TOWN OF TORBAY

WATER TREATMENT OPTIONS STUDY

USING GREAT POND AS SOURCE - FINAL

DECEMBER 20, 2023

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PROJECT NO.: WW23031003
DATE: DECEMBER 20, 2023

WSP E&I Canada Limited
36 Pippy PLace
St. John's, NL   A1B 3X4

WSP.com

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ISSUE/REVISION	FIRST ISSUE	FINAL ISSUE
Remarks	DRAFT – REV. A	REV. B
Date	June 21, 2023	December 20, 2023
Prepared by	Lars Sterne, M.Sc., P.Eng.	Lars Sterne, M.Sc., P.Eng.
Signature		
Checked by	Susann Hickey ,FEC, FCSCE, P. Eng.	Susann Hickey ,FEC, FCSCE, P. Eng.
Signature		
Authorized by	Cluney Mercer, P. Eng.	Cluney Mercer, P. Eng.
Signature		
Project number	WW23031003	WW23031003
Report number		
File reference		

SIGNATURES

PREPARED BY

Lars Sterne, M.Sc., P. Eng.
Senior Engineer

REVIEWED BY

Susann Hickey, FEC, FCSCE, P. Eng.
Municipal Engineer

APPROVED[1] BY

Cluney Mercer, P. Eng.
Senior Associate Engineer – Civil

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REGISTERED PROFFESSIONAL ENGINEER
PEG Newfoundland and Labrador
C. G. MERCER
SIGNATURE
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1 INTRODUCTION

As a community that has experienced rapid growth, the Town of Torbay population has grown from 4,700 residents in 1991 to 7,900 residents in 2021. The existing municipal water supply, North Pond, is at capacity and cannot support further development. Other water supply sources have been investigated and Great Pond has been identified as the best option for further development.

In 2022, the Town of Torbay undertook the development of a project registration document for the development of Great Pond, and it was subsequently determined that registration under the Provincial environmental assessment process was not required for this project. Application has also been initiated with Fisheries and Oceans Canada for project review for the anticipated project components.

One of the next steps required related to the development of Great Pond includes further defining the treatment process options. The objective of this work is to select an appropriate treatment process train for meeting applicable water regulations and to develop cost estimates for the construction and anticipated operating and maintenance costs for the proposed Great Pond water treatment facility.

Previous work completed for the Town of Torbay related to Great Pond includes:

- 2011, January "Feasibility Study and Conceptual Cost for a Water Treatment Facility for the Town of Torbay", CH2MHill (2011 CH2MHill Report)
- 2021, February, "Great Pond Study", Wood (Feb 2021 Wood Report)
- 2021, August "Great Pond WTP Conceptual Design – DRAFT", Wood (Aug 2021 Wood Report)
- 2021, December, "Town of Torbay Great Pond Fish and Fish Habitat", Wood (Dec 2021 Wood Report)
- 2022, November, "Great Pond Water Supply Project Description" (Registration of Water Body), WSP (Nov 2022 WSP Report)

A summary of Great Pond is provided in the sections that follow and include:

- Great Pond Raw Water Quality
- Source Water Flow
- Treated Water Quality Objectives
- Treated Water Storage
- Treatment Plant Location

1.1 GREAT POND RAW WATER QUALITY

A Great Pond sampling program was conducted during the period 2019 to 2022. The samples collected were analyzed for the following categories:

- General chemistry and metals
- BTEX (Benzene, Toluene, Ethylbenzene, Xylenes) and THP (Total Petroleum Hydrocarbons)
- PAHs (Poly Aromatic Hydrocarbons)
- Pesticides and herbicides.

During the sampling period, parameter values that exceed the Guidelines for Canadian Drinking Water Quality (GCDWQ) for any one sample are summarized in **Table 1–1**. The table includes the GCDWQ limits, the number of samples collected, the number of samples that exceed the GCDWQ and the values range and average.

Great Pond can be classified as providing aggressive water with low pH and alkalinity. These levels can be adjusted using a variety of chemicals. The true colour and turbidity are considered moderate and can be controlled through filtration following coagulant addition or by membrane filtration. The water quality guidelines for turbidity are a function of the technology used. Examples include slow sand filtration (<1 NTU) and membrane filtration (<0.1 NTU).

Although iron does not exceed the Aesthetic Objective (AO) of 300 ug/L, it has been previously reported in other work (2011 CH2MHill) to exceed the AO. Based on no samples showing high levels of iron over the last three years, the control of iron was not considered.

Manganese does not exceed its Maximum Acceptable Concentration (MAC) of 120 ug/L but its concentration does typically exceed the AO value of 20 mg/L. Based on the non-exceedance of the MAC, manganese was not considered a priority for removal.

Aluminum in Great Pond can reach values above the Operating Guideline (OG) value of 100 ug/L; however, this value represents a target when aluminum-based coagulants are used and is based on the assumption of near zero raw water concentrations. Based on no MAC value for aluminum, it is proposed that aluminum not be actively controlled.

The Total Organic Carbon (TOC) does not have a regulatory limit; however, to control Disinfection By-Product (DBP) formation, it will need to be controlled. The raw water values for TOC are typical of those found elsewhere in Newfoundland and Labrador. The Province provides guidance on the Dissolved Organic Carbon (DOC) concentrations. DOC and TOC can be reduced by coagulation/filtration and membrane filtration.

Table 1–1 Great Pond – Historical Raw Water Quality

PARAMETER	GCDWQ	SAMPLES COLLECTED	SAMPLE EXCEEDENCES	RANGE	AVERAGE
pH (--)	7.5-10.5 (Provincial: 6.5-8.5)	12	12 (12)	5.9-6.5	6.20
True Colour (TCU)	15 TCU (AO)	12	5	9.0-39.4	19.0
Turbidity (NTU)	<1/<0.3/<0.1 NTU	12	--	0.9-4.5	1.9
Total Fe (iron) (ug/L)	300 ug/L (AO)	12	0	<50-209	126
Mn (manganese) (ug/L)	120 (MAC)/20(AO) ug/L	12	0 (MAC) 9 (AO)	10-65	29
Al (aluminum) (ug/L)	100 ug/L (OG)	12	2 (OG)	30-163	68
TOC (total organic carbon) (mg/L)	--	12	--	3.5-8.0	4.6
Alkalinity (mg/L as $CaCO_3$)	--	12	--	<5 - 8	--

1.2 SOURCE WATER FLOW AND WATER PRODUCTION

As a surface water source, the draw of water from Great Pond must comply with Section 3.2.3 (Surface Water) of 2005 edition of the Provincial Guidelines for the Design, Construction and Operation of Water and Sewage System (2005 Design Guidelines). This Section indicates that, where possible, a minimum drought period of one in fifty years be used for calculating the safe yield. In addition, the yield must consider other users including any required fish flows.

The February 2021 Wood Report documented the results of a bathymetric survey, discharge flow monitoring and a water balance for Great Pond. The dry year surface runoff was determined to be 0.05 m^3/s.

The December 2021 Wood Report conducted a study of the fish habitat for Great Pond which included the Great Pond Outflow. Wetted permitter modelling was conducted for four representative transects utilizing data from pressure transducers in the stream which have been collecting data since December 2019. The average wetted perimeter inflection point for the transects was 0.02 m^3/s and is "taken as the flow below which dewatering would take place rapidly for the represented habitat" (Section 2.2.2 of December 2021 Wood Report) which is understood to be the minimum required flow rate to maintain fish habit at in the Great Pond Outflow.

Based on the dry year fill of 0.05 m^3/s and the flow of 0.02 m^3/s to maintain fish habitat, an average withdraw rate of 0.3 m^3/s (2,592 m^3/d) was considered for a water treatment plant. Based on waste streams generated in the water treatment process potentially being in the order of 20%, the withdraw rate corresponds with finished water flows of approximately 2,000 m^3/d.

The Provincial 2005 Design Guidelines (Section 3.7.3.2) provides the maximum day water production factor as a function of equivalent population. For a population range of 3,001 to 10,000, the maximum day factor is 2.00. That is, based on an average finished water production rate of 2,000 m^3/d, the maximum day flow is 4,000 m^3/d.

1.3 WATER QUALITY OBJECTIVES

The water quality objectives include the control of pathogens and other parameters (e.g., disinfection by-products).

From a pathogen perspective, and as Great Pond is a surface water source, the treatment must include:

- Primary disinfection
- Secondary disinfection

Primary disinfection is the process or series of processes to remove/inactivate viruses, bacteria and protozoa. Secondary disinfection is the addition of chemical that provides a residual in the distribution system to protect from pathogen re-inactivation and biofilm regrowth.

Primary disinfection has been assumed to be achieved by Ultra Violet (UV) light (minimum dose 40 mJ/cm^2) and secondary disinfection will be achieved by adding chlorine (liquid sodium hypochlorite) following UV disinfection. Since UV disinfection is not effective for virus inactivation, provincial treatment standards allow for the secondary disinfection (chlorination) to provide full disinfection of viruses (2021, "Drinking Water Treatment Standards for Newfoundland and Labrador", p.5). Based on the USEPA guidance for the USA surface water treatment rule, a UV dose of 40 mJ/cm^2 can achieve a 0.5 log removal for viruses. UV is very effective at controlling Giardia and Cryptosporidium.

The key Provincial standards for drinking water plants (April 2021, "Drinking Water Standards for Newfoundland & Labrador") are provided below in **Table 1–2**. Based on the conservative assumption that all of the raw water TOC in **Table 1–1** (average 4.6 mg/L) is in the form of DOC, the effluent DOC from the facility must be less than or equal to 2.0 mg/L (Table 3, p.7 of April 2021 Drinking Water Standards).

In addition to the control of pathogens, the treated water must control for other constituents such as organic material and metals and other parameters as noted previously in **Section 1.1** and **Table 1–1**.

Disinfection by-products (DBP) form as a result of disinfection (chlorine) and its reaction with constituents in the water (e.g., bromine, carbon/organics) and must not exceed values noted the GCDWQ. The DBP compound groups include trihalomethanes (THM) and Haloacetic acid (HAA) both of which include a number of individual chemical compounds. The removal of DBP precursors is important to control THM and HAA formation.

Table 1–2 Treated Water Quality Objectives/Requirements

PARAMETER	STANDARD REMOVAL RATE OR EFFLUENT VALUE LIMIT	COMMENTS
Giardia	3-log reduction/inactivation	Conventional filtration provides 3.0 log removal
Cryptosporidium	3-log reduction/inactivation	Conventional filtration provides 2.5 log removal
Viruses	4-log reduction/inactivation	
Distribution System Chlorine Residual	Detectable; 0.3 – 4 mg/L	Detectable: anywhere in distribution system Min value: before or at first customer Max value: anywhere is distribution system
Disinfection By-Products	THM: <0.1 mg/L HAA: < 0.08 mg/L	

1.4 TREATED WATER STORAGE

Following treatment, the treated water will be directed to a tank to provide storage for fire water, peak demand balancing and emergency storage. The 2005 Provincial Design Guidelines (Section 3.6.5), provides the following total storage volume calculation:

$$S = A + B + C$$

Where:

S: Total storage requirement (m^3)

A: Fire protection (m^3)

B: Peak Balanced Storage (m^3)

C: Emergency storage (25% of A + B).

The equation above is applicable where the water plant can provide only the maximum day demand.

Each of the above are described in the sections below.

Fire Protection

The 2005 Provincial Design Guidelines note that fire flow requirements should meet requirements established by the Insurance Advisory Organization (IAO). To estimate fire protection requirements, a 2020 version of the Fire Underwriters Survey (FUS) Water Supply for Public Fire Protection was used. It is noted that a fire professional should be utilized to finalize the fire flow requirements.

The fire protection volume is the product of the water flow fire flow requirement (L/min) and the corresponding time for that flow. It is understood that the Great Pond WTP will service primarily detached one family and small two-family dwellings not exceeding 2 stories in height; however, future development is unknown. To provide a conservative estimate of fire flow requirements, larger dwellings exceeding 450 m^2 and row housing exposure was considered. Based on this, the FUS provides a table of flows as a function of exposure distance for wood frame and masonry or brick construction. For a 10 to 30m separation distance, the recommended flow is 6,000 L/min.

The duration of fire flow is a function of the flow. For the case of a 6,000 L/min flow, the FUS recommended duration is 2 hours. Therefore, for a single fire event, the fire protection volume would be 720 m^3 (6,000 L/min * 60 min/hr * 2 hrs *1m^3/1000L).

Based on the above, the fire protection storage volume was assumed to be 720 m^3.

<u>Peak Balanced Storage</u>

The peak balanced storge is 25% of the maximum day demand. Based on the maximum day flow of 4,000 m^3 noted previously, this peak balanced storage volume is 1,000 m^3 (4,000 * 0.25).

<u>Emergency Storage</u>

The emergency storage as noted previously is 25% of the sum of the total fire protection and peak balanced storage. Based on a fire protection value of 720 m^3 and a peak balance value of 1,000 m^3, the total volume for emergency storage is 430 m^3 ((1,000 + 720) * .25).

Based on the above sections on storage volumes for fire protection, peak balanced storage and emergency storage, the minimum total required storage volume is 2,150 m^3 (720 + 1,000 + 430).

The Design Guideline also note that if the potable water supply and distribution is not capable of providing fire protection, that the usable volume of storage should be 25% of the maximum daily demand (4,000*0.25 = 1,000 m^3) **plus** 40% of the design year average flow for a volume of 800 m^3 (2,000 m^3 * 0.40=800 m^3). In this latter case, the total usable storage volume would be 1,800 m^3 (1,000 + 800).

The detailed calculated method value of 2,150 m^3 is used to determine the treated water storage volume.

1.5 TREATMENT PLANT LOCATION

The August 2021 Wood report provides a proposed location for the Great Pond WTP and storage tank. The figure indicating the location is reproduced below in **Figure 1–1**.

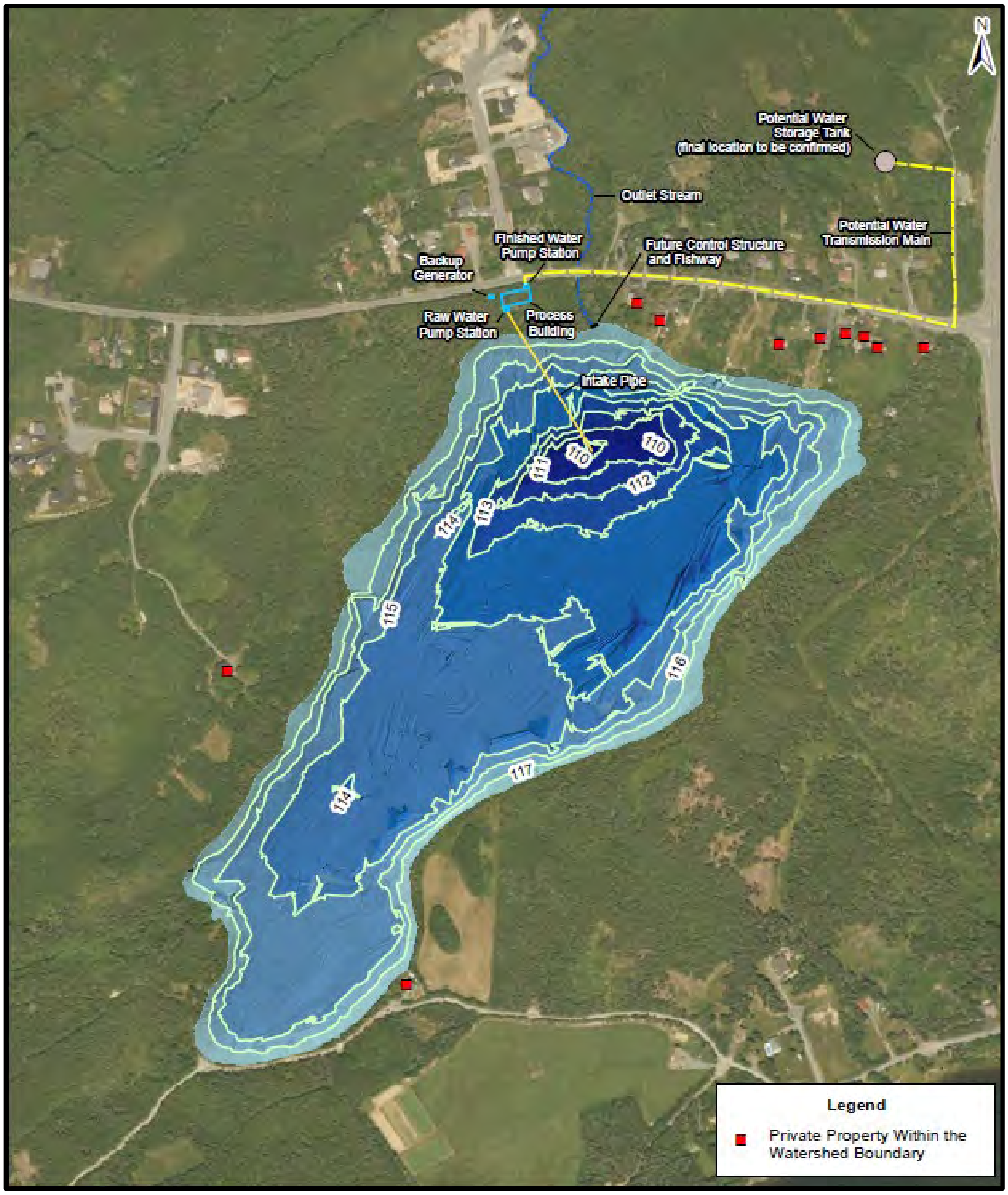

Figure 1–1 Location of Great Pond WTP and Storage

2 TREATMENT OPTIONS

2.1 TREATMENT SYSTEM COMPONENTS

The basic treatment system for the Great Pond WTP is considered to consist of the following unit processes:

- Intake pipe and pump station
- Treatment for DBP precursor removal
- UV Disinfection
- Alkalinity/pH Adjustment
- Chlorine addition
- Finished water storage and booster pump system
- Waste steams discharge
- Great Pond discharge control structure

Each of the above is briefly described in the sections below.

Intake Pipe and Pump Station

Based on the location identified in previously **Figure 1–1**, the raw water intake pipe is directed to the deepest part of Great Pond with an approximate length of 150m from a pond depth of approximately 7m. The intake piping will lead to a pump station to lift the raw water to the treatment system.

Treatment System for DBP Precursor Removal

As noted in the raw water quality section, the main concern with the Great Pond raw water quality is the high levels of TOC/DOC. To control levels of Disinfection By-Product (DBP) Formation such as THM and HAAs, the treatment system's main objective is to control TOC/DOC. Two treatment systems are considered in this work, Dissolved Air Floatation (DAF) combined with conventional media filtration (DAF/Filtration) and pre-treatment filtration followed by membrane treatment (membrane). These are common in Newfoundland and Labrador with the systems described in detail in a later section of this report.

UV Disinfection

As noted previously, UV disinfection has been selected for primary disinfection. The use of variable power bulbs connected to flow meters allows for UV power to be reduced when treated flows are low. A typical enclosed in-pipe UV unit is shown below in **Figure 2–1**.

Figure 2–1 Typical Inline UV Disinfection System (Trojan)

Alkalinity/pH Adjustment

As noted previously, the Great Pond water has very low alkalinity and pH. To control discharge levels of alkalinity and pH, soda ash (sodium carbonate; Na_2CO_3) is considered for this work. In this process, bags of soda ash are added to a hopper which is augered at a controlled rate to a mix tank. With water also added at a controlled rate, a solution is made continuously and injected into the process as required. An example isometric drawing of a bag sourced chemical injection system is provided in **Figure 2–2**.

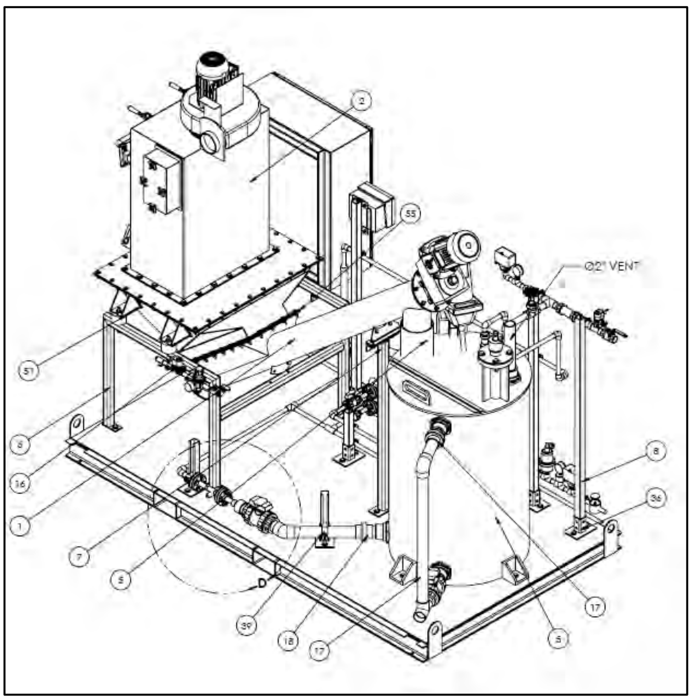

Figure 2–2 Typical Dry Chemical Makeup System (Con-V-Air)

Chlorine Addition

To provide secondary disinfection including virus control, chlorine is added to the process after UV disinfection. There are multiple sources of chlorine including gas and liquid (bleach/NaOCl) and for this work, liquid chlorine (12% solution) in the form of totes (nominal volume of 1000L) was considered for this work. The addition rate of up to 3 mg/L was considered and would includes consideration for chlorine decay within the system.

Finished Water Storage

As noted previously, the finished water storage tank will have an estimated storage volume of 2,150 m^3 to accommodate flows for fire protection, emergency storage and balancing peak demand. The storage tank is assumed to be a glass lined steel bolted tank with approximate diameters and heights of 15m and 14m, respectively. An example storage tank is provided below in **Figure 2–3**.

At the site of the storage tank, a pump booster station will be provided to ensure adequate pressure for the transmission main. A gravel access road and fencing around the facility have also been considered.

Figure 2–3 Typical Potable Water Storage Tank (https://www.cstindustries.com/)

Waste Streams

Waste streams generated by the treatment system will be directed to two on-site residual storage lagoons. The lagoons are considered to be lined with synthetic material including filter cloth protection. Granular material on the liner will protect the linear during the annually occurring solids removal process. The discharge would include an overflow structure and a decanting system. The discharge would be tested to meet environmental standards and be directed to the Great Pond discharge stream. The lagoon site would include a gravel access road and fencing.

The key parameters used in conceptual design of lagoons include there being two residual lagoons with one taken out of service while the other is being cleaned. Each lagoon will have a minimum of 1 day hydraulic retention time to allow for solids settling and additional volume to store 12 months generation of solids between both of the lagoons (i.e. half of yearly generated solids in each lagoon). The estimated sludge depth would not exceed 1m.

Great Pond Discharge Control Structure

To preserve the fish habitat and control levels in Great Pond, a water control structure will be placed at the outflow of Great Pond and the head of Big River. The structure will be approximately 10m in length and 2m in height and consist of concrete and earth fill. The average width of the structure will be 2m at the base. The control structure will be designed to hold the water level at existing high watermark levels.

In addition to the control structure, a fishway (a.k.a., fish ladder) will be provided. The fishway will be constructed in conjunction with the control structure and will maintain flows for fish passage. The fishway will be approximately 10m in length and 1.5m high with an average width of 1m.

2.2 OPTIONS REVIEW - TREATMENT

As noted previously, this work considers two treatment systems currently used in Newfoundland and Labrador: DAF plus filtration and membrane filtration. The primary objective of these treatment systems is to pretreat the water prior to primary disinfection (i.e. UV). Each is discussed separately.

2.2.1 DAF/FILTRATION BASED OPTION

A typical DAF/Filtration treatment system process flow diagram (PFD) is provided in **Figure 2–4**. The PFD includes all of the unit processes presented previously (e.g., intake, UV, storage) and is intended to provide context for the system's place within the entire process.

In the DAF/Filtration based system, a coagulant is added to the raw water and mixed in a two-stage process; rapid mix followed by a gentle flocculation mix. The solids generated in the flocculation process are partially removed in the Dissolved Air Flotation (DAF) process before a media filter (e.g., sand) removes finer particles. The DAF system uses air injected under pressure at the bottom of the DAF vessel to lift solids to the surface (float). A surface skimmer then scrapes the float to a discharge box. Since the coagulant will consume alkalinity and there is very little alkalinity in the raw water, a high basicity coagulant would be used to minimize the alkalinity reduction. In the PFD, it is noted that alkalinity is added after UV disinfection.

The gravity filter system must be backwashed to clean trapped particles with the backwash waste stream being combined in the solids/surge tank before being pumped to the lagoons when the solids gravity settle. A backwash tank with non-chlorinated water is used to backwash the system to minimize the potential of DBP formation. The backwash tank would be sized to accommodate at least one backwash.

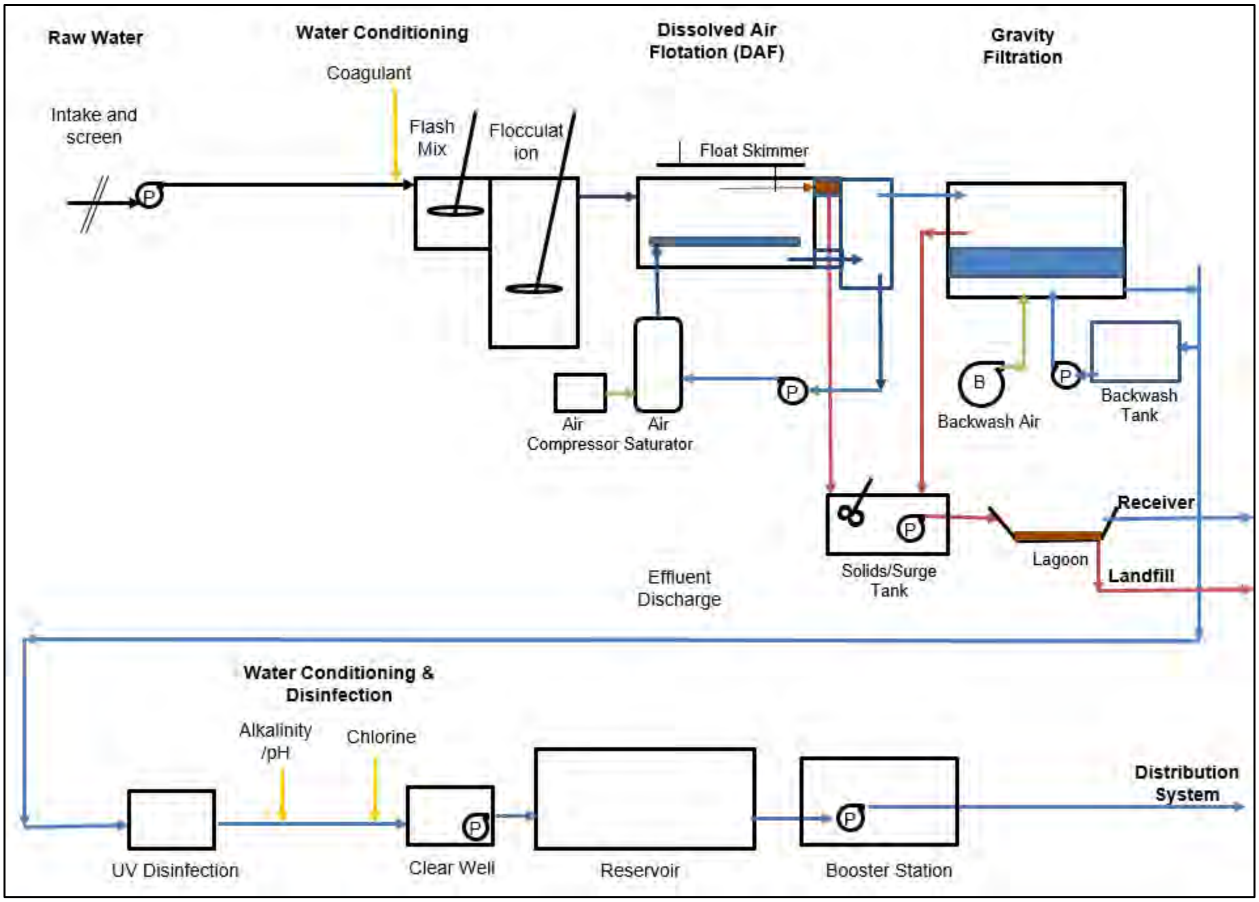

Figure 2–4 Process Flow Diagram – DAF Based System

A conceptual building layout of the DAF with filtration process is provided in **Figure 2–5.** The process is capable of providing the peak flow of 4,000 m^3/d and includes two independent DAFs in parallel, two independent gravity filter in parallel and UV disinfection.

The layout excludes a garage/work area but includes washrooms/locker rooms, office and an electrical room. In addition, access rollup doors and person doors are provided.

The overall building size is 31m long with one section being 15m wide and the other being 10m wide with a total floor area of 385 m^2. The inside height is 5.5m to accommodate the filters which are 3.7m high. The facility is a slab on grade construction with outside, below grade tanks for the filter backwash and surge tanks. To provide a sense of scale, each DAF unit is 6.5m long by 3m wide.

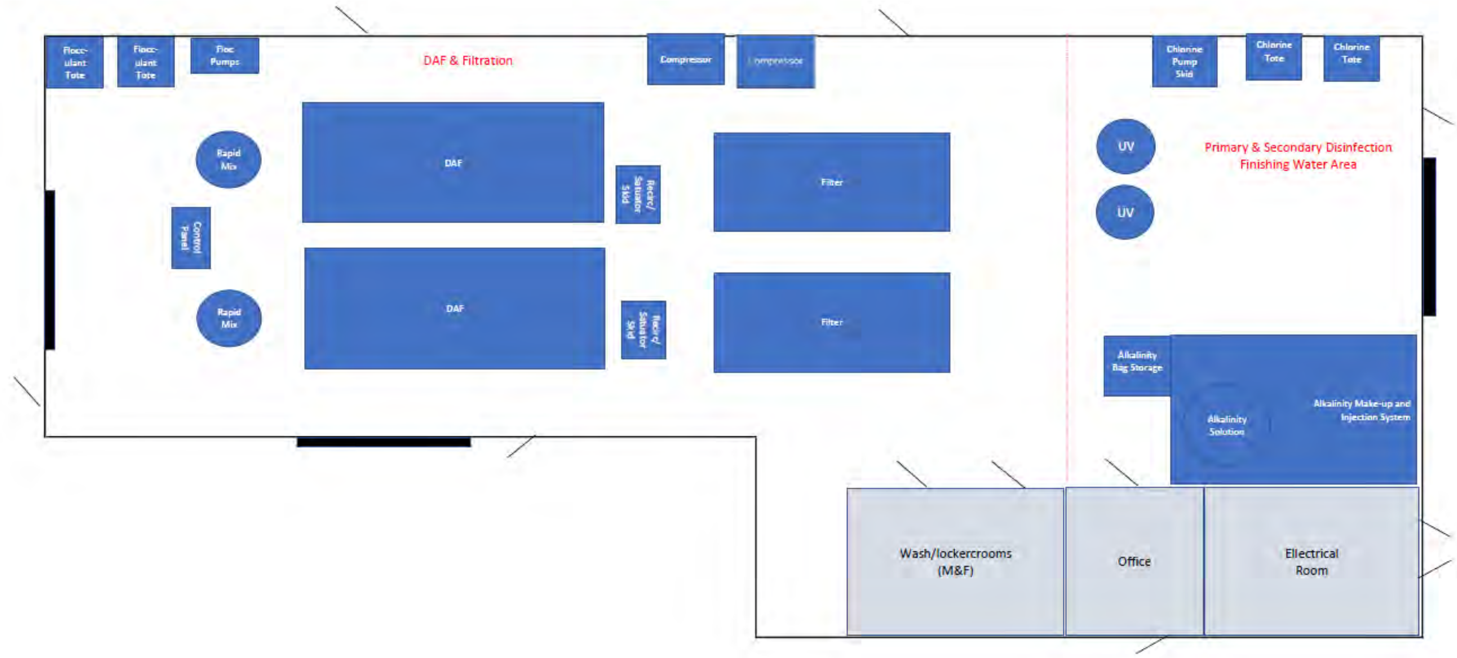

Figure 2–5 Conceptual Facility Layout – DAF Based System

2.2.2 MEMBRANE BASED OPTION

A typical membrane based system PFD is provided in **Figure 2–6**. The PFD includes all of the unit processes presented previously (e.g., intake, UV, storage) and is intended to provide context for the system's place within the entire process.

In a membrane system, it is important to pretreat the raw water to remove particulates that may damage the membrane. In this case, pressure filters were considered. The use of a pressurized system allows the raw water pumps to lift the water through the entire process (i.e. through UV) without any hydraulic breaks (i.e. open to air tanks). To provide additional protection for the membranes, the membrane skids include a single use cartridge filter upstream of the membranes.

Membrane systems are typically configured in either a recirculation configuration or a staged configuration. The intent with both is to reduce the flow of the waste stream by optimizing the hydraulics through the membrane units. The two configurations are shown in **Figure 2–7**. For this work, a supplier provided information on the staged approach. It is noted that the recirculation approach is shown in the PDF on **Figure 2–6**.

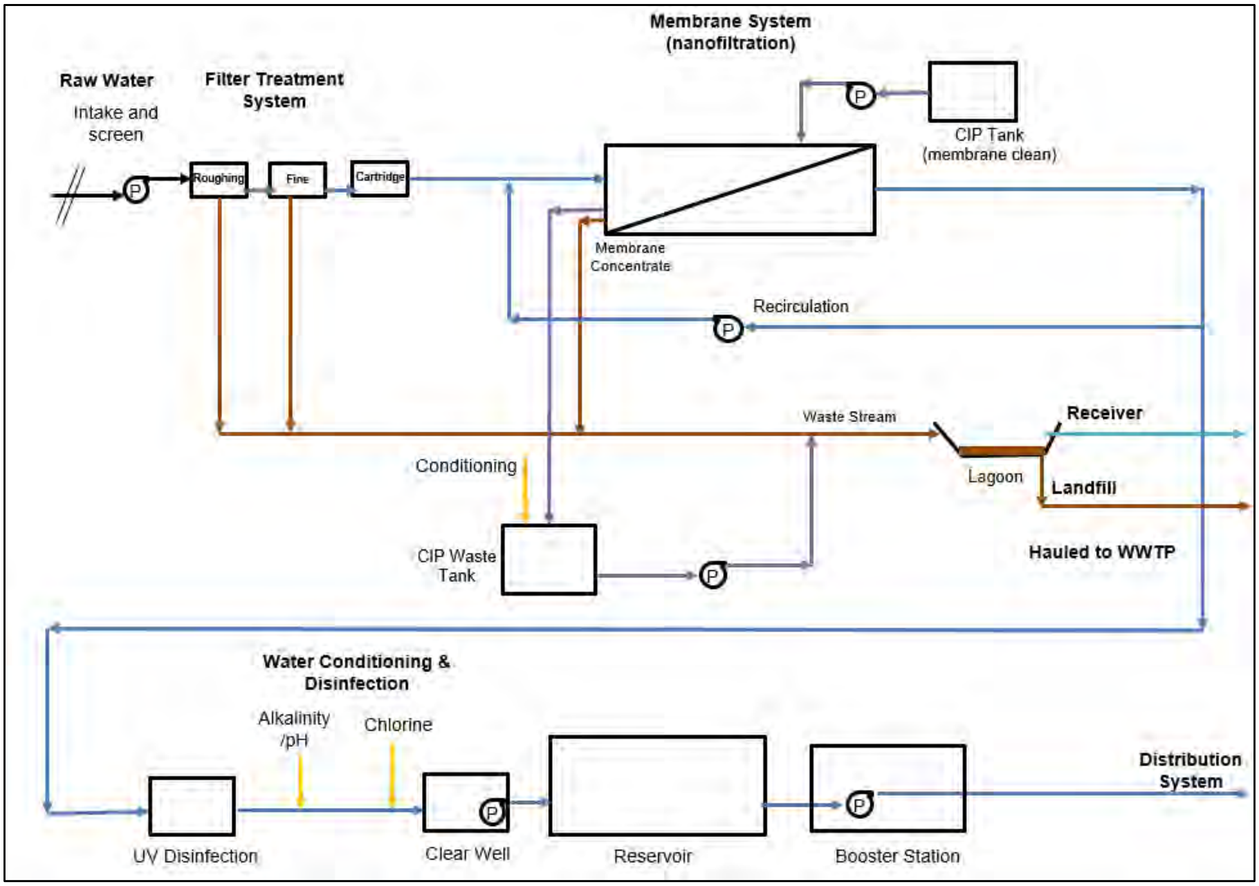

Figure 2–6 Process Flow Diagram – Membrane Based System

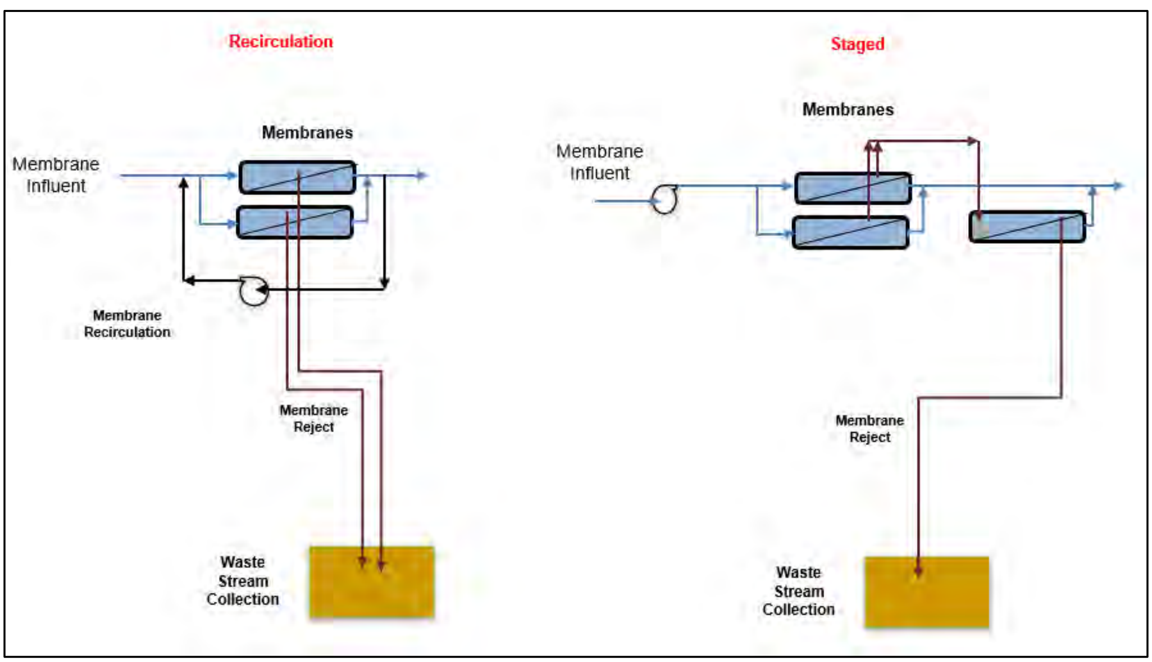

Figure 2–7 Membrane Process – Configuration Approach

A conceptual building layout of the membrane preceded by pressure filtration is provided in **Figure 2–8**. The process is capable of providing the peak flow of 4,000 m^3/d with redundant pressure filtration (4+1 configuration), 2 independent membrane trains in parallel and UV disinfection. The flow through the process is generally from the left to right.

The layout excludes a garage/work area, but includes washrooms/locker rooms, an office and an electrical room. In addition, access rollup doors and person doors are provided.

The overall building size is 28m long with one section being 8m wide and the other being 15 m wide with a total floor area of 336 m^2. The ceiling height is 4m. The facility is considered to be a slab on grade construction with the CIP tank being at grade. To provide a sense of scale, each membrane system/skid is 7m long by 1.7m wide.

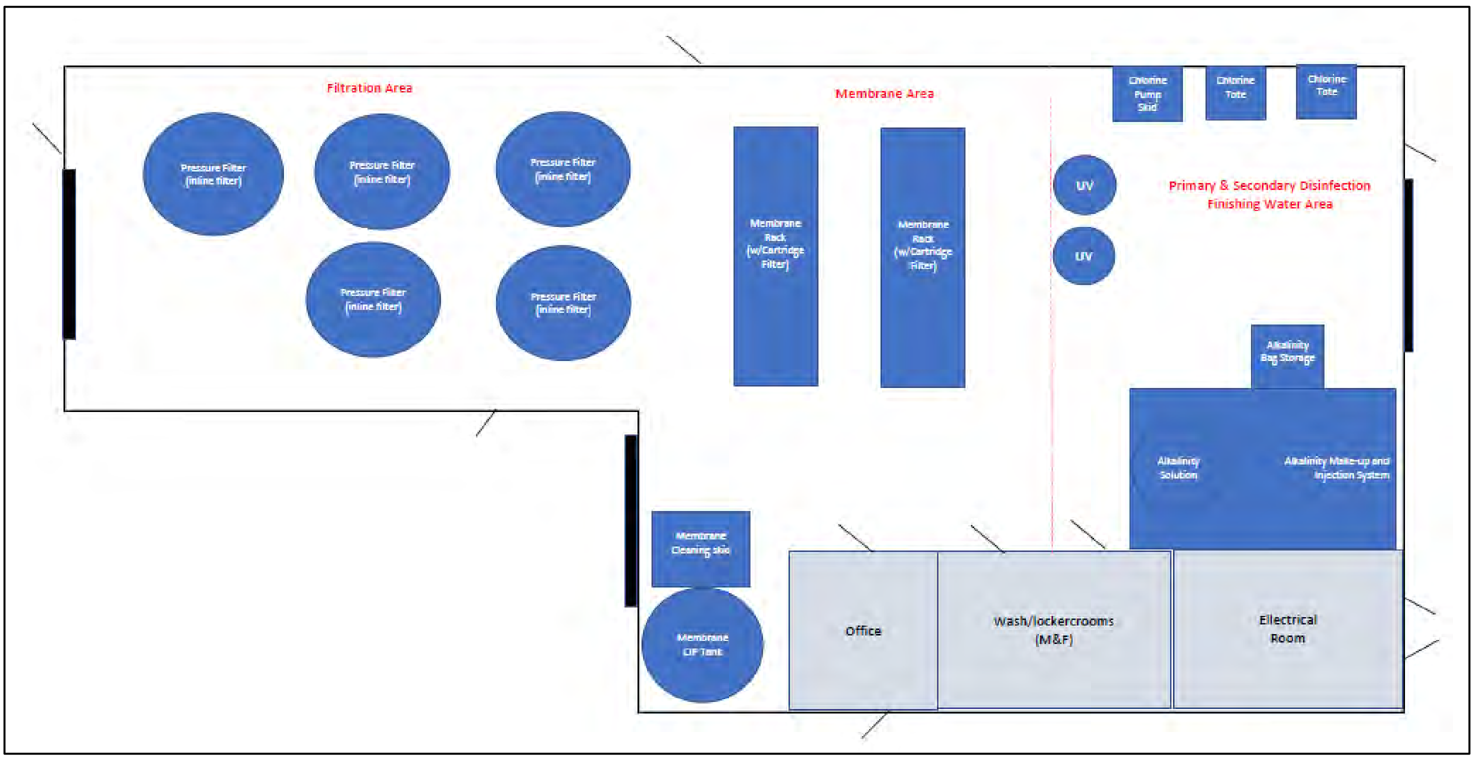

Figure 2–8 Conceptual Facility Layout – Membrane Based System

3 CONCEPTUAL CAPITAL AND OPERATING COST

Conceptual capital and operating costs for the DAF/filtration and membrane based systems are provided in the sections that follow.

3.1 CAPITAL COST

A summary of conceptual level capital costs is provided below in **Table 3–1** with detailed capital costing sheets provided in **Appendix A**. The table provides a broad breakout of the items associated with the DAF/Filtration based configuration and the membrane based configuration. There are many items that are common to both (e.g., intake, UV system) and with the three being dependent on technology include the treatment system, the building to house the system and the residuals solids lagoons.

The conceptual level total cost for all items including taxes for the DAF/Filtration and membrane systems are $13.1M and 12.4M, respectively.

Comments regarding the capital costs are listed below.

- The total costs vary by less than 6% between the two options.
- Common features between the two options represent approximately 20% of the total cost (Category A).
- The higher building height for the DAF/filtration process contribute to this option's higher building capital cost relative to the membrane option.
- A higher flow waste stream for the membrane process relative to the DAF/Filtration process requires larger residuals lagoon volume. To maintain sludge depths at acceptable levels, the DAF system lagoon surface area was increased but had a shallower overall depth than the membrane lagoons.

Table 3–1 Capital Cost Estimates

ITEM	DAF/FILTRATION CONFIGURATION	MEMBRANE CONFIGURATION
Intake and raw water pumping	$341,000	$341,000
Treatment system	$3,547,000	$3,245,000
UV system	$218,000	$218,000
Alkalinity chemical system	$180,000	$180,000
Chlorine system	$60,000	$60,000
Building for WTP	$1,446,000	$1,201,000
General site works (WTP)	$420,000	$420,000
Finished water storage (including booster system)	$1,640,000	$1,640,000
Residuals lagoons	$416,000	$483,000
Great Pond discharge control structure & fishway	$500,000	$500,000

ITEM	DAF/FILTRATION CONFIGURATION	MEMBRANE CONFIGURATION
SUB-TOTAL (A)	**$8,768,000**	**$8,288,000**
Contingency (10%)	$876,800	$828,800
Contractor Overhead and Markup (10%)	$876,800	$828,800
Engineering Fees (10%)	$876,800	$828,800
SUB-TOTAL (B)	**$2,630,400**	**$2,486,400**
TOTAL BEFORE TAXES (C= A+B)	**$11,398,400**	**$10,774,400**
HST (15%)	$1,709,760	$1,616,160
PROJECT TOTAL (C+ TAXES)	**$13,108,160**	**$12,390,560**

3.2 OPERATING COST

A summary of conceptual level operating costs is provided below in **Table 3–1** with detailed operating costing sheets provided in **Appendix B.** The table provides a broad breakout of the items associated with the DAF/filtration based configuration and the membrane based configuration.

The conceptual level total operating yearly cost for all items including anticipated salaries for the DAF/Filtration and membrane systems are $338,000/yr and $352,000/yr, respectively.

Comments regarding the capital costs are listed below.

- Operating costs vary by less than 6% between the two options.
- Higher operating costs for the membrane configuration is primarily due to high operating pressure requirements and membrane replacement.
- Building operating costs are higher for the DAF/filtration system due to the higher building ceiling relative to the membrane system building height.
- Due to the use of chemicals in its process, the DAF/filtration process is required to add more alkalinity chemical and hence has a higher operating cost for this item.

Table 3–2 Operating Cost Estimates

ITEM	DAF/FILTRATION CONFIGURATION (/YR)	MEMBRANE CONFIGURATION (/YR)
Intake and raw water pumping	$7,000	$7,000
Treatment system	$48,000	$100,000
UV system	$6,000	$6,000
Alkalinity chemical system	$75,000	$39,000
Chlorine system	$43,000	$43,000
Building for WTP	$22,000	$16,000
General site works (WTP)	$0	$0

ITEM	DAF/FILTRATION CONFIGURATION (/YR)	MEMBRANE CONFIGURATION (/YR)
Finished water storage (including booster system)	$18,000	$18,000
Residuals lagoons	$69,000	$73,000
Great Pond discharge control structure & fishway	$0	$0
SUB-TOTAL (A)	**$288,000**	**$302,000**
Salaries (0.5 people full time)	$50,000	$50,000
SUB-TOTAL (B)	**$50,000**	**$50,000**
TOTAL (C= A+B)	**$338,000**	**$352,000**

4 CONCLUDING COMMENTS

The two treatment systems considered in this work, DAF/filtration and membrane, are both capable of using Great Pond as a source, to provide potable water that meets regulatory requirements. At the conceptual costing level, the DAF/filtration system has a greater capital cost; however, the difference between the two options varies by less than 6%. Operating costs are considered greater for the membrane system; however, again, the difference between the two options varies by less than 6%.

As is typical in Newfoundland and Labrador, it is anticipated that any development of Great Pond to provide potable water will be through the Design Build (DB) model. It should be noted that the Town of Torbay's current water supply is provided by North Pond with the existing water treatment system being considered for upgrading and, that, this too is anticipated to be constructed through the DB model. From an operational perspective, it is preferable to operate one technology rather two; so the Town may wish consider having both the North and Great Ponds treating water using the same technology.

5 CLOSURE

Using the available information for raw water quality and quantity obtained from Great Lake, this work provides conceptual level capital and operating costs for two treatment options that are considered capable of meeting required water quality standards. We trust this report meets the Town of Torbay's needs in its development of Great Lake as a new water source.

Appendix A

Detailed Capital Costing Sheets

Great Pond WTP - Capital Costing

Intake - With DAF System and Membrane Systems

Item	Units	Unit Qty	Unit Cost $	Install. Factor	Total Installed Cost $	Category Subtotal $
Intake piping						
Piping	LS	1	150,000	1	$ 150,000.00	
Screen	LS	1	40,000	1	$ 40,000.00	
						$ 190,000.00
Intake Pump House (lift to Treatment; 4,000 m3/d capacity)						
Pump house building (with electronics; heating) - adjacent to WTP	LS	1	50,000	1	$ 50,000.00	
5kW installed (1+1) pump system with control panel	EA	2	40,000	1.2	$ 96,000.00	
						$ 146,000.00
Civil						
piping to WTP (adjacent to building)	LS	1	5,000	1	$ 5,000.00	
						$ 5,000.00
SUBTOTAL ALL DIVISIONS (EXCLUDING FRONT END)					**$ 341,000**	**$ 341,000**

Great Pond WTP - Capital Costing

Treatment System DAF (DAFx2 + Filtrationx2; on-ground units)

Item	Units	Unit Qty	Unit Cost $	Install. Factor	Total Installed Cost $	Category Subtotal $
DAF System						
AquDAF System (from Veolia) (2+0)	EA	2	$1,350,000.00	1	$ 2,700,000.00	
Shipping (Ashland, VA) - likely several truck required	LS	1	15,000	1	$ 15,000.00	
Install of system and piping	LS	1	200,000	1	$ 200,000.00	
VFDs (out of supplier scope - each unit: rapid mix=1; floc mix=2;recirc=1-->4 each unit or 8 total)	EA	8	4,000	1	$ 32,000.00	
						$ 2,947,000.00
Filtration - sand						
Lump sum for 2 systems (including backwash)	LS	2	250,000	1.2	$ 600,000.00	
						$ 600,000.00
Building						
See Building tab						
Miscellaneous Building Components						
See building tab						
Miscellaneous Items						
backup generator - see building						
SCADA integration - see site						
SUBTOTAL ALL DIVISIONS (EXCLUDING FRONT END)					**$ 3,547,000**	**$ 3,547,000**

Great Pond WTP - Capital Costing

Treatment System Membrane (pressure filter 4+1; membrane units x2)

Item	Units	Unit Qty	Unit Cost $	Install. Factor	Total Installed Cost $	Category Subtotal $
Pressure Filtration (inline filtration)						
Prefilter (4+1)	EA	5	250,000	1.1	$ 1,375,000.00	
Filter aid system - assumed to be not needed	EA	0	0	1	$ -	
Shipping	LS	1	20,000	1	$ 20,000.00	
						$ 1,395,000.00
Membrane System						
Basic supply (2 systems of 2,000 m3/d capacity each) (2+0)	LS	2	750,000	1.2	$ 1,800,000.00	
Shipping	LS	1	50,000	1	$ 50,000.00	
CIP Tank - Chemical and Waste Storage - included in supply	LS	0	0	1	$ -	
						$ 1,850,000.00
Building						
See building tab						
Miscellaneous Building Components						
See building tab						
Miscellaneous Items						
backup generator - see site						
SCADA integration - see site						
SUBTOTAL ALL DIVISIONS (EXCLUDING FRONT END)					**$ 3,245,000**	**$ 3,245,000**

Great Pond WTP - Capital Costing
UV Disinfection

Item	Units	Unit Qty	Unit Cost $	Install. Factor	Total Installed Cost $	Category Subtotal $
UV Disinfection (1+1 Configuration)						
Components (UV Swift SC D12; 4,000 capacity' 300 dia flange; auto clean;adjustable power based on flow)	Package	1	198,000	1.1	$ 217,800.00	
						$ 217,800.00
SUBTOTAL ALL DIVISIONS (EXCLUDING FRONT END)					**$ 217,800**	**$ 217,800**

Great Pond WTP - Capital Costing

pH/Alkalinity Addition

Item	Units	Unit Qty	Unit Cost $	Install. Factor	Total Installed Cost $	Category Subtotal $
Alkalinity - Na2(CO3) System						
Supply	EA	1	150,000	1.2	$ 180,000.00	
						$ 180,000.00
SUBTOTAL ALL DIVISIONS (EXCLUDING FRONT END)					**$ 180,000**	**$ 180,000**

Great Pond WTP - Capital Costing
Chlorine System

Item	Units	Unit Qty	Unit Cost $	Install. Factor	Total Installed Cost $	Category Subtotal $
Chlorine System - assume use of 12% Chlorine Solution						
Storage tank - use of totes - part of operating cost	EA	1	0	1.5	$ -	
Injection system	EA	1	40,000	1.5	$ 60,000.00	
						$ 60,000.00
SUBTOTAL ALL DIVISIONS (EXCLUDING FRONT END)					**$ 60,000**	**$ 60,000**

Great Pond WTP - Capital Costing

Building - DAF System (DAFx2; Filterx2; on-ground units; no garage)

Item	Units	Unit Qty	Unit Cost $	Install. Factor	Total Installed Cost $	Category Subtotal $
Bulding (slab, metal clad, equipment is 3.7m high; roof 5.5m)						
Part 1	L =	31	m			
	W =	15	m			
	H =	5	m			
	Area =	**465**	m2			
Part 2 (removed from Part 1)	L =	16	m			
	W =	5	m			
	H =	5.5	m			
	Area =	**-80**	m2			
TOTAL AREA		**385**	m2			
Building (Nominal with general electric) - commercial	m2	385	2,500	1	$ 962,500.00	
						$ 962,500.00
Updated Building Items - not part of typical commercial bldg						
Div 11 - Mech (safty features; plant water) - equipment has priced separately for installation	LS	1	50,000	1	$ 50,000.00	
Div 13 - Instrument (flow meters; sensors etc) - equipment has own instrumentation; this cost shown as part of equipment installation	LS	1	60,000	1	$ 60,000.00	
Div 15 -Mech - general piping outside equipment	LS	1	80,000	1	$ 80,000.00	
Div 16 - Electrical (MCC, PLC)	LS	1	120,000	1	$ 120,000.00	
						$ 310,000.00
Miscellaneous Items						
backup generator (part of general site)	LS	0	100,000	1	$ -	
SCADA integration (part of general site)	LS	0	40,000		$ -	
Clearwell (2x33 m3=66m3)						
Underflow						
Cover =		0	m	input		
Size of tank:	L =	6	m	input		
	W =	6	m	input		
	D =	2	m	input		
	Volume =	72	m3	calc		
Excavation - part of building ->0						
Concrete						
Wall thickness		0.4	m	input		
Floor volume		14.4	m3			
Tank top volume		14.4	m3			
wall volume		19.2	m3			
Concrete	m3	48	1000	1	$ 48,000.00	
						$ 48,000.00
Concrete Tanks - Filter backwash (100 m3)						
Subterranian; 1.7m cover;						
Cover =		1.7	m	input		
Size of tank:	L =	6	m	input		
	W =	6	m	input		
	D =	3	m	input		
	Volume =	108	m3	calc		
Excavation						
bottom of tank		4.7	m	calc		
L =		6	m	reprint		
W=		6	m	reprint		
Nominal volume		169.2	m3	calc		
Exvacation factor increase		0.5	--	input		
Excavation Volume		253.8	m3			
Excavation and fill	m3	253.8	30	1	$ 7,614.00	
Concrete						
Wall thickness		0.4	m	input		
Floor volume		14.4	m3			
Tank top volume		14.4	m3			
wall volume		28.8	m3			
Concrete	m3	57.6	1000	1	$ 57,600.00	
Misc items						
hatches, piping, level sensor etc	LS	1	15,000	1	$ 15,000.00	
						$ 80,214.00
Surge Tank - (FRP 10 m3)						
Excavation	LS	1	5,000	1	$ 5,000.00	
Tank	LS	1	20,000	1	$ 20,000.00	
Pump for removal; mixer; controller; level sensor	LS	1	20,000	1	$ 20,000.00	
						$ 45,000.00
SUBTOTAL ALL DIVISIONS (EXCLUDING FRONT END)					**$ 1,445,714**	**$ 1,445,714**

Great Pond WTP - Capital Costing

Building - Membrane System (pressure filter 4+1; 2 membrane units; no garage)

Item	Units	Unit Qty	Unit Cost $	Install. Factor	Total Installed Cost $	Category Subtotal $
Bulding (slab; metal clad; 4m high building)						
	L =	28	m			
	W =	15	m			
	H =	4	m			
	Area =	420	m2			
Area removed (not square building)	L =	7	m			
	W =	12	m			
	Area =	84	m2			
Building (Nominal with general electric) - commercial	m2	336	2,300	1	$ 772,800.00	
						$ 772,800.00
Updated Building Items - not part of typical commercial bldg						
Div 11 - Mech (safty features; plant water) - equipment has priced separately for installation	LS	1	50,000	1	$ 50,000.00	
Div 13 - Instrument (flow meters; sensors etc) - equipment has own instrumentation; this cost shown as part of equipment installation	LS	1	80,000	1	$ 80,000.00	
Div 15 -Mech - general piping outside equipment	LS	1	100,000	1	$ 100,000.00	
Div 16 - Electrical (MCC, PLC)	LS	1	150,000	1	$ 150,000.00	
						$ 380,000.00
Clearwell (2x33 m3=66m3)						
Underflow						
Cover =		0	m	input		
Size of tank:	L =	6	m	input		
	W =	6	m	input		
	D =	2	m	input		
	Volume =	72	m3	calc		
Excavation - part of building ->0						
Concrete						
Wall thickness		0.4	m	input		
Floor volume		14.4	m3			
Tank top volume		14.4	m3			
wall volume		19.2	m3			
Concrete	m3	48	1000	1	$ 48,000.00	
						$ 48,000.00
Miscellaneous Items						
backup generator (part of general site)	LS	0	100,000	1	$ -	
SCADA integration (part of general site)	LS	0	40,000		$ -	
						$ -
SUBTOTAL ALL DIVISIONS (EXCLUDING FRONT END)					**$ 1,200,800**	**$ 1,200,800**

Great Pond WTP - Capital Costing

General Site Works - Both DAF/Filtration & Membrane

Item	Units	Unit Qty	Unit Cost $	Install. Factor	Total Installed Cost $	Category Subtotal $
General site works						
Studies - Geotechnical work	LS	1	15,000	1	$ 15,000.00	
Survey	LS	1	5,000	1	$ 5,000.00	
Fencing	LS	1	30,000	1	$ 30,000.00	
						$ 50,000.00
Road Works						
Asphalt (road bed and asphalt)	LS	1	30,000	1	$ 30,000.00	
						$ 30,000.00
Piping - various piping	LS	1	50,000	1	$ 50,000.00	
						$ 50,000.00
Site Miscellaneous						
Commissioning, Testing and other supplier requirements	LS	1	10,000	1	$ 10,000.00	
Backup generator	LS	1	150,000	1	$ 150,000.00	
Electrical site work (power to new area)	LS	1	50,000	1	$ 50,000.00	
site prep and finishing:						
Excavation and fill (part of building cost) - no building	m3	0	35	1	$ -	
Surface finishing (Subgrade & Asphalt)	L	0	m	input		
	W	0	m	input		
	m2	0	m2	calc		
	m2	0	200	1.2	$ -	
General site repair after works	LS	1	50,000	1	$ 50,000.00	
SCADA Integration	LS	1	30,000	1	$ 30,000.00	
						$ 290,000.00
SUBTOTAL ALL DIVISIONS (EXCLUDING FRONT END)					**$ 420,000**	**$ 420,000**

Great Pond WTP - Capital Costing

Finished Water Storage

Item	Units	Unit Qty	Unit Cost $	Install. Factor	Total Installed Cost $	Category Subtotal $
Glass Lined Tank (dia = 15m; h=14m; usable capacity >2150 m3)						
Tank (glass lined bolter) - design/build	LS	1	1,080,000	1	$ 1,080,000.00	
Ringwall footing - design/build	LS	1	85,000	1	$ 85,000.00	
Mixing system (include SCADA panel) - design/build	LS	1	19,000	1	$ 19,000.00	
Town name on tank	LS	1	10,000	1	$ 10,000.00	
						$ 1,184,000.00
Booster station						
Building and piping	LS	1	100,000	1	$ 100,000.00	
Pumps and controls	LS	1	200,000	1	$ 200,000.00	
						$ 300,000.00
Transmission lines						
Pipe for storage and pipe under gravel road to connect to system	LS	1	10,000	1	$ 10,000.00	
						$ 10,000.00
Access Road (gravel)						
granual road include excvation (300mm B; 150mm A)	m	100	length			
	m	6	width			
	m2	600	60	1	$ 36,000.00	
						$ 36,000.00
Site Miscellaneous						
Backup generator (50kW)	LS	1	50,000	1.1	$ 55,000.00	
Fencing	m	100	300	1	$ 30,000.00	
Electrical site work (bring power - assume 1 pole)	LS	1	15,000	1	$ 15,000.00	
site prep and finishing:						
Excavation and fill (for storage tank) - 20m dia/0.5m	m3	157	35	1	$ 5,497.79	
Surface finishing (Subgrade & Asphalt) - NO ASPHALT	L	0	m	input		
	W	0	m	input		
	m2	0	m2	calc		
	m2	0	200	1.2	$ -	
General site repair after works	LS	1	5,000	1	$ 5,000.00	
SCADA Integration - covered elsewhere	LS	0	20,000	1	$ -	
						$ 110,497.79
SUBTOTAL ALL DIVISIONS (EXCLUDING FRONT END)					**$ 1,650,498**	**$ 1,640,498**

Great Pond WTP - Capital Costing

Residuals Lagoon - DAF/Filtration

2 day total storage; 2 lagoons

Item	Units	Unit Qty	Unit Cost $	Install. Factor	Total Installed Cost $	Category Subtotal $
Lagoon - Each (1 day free water HRT each)						
Total volume (to top of berm) - half excavation require; elevated berms	m3	1250	30	0.5	$ 18,750.00	
Liner (including cloth either side) - to top of berm	m2	850	30	1	$ 25,500.00	
Granual on top of liner						
Area	m2	850	reprint			
depth	m	0.3	input			
Volume	m3	255	calc			
Bulk density	tonnes/m3	1.5	input			
Mass	tonnes	383	calc			
COST	tonnes	383	50	1	$ 19,125.00	
Decanting/discharge/mechanical items	LS	1	60,000	1	$ 60,000.00	
						$ 123,375.00
Number of additional lagoons		1			$ 123,375.00	
						$ 123,375.00
Access Road (gravel)						
granual road include excvation (300mm B; 150mm A)	m	150	length			
	m	6	width			
	m2	900	60	1	$ 54,000.00	
						$ 54,000.00
Site Miscellaneous						
Pipe to discharge (to Great Pond discharge stream)	LS	1	50,000	1	$ 50,000.00	
Fencing	m	400	150	1	$ 60,000.00	
General site repair after works	LS	1	5,000	1	$ 5,000.00	
						$ 115,000.00
SUBTOTAL ALL DIVISIONS (EXCLUDING FRONT END)					**$ 415,750**	**$ 415,750**

Great Pond WTP - Capital Costing

Residuals Lagoon - Membrane (preceded by pressure filtration)

2 day total storage; 2 lagoons

Item	Units	Unit Qty	Unit Cost $	Install. Factor	Total Installed Cost $	Category Subtotal $
Lagoon - Each (1 day free water HRT each)						
Total volume (to top of berm) - half excavation require; elevated berms	m3	1900	30	0.5	$ 28,500.00	
Liner (including cloth either side) - to top of berm	m2	1000	30	1	$ 30,000.00	
Granual on top of liner						
Area	m2	1000	reprint			
depth	m	0.3	input			
Volume	m3	300	calc			
Bulk density	tonnes/m3	1.5	input			
Mass	tonnes	450	calc			
COST	tonnes	450	50	1	$ 22,500.00	
Decanting/discharge/mechanical items	LS	1	60,000	1	$ 60,000.00	
						$ 141,000.00
Number of additional lagoons		1			$ 141,000.00	
						$ 141,000.00
Access Road (gravel)						
granual road include excvation (300mm B; 150mm A)	m	200	length			
	m	6	width			
	m2	1200	60	1	$ 72,000.00	
						$ 72,000.00
Site Miscellaneous						
Pipe to discharge (to Great Pond discharge stream)	LS	1	50,000	1	$ 50,000.00	
Fencing	m	400	186	1	$ 74,400.00	
General site repair after works	LS	1	5,000	1	$ 5,000.00	
						$ 129,400.00
SUBTOTAL ALL DIVISIONS (EXCLUDING FRONT END)					**$ 483,400**	**$ 483,400**

Appendix B

Detailed Operating Costing Sheets

Great Pond Operating Costing of Options

Intake Pumps to WTP - DAF and Membrane systems

notes:

Flow average = 2,000 m3/d

Summary of Cost categories	
Electricity (E)	$3,900
Heat (H)	$900
Chemical (C)	$0
Maintenance (M)	$2,000
Disposal (D)	$0
Sample Analysis (S)	$0
Labour (L)	$0
TOTAL	**$6,800**
note: each item rounded to:	-2

Table: O&M Cost Estimate

Estimated Yearly Operating & Maintenance Costs of the Constructed Works

Solids Processing Costs Item Name	Estimate Details/Basis								Quantity /year	Unit	Unit Price	Yearly Cost
Electrical												
Pumps running at 2,000 m3/d (50% effeciency) (1+1 Config)	3	kW	1	# of lift stations	1	# of units operating	24	hrs/day	26,280	kW hrs/yr	$0.15	**$3,900**
	0	kW	1	#/unit	4	# of units	24	hrs/day	0	kW hrs/yr	$0.15	**$0**
	0	kW	1	#/unit	4	# of units	4	hrs/day	0	kW hrs/yr	$0.15	**$0**
	0	kW	2	hrs/d					0	kW hrs/yr	$0.15	**$0**
	0	hp	24	hrs/day					0	kW hrs/yr	$0.15	**$0**
Credit for existing units (none in service)	0	hp	24	hrs/day					0	kW hrs/yr	$0.15	**$0**
											SUM	$3,900
Building Heating												
Heating pump House area	2	kW each	120	days/yr	1	# of units	24	hrs/day	5,760	kW hrs/yr	$0.15	**$900**
Other - none required	-	kW	0	days/yr					0	kW hrs/yr	$0.15	**$0**
											SUM	$900
Chemical												
Chemical 1 - NONE considered	0	L/month	0	months/yr					0	L/yr	$0.00	**$0**
	0	L/month	0	months/yr					0	L/yr	$0.00	**$0**
											SUM	$0
Specified Maintenance												
Pumps - new; 2 total	2	pump	500	$/service	2	services/yr			2,000	$/yr	1.00	**$2,000**
Other - none required	$0	replacement cost	5	year life					0	$/yr	1.00	**$0**
Other - none required	0	motors	200	$/service	1	services/yr			0	$/yr	1.00	**$0**
											SUM	$2,000
Disposal												
none considered												**$0**
Sample Analysis												
Lab Analysis - not considered									0	Samples per year	$250	**$0**
Labour (no additional labour considered)												
Operators - covered by main WTP:	0	ops on duty	8	hrs/day ea.								
Operator Labour (wage+benefits+OH)	0	hrs/day	0	days/yr					0	hours/yr	$70	**$0**
Supervisor Labour (wage+benefits+OH)	0	hrs/day	0	days/yr					0	hours/yr	$140	**$0**
											SUM	$0
Maintenance - Percent of capital costs/yr (considered elsewhere)									0%	per year		**$0**
Maintenance - thermal Units (considered elsewhere)									0%	per year		**$0**
Total O&M per Year - Direct Solids Treatment												$6,800

Great Pond Operating Costing of Options

DAF Treatment System

notes:

Flow average = 2,000 m3/d; Each DAF sized for 2,000 m3/d

Summary of Cost categories	
Electricity (E)	$36,400
Heat (H)	$0
Chemical (C)	$5,000
Maintenance (M)	$6,800
Disposal (D)	$0
Sample Analysis (S)	$0
Labour (L)	$0
TOTAL	**$48,200**
note: each item rounded to:	-2

Table: O&M Cost Estimate

Estimated Yearly Operating & Maintenance Costs of the Constructed Works

Solids Processing Costs Item Name	Estimate Details/Basis								Quantity /year	Unit	Unit Price	Yearly Cost
Electrical												
Rapid Mixer	0.7	kW	1	# installed/unit	2	# of units operating	24	hrs/day	12,264	kW hrs/yr	$0.15	**$1,800**
Primary Floc Tank	0.7	kW	1	# installed/unit	2	# of units operating	24	hrs/day	12,264	kW hrs/yr	$0.15	**$1,800**
Secondary Floc Tank	0.7	kW	1	# installed/unit	2	# of units operating	24	hrs/day	12,264	kW hrs/yr	$0.15	**$1,800**
Recyle pump	7.5	kW	1	# installed/unit	2	# of units operating	24	hrs/day	131,400	kW hrs/yr	$0.15	**$19,700**
Air Compressor (1 for 3 units; 1+1 config)	3.7	kW	2	# installed for system	1	# of units operating	24	hrs/day	32,412	kW hrs/yr	$0.15	**$4,900**
Sludge Scaper	0.6	kW	1	# installed/unit	2	# of units operating	24	hrs/day	10,512	kW hrs/yr	$0.15	**$1,600**
Misc. - Instrument, panels etc	2	kW					24	hrs/day	17,520	kW hrs/yr	$0.15	**$2,628**
Filter backwash	5	kW	2	# installed for system	2	# of units operating	2	hrs/day	14,600	kW hrs/yr	$0.15	**$2,200**
	0	hp	24	hrs/day					0	kW hrs/yr	$0.15	**$0**
Credit for existing units (none in service)	0	hp	24	hrs/day					0	kW hrs/yr	$0.15	**$0**
											SUM	**$36,428**
Building Heating												
None - part of building heat (see separate tab)	-	kW each	120	days/yr	1	# of units	24	hrs/day	0	kW hrs/yr	$0.15	**$0**
Other - none required	-	kW	0	days/yr					0	kW hrs/yr	$0.15	**$0**
											SUM	**$0**
Chemicals												
Coagulant (PAX XL 1900 - Kemira)	51	L/d	1.32	SG	67.32	kg/d	365	days/yr	2,393	kg/yr	$2.10	**$5,026**
	0	L/clean	0	Cleans/yr						L/yr	$14.12	**$0**
	0	L/clean	4	Cleans/yr						L/yr	$1.81	**$0**
	0	L/clean	6	Cleans/yr						L/yr	$1.25	**$0**
										L/yr	$1.00	**$0**
											SUM	**$5,026**
Specified Maintenance												
Pump and motor maintenance	6	pump	400	$/service	2	services/yr			4,800	$/yr	1.00	**$4,800**
Media replacement							lump sum		2,000	$/yr	$950.00	**$2,000**
Other - none required		Number of Systems		Filters/system		months of life	$0.00	$/life		$/yr	$350.00	**$0**
Other - none required	0	motors	200	$/service	1	services/yr			0	$/yr	1.00	**$0**
											SUM	**$6,800**
Disposal												
none considered												**$0**
Sample Analysis												
Lab Analysis - not considered									0	Samples per year	$250	**$0**
Labour (no additional labour considered)												
Operators - covered by main WTP:	0	ops on duty	8	hrs/day ea.								
Operator Labour (wage+benefits+OH)	0	hrs/day	0	days/yr					0	hours/yr	$70	**$0**
Supervisor Labour (wage+benefits+OH)	0	hrs/day	0	days/yr					0	hours/yr	$140	**$0**
											SUM	**$0**
Maintenance - Percent of capital costs/yr (considered elsewhere)									0%	per year		**$0**
Maintenance - thermal Units (considered elsewhere)									0%	per year		**$0**
Total O&M per Year - Direct Solids Treatment												**$48,254**

Great Pond Operating Costing of Options

Membrane Treatment System

notes:

Flow average = 2,000 m3/d

Summary of Cost categories	
Electricity (E)	$63,100
Heat (H)	$0
Chemical (C)	$9,900
Maintenance (M)	$26,700
Disposal (D)	$0
Sample Analysis (S)	$0
Labour (L)	$0
TOTAL	**$99,700**
note: each item rounded to:	-2

Table: O&M Cost Estimate

Estimated Yearly Operating & Maintenance Costs of the Constructed Works

Solids Processing Costs **Item Name**	**Estimate Details/Basis**								**Quantity /year**	**Unit**	**Unit Price**	**Yearly Cost**
Electrical												
Booster Pumps - Feed to system (250 psi; 75 hp (60kw)nameplate); assume 70% of rating for operaing (42 kW); each system has capacity of 2,000 m3/d; average flow is 2,000 m3/d therefore 1 system in service on average	42	kW	2	# installed	1	# of units operating	24	hrs/day	367,920	kW hrs/yr	$0.15	**$55,200**
Misc items (controls, instruments etc)	3	kW	2	# installed	1	# of units operating	24	hrs/day	52,560	kW hrs/yr	$0.15	**$7,900**
CIP Heater and Pumping system - on occassionally, assumed small relative to other and not considered	0	kW	1	#/unit	4	# of units	4	hrs/day	0	kW hrs/yr	$0.15	**$0**
	0	kW	2	hrs/d					0	kW hrs/yr	$0.15	**$0**
	0	hp	24	hrs/day					0	kW hrs/yr	$0.15	**$0**
Credit for existing units (none in service)	0	hp	24	hrs/day					0	kW hrs/yr	$0.15	**$0**
											SUM	**$63,100**
Building Heating												
None - part of building heat (see separate tab)	-	kW each	120	days/yr	1	# of units	24	hrs/day	0	kW hrs/yr	$0.15	**$0**
Other - none required	-	kW	0	days/yr					0	kW hrs/yr	$0.15	**$0**
											SUM	**$0**
Chemical (as provided by supplier)												
Kleen MCT405	0	L/clean	0	Cleans/yr	Number in service	1	on average		546	L/yr	$9.20	**$5,026**
Kleen MCT115	0	L/clean	0	Cleans/yr	Number in service	1	on average		307	L/yr	$14.12	**$4,337**
Sulfuric acid (50%)	0	L/clean	4	Cleans/yr	Number in service	1	on average		236	L/yr	$1.81	**$426**
Sodium Hydroxide (50%)	0	L/clean	6	Cleans/yr	Number in service	1	on average		82	L/yr	$1.25	**$102**
Other - none required									0	L/yr	$1.00	**$0**
											SUM	**$9,891**
Specified Maintenance												
Booster Pumps - Feed to system (250 psi; 75 hp nameplate)	2	pump	500	$/service	2	services/yr			2,000	$/yr	1.00	**$2,000**
Membrane Replacement	1	Number of Systems in service (2 installed)	108	Elements per system	5	year life	$102,600.00	$/life	20,520	$/yr	$950.00	**$20,520**
Canister Cartridge Filters	1	Number of Systems in service (2 installed)	4	Filters/system	3	months of life	$1,400.00	$/life	4,200	$/yr	$350.00	**$4,200**
Other - none required	0	motors	200	$/service	1	services/yr			0	$/yr	1.00	**$0**
											SUM	**$26,720**
Disposal												
none considered												**$0**
Sample Analysis												
Lab Analysis - not considered									0	Samples per year	$250	**$0**
Labour (no additional labour considered)												
Operators - covered by main WTP:	0	ops on duty	8	hrs/day ea.								
Operator Labour (wage+benefits+OH)	0	hrs/day	0	days/yr					0	hours/yr	$70	**$0**
Supervisor Labour (wage+benefits+OH)	0	hrs/day	0	days/yr					0	hours/yr	$140	**$0**
											SUM	**$0**
Maintenance - Percent of capital costs/yr (considered elsewhere)									0%	per year		**$0**
Maintenance - thermal Units (considered elsewhere)									0%	per year		**$0**
Total O&M per Year - Direct Solids Treatment												**$99,711**

Great Pond Operating Costing of Options

UV System

notes:

Flow average = 2,000 m3/d

Summary of Cost categories	
Electricity (E)	$2,500
Heat (H)	$0
Chemical (C)	$0
Maintenance (M)	$3,200
Disposal (D)	$0
Sample Analysis (S)	$0
Labour (L)	$0
TOTAL	**$5,700**
note: each item rounded to:	-2

Table: O&M Cost Estimate

Estimated Yearly Operating & Maintenance Costs of the Constructed Works

Solids Processing Costs Item Name	Estimate Details/Basis								Quantity /year	Unit	Unit Price	Yearly Cost
Electrical												
UV (1+1) system with one in service. Flow paced system (3.2 kW at 4,000m3/d. Average is 2,000 m3/d but only 60% turndown available).	1.9	kW	1	# of units online at one one time	1	# of units operating	24	hrs/day	16,644	kW hrs/yr	$0.15	$2,500
	0	kW	1	#/unit	4	# of units	24	hrs/day	0	kW hrs/yr	$0.15	$0
	0	kW	1	#/unit	4	# of units	4	hrs/day	0	kW hrs/yr	$0.15	$0
	0	kW	2	hrs/d					0	kW hrs/yr	$0.15	$0
	0	hp	24	hrs/day					0	kW hrs/yr	$0.15	$0
Credit for existing units (none in service)	0	hp	24	hrs/day					0	kW hrs/yr	$0.15	$0
											SUM	$2,500
Building Heating												
Not considered in this section	-	kW each	120	days/yr	1	# of units	24	hrs/day	0	kW hrs/yr	$0.15	$0
Other - none required	-	kW	0	days/yr					0	kW hrs/yr	$0.15	$0
											SUM	$0
Chemical												
Chemical 1 - NONE considered	0	L/month	0	months/yr					0	L/yr	$0.00	$0
	0	L/month	0	months/yr					0	L/yr	$0.00	$0
											SUM	$0
Specified Maintenance												
bulb replacements (bulbs every 1.5 yrs years if on full time; 12 bulbs every time; each unit has 12 bulbs but they are on only half time each)	6	bulbs	1.5	year life					4	bulbs/yr	600.00	$2,400
Ballasts (rarely fail; assumed to last 5 years; each unit has 6 ballasts)	3	ballasts	5	year life					1	Ballasts/yr	1400.00	$840
Other - none required	0	motors	200	$/service	1	services/yr			0	$/yr	1.00	$0
											SUM	$3,240
Disposal												
none considered												$0
Sample Analysis												
Lab Analysis - not considered									0	Samples per year	$250	$0
Labour (no additional labour considered)												
Operators - covered by main WTP:	0	ops on duty	8	hrs/day ea.								
Operator Labour (wage+benefits+OH)	0	hrs/day	0	days/yr					0	hours/yr	$70	$0
Supervisor Labour (wage+benefits+OH)	0	hrs/day	0	days/yr					0	hours/yr	$140	$0
											SUM	$0
Maintenance - Percent of capital costs/yr (considered elsewhere)									0%	per year		$0
Maintenance - thermal Units (considered elsewhere)									0%	per year		$0
Total O&M per Year - Direct Solids Treatment												$5,740

Great Pond Operating Costing of Options

Alkalinity Addition (soda ash - Na_2CO_3) - DAF

notes:

Flow average = 2,000 m3/d

Summary of Cost categories	
Electricity (E)	$3,000
Heat (H)	$0
Chemical (C)	$70,700
Maintenance (M)	$1,000
Disposal (D)	$0
Sample Analysis (S)	$0
Labour (L)	$0
TOTAL	**$74,700**
note: each item rounded to:	-2

Table: O&M Cost Estimate

Estimated Yearly Operating & Maintenance Costs of the Constructed Works

Solids Processing Costs Item Name	Estimate Details/Basis								Quantity /year	Unit	Unit Price	Yearly Cost
Electrical												
Mixer (0.5hp); injection pump (0.5hp) - continuous	0.8	kW	1	#of units	1	# of units operating	24	hrs/day	7,008	kW hrs/yr	$0.15	**$1,051**
Screw conveyor (1.5hp)	1	kW	1	#of units	1	# of units operating	24	hrs/day	8,760	kW hrs/yr	$0.15	**$1,314**
Exhaust air blower (1.5 hp) - only when filling bag hopper	1	kW	1	# of units	1	# of units operating	0.5	hrs/day	183	kW hrs/yr	$0.15	**$27**
Misc (controllers, instruments etc) (.5kW)	0.5	kW	1	# of units	1	# of units operating	24	hrs/day	4,380	kW hrs/yr	$0.15	**$657**
	0	hp	24	hrs/day					0	kW hrs/yr	$0.15	**$0**
Credit for existing units (none in service)	0	hp	24	hrs/day					0	kW hrs/yr	$0.15	**$0**
											SUM	$3,050
Building Heating												
See separate tab for building	-	kW each	120	days/yr	1	# of units	24	hrs/day	0	kW hrs/yr	$0.15	**$0**
Other - none required	-	kW	0	days/yr					0	kW hrs/yr	$0.15	**$0**
											SUM	$0
Chemical												
Chemical 1 - Soda Ash	22	kg/d	365	days/yr	8,030	kg/yr	22.7	kg/bag	354	bags/yr	$200.00	**$70,749**
	0	L/month	0	months/yr					0	L/yr	$0.00	**$0**
											SUM	$70,749
Specified Maintenance												
Equipment maintain - parts, general (mixer, injection pump etc)	2	general	250	$/service	2	services/yr			1,000	$/yr	1.00	**$1,000**
Other - none required	$0	replacement cost	5	year life					0	$/yr	1.00	**$0**
Other - none required	0	motors	200	$/service	1	services/yr			0	$/yr	1.00	**$0**
											SUM	$1,000
Disposal												
none considered												**$0**
Sample Analysis												
Lab Analysis - not considered									0	Samples per year	$250	**$0**
Labour (no additional labour considered)												
Operators - covered by main WTP:	0	ops on duty	8	hrs/day ea.								
Operator Labour (wage+benefits+OH)	0	hrs/day	0	days/yr					0	hours/yr	$70	**$0**
Supervisor Labour (wage+benefits+OH)	0	hrs/day	0	days/yr					0	hours/yr	$140	**$0**
											SUM	$0
Maintenance - Percent of capital costs/yr (considered elsewhere)									0%	per year		**$0**
Maintenance - thermal Units (considered elsewhere)									0%	per year		**$0**
Total O&M per Year - Direct Solids Treatment												$74,798

Great Pond Operating Costing of Options

Alkalinity Addition (soda ash - Na2CO3) - Membrane

notes:

Flow average = 2,000 m3/d
continuously generatoring solution

Summary of Cost categories	
Electricity (E)	$3,000
Heat (H)	$0
Chemical (C)	$35,400
Maintenance (M)	$1,000
Disposal (D)	$0
Sample Analysis (S)	$0
Labour (L)	$0
TOTAL	**$39,400**
note: each item rounded to:	-2

Table: O&M Cost Estimate

Estimated Yearly Operating & Maintenance Costs of the Constructed Works

Solids Processing Costs Item Name	Estimate Details/Basis								Quantity /year	Unit	Unit Price	Yearly Cost
Electrical												
Mixer (0.5hp); injection pump (0.5hp) - continuous	0.8	kW	1	#of units	1	# of units operating	24	hrs/day	7,008	kW hrs/yr	$0.15	**$1,051**
Screw conveyor (1.5hp)	1	kW	1	#of units	1	# of units operating	24	hrs/day	8,760	kW hrs/yr	$0.15	**$1,314**
Exhaust air blower (1.5 hp) - only when filling bag hopper	1	kW	1	# of units	1	# of units operating	0.5	hrs/day	183	kW hrs/yr	$0.15	**$27**
Misc (controllers, instruments etc) (.5kW)	0.5	kW	1	# of units	1	# of units operating	24	hrs/day	4,380	kW hrs/yr	$0.15	**$657**
	0	hp	24	hrs/day					0	kW hrs/yr	$0.15	**$0**
Credit for existing units (none in service)	0	hp	24	hrs/day					0	kW hrs/yr	$0.15	**$0**
											SUM	$3,050
Building Heating												
See separate tab for building	-	kW each	120	days/yr	1	# of units	24	hrs/day	0	kW hrs/yr	$0.15	**$0**
Other - none required	-	kW	0	days/yr					0	kW hrs/yr	$0.15	**$0**
											SUM	$0
Chemical												
Chemical 1 - Soda Ash	11	kg/d	365	days/yr	4,015	kg/yr	22.7	kg/bag	177	bags/yr	$200.00	**$35,374**
	0	L/month	0	months/yr					0	L/yr	$0.00	**$0**
											SUM	$35,374
Specified Maintenance												
Equipment maintain - parts, general (mixer, injection pump etc)	2	general	250	$/service	2	services/yr			1,000	$/yr	1.00	**$1,000**
Other - none required	$0	replacement cost	5	year life					0	$/yr	1.00	**$0**
Other - none required	0	motors	200	$/service	1	services/yr			0	$/yr	1.00	**$0**
											SUM	$1,000
Disposal												
none considered												**$0**
Sample Analysis												
Lab Analysis - not considered									0	Samples per year	$250	**$0**
Labour (no additional labour considered)												
Operators - covered by main WTP:	0	ops on duty	8	hrs/day ea.								
Operator Labour (wage+benefits+OH)	0	hrs/day	0	days/yr					0	hours/yr	$70	**$0**
Supervisor Labour (wage+benefits+OH)	0	hrs/day	0	days/yr					0	hours/yr	$140	**$0**
											SUM	$0
Maintenance - Percent of capital costs/yr (considered elsewhere)									0%	per year		**$0**
Maintenance - thermal Units (considered elsewhere)									0%	per year		**$0**
Total O&M per Year - Direct Solids Treatment												$39,424

Great Pond Operating Costing of Options

Chlorine system (injection and chemical use)

notes:

Flow average = 2,000 m3/d

Summary of Cost categories	
Electricity (E)	$10,200
Heat (H)	$0
Chemical (C)	$31,900
Maintenance (M)	$800
Disposal (D)	$0
Sample Analysis (S)	$0
Labour (L)	$0
TOTAL	**$42,900**
note: each item rounded to:	-2

Table: O&M Cost Estimate

Estimated Yearly Operating & Maintenance Costs of the Constructed Works

Solids Processing Costs Item Name	Estimate Details/Basis								Quantity /year	Unit	Unit Price	Yearly Cost
Electrical												
General consumption of chlorine dosing and monitoring	0.5	kW	1	# of units online at one one time	1	# of units operating	24	hrs/day	4,380	kW hrs/yr	$0.15	**$700**
Pumping clearwell contents to finishing water storage tank	7.2	kW	1	#/unit	1	# of units	24	hrs/day	63,072	kW hrs/yr	$0.15	**$9,500**
	0	kW	1	#/unit	4	# of units	4	hrs/day	0	kW hrs/yr	$0.15	**$0**
	0	kW	2	hrs/d					0	kW hrs/yr	$0.15	**$0**
	0	hp	24	hrs/day					0	kW hrs/yr	$0.15	**$0**
Credit for existing units (none in service)	0	hp	24	hrs/day					0	kW hrs/yr	$0.15	**$0**
											SUM	$10,200
Building Heating												
Not considered in this section	-	kW each	120	days/yr	1	# of units	24	hrs/day	0	kW hrs/yr	$0.15	**$0**
Other - none required	-	kW	0	days/yr					0	kW hrs/yr	$0.15	**$0**
											SUM	$0
Chemical												
Chemical 1 - Chlorine (using totes) - Liquid NaOCl in totes	42	L/day	12	months/yr	15330	L/year	1200	L/tote	13	totes/yr	$2,500.00	**$31,938**
	0	L/month	0	months/yr					0	L/yr	$0.00	**$0**
											SUM	$31,938
Specified Maintenance												
Injection pump maintenance	2	PD pump	200	$/service	2	services/yr			800	$/yr	1.00	**$800**
Other - none required	0	units	5000	year life	0.2	services/yr			0	$/yr	1.00	**$0**
Other - none required	0	motors	200	$/service	1	services/yr			0	$/yr	1.00	**$0**
											SUM	$800
Disposal												
none considered												**$0**
Sample Analysis												
Lab Analysis - not considered									0	Samples per year	$250	**$0**
Labour (no additional labour considered)												
Operators - covered by main WTP:	0	ops on duty	8	hrs/day ea.								
Operator Labour (wage+benefits+OH)	0	hrs/day	0	days/yr					0	hours/yr	$70	**$0**
Supervisor Labour (wage+benefits+OH)	0	hrs/day	0	days/yr					0	hours/yr	$140	**$0**
											SUM	$0
Maintenance - Percent of capital costs/yr (considered elsewhere)									0%	per year		**$0**
Maintenance - thermal Units (considered elsewhere)									0%	per year		**$0**
Total O&M per Year - Direct Solids Treatment												$42,938

Great Pond Operating Costing of Options

DAF Building

notes:

Flow average = 2,000 m3/d
Building: 385 m2; 5.5m high

Summary of Cost categories	
Electricity (E)	$19,600
Heat (H)	$0
Chemical (C)	$0
Maintenance (M)	$2,000
Disposal (D)	$0
Sample Analysis (S)	$0
Labour (L)	$0
TOTAL	**$21,600**
note: each item rounded to:	-2

Table: O&M Cost Estimate

Estimated Yearly Operating & Maintenance Costs of the Constructed Works

Solids Processing Costs Item Name	Estimate Details/Basis								Quantity /year	Unit	Unit Price	Yearly Cost
Electrical												
Building Heat (140 days/yr; outside -5C) (no AC considered)	35	kW	1	# installed	24	hrs/d	140	Days/yr	117,600	kW hrs/yr	$0.15	**$17,600**
Misc. (lights etc)	3	kW	1	# installed	12	hrs/d	365	Days/yr	13,140	kW hrs/yr	$0.15	**$2,000**
	0	kW	1	#/unit	4	# of units	4	hrs/day	0	kW hrs/yr	$0.15	**$0**
	0	kW	2	hrs/d					0	kW hrs/yr	$0.15	**$0**
	0	hp	24	hrs/day					0	kW hrs/yr	$0.15	**$0**
Credit for existing units (none in service)	0	hp	24	hrs/day					0	kW hrs/yr	$0.15	**$0**
											SUM	$19,600
Building Heating												
None - part of building heat (see separate tab)	-	kW each	120	days/yr	1	# of units	24	hrs/day	0	kW hrs/yr	$0.15	**$0**
Other - none required	-	kW	0	days/yr					0	kW hrs/yr	$0.15	**$0**
											SUM	$0
Chemical (as provided by supplier)												
Not considered part of building												**$0**
												$0
												$0
												$0
Other - none required									0	L/yr		
											SUM	$0
Specified Maintenance												
HVAC system maintenance (Lump Sum)									2,000	$/yr	1.00	**$2,000**
Misc - Snow clearing - not considered										$/yr		**$0**
									0	$/yr		**$0**
Other - none required	0	motors	200	$/service	1	services/yr			0	$/yr	1.00	**$0**
											SUM	$2,000
Disposal												
none considered												**$0**
Sample Analysis												
Lab Analysis - not considered									0	Samples per year	$250	**$0**
Labour (Consisdered elsewhere)												
Operators - covered by main WTP:	0	ops on duty	8	hrs/day ea.								
Operator Labour (wage+benefits+OH)	0	hrs/day	0	days/yr					0	hours/yr	$70	**$0**
Supervisor Labour (wage+benefits+OH)	0	hrs/day	0	days/yr					0	hours/yr	$140	**$0**
											SUM	$0
Maintenance - Percent of capital costs/yr (considered elsewhere)									0%	per year		**$0**
Maintenance - thermal Units (considered elsewhere)									0%	per year		**$0**
Total O&M per Year - Direct Solids Treatment												$21,600

Great Pond Operating Costing of Options

Membrane Building

notes:

Flow average = 2,000 m3/d
Building: 336 m2; 4m high

Summary of Cost categories	
Electricity (E)	$14,100
Heat (H)	$0
Chemical (C)	$0
Maintenance (M)	$2,000
Disposal (D)	$0
Sample Analysis (S)	$0
Labour (L)	$0
TOTAL	**$16,100**
note: each item rounded to:	-2

Table: O&M Cost Estimate

Estimated Yearly Operating & Maintenance Costs of the Constructed Works

Solids Processing Costs Item Name	Estimate Details/Basis								Quantity /year	Unit	Unit Price	Yearly Cost
Electrical												
Building Heat (140 days/yr; outside -5C) (no AC considered)	24	kW	1	# installed	24	hrs/d	140	Days/yr	80,640	kW hrs/yr	$0.15	**$12,100**
Misc. (lights etc)	3	kW	1	# installed	12	hrs/d	365	Days/yr	13,140	kW hrs/yr	$0.15	**$2,000**
	0	kW	1	#/unit	4	# of units	4	hrs/day	0	kW hrs/yr	$0.15	**$0**
	0	kW	2	hrs/d					0	kW hrs/yr	$0.15	**$0**
	0	hp	24	hrs/day					0	kW hrs/yr	$0.15	**$0**
Credit for existing units (none in service)	0	hp	24	hrs/day					0	kW hrs/yr	$0.15	**$0**
											SUM	$14,100
Building Heating												
None - part of building heat (see separate tab)	-	kW each	120	days/yr	1	# of units	24	hrs/day	0	kW hrs/yr	$0.15	**$0**
Other - none required	-	kW	0	days/yr					0	kW hrs/yr	$0.15	**$0**
											SUM	$0
Chemical (as provided by supplier)												
Not considered part of building												**$0**
												$0
												$0
												$0
Other - none required									0	L/yr		
											SUM	$0
Specified Maintenance												
HVAC system maintenance (Lump Sum)									2,000	$/yr	1.00	**$2,000**
Misc - Snow clearing - not considered										$/yr		**$0**
									0	$/yr		**$0**
Other - none required	0	motors	200	$/service	1	services/yr			0	$/yr	1.00	**$0**
											SUM	$2,000
Disposal												
none considered												**$0**
Sample Analysis												
Lab Analysis - not considered									0	Samples per year	$250	**$0**
Labour (Consisdered elsewhere)												
Operators - covered by main WTP:	0	ops on duty	8	hrs/day ea.								
Operator Labour (wage+benefits+OH)	0	hrs/day	0	days/yr					0	hours/yr	$70	**$0**
Supervisor Labour (wage+benefits+OH)	0	hrs/day	0	days/yr					0	hours/yr	$140	**$0**
											SUM	$0
Maintenance - Percent of capital costs/yr (considered elsewhere)									0%	per year		**$0**
Maintenance - thermal Units (considered elsewhere)									0%	per year		**$0**
Total O&M per Year - Direct Solids Treatment												$16,100

Great Pond Operating Costing of Options

Finished water storage including booster station

notes:

Flow average = 2,000 m3/d

Summary of Cost categories	
Electricity (E)	$12,900
Heat (H)	$900
Chemical (C)	$0
Maintenance (M)	$4,000
Disposal (D)	$0
Sample Analysis (S)	$0
Labour (L)	$0
TOTAL	**$17,800**
note: each item rounded to:	-2

Table: O&M Cost Estimate

Estimated Yearly Operating & Maintenance Costs of the Constructed Works

Solids Processing Costs Item Name	Estimate Details/Basis								Quantity /year	Unit	Unit Price	Yearly Cost
Electrical												
Pumps running at 2,000 m3/d (70% effeciency) (1+1 Config)	7.3	kW	1	# of Pumps	1	# of units operating	24	hrs/day	63,948	kW hrs/yr	$0.15	**$9,600**
Misc items - flow monitoring; etc	1	kW	1	#/unit	1	# of units operating	24	hrs/day	8,760	kW hrs/yr	$0.15	**$1,300**
Tank Mixer (120V system)	1.5	kW	1	#/unit	1	# of units operating	24	hrs/day	13,140	kW hrs/yr	$0.15	**$1,971**
	0	kW	2	hrs/d					0	kW hrs/yr	$0.15	**$0**
	0	hp	24	hrs/day					0	kW hrs/yr	$0.15	**$0**
Credit for existing units (none in service)	0	hp	24	hrs/day					0	kW hrs/yr	$0.15	**$0**
											SUM	$12,871
Building Heating												
Heating pump House area	2	kW each	120	days/yr	1	# of units	24	hrs/day	5,760	kW hrs/yr	$0.15	**$900**
Other - none required	-	kW	0	days/yr					0	kW hrs/yr	$0.15	**$0**
											SUM	$900
Chemical												
Chemical 1 - NONE considered	0	L/month	0	months/yr					0	L/yr	$0.00	**$0**
	0	L/month	0	months/yr					0	L/yr	$0.00	**$0**
											SUM	$0
Specified Maintenance												
Pumps - new; 2 total	2	pump	500	$/service	2	services/yr			2,000	$/yr	1.00	**$2,000**
Tank inspection (ROV; every 5 years)	1	Inspection	5	Year interval	$5,000	$/inspection			1,000	$/yr	1.00	**$1,000**
General exterior inspection	1	Inspection	3	Year interval	$3,000	$/inspection			1,000	$/yr	1.00	**$1,000**
											SUM	$4,000
Disposal												
none considered												**$0**
Sample Analysis												
Lab Analysis - not considered									0	Samples per year	$250	**$0**
Labour (no additional labour considered)												
Operators - covered by main WTP:	0	ops on duty	8	hrs/day ea.								
Operator Labour (wage+benefits+OH)	0	hrs/day	0	days/yr					0	hours/yr	$70	**$0**
Supervisor Labour (wage+benefits+OH)	0	hrs/day	0	days/yr					0	hours/yr	$140	**$0**
											SUM	$0
Maintenance - Percent of capital costs/yr (considered elsewhere)									0%	per year		**$0**
Maintenance - thermal Units (considered elsewhere)									0%	per year		**$0**
Total O&M per Year - Direct Solids Treatment												$17,771

Great Pond Operating Costing of Options

Residuals Lagoon - removal of solids in lagoon

notes:

Flow average = 2,000 m3/d
System: 2 lagoons; 2 day combined retention time - pressure filter with membrane

Summary of Cost categories	
Electricity (E)	$1,300
Heat (H)	$0
Chemical (C)	$0
Maintenance (M)	$67,700
Disposal (D)	$0
Sample Analysis (S)	$0
Labour (L)	$0
TOTAL	**$69,000**
note: each item rounded to:	-2

Table: O&M Cost Estimate

Estimated Yearly Operating & Maintenance Costs of the Constructed Works

Solids Processing Costs Item Name	Estimate Details/Basis								Quantity /year	Unit	Unit Price	Yearly Cost
Electrical												
Instrumentation	1	kW	2	# installed	1	# of units operating	24	hrs/day	8,760	kW hrs/yr	$0.15	**$1,300**
pumpings - assume gravity discharge	0	kW	3	# installed	1	# of units operating	24	hrs/day	0	kW hrs/yr	$0.15	**$0**
	0	kW	1	#/unit	4	# of units	4	hrs/day	0	kW hrs/yr	$0.15	**$0**
	0	kW	2	hrs/d					0	kW hrs/yr	$0.15	**$0**
	0	hp	24	hrs/day					0	kW hrs/yr	$0.15	**$0**
Credit for existing units (none in service)	0	hp	24	hrs/day					0	kW hrs/yr	$0.15	**$0**
											SUM	$1,300
Building Heating												
None - outdoors	-	kW each	120	days/yr	1	# of units	24	hrs/day	0	kW hrs/yr	$0.15	**$0**
Other - none required	-	kW	0	days/yr					0	kW hrs/yr	$0.15	**$0**
											SUM	$0
Chemical (as provided by supplier)												
None	0	L/clean	0	Cleans/yr					0	L/yr	$9.20	**$0**
	0	L/clean	0	Cleans/yr					0	L/yr	$14.12	**$0**
	0	L/clean	4	Cleans/yr					0	L/yr	$1.81	**$0**
	0	L/clean	6	Cleans/yr					0	L/yr	$1.25	**$0**
									0	L/yr	$1.00	**$0**
											SUM	$0
Specified Maintenance												
	0	pump	500	$/service	2	services/yr			0	$/yr	1.00	**$0**
Solids Removal (dewatering)	36	kg solids/d	365	days/yr	13,140	kg/yr	13	Tonnes/yr	65,700	$/yr	$5,000.00	**$65,700**
Disposal at Landfill (includes hauling)	36	kg/d solids	365	days/yr	13,140	kg/yr	13	Tonnes/yr	1,971	$/yr	$150.00	**$1,971**
Other - none required	0	motors	200	$/service	1	services/yr			0	$/yr	1.00	**$0**
											SUM	$67,671
Disposal												
none considered												**$0**
Sample Analysis												
Lab Analysis - not considered									0	Samples per year	$250	**$0**
Labour (no additional labour considered)												
Operators - covered by main WTP:	0	ops on duty	8	hrs/day ea.								
Operator Labour (wage+benefits+OH)	0	hrs/day	0	days/yr					0	hours/yr	$70	**$0**
Supervisor Labour (wage+benefits+OH)	0	hrs/day	0	days/yr					0	hours/yr	$140	**$0**
											SUM	$0
Maintenance - Percent of capital costs/yr (considered elsewhere)									0%	per year		**$0**
Maintenance - thermal Units (considered elsewhere)									0%	per year		**$0**
Total O&M per Year - Direct Solids Treatment												$68,971

Great Pond Operating Costing of Options

Residuals Lagoon - removal of solids in lagoon

notes:

Flow average = 2,000 m3/d

System: 2 lagoons; 2 day combined retention time - pressure filter with membrane

Summary of Cost categories	
Electricity (E)	$1,300
Heat (H)	$0
Chemical (C)	$0
Maintenance (M)	$71,400
Disposal (D)	$0
Sample Analysis (S)	$0
Labour (L)	$0
TOTAL	**$72,700**
note: each item rounded to:	-2

Table: O&M Cost Estimate

Estimated Yearly Operating & Maintenance Costs of the Constructed Works

Solids Processing Costs Item Name	Estimate Details/Basis								Quantity /year	Unit	Unit Price	Yearly Cost
Electrical												
Instrumentation	1	kW	2	# installed	1	# of units operating	24	hrs/day	8,760	kW hrs/yr	$0.15	**$1,300**
pumpings - assume gravity discharge	0	kW	3	# installed	1	# of units operating	24	hrs/day	0	kW hrs/yr	$0.15	**$0**
	0	kW	1	#/unit	4	# of units	4	hrs/day	0	kW hrs/yr	$0.15	**$0**
	0	kW	2	hrs/d					0	kW hrs/yr	$0.15	**$0**
	0	hp	24	hrs/day					0	kW hrs/yr	$0.15	**$0**
Credit for existing units (none in service)	0	hp	24	hrs/day					0	kW hrs/yr	$0.15	**$0**
											SUM	**$1,300**
Building Heating												
None - outdoors	-	kW each	120	days/yr	1	# of units	24	hrs/day	0	kW hrs/yr	$0.15	**$0**
Other - none required	-	kW	0	days/yr					0	kW hrs/yr	$0.15	**$0**
											SUM	**$0**
Chemical (as provided by supplier)												
None	0	L/clean	0	Cleans/yr					0	L/yr	$9.20	**$0**
	0	L/clean	0	Cleans/yr					0	L/yr	$14.12	**$0**
	0	L/clean	4	Cleans/yr					0	L/yr	$1.81	**$0**
	0	L/clean	6	Cleans/yr					0	L/yr	$1.25	**$0**
									0	L/yr	$1.00	**$0**
											SUM	**$0**
Specified Maintenance												
	0	pump	500	$/service	2	services/yr			0	$/yr	1.00	**$0**
Solids Removal (dewatering)	38	kg solids/d	365	days/yr	13,870	kg/yr	14	Tonnes/yr	69,350	$/yr	$5,000.00	**$69,350**
Disposal at Landfill (includes hauling)	38	kg/d solids	365	days/yr	13,870	kg/yr	14	Tonnes/yr	2,081	$/yr	$150.00	**$2,081**
Other - none required	0	motors	200	$/service	1	services/yr			0	$/yr	1.00	**$0**
											SUM	**$71,431**
Disposal												
none considered												**$0**
Sample Analysis												
Lab Analysis - not considered									0	Samples per year	$250	**$0**
Labour (no additional labour considered)												
Operators - covered by main WTP:	0	ops on duty	8	hrs/day ea.								
Operator Labour (wage+benefits+OH)	0	hrs/day	0	days/yr					0	hours/yr	$70	**$0**
Supervisor Labour (wage+benefits+OH)	0	hrs/day	0	days/yr					0	hours/yr	$140	**$0**
											SUM	**$0**
Maintenance - Percent of capital costs/yr (considered elsewhere)									0%	per year		**$0**
Maintenance - thermal Units (considered elsewhere)									0%	per year		**$0**
Total O&M per Year - Direct Solids Treatment												**$72,731**