and backup pumps and blowers. The system also activates alarms including a visual beacon at Hayes Camp in the event of any abnormal operation. NGCC will engage Sanitherm to assist in the development of detailed site specific operating procedures and operator training upon final commissioning of the WWTS.

10.1 Wastewater treatment supervisor

Upon final commissioning of the WWTS, Sanitherm will provide a Wastewater treatment technician to ensure proper operation of the plant. This technician will train an NCGC employee whose responsibilities will include regular daily monitoring, record keeping and maintenance of the wastewater treatment system at Hayes Camp.

10.2 WWTS Inspections

10.2.1 Daily inspection

Daily check-ups of the WWTS will include:

- General inspection of the plant for leaks, abnormal tank levels, or any spills

- Inspection of filtration system and sludge press collection system
- Check PLC for program alarms, and record these alarms and clear if necessary
- Record pump operation hours
- Record permeate flow rate (membrane)
- Record EQ tank level
- Record effluent discharge meter
- Check lubricant levels of blowers

10.2.2 Weekly inspection

- Dispose of any waste on the screen collector

10.2.3 Monthly inspection

- Clean aeration blower filters
- Clean all in-basic float switches

11.0 **MAINTENANCE**

NCGC will conduct regular maintenance and monitoring of the WWTS to ensure optimal performance. In the event of any failure or fault that cannot be rectified by the Wastewater Treatment Supervisor, NCGC will contact Sanitherm for assistance in fault diagnosis and rectification.

The following regular maintenance will be completed:

11.1 Membrane

The membrane permeate flow rate will be monitored daily. During normal operations when permeate flow falls to only 75% of the original permeate flow a membrane chemical clean is required.

11.1.1 Membrane Chemical Clean

Cleaning of the membrane must be performed periodically to remove accumulated biological fouling. Cleaning is completed using a solution comprising sodium hypochlorite and treated effluent water. Mild hypochlorite is added to a chemical mixing tank and circulated by a chemical mixing pump during membrane cleaning. The solution is generally left to soak for 2 hours. Note: Sodium hypochlorite is not used during the normal course of wastewater treatment.

11.2 Automatic Fine Screen

The motor on the automatic fine screen should be checked every 500 hours or three months (whichever occurs first). Inspection should comprise the following:

- Check motor is clean. Check interior and exterior of motor is free of dirt, oil, water and grease to enable proper ventilation.
- Using an ohmmeter check to ensure the integrity of the winding insulation is maintained. Record ohmmeter readings.
- Check all electrical connections

11.3 Pumps

Pumps should be checked regularly and specifically if any decrease in performance is observed. Inspections/maintenance should comprise the following:

- Bearing lubrication
- Check impeller body for build-up or clogging

Motors should be inspected every 500 hours or three months (whichever occurs first). Inspection comprises the following:

- Check motor is clean. Check interior and exterior of motor is free of dirt, oil, water and grease to enable proper ventilation.
- Using an ohmmeter check to ensure the integrity of the winding insulation is maintained. Record ohmmeter readings.
- Check all electrical connections

11.4 Blower

Blowers should be visually inspected on a daily basis. After 500 hours of use or three months (whichever occurs first) the following should occur:

- Motors, blowers and belts should be inspected and cleaned
- Bearing grease should be replaced

12.0 **EFFLUENT QUALITY**

In accordance with NCGC's Water Licence all effluent discharged from the MBR WWTS be within the guidelines described in Table 4.1 'Municipal Wastewater Effluent Quality Guidelines' for lake environments of the Guidelines for the Discharge of Treated Municipal Waste Water in the Northwest Territories (1992).

Parameter	**Maximum Concentration (any grab sample)**
BOD_5	80 mg/L
Total Suspended Solids	100 mg/L
Fecal Coliform	$1x10^4$ CFU/100mL
pH (range)	6-9
Oil and Grease	5 mg/L and no visible sheen
Residual Chlorine	0.1 mg/L

12.1 Pre-discharge Monitoring

Prior to initial discharge of effluent from the WWTS NCGC's Wastewater treatment supervisor or Environmental Coordinator (or other designated person) will collect a sample of effluent to ensure that it meets the required quality guidelines (listed above).

12.2 Effluent Monitoring

NCGC will collect regular samples from the effluent stream to ensure ongoing compliance. Parameters will be measured onsite daily (where possible) and at an accredited laboratory every 2 weeks.

Parameter	**Monitoring interval**
BOD_5	Every 2 weeks (Laboratory)
Total Suspended Solids	Daily (onsite), Every 2 weeks (Laboratory)
Fecal Coliform	Every 2 weeks
pH (range)	Daily (onsite), Every 2 weeks (Laboratory)
Oil and Grease	Daily (visual onsite) Every 2 weeks (Laboratory)
Residual Chlorine	Every 2 weeks (Laboratory)

12.3 Receiving Waters Monitoring

NCGC will establish monitoring stations at the lake west of Hayes camp receiving effluent (station CRA-2) and at the point where this lake drains into the second lake (station CRA-3). See Appendix 2.

Water will be sampled at these locations on a monthly basis during the course of operations when the WWTS is operational and on an annual basis when the WWTS is not in operation.

In addition, NCGC will conduct toxicity testing to demonstrate non-acute toxicity of the effluent discharged from the WWTS at CRA-2 on an annual basis during the open water season. This testing will include the following analyses:

- Acute lethality to Rainbow Trout (Onchorhynchus mykiss) in accordance with Environment Canada's Environmental Protection Series Biological Test Method EPS/1/RM/13 (Appendix 3).

- Acute lethality to the crustacean (Daphnia magna) in accordance with Environment Canada's Environmental Protection Series Biological Test Method EPS/1/RM/14 (Appendix 3).

13.0 **EMERGENCY PROCEDURES**

13.1 Sewage Spill / Overflow

NCGC anticipates that the likelihood of sewage spills and overflow can be significantly reduced by regular inspection of the WWTS and high level alarms and warning systems. In the event of a sewage spill NCGC will undertake the following (in accordance with NCGC Spill prevention and contingency plan) :

- Ensure the safety of all persons/bystanders.
- Isolate power to the WWTS and pumps (where possible and safe to do so)
- Notify Environmental Coordinator (or designated person). Request assistance.
- Contain spill (stop spill from spreading)
- Notify relevant authorities
- Wear appropriate Personal Protective Equipment (gloves, mask, eye protection, coveralls)
- Initiate cleanup. Pump/shovel sewage into empty drums for reprocessing
- Conduct an investigation into cause of spill and rectify as necessary

13.2 Sample failure

In the event that effluent samples exceed guidelines the WWTS will be immediately shut down to prevent further discharge. Effluent will be contained until the issue is rectified.

An investigation will be initiated to identify the cause of effluent anomalies. This will involve a review of maintenance logs and records. A Sanitherm technician will be contacted and if necessary mobilized to site.

14.0 **TRAINING**

14.1 Operators

NCGC will ensure that WWTS supervisors and personnel are trained appropriately in the operation, maintenance, fault diagnosis, record keeping, monitoring and sampling of the WWTS

14.2 Camp population

NCGC will ensure that all employees, contractors and visitors are made aware of the limitations of the WWTS and that plastics, rubber, sanitary supplies, non-biodegradable materials and chemicals are not disposed in sinks of toilets.

15.0 **SHUT DOWN**

During temporary or seasonal shut downs, NCGC complete a WWTS shut down procedure. In summary, this will comprise the following:

- Wash-cars and washroom facilities will be shut down and isolated
- Greywater from the kitchen and dry will be diverted to covered sumps (with grease traps) and pacto toilets will be used by shut down crew
- Lines will be drained and transfer tanks pumped into WWTS
- WWTS will process all contained wastewater
- All biomass sludge will be pressed and processed
- WWTS tanks and plumbing will be drained of any residual unprocessed wastewater and stored within sealed drums for susequent treatment.

16.0 **EMERGENCY CONTACTS**

NORTH COUNTRY GOLD CORP			
Simeon Robinson	Project Manager	Phone	(780) 616-9459
Site Office[2]	Camp Manager (24 hrs)	Phone	* TBA *
Peter Kleespies	Vice President Exploration	Phone	(780) 966 6638
John Williamson	Chief Executive Officer	Phone	(780) 966 7014
TERRITORIAL / FEDERAL ENVIRONMENTAL CONTACTS			
24-Hour NU/NT Spill Line		Phone	(867) 920-8130
		Fax	(867) 973-6924
		Email	spills@gov.nt.ca
AANDC Manager of Field Ops	Peter Kusugak	Phone	(867) 975-4295
		Fax	(867) 979-6445
AANDC Water Resource Officer	Eva Paul	Phone	(867) 975-4548
Government of Nunavut (Department of Environment)	Pollution / Air quality	Phone	(867) 975-7748
		Fax	(867) 979-5981
	Curtis Didham	Phone	(867) 975-4644
Kitikmeot Inuit Association	Senior Lands Officer	Phone	(867) 982-3310
		Fax	(867) 982 3311
Fisheries and Oceans (DFO)		Phone	(867) 979-8007
Nunavut Water Board	Phyllis Beaulieu	Phone	(867) 360-6338
		Fax	(867) 360-6369
OTHER CONTACTS			
Sanitherm (Wastewater Process)	Philip Tam	Phone	(604) 529-2155
Sanitherm (Clean Harbors OPS)	Cid McLean	Phone	(780) 960-6406
Health Centre Repulse Bay		Phone	(867) 462-9916
Stanton Regional Hospital	Yellowknife	Phone	(867) 920-4111
Poison Control Centre		Phone	1-800-567-8911
Yellowknife Fire Department		Phone	(867) 873-2222
WSCC	24 hr hotline for injuries	Phone	1-800-661-0792
WSCC Chief inspector of mines	Peter Bengts	Phone	(867) 669-4412
WSCC Inspector	Martin Van Rooy	Phone	(867) 979-8527
RCMP Repulse Bay	Emergency	Phone	(867) 462-1111
	Non-emergency	Phone	(867) 462-0123
Discovery Mining Services		Phone	(867) 920-4111
Ookpik Aviation (Baker Lake)	24 hour number	Phone	(867) 793-4720
Ken Borek Air (Rankin Inlet)		Phone	(867) 645-2535
Custom Helicopters (Rankin Inlet)	Residence (24 hr number)	Phone	(867) 645-3885
Great Slave Helicopters		Phone	(867) 873-2071

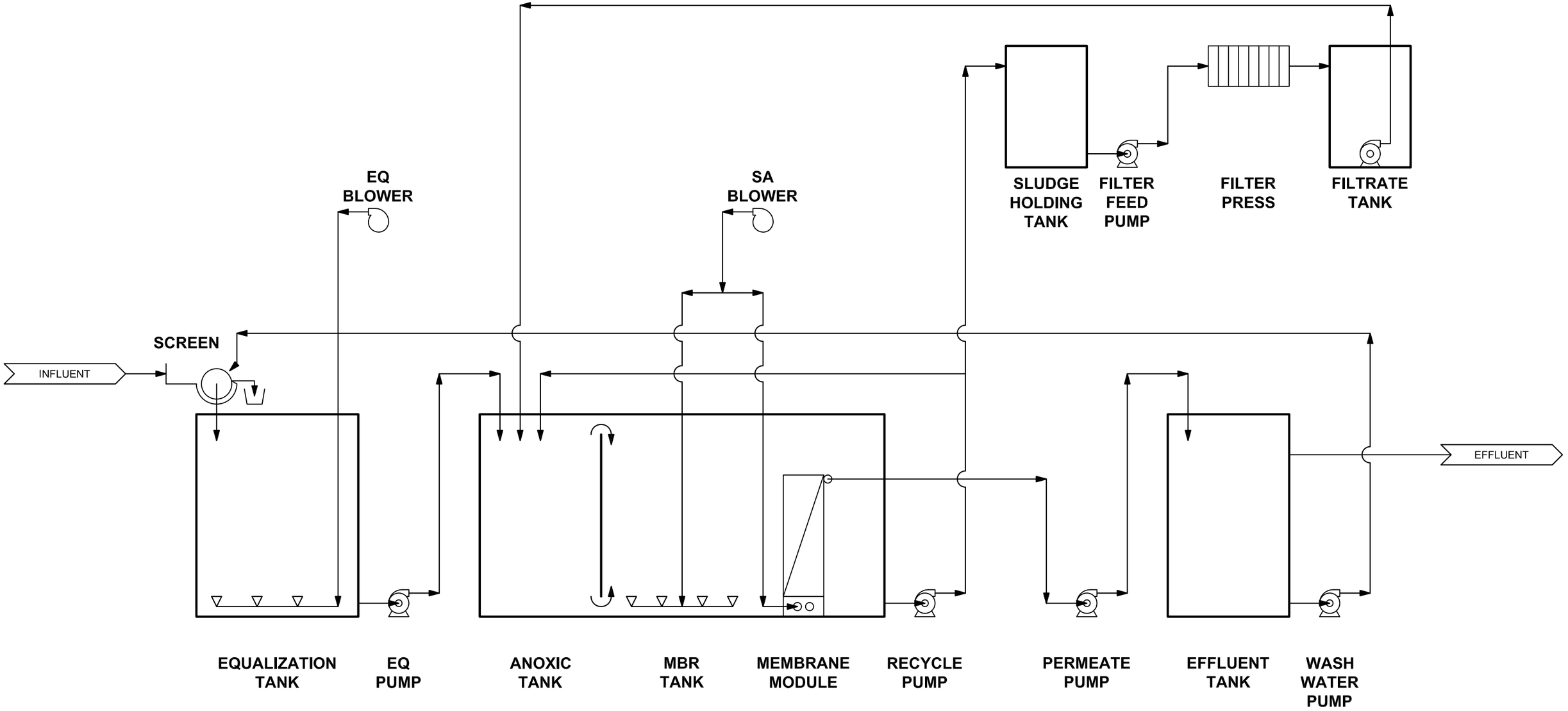
[2] The name and contact details for the site office will be provided each year once communications and a phone number have been established

17.0 **REVIEW**

NCGC will conduct annual reviews of this document to address changes in technology an operational practises. Changes will be implemented upon approval from the NWB. Contact details and information will be updated as required and distributed accordingly.

APPENDIX 1

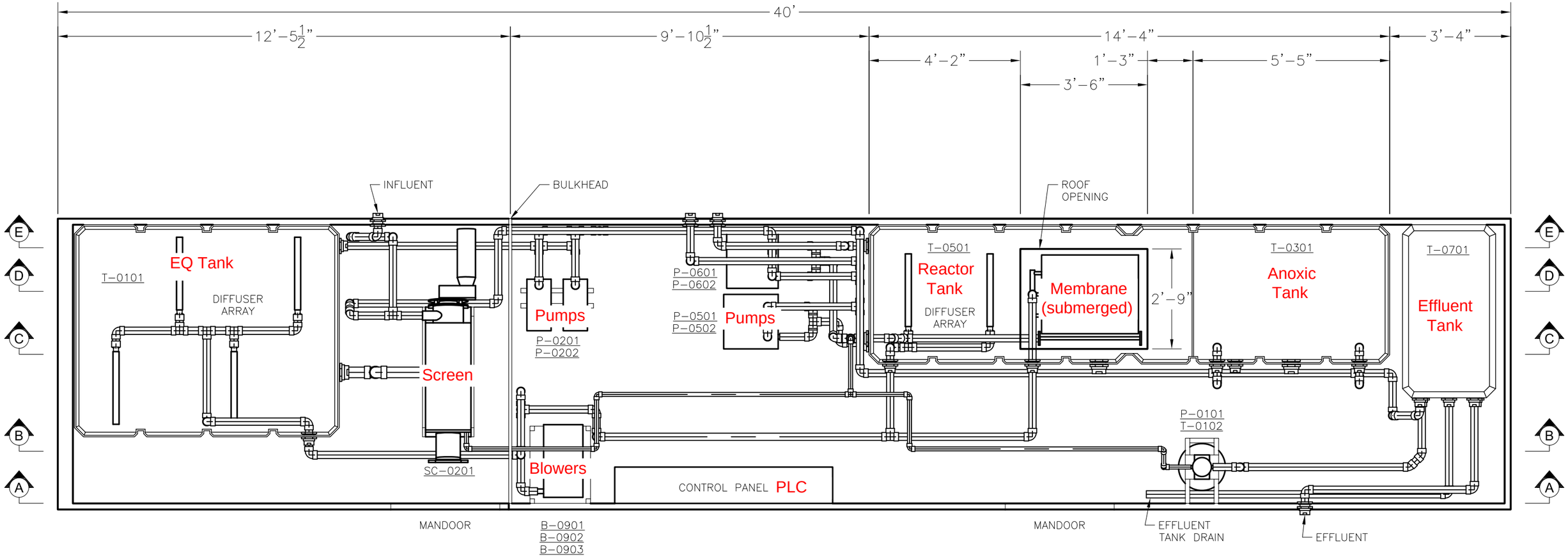
Sanitherm Wastewater Treatment System Design Plans



REVISION	DATE	DESCRIPTION
-	-	-
-	-	-
-	-	-

SANITHERM INC.
A CLEAN HARBORS COMPANY
2120 HARTLEY AVE, COQUITLAM, BC, V3K 6W5, CANADA
TEL: (604) 529 - 2150
FAX: (604) 529 - 2160
E-MAIL: saneng@sanitherm.com
WEBSITE: www.sanitherm.com

PROJECT	NORTH COUNTRY GOLD WASTE WATER TREATMENT PLANT
PROJ. NO.	100085
CLIENT	NORTH COUNTRY GOLD CORP
REV. NO.	7
TITLE	FLOW DIAGRAM - PROPOSED EQUIPMENT
DRAWN BY	K.C.D.
CHECKED BY	-
DATE	27-NOV-2014
SCALE	N.T.S.
DRAWING NO.	SEL-100055-PFD1



REVISION	DATE	DESCRIPTION
7	10-JUL-2012	REVISED FOR SUBMERSIBLE MEMBRANE MODULE

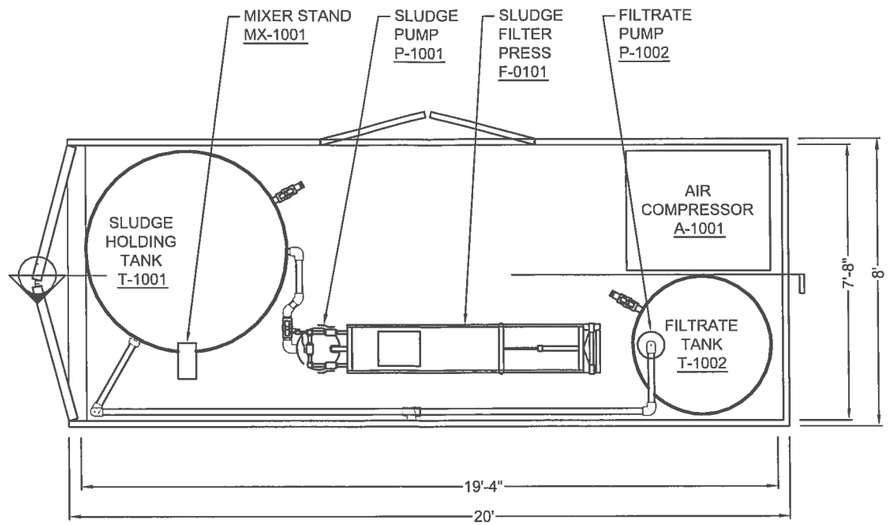
SANITHERM INC.

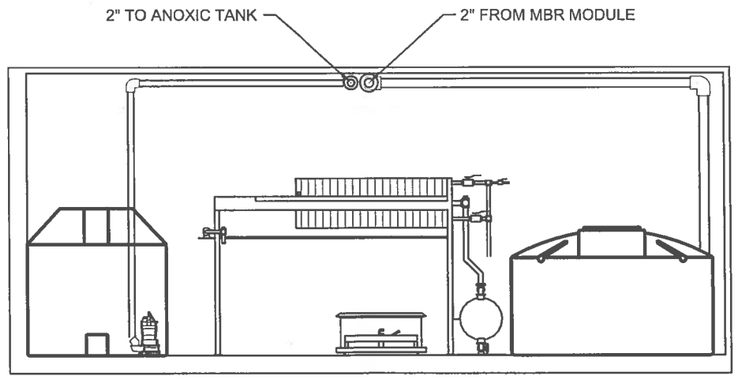
A CLEAN HARBORS COMPANY
2120 HARTLEY AVENUE, COQUITLAM, BC, V3K 6W5, CANADA

TEL: (604) 529 - 2150
FAX: (604) 529 - 2160

E-MAIL: information@sanitherm.com
WEBSITE: www.sanitherm.com

PROJECT: JDS MINING WWTP					PROJ. NO. 100085
CLIENT: JDS MINING					REV. NO. 7
TITLE: GENERAL ARRANGEMENT - 40' CONTAINER - PLAN VIEW					
DRAWN BY K.C.D.	CHECKED BY	DATE 10/07/2012	SCALE 3/8" = 1'-0"	DRAWING NO. SEL-100085-GA1	





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SECTION
SCALE 1/4" = 1'-0"

REVISION	DATE	DESCRIPTION
3	02-JUN-11	GENERAL REVISIONS, AS BUILT
2	25-MAY-11	UPDATED T-0301 TANK PENETRATIONS, RELOCATED AERATION BLOWERS
1	29-MAR-11	INITIAL RELEASE

SANITHERM INC.
A SUBSIDIARY OF PEAK SERVICES
2120 HARTLEY AVENUE, COQUITLAM, BC, V3K 6W5, CANADA
TEL: (604) 529 - 2150
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E-MAIL: saneng@sanitherm.com
WEBSITE: www.sanitherm.com

PROJECT: JDS MINING WASTE WATER TREATMENT PLANT					PROJ. NO. 100085
CLIENT: JDS MINING					REV. NO. 3
TITLE: GENERAL ARRANGEMENT - 20' CONTAINER					
DRAWN BY: T.Y.	CHECKED BY: -	DATE: 14-FEB-2011	SCALE: 1/4"=1'-0"	DRAWING NO.: SEL-100085-GA07	

APPENDIX 2

Sanitherm Wastewater Treatment System Process Control Description

NORTH COUNTRY GOLD CORP
SANIBRANE® MBR PLANT

Process Control Description

Sewage Treatment Plant

SEL-100085

July 2012

2120 Hartley Avenue
Coquitlam, BC
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V3K 6W5

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SANITHERM® INC.

Over Sixty Years of Excellence
in Water and Wastewater Treatment Solutions

TABLE OF CONTENTS

1.0 EXECUTIVE SUMMARY

1.1 INTRODUCTION

North Country Gold has selected Sanitherm Inc. to provide a package design for a sewage treatment system. The objective of this system is to process the sewage coming from the camp facility, with the average design flow expected to be 23 CMD (m^3/day). Peak flow is assumed to be 3.8 m^3/hr. The design criteria are as follows:

Table 1.1A – Design Criteria

Parameter	*Influent*	*Effluent*
BOD_5	450 mg/L	80 mg/L
TSS	450 mg/L	100 mg/L
pH	-	6-9
Fecal Coliform	- CFU/100mL	10^4 CFU/100mL
Oil and Grease*	<50 mg/L	5 mg/L
Residual Chlorine**	- mg/L	0.1 mg/L

* Kitchen grease traps should be kept well serviced to ensure O&G in the plant influent not exceed 50 mg/L.
** No chlorine will be added to the system, except for membrane cleaning. The effluent that contains chlorine after membrane cleaning can be returned to the EQ tank to meet the requirement for residual chlorine.

This document will provide an understanding of the operation logic behind the sewage treatment plant.

1.2 UNDERSTANDING THE MBR TREATMENT

A membrane bioreactor (MBR) process composes of two major processes: The bioreactor and the membrane.

The bioreactor (biological treatment process) is another category of the activated sludge process, but it is differentiated by concentrations of the mixed liquor suspended solids (MLSS). The MLSS concentration in a membrane bioreactor system can be three to ten times greater than the conventional activated sludge systems (such as extended aeration, high-rate sequencing batch reactors, contact stabilization, etc.). Under typical operating conditions, MLSS concentrations for the MBR process will range between 10,000 and 20,000 mg/L (1.0% to 2.0%). These values are normally seen in a digester of a standard system.

The membrane (filter process) is the device which separates the MLSS from the biologically treated effluent. It is the clarification section of the overall system that replaces rectangular clarifiers (chain and scraper), circular clarifiers, or the settling cycle in a Sequential Batch Reactor (SBR). The Sanibrane® membranes are classified under the “ultra-filtration” category.

1.3 DISCLAIMER

This sewage treatment plant is designed to treat human domestic waste from toilets, showers, laundries and kitchens.

This sewage treatment is NOT designed to treat industrial wastes, chemical cleaning agents or antibiotic products. Such products could negatively affect the biological treatment process.

Please keep plastic, rubber and other non-biodegradable products out of the sewage flow.

2.0 OVERALL DESIGN PHILOSOPHY

2.1 PROCESS SUMMARY

There are three (3) major components to the design process: Pre-Treatment, Biological Treatment and Effluent Separation.

The influent initially passes through an automatic fine screening machine which filters debris and large particles from the flow. The screening machine discharges filtered influent into the flow equalization (EQ) tank. In the case of unexpected variation in flow quantity, the capacity of the EQ tank can minimize the incoming variance and provide a homogenous influent to the downstream processes. An aeration diffuser is present at the EQ tank to provide aeration and agitation as required.

Content from the EQ tank is pumped into the Anoxic Tank where it then overflows into the Reactor tank. Here, biological treatment will occur. The tank provides suitable conditions to culture nitrate-removing microorganisms (aka "bugs"), hence the term biological treatment.

Effluent Separation is handled by the membrane module in-lieu of a conventional clarifier. The membrane will filter out any bio-solids or suspended solids from the flow created by the permeate pump.

After undergoing the above processes, the effluent can be considered as treated to meet the design criteria.

***

Please refer to the technical drawing "Process Flow Diagram" for a general schematic of the treatment process.

Please also refer to the technical drawings "Process an Instrumentation Diagram" for a detailed schematic of the treatment process.

2.2 INFLUENT SCREEN

The Influent is pumped from an external pump station to an automatic fine screening device for solids filtering. This filtering process ensures debris and large particles are kept out of the subsequent treatment processes. The filtered debris will be captured by a bagger system for periodical manual disposal by the operator.

Control and valve settings are described in Table 2.2.1A and 2.1.1B

2.2.1 AUTOMATED AND MANUAL CONTROLS

Table 2.2.1A – Automated Controls for the Influent Screen

Tag	*Instrument / Equipment*	*Control*
SCR-0101	Automatic Fine Screen	• Hands/off controlled at the PLC • Motor overload fault alarm indication at the PLC
FIT-0101	Flow Sensor	• Continuous monitoring of influent flow • Total Flow Count

Table 2.2.1B - Manual Controls for the Influent Screen

Tag	*Valve Type*	*Location / Purpose*
CV-0101	Check	• Prevent reverse flow into influent line

2.3 FLOW EQUALIZATION

After primary screening, the filtered flow drains into the Flow Equalization (EQ) tank. The EQ tank provides hydraulic capacity for the incoming flow so as to maintain a constant flow for subsequent downstream processes. In addition to the automatic fine screen, the EQ tank may receive flows from the membrane module during recycle conditions.

Coarse bubble diffusers agitate and aerate the sewage to provide odour control. The air flow quantity can be manually adjusted by a ball valve at the aeration header pipe line.

After being received at the EQ tank, the flow is pumped to the Anoxic Tank. Based on calculated design loading, the flow is anticipated to be 23 m^3/day. The flow rate can be manually adjusted by a ball valve on the EQ Pipe Line.

Control and valve settings are described in Table 2.3.1A and 2.3.1B:

2.3.1 AUTOMATED AND MANUAL CONTROLS

Table 2.3.1A – Automated Controls for the EQ Process

Tag	*Instrument / Equipment*	*Control*
P-0201 P-0202	EQ Pumps	• Automated by the PLC, based on EQ tank liquid level • De-energized if: o Anoxic/Reactor tank has high level alarm o EQ Tank is at low level o (Re-energized if high level alarms are reset) • Can be hands/off controlled at the PLC • Motor overload fault alarm indication at the PLC • To equalize operation periods, duty unit will transition to become the standby unit (while standby becomes duty) during low flow level (known as shut down)
P-0201	EQ Pumps (Duty)	• Will operate in lieu of the standby pump if standby pump has a fault signal
P-0202	EQ Pumps (Standby)	• Will operate in lieu of the duty pump if duty pump has a fault signal
LIT-0201	EQ Tank Level Sensor	• Monitoring of flow level in the EQ tank • If EQ and Reactor tank reach low level, sleep mode is activated
LITLL-0201	EQ Tank Level Sensor (Low Low Level)	• Duty Flow EQ pump off
LITL-0201	EQ Tank Level Sensor (Low Level)	• Duty Flow EQ pump on • Standby Flow EQ pump off
LITH-0201	EQ Tank Level Sensor (High Level)	• Standby Flow EQ pump on
LITHH-0201	EQ Tank Level Sensor (High High Level)	• Indicate high level alarm at the PLC
LS-0201	EQ Tank Level Switch (High High Level)	• Indicate high level alarm at the PLC
PI-0201	Pressure Gauge	• EQ Pump (duty) pressure indication
PI-0202	Pressure Gauge	• EQ Pump (stand by) pressure indication

Table 2.3.1B – Manual Controls for the EQ Process

Tag	*Valve Type*	*Location / Purpose*
BV-0201	Ball	• Flow EQ pump (duty) upstream isolation
BV-0202	Ball	• Flow EQ pump (standby) upstream isolation
BV-0203	Ball	• Flow EQ pump (duty) downstream isolation
BV-0204	Ball	• Flow EQ pump (standby) downstream isolation
BV-0907	Ball	• Flow EQ tank bubble diffuser aeration control
CV-0201	Check	• Prevent reverse flow back into Flow EQ pump (duty)
CV-0202	Check	• Prevent reverse flow back into Flow EQ pump (standby)

2.4 ANOXIC AND REACTOR (AERATION) ZONE

The anoxic tank is the biological step for the treatment process. Microorganism is cultured in this tank to break down biodegradable constituents from the sewage.

The tank is partitioned by an overflowing baffle wall where one side is called the “anoxic tank” and the other the “reactor tank”. The anoxic zone content will gravity overflow into the reactor tank where coarse bubble diffusers provide aeration. It will then be forward pumped into the MBR module.

2.5 EFFLUENT SEPARATION (MEMBRANE FILTRATION)

The permeate pumps will draw effluent through the membrane module while filtering biomass within the membrane tank.

The operator should note that the minimum flow level in the MBR tank will be kept at 300mm above the top of the MBR unit. The MBR unit should always be submerged under water, unless otherwise stated in the official operation and maintenance manual.

Fine bubble diffusers are installed in the tank and under the membrane module for two purposes: biomass agitation and membrane cleaning. The process air creates a high scouring velocity across the membrane surfaces to prevent accumulation of biomass on the membrane. Also, the permeate pumps are never to operate if any of the membrane modules are not aerated. The air flow quantity to the tank diffusers can be manually adjusted by a ball valve.

Control and valve settings are described in Table 2.5.1A and 2.5.1B:

2.5.1 AUTOMATED AND MANUAL CONTROLS

Table 2.5.1A – Automated Controls for the Influent Screen

Tag	*Instrument / Equipment*	*Control*
LIT-0501	Level Sensor	• Monitoring of level in Reactor Tank • If Reactor Tank and EQ tank reach low level, sleep mode is activated
LILL-0501	Level Sensor	• Low Level Alarm • RAS Pump Off
LIL-0502	Level Sensor	• Permeate Pump Off
LIH-0503	Level Sensor	• RAS Pump On • Permeate Pump On
LIHH-0504	Level Sensor	• High Level Alarm • EQ Pumps Off
LS-0501	Level Switch	• High Level Alarm
P-0501 P-0502	Permeate Pump	• Automated by the PLC, based on Reactor tank liquid level • Operation will halt if liquid level in Reactor tank is low • Can be hands/off controlled at the PLC • Fault alarm indication at PLC • Operation will halt if MBR unit is not aerated • Pumps Off in Sleep Mode
P-0501	Permeate Pump (Duty)	• Will operate manually in lieu of the standby pump if standby pump has a fault signal
P-0502	Permeate Pump (Standby)	• Will operate manually in lieu of duty pump if duty pump has a fault signal
P-0501 P-0502	RAS /WAS Pumps	• Automated by the PLC, based on Reactor tank level and membrane flow • Operation will halt if reactor tank has low liquid level • Can be hands/off controlled at the PLC • Motor overload fault alarm indication at the PLC • To equalize operation periods, duty unit will transition to become the standby unit (while standby becomes duty) during low flow level (known as shut down) • Pumps Off in Sleep Mode
P-0501	RAS / WAS Pump (Duty)	• Will operate in lieu of the standby pump if standby pump has a fault signal
P-0502	RAS / WAS	• Will operate in lieu of the duty pump if duty

	Pump (Standby)	pump has a fault signal
FIT-0601	Flow Sensor	• Continuous monitoring of permeate flow
PT-0601	Pressure Transmitter	• Monitoring of Trans-membrane pressure of module MM-0501 • Will allow a set point (Start Up) pressure to be recorded and indicate an alarm when the pressure has increased by 0.7kPa

Table 2.5.1B – Manual Valves for the Influent Screen

Tag	*Valve Type*	*Location / Purpose*
BV-0505	Ball	• RAS/WAS Pump (P-0501) upstream isolation
BV-0506	Ball	• RAS/WAS Pump (P-0502) upstream isolation
BV-0507	Ball	• RAS/WAS Pump (P-0501) down stream isolation
BV-0508	Ball	• RAS/WAS Pump (P-0502) down stream isolation
BV-0515	Ball	• Membrane Recycle line to Anoxic Tank
BV-0516	Ball	• Membrane Recycle Line to Reactor Tank
BV-0602	Ball	• Permeate Header isolation
BV-0603	Ball	• Permeate Pump (P-0601) upstream isolation
BV-0604	Ball	• Permeate Pump (P-0602) upstream isolation
BV-0605	Ball	• Permeate Pump (P-0601) downstream isolation
BV-0606	Ball	• Permeate Pump (P-0602) downstream isolation
BV-0607	Ball	• Permeate Pump recycle line isolation
CV-0102	Check	• Prevent influent flow to Permeate Pumps
CV-0501	Check	• Prevent reverse flow into RAS/WAS Feed pump (P-0501)
CV-0502	Check	• Prevent reverse flow into RAS/WAS pump (P-0502)
CV-0601	Check	• Prevent reverse flow into Permeate Pump (P-0601)
CV-0602	Check	• Prevent reverse flow into Permeate Pump (P-0602)
FCV-0601	Flow Control	• Control Permeate Flow
FIT-0601	Flow Meter	• Continuous monitoring of permeate flow
PI-0602	Pressure Gauge	• Membrane permeate header pressure gauage
PI-0602	Pressure Gauge	• Permeate flow pressure gauage

2.6 EFFLUENT DISCHARGE

The filtrate from the membrane module will be stored in a holding tank. Overflow from this tank will be discharged as treated effluent.

A wash water pump will periodically draw effluent from the holding tank and pump it to the automatic fine screen compactor for its internal spray bar screen cleaning function. In addition, the wash water pump will also provide treated water for the membrane unit's manual chemical clean process

Control and valve settings are described in Table 2.6.1A and 2.6.1B:

2.6.1 AUTOMATED AND MANUAL CONTROLS

Table 2.6.1A – Automated Controls for Permeate Pump

Tag	*Instrument / Equipment*	*Control*
P-0101	Wash Water Pump	• Can be hands/off controlled at the PLC • Motor overload fault alarm indication at the PLC
LT-0701	Effluent Tank Level Sensor	• Monitoring of flow level in the Reactor Tank
LTLL-0701	Level Sensor (Low Low Level)	• Wash Water Pump off
LTL-0701	Level Sensor (Low Level)	• Wash Water Pump on
LTH-0701	Level Sensor (High Level)	• Indicate high level alarm at the PLC
LS-0701	Level Switch (High High Level)	• Indicate high level alarm at the PLC
SV-0101	Solenoid Valve	• Will operate with the Wash Water Pump • Close position during: o P-0101 off • Open position during:P-0101 on o P-0101 on

Table 2.6.1B –Manual Controls for Permeate Pump and UV System

Tag	*Valve Type*	*Location / Purpose*
BV-0101	Ball	• Screen Rinse pump upstream isolation
BV-0102	Ball	• Screen Rinse pump downstream isolation
BV-0103	Ball	• Pressure tank isolation
BV-0706	Ball	• Effluent tank drain
CV-0503	Check	• Prevent reverse flow back into Effluent Tank
CV-0103	Check	• Prevent reverse flow back into Screen Rinse pump
PI-0101	Pressure Gauge	• Monitoring of pressure of screen rinse pump discharge line
SV-0101	Solenoid Valve	• Control screen rinse pump discharge

2.7 SLUDGE HOLDING AND DEWATERING

Periodically the operator will need to remove a certain portion of biomass from the system by redirecting the membrane recycle flow to the Sludge Holding tank. Here, a suspended mixer will agitate and aerate the sludge to provide odour control while also aiding in flocculation of the sludge.

The sludge will be pumped from the Sludge Holding Tank into the filter press for dewatering. The dewatered sludge will be discharged into a sludge hopper, while the filtrate is directed to the Sludge Filtrate Tank.

Two float switches monitor the level of the Filtrate tank. Upon activating the high level alarm, the filtrate pump will energize and pump the filtrate back to the Anoxic tank.

A cam-lock fitting is installed at the bottom of the Sludge holding tank for sludge wasting purposes.

Control and valve settings are described in Table 2.7.1A and 2.7.1B:

2.7.1 AUTOMATED AND MANUAL CONTROLS

Table 2.7.1A – Automated Controls for Sludge Holding and Dewatering

Tag	*Instrument / Equipment*	*Control*
P-1002	Sludge Filtrate Pump	• Automated by the PLC, based on the water level in the Filter Press Sump
LS-1002	Level Switch	• Filter Press Sump pump off
LS-1003	Level Switch	• Indicate high level alarm at the PLC • Filter Press Sump pump on

Table 2.7.1B – Manual Valves for Sludge Holding and Dewatering

Tag	*Valve Type*	*Location / Purpose*
BV-1001	Ball	• Filter press feed pump upstream isolation
BV-1002	Ball	• Sludge Holding Tank drain
BV-1003	Ball	• Sludge Filtrate Tank aeration control
BV-1004	Ball	• Sludge Filtrate Tank drain

2.8 COMPLEMENTING PROCESSES

2.8.1 PROCESS AERATION

Process aeration is required to facilitate the biological breakdown of the nutrient and solid within the sewage, it can also be used to agitate sewage at various stages of the process.

There are a total of three (3) aeration blowers: One (1) for the flow equalization tank and two (2) for the reactor tank. An air flow sensor will continuously monitor the air flow quantity feeding into the Reactor tank.

2.8.2 CHEMICAL CLEAN-IN-PLACE FOR MEMBRANE MODULE

Biological fouling is a common occurrence in wastewater treatment operations. Therefore, the membrane clean procedure must be performed periodically to prevent potential fouling on the surface of the membrane.

Upon commissioning of the plant, the operator will input the initial membrane pressure read by the units' pressure transmitters into the PLC. The system will store this set point and indicate a warning when the pressure has increased

The chemical required to perform the clean in place procedure will vary depending on the type of fouling experienced by the membrane. The operators will have to examine the membrane to determine the best solution to remove such fouling on the membrane.

2.8.2.1 CHEMICAL CLEAN PROCEDURE

A mild solution of sodium hypochlorite (0.5%) is used as a cleaning reagent for the membrane module. Daily monitoring of the trans-membrane pressure can provide an indication for membrane cleaning. Trans-membrane pressure is the pressure differential across the membranes, which compares the pressure reading between the discharge headers in the MBR tank and the discharge pressure of the permeate pump. The membranes will require cleaning every 6 months or if the pressure reading indicates a rise of 5 kPa (0.7 psi) from the initial recorded reading.

A cleaning solution is created by mixing sodium hypochlorite with treated effluent water. The wash water pump (P-0101) provides treated effluent water to the membrane module, while the chemical pump (P-0801) injects sodium hypochlorite into this line. After 300 L (80 gallons) of the sodium hypochlorite solution enters the module, the chemical will soak in the membrane module for 2 hours.

During an inorganic cleaning, a solution of oxalic acid or citric acid will be used in substitute to sodium hypochlorite.

2.8.3 SLEEP MODE

The aeration blowers contain a “sleep mode” which conserves energy during low flow periods.

The Aeration blowers’ sleep mode is activated when low flow is detected in the Reactor and Equalization Tank. During this mode, the blowers will only operate for 5 minutes over an hourly period (5 minutes on, 55 minutes off). The sleep mode will deactivate when normal operation commences (EQ and Reactor tank reach normal operating level)

2.8.4 AUTOMATED AND MANUAL CONTROLS

Table 2.7.3A – Controls for Complementing Processes

Tag	*Instrument / Equipment*	*Control*
B-0901	Aeration Blower (Flow Equalization)	• Automated by the PLC, based on EQ tank liquid level • Can be hands/off controlled at the PLC • Fault alarm indication at the PLC • In Sleep-Mode EQ blower is set to run for 5 minutes every hour (operator settable)
B-0902 B-0903	Aeration Blower (Reactor)	• Automated by the PLC, based on Reactor tank liquid level • Can be hands/off controlled at the PLC • Fault alarm indication at the PLC • In Sleep-Mode Reactor blower is set to run for 5 minutes every hour (operator settable)
FIT-0901	Flow Sensor	• Continuous monitoring of air flow quantity to the Reactor tank

Table 2.7.3B – Manual Valves for Complementing Processes

Tag	*Valve Type*	*Location / Purpose*
BV-0901	Ball	• Flow EQ aeration blower isolation
BV-0902	Ball	• Reactor aeration blower isolation
BV-0903	Ball	• Reactor aeration blower isolation
BV-0904	Ball (Normally Open)	• Aeration unit isolation on header pipe
BV-0905	Ball (Normally Closed)	• Aeration unit isolation on header pipe
BV-0906	Ball	• EQ Tank aeration isolation
BV-0907	Ball	• Reactor Tank aeration isolation
BV-0908	Ball	• Reactor Tank aeration isolation
BV-0801	Ball	• Wash water pump cleaning isolation
CV-0901	Check	• Aeration blower B-0901 check valve
CV-0902	Check	• Aeration blower B-0902 check valve
CV-0903	Check	• Aeration blower B-0903 check valve
FCV-0801	Flow Control Valve	• Set CIP flow to membrane at 2.5 GPM
P-0801	Chemical Pump	• Manually activated when CIP is required

3.0 OPERATION AND MAINTENANCE

3.1 PLC ALARMS AND SOLUTIONS

The following is a summary table that explains all the PLC alarm status and the relevant conditions within the process.

Table 3.1A – PLC Alarms and Solution

Equipment	*PLC Alarm/Status*	*Indication/Solution*
Blower	Pressure Switch condition	Indicating a minimum pressure in the air line. Operator action is required to open the ball valve to re-direct air from the standby blower, and perform maintenance check on the affected blower.
Pumps and Blowers	Overload condition.	If there is an overload on either of the pumps or blowers, it is shut down and an alarm is thrown. Operator action is then required to investigate the cause of the overload and perform maintenance on the affected piece of equipment.
Reactor Tank	High Tank Level	A high tank level alarm is activated upon a high water level in the Reactor Tank. This will require operator intervention to ensure that this is not an indication of pump failure. It should be noted that upon failure of either duty or standby pump, the other unit will start automatically.
Membrane Bioreactor	Low Level Alarm	A low level alarm indicates a malfunction in the effluent return line actuator. The issue will have to be examined and properly corrected before the system can be placed back into automatic operation.
All Motors	Overload	In the event of an overload in any of the relays, there will be an overload alarm. This will require operator intervention to reset the affected breaker, and troubleshoot the reason for the overload.

3.2 SUGGESTED MAINTENANCE SCHEDULE

The following is a recommended maintenance schedule based on Sanitherm's experience with the packaged sewage treatment plants. For official maintenance manuals and spare parts list, please refer to the specific manufacturer's official operations and maintenance manual.

Table 3.2A – Sanitherm Recommended Maintenance Schedule

Equipment	*Task*	*Frequency*
Membrane Module	Monitor permeate flow rate.	Daily.
	Perform membrane chemical clean procedures.	During start-up / commissioning phase, cleaning is performed weekly. During normal operations, cleaning is performed when permeate flow is producing only 75% of the original permeate flow upon start-up.

Automatic Fine Screen	Motor Inspection with the following tasks: 1) Check that the motor is clean. Check that the interior and exterior of the motor is free of dirt, oil, grease, water etc. Oily vapour, paper, pulp, textile lint etc., can accumulate and block motor ventilation. If the motor is not properly ventilated, overheating can occur and cause early motor failure. 2) Use an Ohmmeter (“Megger”) periodically to ensure that the integrity of the winding insulation has been maintained. Record the Ohmmeter readings. Immediately investigate any significant drop in insulation resistance. 3) Check all electrical connectors to be sure that they are tight.	Every 500 hours or every three (3) months or whichever occurs first.

Equipment	*Task*	*Frequency*
Pump	Bearing Lubrication.	As required upon inspection.
	Major Overhaul.	As required depending on pump performance.
	Motor Inspection with the following tasks: 1) Check that the motor is clean. Check that the interior and exterior of the motor is free of dirt, oil, grease, water etc. Oily vapour, paper, pulp, textile lint etc., can accumulate and block motor ventilation. If the motor is not properly ventilated, overheating can occur and cause early motor failure. 2) Use an Ohmmeter ("Megger") periodically to ensure that the integrity of the winding insulation has been maintained. Record the Ohmmeter readings. Immediately investigate any significant drop in insulation resistance. 3) Check all electrical connectors to be sure that they are tight.	Every 500 hours or every three (3) months or whichever occurs first.
	Inspect impeller and body for excessive build-up or clogging and repair as required.	Upon significant decrease in pump performance.
Blower	Check all lubricant levels including gearbox, bearing reservoirs and refer to manufacturers instructions.	Daily.
	Drain and replace gear case oil.	As per Manufacturers recommendations.
	Check for hot spots, increase or changes in vibration and noise.	Daily.
	Check blower inlet filters, belts and replace as necessary. (Refer to diagram 10.3.1 at the end of this document for explanation)	Weekly.

3.3 SUGGESTED GENERAL CHECK-UP

The following is a recommended check up on the sewage plant based feedbacks from operators who have worked with our packaged sewage treatment plants.

Suggested daily check-up

- Record pump operation hours to verify operations
- Record permeate flow rate
- Record EQ tank level
- Record any program alarms and clear the alarm entry

Suggested weekly check-up

- Dispose of any waste on screen collector
- Sample effluent as required by the permit

Suggested monthly check-up

- Clean aeration blower filters
- Clean all in-basin float switches
- MLSS parameter

4.0 MISCELLANEOUS INFORMATION

4.1 ELECTRICAL INFORMATION

Table 2.1A – Electrical Specification of Major Process Equipment

Equipment	Tag	Model	Power	Voltage	Full Load Amperage
Automatic Fine Screen (XP Rated)	SC-0201	IPEC SLB 6LB636	0.5 HP	460V/3ph/60Hz	0.9 A
Wash Water Pump	P-0101	Goulds 1SV4TA4F22	0.5HP	480V/3ph/60Hz	1 A
Flow Equalization Pump	P-0201 P-0202	Monarch BSE-50/150	½ HP	120V/1Ph/60 HZ	
RAS/WAS Pumps	P-0501 P-0502	AMT 282F-95	¾ HP	460V/3Ph/60Hz	2.0 A
Permeate Pump	P-0701 P-0702	Goulds 1SN2C5G6	0.5HP	480V/3ph/60Hz	1 A
Sludge Filtrate Pump	P-1002	Tsurumi HS2.4S	0.5 HP	120V/1ph/60Hz	5.4 A
Flow Equalization Aeration Blower	B-0901	Republic HRB302	2 HP	480V/3ph/60Hz	3.4A
Reactor Aeration Blower	B-0902 B-0903	Republic HRB402	2.35 HP	480V/3ph/60Hz	4.2A
Process Air Compressor	A-1001	Ingersoll Rand 2545E10V	10 HP	460V/3ph/60Hz	13.3 A
Flocculation Mixer	M-1001	Dynamix DMX-51O2D-9C7B	0.25 HP	460V/3ph/60Hz	0.65 A

Equipment	Tag	Model	Power	Voltage	Full Load Amperage
Building Fans (XP Rated)	EFX-0001	Leco A1214E	0.25 HP	120V/1ph/60Hz	5.0 A
Building Fans	EF-0001 EF-0002	Dayton 2C819B	0.03 HP	120V/1ph/60Hz	1.4 A
Building Heater (XP Rated)	HX-0001	Norseman XB4-6450T2D	4.5 kW	480V/3ph/60Hz	5.4 A
Building Heater	H-0001 H-0002	Caloritech GE052CT	5 kW	480V/3ph/60Hz	7 A

Table 2.1A – Electrical Specification of Instrumentation

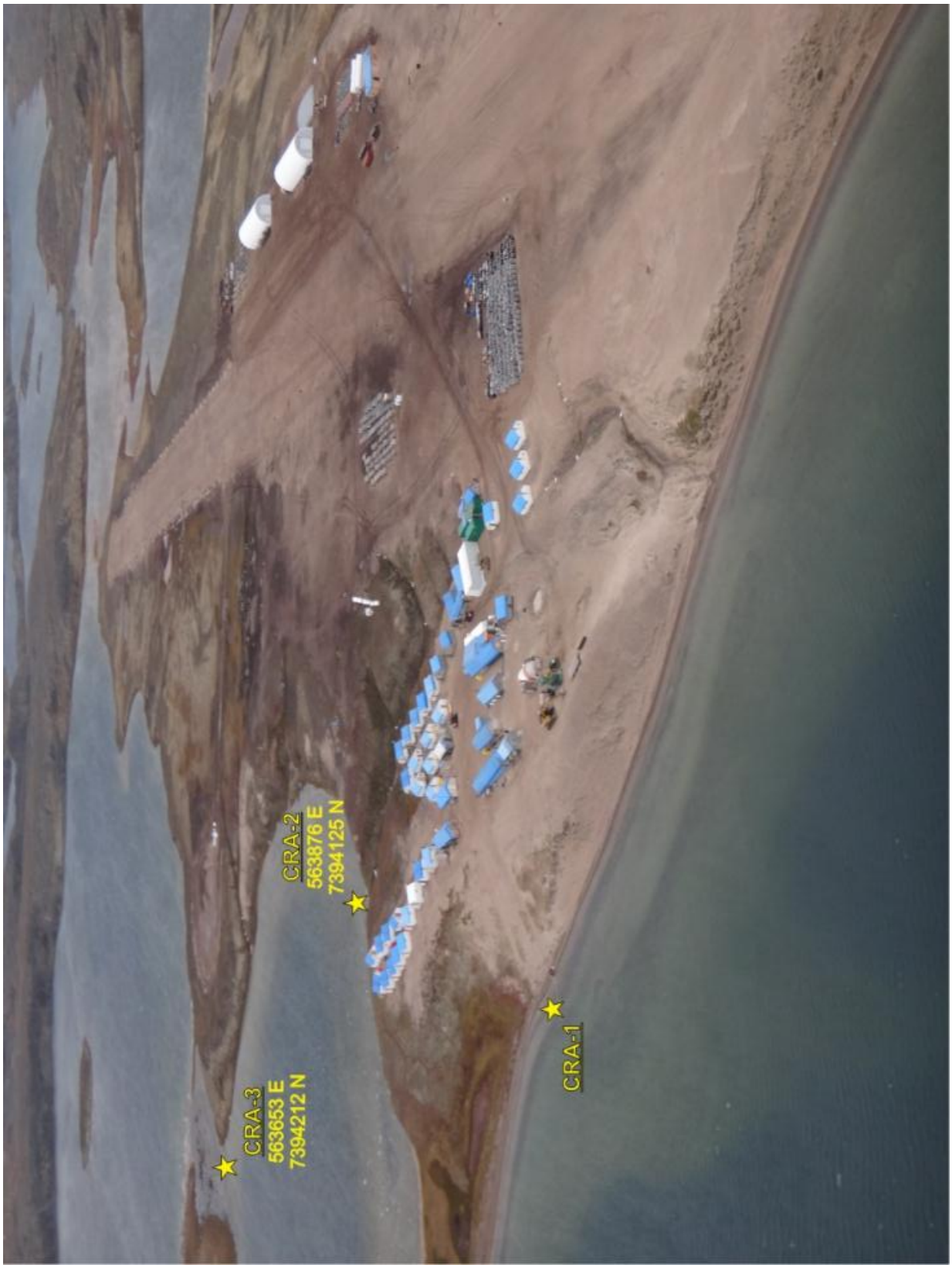
Equipment	Tag	Model	Description
Process Flow Meter	FE-0101 FE-0501 FE-0701	Endress+Hauser Promag 10W 10W50-ULGA1RA0B4AA	4-20mA output
Level Sensor	LE-0201 LE-0501	KPSI Series 705	4-20mA output
Level Sensor (Effluent Tank)	LE-0701	KPSI Series 28	4-20mA output
Air Flow Meter	FE-0901	Endress+Hauser T-Trend ATT12-C21F31B6H1	4-20mA output
3-Way Actuator	MV-0701	Hayward	4-20mA output
Solenoid Valve	SV-0101	GC Valves S20 Series S201GF02N5EG5E	

5.0 NOTES

APPENDIX 3

Hayes Camp Water Sampling Locations

North Country Gold Corp. (Hayes Camp) Water Sampling Locations



APPENDIX 4

Environment Canada's Environmental Protection Series Biological Test Method

- EPS/1/RM/13 (Acute lethality to Rainbow Trout (Onchorhynchus mykiss))
- EPS/1/RM/14 (Acute lethality to the crustacean (Daphnia magna))

Please see attached DVD

APPENDIX 5

Guidelines for the Discharge of Treated Municipal Wastewater in the Northwest Territories

NORTHWEST TERRITORIES WATER BOARD

Guidelines for the Discharge of Treated Municipal Wastewater in the Northwest Territories

1992

Guidelines for the Discharge of Treated Municipal Wastewater in the Northwest Territories

1992

Foreword

Under the Northern Inland Waters Act the Northwest Territories Water Board is charged with the responsibility for licensing water use and waste disposal in the Northwest Territories. Municipal wastewater discharges are a most important consideration in that they have a direct impact on public health and general environmental quality. Reflecting public input at numerous public hearings, the Board has adopted the policy of requiring the treatment of all municipal waste by the best practical means before it is discharged into the receiving environment. It is believed that such a policy will help to keep the North's waters pure and clean and avert the problems allowed to build up in Southern Canada where often strict controls were not imposed in the early days of municipal growth. Fortunately the Board's goals and objectives are shared by departments and agencies of all levels of government, such as the Northwest Territories Association of Municipalities and the Department of Municipal and Community Affairs of the Government of the Northwest Territories. This results in a high level of cooperation between all the parties involved.

As a service to those operating and planning municipal waste systems, the Board published its first edition of "Guidelines" in 1981. The work of revision started almost contemporaneously with publication and so many people have participated in the process over the years that it is impossible to name them all. Much of the work was done by the Board's Technical Advisory Commitee as well as special committees established for specific purposes. Constant advice, assistance and committee participation were forthcoming from the Federal departments of Environment, National Health and Welfare, and Indian Affairs and Northern Development, and from the territorial government's departments of Health and Municipal and Community Affairs. The Board would like to acknowledge the special assistance of Mr. Ron J. Kent, who chaired a working committee, Mr. Richard E.K. Feilden of Reid Crowther and Partners Ltd. and Dr. Daniel W. Smith of the University of Alberta. Board Members who were intimately involved with the revisions include Mr. Glenn Warner who oversaw the process for a period of ten years, Mr. Scott Howarth and Mr. Brian Wilson of the Federal Department of Environment and Dr. Ian Gilchrist of the Territorial Department of Health. The Board's Executive Assistant, Mrs. Pamela LeMouel deserves special thanks for the exercise of her administrative talents throughout the process from first draft to final publication

The principal changes incorporated into the revised Guidelines come as a result of empirical data collected since the original publication. Together with recommendations made by a variety of people with an expertise or general knowledge of Northern wastewater treatment, they centre on the following topics:

a) the updating of effluent quality criteria including the replacement of total coliform with fecal coliform as a discharge parameter;
b) the establishment of differing effluent quality criteria for summer and winter discharges; and
c) the addition of the requirement for proper operation and maintenance plans for waste treatment facilities.

The Board thanks all those who have participated in the preparation of these revised Guidelines and hopes that they will provide a sound basis for municipal wastewater planning for the next decade.

Dave Nickerson
Chairman
N.W.T. Water Board

Table of Contents

LIST OF ABBREVIATIONS

BOD_5	— biochemical oxygen demand, 5 days and 20 degrees C, mg/L
CFU	— colony forming units
dL	— decilitre (100 mL)
F. Coli	— fecal coliform
g	— gram
GNWT	— Government of the Northwest Territories
ha	— hectare
kg	— kilogram
L	— litre
Lcd	— litres per capita per day
L/d	— litres per day
m	— metre
m^3	— cubic metre
m^3/d	— cubic metres per day
mg	— milligram
mg/L	— milligrams per litre
mL	— millilitre
N	— nitrogen
NWT	— Northwest Territories
P	— phosphorus
pH	— hydrogen ion concentration (-log [molar conc. of H^+])
SS	— suspended solids
TL_m	— median tolerance limit concentration in mg/L at which half of the test organisms die within a specified time period.
T_r	— residence time in years

1.0 Introduction

The objectives of the Northwest Territories Water Board "are to provide for the conservation, development and utilization of the water resources" in the Northwest Territories (Northern Inland Waters Act, 1970). These guidelines for the discharge of treated municipal wastewater serve those objectives, and as well seek to protect public health. They are based on the following precepts:

(a) Water is a renewable resource to be conserved and protected;
(b) Municipal wastewaters may pollute receiving waters by depletion of oxygen, deposition of solids, eutrophication, toxicity, release of pathogenic organisms, release of mutagens and carcinogens and aesthetic nuisance;
(c) The discharge of raw wastewater should be eliminated due to the special relationship between northern residents and northern inland waters;
(d) The discharge of treated municipal wastewater needs to be regulated, and the Water Board accomplishes this function through a licensing and monitoring process;
(e) The Water Board should consider each case on a site-specific basis because the range of environmental conditions found throughout the Northwest Territories is so broad;
(f) Receiving water quality objectives need not be satisfied in a defined initial mixing zone immediately around an effluent discharge point;
(g) The onus is on the applicant to obtain all the information necessary to design an adequate treatment and disposal system, and to demonstrate that the proposed system will meet these guidelines after implementation;
(h) These guidelines are subject to the provisions of the Northern Inland Waters Act and Regulations, as amended;
(i) The Water Board expects that these guidelines will be appropriate in most cases, and intends to follow them. The Water Board will, however, include more stringent or less stringent limits in water licences whenever it is deemed appropriate to do so in light of site-specific circumstances;
(j) The Water Board is committed to full public consultation prior to making any licensing decision;
(k) Licensees are to comply with the terms of their water licences;
(l) Licences which are granted by the Water Board prior to the effective date of these guidelines remain in effect and are not altered by these guidelines; and
(m) Compliance with these guidelines, the Northern Inland Waters Act and Regulations, and the terms and conditions of any licence issued thereunder does not absolve the owner or operator of any wastewater collection, treatment or disposal system from the responsibility to comply with any other applicable Federal, Territorial or Municipal legislation. For example, subsection 36(3) of the Fisheries Act prohibits the deposit of a deleterious substance of any type into waters frequented by fish. Deleterious is generally accepted as acutely lethal, whereby undiluted effluent kills more than 50% of the trout or daphnids in their respective bioassay tests. This end-of-pipe requirement may or may not be more stringent than the mixing zone approach incorporated within these guidelines. Potential licensees may obtain additional information by contacting the NWT District Office of Environmental Protection, Conservation and Protection, Environment Canada, (403) 920-6060."

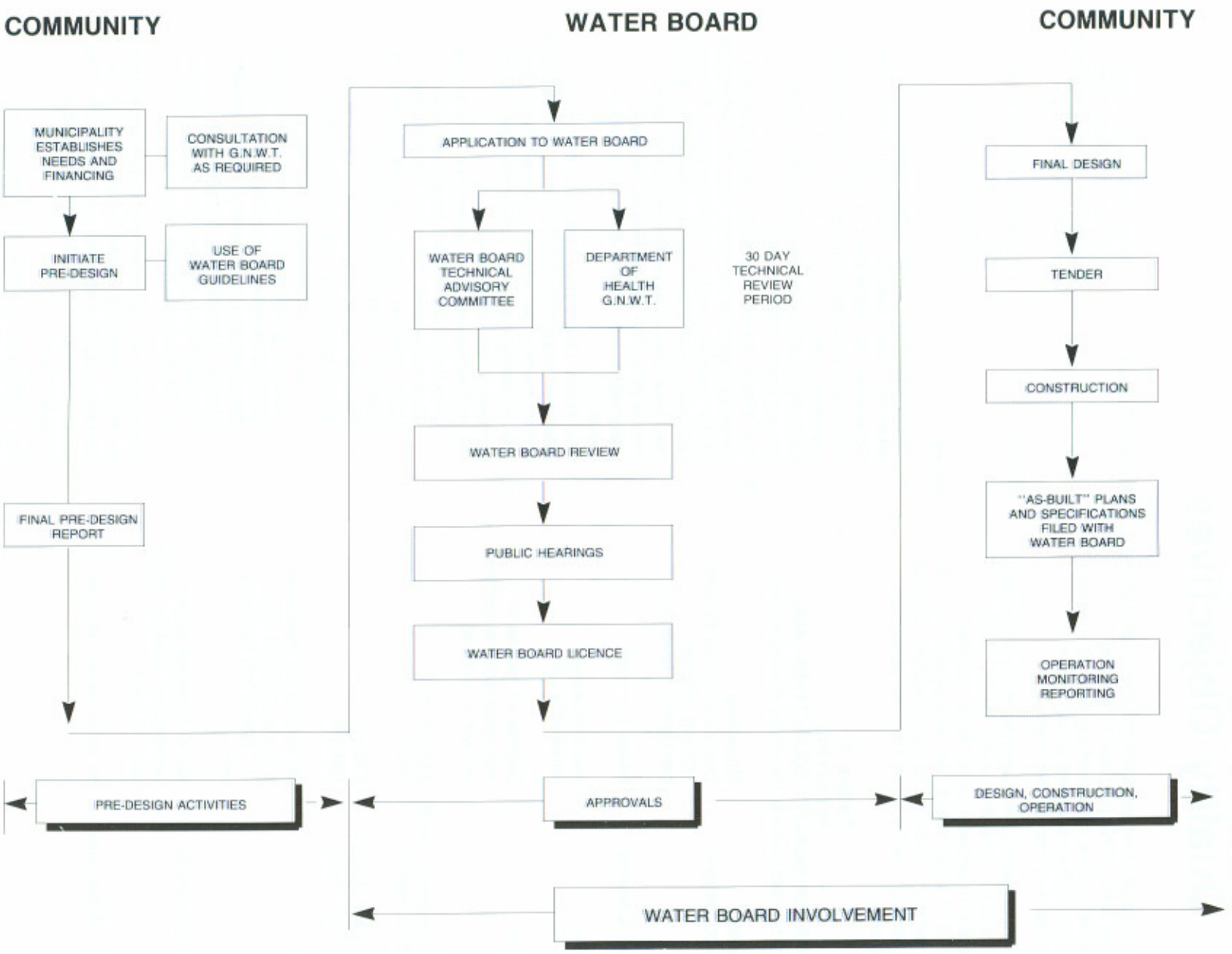


FIGURE 2.2: PROCESS FOLLOWED FOR PROJECTS REQUIRING N.W.T. WATER BOARD LICENSING IN CITIES, TOWNS AND VILLAGES.

3.0 Receiving Water Quality Objectives

Any discharge of effluent affects the quality of the receiving water. The purpose of treating wastewater before it is discharged is to maintain the quality of the receiving water within reasonable and acceptable limits.

Table 3.1 presents the Water Board's objectives and criteria for receiving water quality. Most criteria are expressed either as a maximum permitted change above the background level, or as a maximum level not to be exceeded. Criteria which are not readily quantified are described qualitatively.

TABLE 3.1
RECEIVING
WATER QUALITY OBJECTIVES (a)(b)
(To be met outside the initial mixing zone)

Parameter	Objective
Dissolved Oxygen	Decrease not to exceed 10% of original background level (c).
Residual Chlorine	Below 0.1 mg/L.
Nutrients	Avoid nuisance conditions (d).
Coliforms:	Geometric means of individual determinations are not to exceed:
— shellfish meat, fecal	230/100 g
— shellfish waters, fecal	14/dL
— all waters, fecal	100/dL
— all waters, total	1000/dL
Toxicity	No toxicity as measured in a standard 96 hour TL_m static fish bioassay test.
Suspended Solids	Not to increase above background level by more than 10 mg/L.
Floatable Solids and Scum	No observable increase.
Oil and Grease	None visible on water surface; no observable increase; in any case not greater than 5 mg/L.
Metals	Increase not to exceed 10% of original background levels.

Notes:

(a) These objectives protect the quality of the receiving water outside the initial mixing zone. Objectives are expressed in terms of maximum allowable change, or in terms of a maximum value not to be exceeded. Objectives do not apply within the "initial mixing zone" (Section 4.4).

(b) The Water Board may apply more stringent criteria if deemed necessary for the protection of the receiving water. In determining if more stringent criteria are needed, the Water Board may take into account the effects of other discharges. The Water Board may add parameters and criteria to those listed in Table 3.1.

(c) The Water Board may specify a minimum dissolved oxygen concentration if the receiving environment is sensitive to oxygen depletion.

(d) The following nuisance conditions are typical of those to be considered.

  (i) In freshwater lakes, presence of massive growths of planktonic bluegreen algae (Cyanophyceae) for more than several days duration and/or massive growths of attached, filamentous diatoms (Bacillariophyceae) and/or rooted aquatic plants especially near the shoreline.

  (ii) In rivers and streams, presence of massive growths of attached green algae (Chlorophyceae), filamentous diatoms (Bacillariophyceae) and/or rooted aquatic plants, slime-forming bacteria (as Sphaerotilus), sludge worms (Tubificidae) or chironomids (Chironomidae).

Limits may be set on productivity parameters if the Water Board considers such limits to be warranted by site-specific considerations. The usual parameters are phosphorus and/or nitrogen forms.

The objectives in Table 3.1 have been formulated with due regard to social and environmental circumstances, and to the types

of wastewater treatment systems that have been found to be operable and affordable in small northern communities. As indicated, they are to be met outside the "initial mixing zone", defined in Section 4.4.

If the effluent guidelines set out in Table 4.1, and in Table 4.2 if applicable, do not achieve the receiving water quality specified in Table 3.1, the Water Board may require effluent quality to be improved further in order to reach the stated receiving water objectives.

Health and Welfare Canada publishes national standards and objectives for drinking water quality (Canadian Drinking Water Quality, Health and Welfare Canada, 1989). Recommended limits on concentration of selected elements and compounds are reproduced in Appendix C.

Environment Canada publishes national guidelines for water quality in natural environments, which have been developed for protection of freshwater aquatic life. Selected guideline concentrations are reproduced in Appendix D.

4.0 Wastewater Discharge Guidelines

4.1 Introduction

This chapter sets out effluent quality guidelines intended to achieve the receiving water quality objectives stated in Section 3. The guidelines have been developed giving due consideration to the types of sewage treatment facilities that have been found to be practical in northern community settings (i.e. lagoon systems, in most cases).

The Water Board will use these guidelines and site-specific information to determine the effluent quality limits to be applied in each water licence. The Water Board may set limits that are more stringent or less stringent than these guidelines, depending on site-specific considerations.

Although operation and enforcement are based on effluent quality measurements, the receiving water quality objectives stated in Section 3 remain the paramount considerations. If it is determined that a particular licence limit or effluent quality limit will not achieve the intended receiving water objective, then the Water Board may adjust the licence limit as necessary to achieve the desired result.

4.2 Guidelines for Discharges to Receiving Waters

Water licences usually will state limits on effluent concentrations of BOD_5, suspended solids, pH, oil and grease, fecal coliforms and, where warranted, phosphorus.

Guidelines for these parameters are presented in Table 4.1 and accompanying notes. Guidelines for a number of additional parameters, which the Water Board may include in water licences, are presented in Table 4.2.

Rates of water use vary widely between NWT communities, when compared on a volume per person (litres per capita per day; Lcd) basis. In particular, water use tends to be much lower in truck serviced communities, as compared to piped ones. Low water use results in proportionally "stronger" (more concentrated) raw domestic wastewater.

As indicated in Table 4.1, licence limits will be chosen considering the type and relative size of the receiving environment, and the community's per capita wastewater flow rate.

Generally, Table 4.1 imposes higher effluent standards in communities where the per capita use of water and discharge of wastewater is high. Less stringent requirements may be applied to small communities, where daily water withdrawal is less than 30 m^3/d.

A discharge is not normally acceptable if the dilution afforded by the receiving stream is less than 10:1, unless the quality of the effluent equals or betters that of the receiving water.

TABLE 4.1
MUNICIPAL WASTEWATER EFFLUENT QUALITY GUIDELINES

Wastewater Flow (Lcd) & Season	Parameter	Unit	Receiving Environment: Stream, River or Estuary (a) — Dilution (b): >10:1 <100:1	>100:1 <1,000:1	>1,000:1 <10E4	>10E4:1	Lake (a) — Residence Time or Dilution (c): T_r > 5 yr	T_r < 5 yr	Marine (d) — Mixing Condition: Open Coastline	Bay or Fjord
<150 Lcd Summer	BOD	mg/L	30	80	100	360	30	80	360	100
	SS	mg/L	35	100	120	300	35	100	300	120
	P (e)	mg/L	10	—	—	—	—	—	—	—
	F. coli.	CFU/dL	10E3 (f)	10E4 (f)	10E5 (f)	10E6 (f)	10E3 (f)	10E4 (f)	(g)	(g)
<150 Lcd Winter	BOD	mg/L	no	special	100	260	30	80	same	same
	SS	mg/L	discharge	permit	100	240	35	100		
	P (e)	mg/L			—	—	—	—	—	—
	F. coli.	CFU/dL			10E6 (f)	10E6 (f)	10E3 (f)	10E4 (f)		
150 - 600 Lcd Summer	BOD	mg/L	30	40	120	120	30	40	120	120
	SS	mg/L	35	60	180	180	35	60	180	180
	P (e)	mg/L	9	—	—	—	—	—	—	—
	F. coli.	CFU/dL	10E4 (f)	10E4 (f)	10E5 (f)	10E6 (f)	10E3 (f)	10E4 (f)	(g)	(g)
150 - 600 Lcd Winter	BOD	mg/L	no	special	100	120	same	same	same	same
	SS	mg/L	discharge	permit	100	180				
	P (e)	mg/L			—	—				
	F. coli.	CFU/dL			10E6 (f)	10E7 (f)				
>600 Lcd Summer	BOD	mg/L	25	30	80	80	25	30	80	80
	SS	mg/L	30	30	70	70	30	30	70	70
	P (e)	mg/L	2	—	—	—	2	—	—	—
	F. coli.	CFU/dL	10E3 (f)	10E4 (f)	10E5 (f)	10E6 (f)	10E3 (f)	10E4 (f)	(g)	(g)
>600 Lcd Winter	BOD	mg/L	no	70	70	70	same	same	same	same
	SS	mg/L	discharge	70	70	70				
	P (e)	mg/L		—	—	—				
	F. coli.	CFU/dL		10E4 (f)	10E6 (f)	10E7 (f)				

Legend: Same indicates that the summer guideline applies in winter.
Lcd is flow rate in litres per capita per day.
10E3 is 1,000; 10E4 is 10,000; 10E5 is 100,000; 10E6 is 1,000,000; 10E7 is 10,000,000.

Notes to Table 4.1

(a) Untreated wastewater discharges are not permitted to any inland waters, except where the Water Board has specifically permitted the use of inland waters for the containment or treatment of municipal wastewater;

(b) Dilution in streams, rivers and estuaries is calculated as follows:

$$\text{dilution} = \frac{\text{minimum average monthly stream flow}}{\text{average daily wastewater flow}}$$

where both flows are expressed in the same units.

If discharge is discontinuous, the stream flow is based on the average flow at the time of discharge. Note that the minimum monthly streamflow will occur during winter;

Stream flow in estuaries is to be based on the fresh water component;

(c) Residence time in a lake is calculated as follows:

$$\text{residence time } T_r \text{ (years)} = \frac{V}{Q_t}$$

where V = volume of lake (m^3)
Q_t = annual outflow from lake (m^3/yr)

(d) Marine outfalls are to meet the design specifications in Appendix A. Where treatment is not practicable, discharge of untreated wastewater to the open sea is permitted if, as a minimum, floatable materials are removed and the wastewater is comminuted or macerated. The requirements for discharges to bays and fjords may be relaxed, depending on the findings of site-specific studies. Similarly, the minimum distance offshore may be relaxed, depending on effluent quality and on the findings of site-specific studies;

(e) Guidelines for the concentration of phosphorus are considered to be flexible. A site-specific study may indicate that a less stringent limit is appropriate or that a more stringent limit is needed. Site-specific studies are to address effects on any lakes less than 10 km downstream. Appendix B describes the site-specific determination of permissible phosphorus concentration;

(f) Guidelines for fecal coliform levels are intended to limit concentrations everywhere outside the initial mixing zone so that the geometric mean of the fecal coliform density does not exceed 100 CFU/dL. Treated effluent ordinarily need not be disinfected; however, disinfection will be required in any case where site-specific studies show that it is needed for protection of public health;

(g) In the case of an open, well flushed marine bay or fjord, bacteriological standards will be of concern only where the discharge might affect a fishery (including shellfish harvesting) or water contact recreation;

(h) pH is to be in the range 6 to 9;

(i) Guidelines for oil and grease: none visible and in any case not greater than 5 mg/L;

(j) "Same" indicates that the guideline for summer applies in winter; and

(k) Where wetlands are used as part of the treatment system, limits may be chosen to suit the point of measurement and control.

Table 4.2 lists guidelines for additional parameters that may be included in a licence, if the Water Board deems it to be appropriate. The usual source of substances listed in Table 4.2 is industrial effluent. The onus is on the applicant to establish that there is no significant industrial waste contribution that may cause the tabulated guidelines to be exceeded. Parameters listed in Table 4.2 need to be monitored only if they are listed in the licence, or if so ordered by the Water Board.

TABLE 4.2
LIMITS FOR ADDITIONAL EFFLUENT PARAMETERS THAT MAY BE OF CONCERN IN SPECIFIC DISCHARGES (a) (c)

Parameter	Maximum Concentration (mg/L) (b)
Aluminum (total)	2.0
Arsenic (total)	0.05
Barium (dissolved)	1.0
Boron (dissolved)	5
Cadmium (dissolved)	0.005
Chromium (total)	0.1
Cobalt (dissolved)	0.1
Copper (dissolved)	0.2
Cyanide (total)	0.1
Fluoride (dissolved)	5.0
Iron (dissolved)	0.3
Lead (dissolved)	0.05
Manganese (dissolved)	0.05
Mercury (total)	0.0006
Methylene Blue Active Substances (MBAS)	5
Molybdenum (total)	0.2
Nickel (dissolved)	0.3
Selenium (total)	0.05
Silver (total)	0.1
Sulphate (dissolved)	500
Sulphide (dissolved)	0.5
Tin (total)	5
Zinc (total)	0.5

Notes to Table 4.2

(a) Table 4.2 normally applies to wastewaters that

contain a significant non-municipal component, i.e. discharge from an industrial or commercial process, which is likely to contribute elements or compounds listed in the table.

(b) Limits may be adjusted to take background levels into account, particularly where water supplies may be affected.

(c) The Water Board may prescribe limits for additional elements or compounds not listed in Table 4.2.

4.3 Compliance

Effluent must comply with licence limits. Compliance is defined as follows:

(a) the arithmetic mean of all parameters (other than coliform) measured in the last four (4) samples collected in the same season shall not exceed the licence limit;

(b) of the samples referred to in (a) above, three (3) shall not exceed the licence limit;

(c) of the samples referred to in (a) above, no sample shall exceed one hundred and fifty (150) percent of the licence limit;

(d) the geometric mean of the last four (4) fecal coliform samples shall not exceed the licence limit; and

(e) spring and fall samples shall meet the mean of the licence limits stated for summer and winter.

The design of treatment systems shall include appropriate safety factors to ensure compliance. Lagoon systems, for example, should be subjected to a regular maintenance program, which includes the management and disposal of accumulated sludge. Applicants will be required to submit their proposed plan to the Water Board. It may also be appropriate to design to more stringent effluent criteria than those in Tables 4.1 and 4.2, depending on the reliability of the treatment system.

In the event that an emergency or upset condition precludes compliance, refer to Section 9, *Spills and Other Emergencies*.

4.4 Site-Specific Studies for Discharges to Receiving Waters

The Water Board may require site-specific studies to be conducted, as described below, to establish effluent quality limits appropriate to the particular setting. Site-specific studies may also be required where a municipal system collects process effluent from industrial or commercial enterprises, etc.

The onus is on the applicant to determine from the Water Board whether a site-specific study is required. Details of the study's scope and program are subject to approval by the Water Board, as provided for in Section 13 (2) of the Northern Inland Waters Act.

4.4.1 Effluent Discharges to Streams and Rivers

A site-specific study will be required in every case where discharge to a stream or river results in dilution less than 100:1.

A site-specific study may be required
- if the effluent discharge exceeds 5,000 m^3/d,
- if the receiving stream or river is used for other purposes (e.g. water extraction or for water contact recreation,)
- if there are other discharges to the same stream or river, and
- if the receiving stream or river empties into a lake less than 10 km downstream.

4.4.2 Effluent Discharges to Lakes

A site-specific study may be required
- if the effluent discharge exceeds 5,000 m^3/d,
- if the ratio of average outflow from the lake to design average high effluent flow into the lake is less than 200:1,
- if the ratio of average outflow from the lake to design average effluent flow into the lake is less than 1,000:1,
- if local conditions indicate that effluent may drift into an area that is used for water extraction or for water contact recreation, or an area that is due particular consideration for any other reason, and
- if the proposed discharge increases the total of all discharges to the lake so that the ratios listed above are exceeded.

4.4.3 Effluent Discharges to Estuaries

A site-specific study will be required in every case where discharge to an estuary results in dilution less than 100:1.

A site-specific study may be required
- if the effluent discharge exceeds 5,000 m^3/d,
- if dilution by the freshwater component is less than 100:1.

4.4.4 Effluent Discharges to the Ocean

A site-specific study will be required:
- if receiving water objectives are to be met by use of a long outfall (as described in Appendix A), and
- if the boundary between marine and estuary conditions is in question.

A site-specific study may be required:

— if the discharge may affect waters that provide habitat for shellfish, or are used by fish for spawning, or are used extensively by marine mammals, or are used for recreation,
— if the receiving area is embayed or otherwise confined.

4.4.5 Effluent Discharges from Land Disposal Sites

Methods for land disposal of municipal wastewaters include but are not limited to: swamps and wetlands; percolation basins, irrigation, and subsurface disposal.

Site-specific studies of discharges from land disposal sites may be required by the Water Board. If so, consideration should be given to: permafrost conditions, effects on ice lenses, ground water, migratory birds and animals, aesthetic nuisance, and impacts on other uses of land, including hunting and trapping.

4.4.6 Discharges from Sanitary Landfill Sites and Garbage Dumps

Discharges from sanitary landfill sites and garbage dumps are not desirable. Where they occur, or seem likely to occur, the Water Board may require site-specific studies.

4.5 Initial Mixing Zone

4.5.1 Initial Mixing Zone Definition

The limits of the initial mixing zone are defined as follows:

(a) The initial mixing zone around a point discharge in a river or stream may extend up to 100 metres downstream of the discharge point, but it shall not encompass more than one-third (⅓) of the transverse cross-sectional area of the river or stream;
(b) The initial mixing zone around a point discharge in a lake, estuary or marine water may extend up to 100 metres horizontally in all directions, but it shall not encompass more than one-third (⅓) of the least cross-sectional area of the water along any horizontal direction through the discharge point;
(c) The initial mixing zone around a multiple point discharge, as in the case of a multiport outfall, may extend up to 100 metres horizontally from all points of discharge, but it shall not encompass a larger cross-sectional area than would be permitted with a single point discharge; and
(d) In all cases, the initial mixing zone extends from the bed of the receiving water to the surface.

Receiving water objectives do not apply within the initial mixing zone.

4.5.2 Initial Mixing Zone Limitations

The following limitations apply to the location and boundaries of initial mixing zones, and to conditions within initial mixing zones:

(a) Initial mixing zones shall not intrude on intakes for drinking water supplies. Initial mixing zones should not intrude on shellfish beds, on restricted routes known to be followed by anadromous fish, on other areas significant to biological resources, or on recreational areas;
(b) Initial mixing zones shall be free of objectionable materials such as oil, grease, scum, or floating debris which constitute any aesthetic nuisance;
(c) No condition shall be permitted within the initial mixing zone that results in sudden fish kills and mortality of organisms passing through the zone, or that causes an irreversible response, which could result in detrimental post-exposure effects, or that results in bio-concentration of toxic materials harmful to any organism or to its predators; and
(d) Initial mixing zones may overlap provided that cumulative effects within and outside initial mixing zones remain within applicable water quality objectives and license limits.

4.6 Upgrading Existing Discharges

Existing municipal effluent discharges that do not meet the Guidelines are to be upgraded. Deadlines for upgrading will be determined by the Water Board in co-operation with the user involved and the Government of the Northwest Territories, with due regard both to practical limitations and to protection of the receiving environment.

7.0 Outfalls

7.1 Objective

The objective of an outfall is to introduce the effluent stream into its receiving water in a place and manner chosen to achieve efficient mixing, and maintenance of receiving water quality objectives outside the initial mixing zone. If winter discharge is permitted, wintertime conditions probably will control hydraulic design.

7.2 Prohibited Discharges

Neither sludge nor excess solids are to be discharged through outfalls.

7.3 General Design Considerations

Minimum outfall lengths, depths, and depth-distance combinations for marine discharges, that may be permitted for disposal of untreated wastewater, are given in Appendix A. For discharges to non-marine waters, outfalls are to extend below the lowest water level that may reasonably be anticipated. This would generally refer to the lowest under-ice water level during the winter season. Both marine and non-marine outfalls should be located and designed to make optimal use of the mixing and dilution characteristics of the receiving water.

The cases in which a site-specific study of the outfall length and depth may be required are outlined in Section 4. Approval of shoreline discharges is subject to site-specific considerations.

7.4 Ice Scour

Designers are cautioned to consider carefully the effects of ice scour in all settings.

7.5 Posting of Outfalls

Signs are to indicate the location of outfalls, of treatment and disposal areas on land, and of all initial mixing zones.

8.0 Monitoring

8.1 General

Both the effluent and the receiving water need to be monitored to ensure that effluent quality and receiving water quality meet licence limits and water quality objectives. The Water Board will specify the parameters to be monitored. The licensee is responsible for monitoring the effluent, while the Water Board normally will arrange for monitoring of the receiving environment. In specific cases, the Water Board may require the licensee to undertake the receiving environment monitoring program or components of that program. Groundwater sampling and monitoring may be required where pollution of groundwater is suspected or anticipated.

The Water Board may amend monitoring requirements during the licence period, based on performance.

8.2 Sampling Procedures

Field sampling and analytical methods are to be acceptable to the Water Board, and normally are to be as described in the current edition of Standard Methods for the Examination of Water and Wastewater (see references). Results from low-accuracy techniques may be acceptable for small discharges or in emergency situations.

Grab samples are acceptable except as stated otherwise in the water licence. The Water Board usually will specify composite sampling for BOD_5, suspended solids, oil and grease, and phosphorus in the case of

(i) any discharge in excess of 5000 m^3/d, whether continuous or intermittent, or
(ii) continuous discharge from a mechanical treatment plant.

Licensees will submit data in a manner stipulated by the Water Board.

8.3 Sampling Frequency

Licensees are to monitor effluent quality to ensure that it meets the conditions of the Water Licence. Monitoring is to be initiated within one month of the commencement of any discharge.

Sampling frequency for effluent, and for lagoon contents, will be stated in the water license. The Water Board may specify any frequency deemed to be appropriate. The following are guidelines:

(a) Continuous discharge less than 500 m^3/d: fecal coliforms monthly; BOD_5 and suspended solids quarterly;
(b) Continuous discharge greater than 500 m^3/d: BOD_5, suspended solids, fecal coliforms and temperature weekly; oil and grease quarterly;
(c) Lagoon, discharge during the open water season only, annual discharge less than $10^6 m^3$: sample BOD_5, suspended solids and temperature in the lagoon before discharge, in good time so that the quality of the proposed discharge is measured and known before discharge is to take place; and
(d) Lagoon, discharge during the open water season only, annual discharge greater than $10^6 m^3$: sample lagoon contents during the open water season; BOD_5, suspended solids, fecal coliforms and temperature weekly, oil and grease quarterly (before discharge).

8.4 Receiving Water Monitoring

Receiving water quality will be monitored to ensure that the objectives in Table 3.1 are met and that undesirable conditions do not develop.

Pre-discharge (or background) data may be required by the Water Board for a full year or longer. Authority to discharge may be delayed if, in the opinion of the Water Board, sufficient data have not been gathered. Design and construction schedules should allow for this possibility.

9.0 Spills and Other Emergencies

All spills and other emergencies must be reported immediately to:

24 hour Spill Report Line
Yellowknife, Northwest Territories
Telephone (403) 920-8130
Fax: 873-5763

Incidents to be reported include accidental spills of contaminants or hazardous materials into collection or treatment systems; spills of sewage due to breaks or breaches in pipes, chambers, dikes, etc; malfunction of a treatment plant; and any other spill or emergency situation, which could adversely affect public health, the quality of the effluent, or the quality of the receiving water.

Apart from any other actions taken under the Northern Inland Water Act or any other act or regulation, the Water Board may require the licensee to undertake a survey that is adequate in extent and frequency to assess the magnitude of the problem. Such emergency monitoring is to be continued until the problem is brought under control and a return to previous conditions can be demonstrated. Survey data and a review of the problem and control measures are to be reported to the Water Board.

References

American Public Health Association, *Standard Methods for the Examination of Water and Wastewater*, current edition.

Health and Welfare Canada, *Guidelines for Canadian Drinking Water Quality*, 1978, and proposed amendments, 1987.

Heinke, G.W., D.W. Smith and G.R. Finch, *Guidelines for the Planning, Design, Operations and Maintenance of Wastewater Lagoon Sytems in the Northwest Territories*, Vol. I, *Planning and Design*, prepared for the Department of Municipal and Community Affairs, Government of the Northwest Territories, 1988.

Heinke, G.W. and D.W. Smith, *Guidelines for the Planning, Design, Operations and Maintenance of Wastewater Lagoon Systems in the Northwest Territories*, Vol. II, *Operation and Maintenance Manual*, prepared for the Department of Municipal and Community Affairs, Government of the Northwest Territories, 1988.

Glossary

BOD_5 — Five day, 20 degree C, biochemical oxygen demand. A standard test used in assessing wastewater strength.

Coliforms — All of the aerobic and faculative anaerobic gram-negative non-spore-forming, rod shaped bacteria which ferment lactose with gas formation within 48 hours of 35 degrees C.

Comminutor — A device used to cut up and screen solids in wastewater before it enters pumps and other units in the treatment plant.

Disinfection — The destruction of micro-organisms with the objective of killing disease-causing organisms. All organisms are not destroyed during the process.

Embayed — In general, the end of an outfall shall be considered embayed if located on the shore side of a line up to 6.4 km long drawn between any two points on a continuous coastline, or located so that the maximum width of ocean access by any route is under 1.5 km wide, but may be taken to include other waters if flushing action is considered to be inadequate. Exceptions may be made where adequate flushing of an "embayed" area is documented. "Coastline" and "sea access" refer to the mean low tide alignment.

Estuary — A passage in which the tide meets a river current; especially an arm of the ocean, at the mouth of a river.

Excess Solids — The sludge produced in a wastewater treatment system that is not needed to maintain the process and is withdrawn from circulation.

Fecal Coliforms — Those coliforms which ferment EC medium with gas formation within 24 hours at 44.5 degrees C.

Lake — A standing body of fresh water with an average retention time of at least one year.

Licence — A license for the use of waters issued by the Water Board.

Licensee — The holder of a valid license.

Percolation Basin — An engineered facility designed to allow rapid infiltration of water into the ground. This treatment method depends on free-draining, coarse-textured soil for successful operation.

Receiving Water — Any body of surface water into which treated wastewater may flow. Receiving waters wholly contained within a licensee's property are not included in this definition, provided that pollutants in such waters cannot be transported outside the property.

Screening — An operation for the removal of relatively coarse floating and suspended solids by straining through screens.

Shellfish Waters — Waters which are inhabited by edible species of shellfish (bivalve molluscs) and from which shellfish for human consumption are taken either commercially or domestically.

Sludge — The accumulated solids separated from liquids.

Standard Methods — "Standard Methods for the Examination of Water and Wastewater" Current Edition, published by the American Public Health Association.

Waste —

(a) any substance that, if added to any waters, would degrade or alter or form part of a process of degradation or alteration of the quality of those waters to an extent that is detrimental to their use by man or by any animal, fish, or plant that is useful to man, and

(b) any water that contains a substance in such a quantity or concentration, or that has been so treated, processed or changed, by heat or other means, from a natural state that it would, if added to any waters, degrade or alter or form part of a process of degradation or alteration of the quality of those waters to an extent that is detrimental to their use by man or by any animal, fish, or plant that is useful to man, and without limiting the generality of the foregoing, includes anything that, for the purposes of the Canada Water Act, is deemed to be waste.

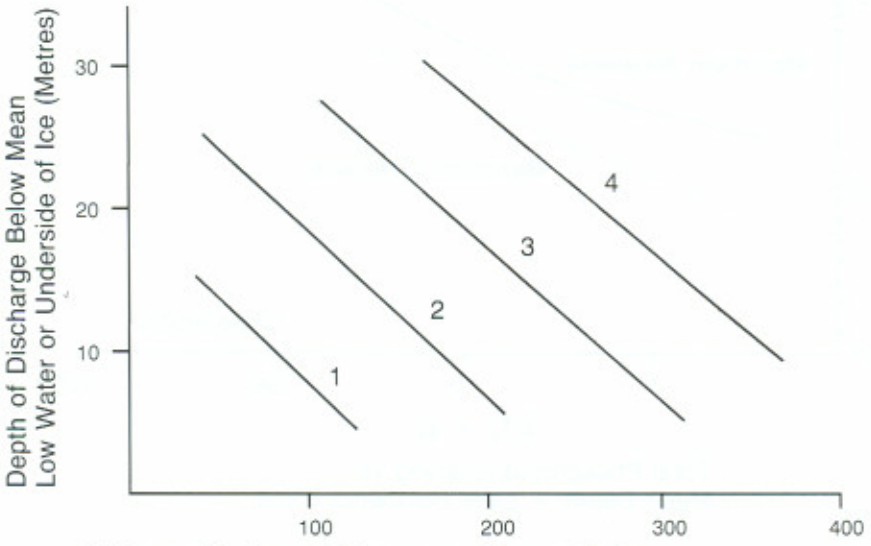
Water Board — The Northwest Territories Water Board.

Work Camp — Work camp means a camp as defined in Section 12 of the Public Health Act and includes the sleeping, kitchen, dining and recreation quarters and facilities thereof and the areas between and adjoining the same, but does not include a camp of less than 10 occupants.

Appendices

APPENDIX A
Depth-Distance Combinations for Outfalls into Marine Waters

(Applicable to Discharges with Effluent Quality Prescribed in Table 4.1)

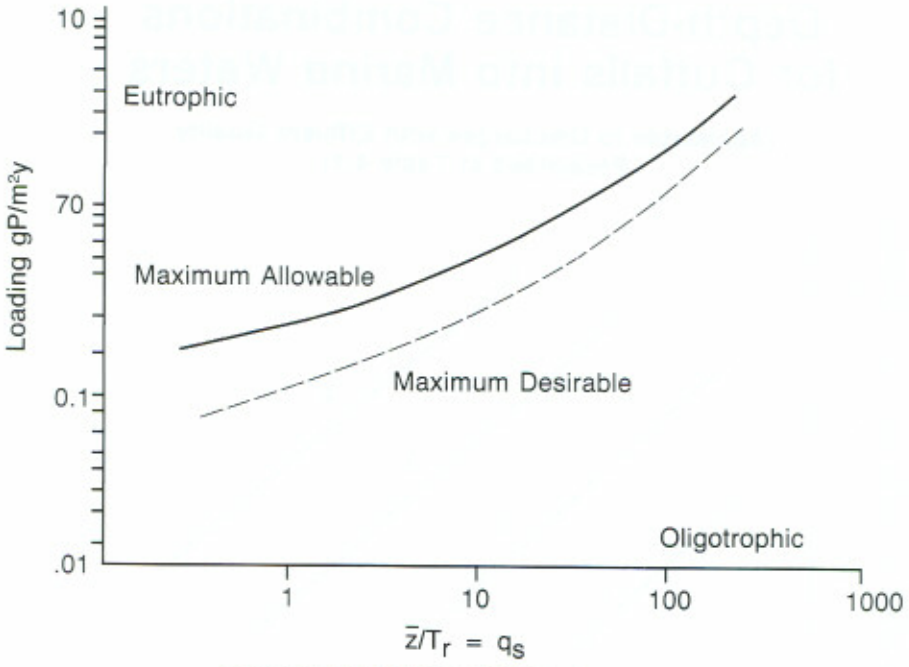


1 Q = 50 m^3/d or less
2 Q = 500 m^3/d (25 m^3/d in shellfish waters)
3 Q = 2,500 m^3/d (125 m^3/d in shellfish waters)
4 Q = 5,000 m^3/d (250 m^3/d in shellfish waters)

Where Q = design average dry weather flow.

Notes:
1. For discharges in excess of 5,000 m^3/d (250 m^3/d in shellfish waters) see Section 2.2.3.
2. Interpolated lines may be used for intermediate flows.
3. Minimum outfall length in shellfish waters is normally 120 m.

APPENDIX B
Determination of Maximum Phosphorus Concentrations in Wastewater Discharges to Lakes



Total Phosphorus Loading vs
Mean Depth ÷ Lake Residence Time

As a rule, calculations should be based on the line labelled "maximum desirable".

To determine the maximum phosphorus concentration for a particular wastewater discharge:

1. Calculate q_s for the water body under consideration

   $$q_s = \frac{\bar{z}}{T_r}$$

   Where $\bar{z}$ = mean depth of lake (metres)
   T_r = lake residence time = $\frac{\text{volume of lake } (m^3)}{\text{annual outflow } (m^3/yr)}$
2. Read the maximum loading from the graph for the given q_s, L_1
3. Estimate the phosphorus loading from sources other than domestic wastes, L_2
4. Calculate maximum loading from the domestic waste source, $L_3 = L_1 - L_2$
5. Determine the maximum concentration of phosphorus in domestic wastewater in mg/L
   Concentration of P = $\frac{L_3 \times \text{lake surface area } (m^2)}{\text{annual wastewater discharge } (m^3/yr)}$

APPENDIX C
Guidelines for Canadian Drinking Water Quality

Table C1 lists the maximum acceptable concentrations (MACs) and aesthetic objectives (AO's) published in *Guidelines for Canadian Drinking Water Quality* (Health and Welfare Canada 1989) for selected elements and compounds.

TABLE C1

Selected Canadian Drinking Water Quality Limits and Objectives

Parameter	Maximum Acceptable Concentration	Aesthetic Objective Concentration	Basis	Notes
Arsenic	0.05	—	H	Under review
Barium	1	—	H	
Benzene	0.005	—	H	
Boron	5	—	H	
Cadmium	0.005	—	H	
Carbon tetrachloride	0.005	—	H	
Chloride	—	< 250	A	
Chromium	0.05	—	H	
Colour (TCU)	—	<15	A	
Copper	—	<1	A	Under review
Cyanide	0.2	—	H	
Fluoride	1.5	1	H	(c) Under review
Hardness(as $CaCO_3$)	500	Between 80 and 100	A	
Iron	—	<0.3	A	
Lead	0.01	—	H	
Manganese	—	< 0.05	A	
Mercury	0.001	—	H	
Nitrate (as N)	10	—	H	
Nitrite (as N)	1	—	H	
Odour	—	Inoffensive	A	
pH	6.5-8.5	—	A	No units
Selenium	0.01	—	H	
Sodium	—	< 200	A	
Sulphate	—	< 500	H&A	
Sulphide (as H_2S)	—	< 0.05	A	
Taste	—	Inoffensive	A	
Temperature (°C)	—	< 15	A	
Total Dissolved Solids	—	<500	A	
Trihalomethanes	0.35	—	H	Under review
Turbidity (NTU)	1	< 5	H&A	
Uranium	0.1	—	H	
Zinc	—	< 5	A	

Notes:

(a) Unless indicated otherwise, the maximum acceptable and objective concentrations are specified in mg/L.

(b) Maximum acceptable and objective concentrations have been established on the basis of either aesthetic (A) or health (H) considerations.

(c) It is recommended that the concentration of fluoride be adjusted to 1.0 mg/L which is the optimum level for the control of dental caries. Where the annual mean maximum temperature is less than 10°C, a concentration of 1.2 mg/L should be maintained.

(d) *Guidelines for Canadian Drinking Water Quality* contains limits for many substances. Substances represented in Table C1 are those most commonly of significance in water supplies in the N.W.T.

APPENDIX D
Canadian Water Quality Guidelines for Freshwater Aquatic Life

Table D1 lists guidelines for maximum concentrations of selected elements and compounds published in *Canadian Water Quality Guidelines* (Task Force on Water Quality Guidelines, 1987).

TABLE D1

Selected Canadian Water Quality Guidelines for Protection of Freshwater Aquatic Life

Parameter	Guideline Concentration	Notes
Arsenic	.05	
Cadmium	.0002	Hardness 0 - 60 mg L^{-1} ($Ca\ CO_3$)
	.0008	Hardness 60 - 120 mg L^{-1} ($CaCO_3$)
	.0013	Hardness 120 - 180 mg L^{-1} ($CaCO^3$)
	.0018	Hardness >180mg L^{-1} ($CaCO_3$)
Chlorine (total residual chlorine)	.002	Measured by amperometric or equivalent method
Chromium	.002	To protect fish.
		To protect aquatic life, including zooplankton and phytoplankton.
Copper	.002	Hardness 0 - 120 mg L^{-1} ($CaCO_3$)
	.003	Hardness 120 - 180 mg L^{-1} ($CaCO_3$)
	.004	Hardness >180 mg L^{-1} ($CaCO_3$)
Cyanide	.005	Free cyanide as CN
Dissolved oxygen	6.0	Warm water biota - early life stages
	5.0	- other life stages
	9.5	Cold water biota - early life stages
	6.5	- other life stages
Iron	0.3	
Lead	.001	Hardness 0 - 60 mg L^{-1} ($CaCO_3$)
	.002	Hardness 60 - 120 mg L^{-1} ($CaCO_3$)
	.004	Hardness 120 - 180 mg L^{-1} ($CaCO_3$)
	.007	Hardness >180 mg L^{-1} ($CaCO_3$)
Mercury	.001	
Nickel	.025	Hardness 0 - 60 mg L^{-1} ($CaCO_3$)
	.065	Hardness 60 - 120 mg L^{-1} ($CaCO_3$)
	.11	Hardness 120 - 180 mg L^{-1} ($CaCO_3$)
	.15	Hardness >180 mg L^{-1} ($CaCO_3$)
Nitrogen Ammonia (total)	2.2	pH 6.5; temperature 10°C
	1.37	pH 8.0; temperature 10°C
Nitrite	.06	
Nitrate		Concentrations that stimulate prolific weed growth should be avoided.
pH	6.5 - 9.0	
Selenium	.001	
Silver	.0001	
Zinc	.03	

Notes:
(a) Unless indicated otherwise, concentrations are reported in mg/L.
(b) Concentrations of metals are reported as total metal in an unfiltered sample.
(c) The referenced publication contains guidelines for many substances. Substances represented in Table D1 are ones most commonly of significance in the N.W.T.