Staff Report

DATE: February 7, 2020

FILE: 5600-20/Denman Island

TO: Chair and Directors
Electoral Areas Services Committee

FROM: Russell Dyson
Chief Administrative Officer

Supported by Russell Dyson
Chief Administrative Officer

R. Dyson

RE: **Denman Island Water Treatment Investing in Canada Infrastructure Program Grant Application**

Purpose
To submit a grant application to the Investing in Canada Infrastructure Program (ICIP) – Green Infrastructure grant program for water treatment upgrades and conversion of the Graham Lake Improvement District (GLID).

Recommendations from the Chief Administrative Officer:
THAT staff be directed to submit an application for grant funding through the *Investing in Canada Infrastructure Program – Green Infrastructure: Environmental Quality Sub-stream* for design and construction of water treatment upgrades to the Graham Lake Improvement District water system;

AND FURTHER THAT Electoral Areas Services Committee supports the project and inherent extension of the Denman Island Water Local Service Area dissolving the Graham Lake Improvement District, and commit to fund the portion of project capital costs remaining after grant funding and capital works reserves through a borrowing bylaw, currently estimated at $352,066.

Executive Summary

- GLID supplies water under a service agreement to Comox Valley Regional District's (CVRD) Denman Island Water Local Service Area (DIWLSA);
- Currently GLID's surface water treatment does not meet Vancouver Island Health Authority's (VIHA) Drinking Water Treatment Objectives and is required to update their treatment technology;
- A treatment option analysis and pilot project were completed by GLID 2019;
- A conversion study was completed in 2019 for converting GLID into a CVRD service;
- Working with the CVRD, GLID has requested a grant application be submitted to the ICIP grant program;
- As a requirement of the grant program, and approved by the GLID Board of Trustees, subject to a successful grant application, GLID would convert into a CVRD service area;
- A successful grant application would assist in funding up to 73 per cent of capital costs for required treatment technology upgrades.
- If the grant is not successful, GLID will remain an improvement district, upgrade costs will be significantly higher which will result in increased costs for both DIWLSA and GLID users.

Prepared by:	Concurrence:	Concurrence:
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Stakeholder Distribution (Upon Agenda Publication)

Graham Lake Improvement District	✓
K'ómoks First Nation	✓
Island Trust, CAO	✓

Background/Current Situation

The GLID on Denman Island has been in operation since 1972 and is responsible for providing drinking water to 67 properties within improvement district boundaries. Separately, the CVRD owns the DIWLSA, which was originally constructed in 1969 by a developer to service a subdivision along East Road. It was subsequently taken over by the former Comox-Strathcona Regional District in 1972. Water is supplied to 23 DIWLSA properties from the GLID, under a service agreement between GLID and the CVRD.

In July 2017, VIHA informed GLID that they are required to meet the new provincial Drinking Water Treatment Objectives for Surface Water Supplies. According to the conditions outlined in GLID's 2017 operating permit issued by VIHA, the improvement district must now work to identify and implement new water treatment infrastructure that complies with the provincial regulations by October 1, 2021. A study commissioned by GLID to identify water treatment options was recently completed in 2019.

In 2018 GLID requested that the CVRD initiate a study to explore governance options for the improvement district, including possible conversion to a regional district service. One motivating factor for GLID to consider conversion is the access to federal/provincial government infrastructure grant programs to support the upgrades required to meet the Surface Water Treatment Objectives.

Policy Analysis

Part 17 of the *Local Government Act (RSBC, 2015, c. 1) (LGA)* speaks to the governance and dissolution of improvement districts, which would be required upon award of grant funding.

GLID has provided a statement of intent for committing to following the conversion process subject to a successful grant application.

Options

Options include:

1. Apply for the ICIP grant for water treatment upgrades, if successful, GLID would convert to a CVRD service.
2. Do not apply for the grant application, and GLID would remain and improvement district and DIWLSA would remain a separate service.

Risks of not proceeding with Option 1 would include the potential for a higher user rate for DIWLSA residents based on GLID not receiving grant funding for required infrastructure upgrades, and continued inefficiencies to GLID and DISWLSA users from having these two systems operated independently.

Financial Factors

Project estimates for the grant application are below:

Description	Cost
(A) Project Estimate	$1,995,000.00
(B) Grant Application Amount (73.33 per cent)	$1,462,933.50
(C) Available Reserves transferred from GLID accounts (keeping $100,000 for unexpected repairs)	$180,000.00
(A-B-C) Required Long Term Borrowing	$352,066.50
Approximate annual cost per connection of combined service areas over 20 year amortization	$238

As part of the grant application, required borrowing bylaws should receive third reading for submittal with the grant application. As the new service is not in existence, a borrowing bylaw is not able to be approved, but a commitment for funding the project costs is in the recommendation for the staff report. ICIP grant program staff have confirmed this approach is satisfactory.

During conversion, balancing of reserves between GLID and DIWLSA properties will be reviewed. Currently the DIWLSA property owners are estimated to have contributed $2,000-$3,000 less per property. The ICIP grant does not allow top up of project costs using Community Works Funds. It will need to be further reviewed how this difference can be addressed during conversion.

Detailed breakdowns for potential future annual costs to residents can be seen in Figure No. 4 and No. 5 in the GLID conversion study attached as Appendix A.

Legal Factors

As part of the grant requirements, upon award of a grant, GLID would be required go through conversion to become a new, or become part of an existing, regional district service area. Estimated timelines are listed below:

- February 26, 2020 grant application;
- Summer/Fall 2020 grant award;
- January 1, 2021 conversion;
- First quarter 2021 loan authorization bylaw;
- Second quarter 2021 initiate detailed design and construction of treatment upgrades.

Regional Growth Strategy Implications

The application to the grant program is supported the Regional Growth Strategy goal number five: "*provide affordable, effective and efficient services and infrastructure that conserves land, water and energy resources.*" A successful grant application will aide in reducing required capital costs for all residents, and provide drinking water to residents that meets VIHA requirements.

Intergovernmental Factors

The CVRD will work closely with GLID on the grant application and conversion process if successful on the grant application.

Interdepartmental Involvement

The CVRD will rely on the Legislative Services branch on the requirements for conversion subject to a successful grant application.

If successful on the grant application, CVRD Engineering Services branch will manage the project for the required water treatment infrastructure upgrades for the new service.

Citizen/Public Relations

If successful on the grant application, GLID will be responsible for communicating with members within GLID relating to requirements for conversion and obtaining approval from GLID residents.

The CVRD will utilize the internal communication department for updating residents on project updates if successful on the grant application, and any future required loan authorizations.

Attachments: Appendix A – "20191219 GLID Conversion Study Final Report"
Appendix B – "20190915 GLID Water Treatment System Options Assessment"

Appendix A

Conversion Study – Phase 1

PREPARED FOR: COMOX VALLEY REGIONAL DISTRICT – JULY 2018

REVISED – DECEMBER 2019

PREPARED BY:
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Contents

List of Appendices

A. Current Boundaries Map (GLID, DIWLSA, GLIDE)
B. GLID 2017 Operating Permit (Island Health)
C. Order in Council to Dissolve Royston Improvement District
D. Olalla Local Community Establishment Bylaw No. 1609, 1995

1. Introduction

1.1 Overview

The Graham Lake Improvement District (GLID) on Denman Island has been in operation since 1972 and is responsible for providing drinking water to 67 properties within Improvement District boundaries. Separately, the Comox Valley Regional District (CVRD) owns and operates the Denman Island Water Local Service Area (DIWLSA), which was originally constructed in 1969 by a developer to service a subdivision along East Road. It was subsequently taken over by the former Comox-Strathcona Regional District in 1972. Water is supplied to approximately 24 DIWLSA properties from the GLID, under a service agreement between GLID and the CVRD.

Between the GLID and DIWLSA service areas is an area informally known as GLIDE (Graham Lake Improvement District Extension) – this area is comprised of 15 properties, virtually all of which are not currently connected to either water system, though an option to join the DIWLSA is available to GLIDE property owners. A map showing the boundaries of GLID, DIWLSA and GLIDE is attached as Appendix A.

The CVRD and GLID have worked together on 2-3 capital projects and have collaborated on operational aspects of the GLID and DIWLSA systems. The CVRD and GLID have identified that amalgamation of the two systems could potentially benefit GLID and DIWLSA property owners with respect to long-term service delivery and system operations, as well as addressing infrastructure renewal and upgrades.

In **July 2017**, the Vancouver Island Health Authority[1] informed GLID that they will be required to meet the new provincial *Drinking Water Treatment Objectives for Surface Water Supplies*[2]. According to the conditions outlined in GLID's 2017 operating permit issued by Island Health (see Appendix B), the Improvement District must now work to identify and implement new water treatment infrastructure that complies with the provincial regulations by October 1, 2021. A study to identify water treatment options (including capital and operating costs) is currently underway with consulting engineers, WSP Opus International Canada. Completion of that study is expected in 2019.

In **January 2018**, the CVRD received correspondence from the GLID formally requesting that the CVRD initiate a study to explore governance options for the Improvement District, including possible conversion to a regional district service. One of the main motivating factors for GLID to consider conversion is to enable access to federal/provincial government infrastructure grants to support the upgrades that will be required to meet the *Surface Water Treatment Objectives (SWTOs).* The request was approved, and this report is intended to fulfil the objectives for the GLID (Denman Island) Water Conversion Study.

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[1] Vancouver Island Health Authority (VIHA) is also referred to as the *Island Health Authority* and *Island Health*.

[2] For more information, see: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/surfacewater-treatment-objectives.pdf

1.2 Study Objective

The study objective involves identifying governance options and completing an initial financial analysis related to possible conversion of the GLID to a CVRD service. It is understood that:

- GLID Trustees would consider retaining a role in governance and service delivery, while the CVRD experiences significant logistical and financial challenges serving the DIWLSA from the regional district offices on Vancouver Island;
- the *Ministry of Municipal Affairs and Housing* (hereinafter referred to as “the Ministry”) has indicated that an expansion of GLID boundaries is an unlikely option – this is consistent with the 2006 provincial *Policy on Improvement District Governance*, which supports the continued gradual elimination of improvement districts, with municipalities and regional districts assuming the responsibilities of improvement districts over time;
- the amount of funding available in financial reserves varies significantly between the GLID and DIWLSA (GLID’s capital asset renewal reserve balance is significantly larger than DIWLSA’s reserve), which is a key consideration for the financial analysis; and,
- property owners in the GLIDE area (the area between the two water systems) currently have the option of joining the DIWLSA, but it is not mandatory.

1.3 History

The GLID and the DIWLSA were both established in the early 1970s, though the DIWLSA system was originally constructed a few years earlier by a developer to serve a subdivision on East Road. Source water for the original DIWLSA system was provided by two wells and did not meet a number of the parameters of the *Canadian Drinking Water Quality Guidelines.* As such, the system was on a permanent boil water advisory. In 2009 the CVRD completed a study that recommended changing the source water supply to Graham Lake by connecting to the GLID water system. The CVRD applied for grant funding to complete the connection and worked with the GLID to evaluate several different interconnection alternatives. The interconnection project and initial Water Supply Agreement between the GLID and the CVRD was completed in 2012, and the boil water advisory was subsequently removed.

As part of the water quality testing to complete the interconnection, it was discovered that a higher than acceptable level of total trihalomethanes (THM) existed in the GLID treated drinking water. THMs in drinking water can result when naturally occurring organic matter reacts with chlorine disinfection treatment and forms disinfection by-products. Graham Lake has high levels of organic matter, and so to reduce the THM levels, the CVRD and the GLID worked together to implement a process called “chloramination” – essentially the addition of ammonia to the treatment process in order to convert the chlorine to a less reactive chloramine, which still provides disinfection but reduces the formation of disinfection by-products that can result in high levels of THMs.

In 2017, GLID was informed by Island Health that the treatment process would not meet the provincial *Drinking Water Treatment Objectives for Surface Water Sources,* and that the Improvement District would be required to upgrade the system to meet the guidelines by October 1, 2021. There is a possibility that the upgrade to GLID's water treatment system, subject to the technologies that are selected, may eliminate the need for the chloramination system.

As previously noted, WSP Opus International Canada is currently leading a study to identify and assess various treatment options, including estimates of the associated capital and operating costs. Though completion of the study is expected later this year, initial indications are that the six options being considered range in initial capital costs from $220,000 - $1,860,000. While a preferred option has not yet been identified, an estimate of $750,000 has been used as a placeholder for the financial analysis included in this report.

1.4 Motivating Factors

During the regular meeting of January 28, 2018, the GLID Trustees supported a motion to explore new forms of governance for the Improvement District and forwarded a written request to the CVRD to initiate a study to assess the impacts of possible conversion to a regional district service. A key driver of this request is the need to comply with provincial (Island Health) surface water treatment objectives by October 1, 2021, which will likely involve the addition of new water treatment technologies at a considerable capital cost.

The 2006 provincial *Policy Statement on Improvement District Governance*[3] supports the continued gradual elimination of improvement districts, with municipalities and regional districts assuming the responsibilities of improvement districts over time. Improvement districts are ineligible for federal/provincial infrastructure grants and cannot borrow funds through the Municipal Finance Authority of British Columbia (MFABC), which pools the borrowing and investment needs of BC communities through a collective structure in order to offer lower interest rates and favourable terms to regional districts and municipalities. Gaining access to these financial tools through the CVRD – particularly given the immediate need to comply with the provincial SWTOs - is a major motivator for the GLID to consider conversion; however, the improvement district has been clear that they may wish to retain a role in the water system operations and administration.

In contrast, the CVRD continues to find it logistically challenging and financially inefficient to operate the DIWLSA system remotely from Vancouver Island. In 2019, the GLID and the CVRD signed a new one-year Water Supply Agreement for 2019 under which the GLID is responsible for managing the operations of the DIWLSA system, and which contains the clarification that GLID is providing treatment and delivery services of water owned by the CVRD that is accessed under the CVRD water license. The GLID's interest in retaining a role in operations and governance is a key motivator for the CVRD to consider governance options that would amalgamate the two systems and improve operating efficiencies through

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[3] See: http://www.cscd.gov.bc.ca/lgd/gov_structure/library/Improvement_District_Governance_Policy.pdf

continued local involvement in administration and operations. Given that Ministry staff have indicated that an expansion of the GLID boundaries is not likely to be accepted, conversion to a regional district service with delegation of operational and administrative responsibilities to a local appointed or elected local body is of interest to the CVRD.

2. GLID / DIWLSA Water System Overview

2.1 Water Source

The water source for both the GLID and the DIWLSA is Graham Lake, which is located in the middle of the southern end of Denman Island.

Figure 1: Graham Lake on Denman Island, British Columbia (Photo credit: Graham Lake Improvement District)

2.2 Treatment and Distribution System

The GLID invested considerable resources in upgrades to the treatment and distribution system between 2004-2008.

The existing GLID system consists of:

- A dam on Graham Lake
- Submerged raw water intake
- Approximately 750m of 150mm diameter Asbestos Cement (AC) supply main
- A water treatment, pumping system, and building
- A concrete reservoir
- Distribution watermains consisting of 100mm diameter and 150mm diameter AC pipe.

The CVRD owns and maintains the following components:

- the connection pipe that services the DIWLSA, which was completed in 2012

- Approximately 470m of 150mm diameter supply main within the DIWLSA (records unclear if this pipe is AC or polyvinyl chloride, PVC)

The existing water treatment process involves the use of sand filters, ultra violet (UV) purification and a chlorine contact tank. Sodium hypochlorite is added following the UV process, and ammonia is added as the water flows out of the chlorine contact tank, which creates chloramine, reducing the risk of THM formation and providing for secondary disinfection.

The GLID does not own any significant additional capital assets beyond what is described above. The Board of Trustees meet on a quarterly basis.

2.3 Future Capital Needs - GLID

In 2012, the GLID commissioned Koers and Associates Engineering Ltd. to prepare a capital plan for the water system. It identified a series of projects for the GLID's consideration and action – Figure 2 on the right includes an excerpt from their Final Report. Items 5 and 8 are the only projects that have not been either initiated and/or completed. Replacement of the lake intake (Item 7) has not been completed, however repairs have been undertaken on an as-needed basis.

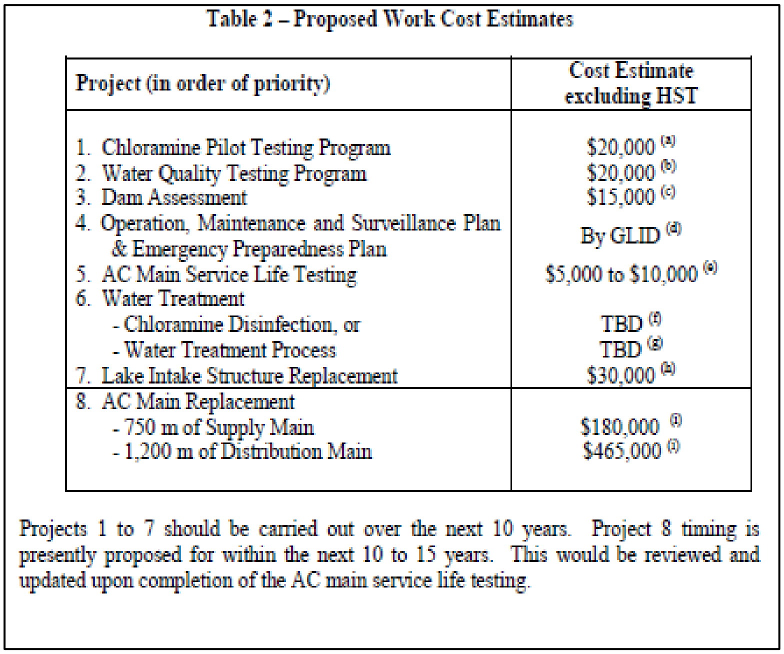

Table 2 – Proposed Work Cost Estimates

Project (in order of priority)	Cost Estimate excluding HST
1. Chloramine Pilot Testing Program	$20,000 (a)
2. Water Quality Testing Program	$20,000 (b)
3. Dam Assessment	$15,000 (c)
4. Operation, Maintenance and Surveillance Plan & Emergency Preparedness Plan	By GLID (d)
5. AC Main Service Life Testing	$5,000 to $10,000 (e)
6. Water Treatment	
- Chloramine Disinfection, or	TBD (f)
- Water Treatment Process	TBD (g)
7. Lake Intake Structure Replacement	$30,000 (h)
8. AC Main Replacement	
- 750 m of Supply Main	$180,000 (i)
- 1,200 m of Distribution Main	$465,000 (j)

Projects 1 to 7 should be carried out over the next 10 years. Project 8 timing is presently proposed for within the next 10 to 15 years. This would be reviewed and updated upon completion of the AC main service life testing.

Figure 2 – Excerpt from GLID's 2012 Capital Plan, prepared by Koers and Associates Engineering Ltd.

Capital needs that must be addressed by the GLID whether or not the improvement district converts to a regional district service include the following (*note - refer to the Financial Analysis for cost impacts*):

- water treatment upgrade to meet Island Health's Surface Water Treatment Objectives, cost-shared with the DIWLSA;
- repair / replacement of the GLID supply and distribution mains;
- lake intake structure repair / replacement; and,
- the dam assessment report is expected in 2019 and may include other capital items, though the GLID has indicated that no significant cost items are anticipated.

In addition, the GLID is considering whether or not to undertake improvements that would enable the water treatment system to achieve fire flows consistent with protection level 3A of the Fire Underwriters Survey (FUS) classification system[4].A final decision will require a more detailed study and a cost/benefit analysis.

2.4 Future Capital Needs - DIWLSA

The pipe connecting the DIWLSA to the GLID water system was completed in 2012, with an estimated usable service life of 80 years, based on CVRD asset management practices for PVC pipe systems. The DIWLSA distribution system, however, is original – roughly the same age as the GLID system, constructed around 1972.

Capital needs that the DIWLSA must address regardless of whether the GLID converts to a regional district service include:

- ➢ contribution to the GLID's water treatment upgrade project to meet Island Health's Surface Water Treatment Objectives; and,
- ➢ repair / replacement of the DIWLSA distribution mains (approximately 470m) may be required (although based on asset management practices of 80 years, replacement would be required prior to 2052).

Conversion would not result in any known additional capital requirements for the DIWLSA.

2.5 Water Demands

As part of the review of treatment, WSP has considered current average and maximum water demands (using the month of August for the baseline), along with forecasts for future water demands based on an estimate of the ultimate number of connections (including properties in GLID, the DIWLSA and GLIDE). The engineers have also examined current and future demand based exclusively on the 67 GLID properties, in order to determine the incremental cost to treat and supply water to the DIWLSA and GLIDE properties, and possibly a future connection to the BC Ferries terminal. The engineer's data shows that the current system has the capacity to supply 8.9 L/s, which is well above the current and projected future average daily demand and maximum day demand (including the ultimate number of connections), but is close to the future peak hour demand.

3. Conversion to a Regional District Service: GOVERNANCE

3.1 Current Situation

The GLID and DIWLSA currently function as two separate organizations, working in collaboration on capital and operational matters where warranted. Table 1 describes the current governance structures, staffing/operations and decision-making authority.

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[4] See: http://www.fireunderwriters.ca/dwelling-protection-grade.html

The impacts of conversion on each of these aspects depends on the preferred governance structure and extent of delegated authority – both are discussed in more detail below.

	GLID	**DIWLSA**
What is the current governance structure?	GLID is currently governed by an elected 3-member Board of Trustees who make all decisions related to governance, strategy, policy, finance and operations of the improvement district.	Governance matters related to the DIWLSA are first reviewed considered by the CVRD's Electoral Area Services Committee (EASC), a standing committee comprised of all three CVRD electoral area directors. The EASC is an advisory body to the CVRD Board of Directors – the EASC makes recommendations to the Board, who have the authority to make decisions. All three electoral area directors also serve on the Board of Directors.
Who is currently responsible for operations?	GLID currently has two paid staff on contract – a part-time operator and relief operator. The GLID Manager serves on a volunteer basis, as do the Secretary and Treasurer (non-voting positions).	CVRD staff is responsible for administration related to the DIWLSA, while the GLID is responsible for operations in accordance with the terms of the 2019 Water Supply Agreement. The CVRD Water Services Department is headed up by the General Manager of Engineering along with the Senior Manager of Water & Wastewater and Manager of Water Services. The staff team is unionized.
Who makes decisions?	The GLID operators and Manager make operational decisions, and Trustees make all decisions related to governance, strategy, policy and finances.	CVRD management make operational decisions; the EASC makes recommendations to the CVRD Board regarding DIWLSA governance, policy and finances and the CVRD makes final decisions on such matters.

Table 1: Current Governance Structures (GLID and DIWLSA)

3.2 Governance Options

The GLID and the CVRD have identified that amalgamating the GLID and DIWLSA systems may be beneficial for continued and long-term service delivery. Though it appears that the GLID does not currently experience challenges related to volunteerism and/or organizational capacity (which is fairly common for improvement districts), they do require access to additional financial tools (i.e. local government infrastructure grants and/or MFABC preferred borrowing) in order to afford ongoing, costly capital requirements - the most immediate priority being water treatment upgrades to comply with the provincial SWTOs. In contrast, the CVRD currently experiences significant logistical challenges and cost inefficiencies to maintain service to the DIWLSA. The fact that the GLID is willing to consider retaining a role in operations and administration of the water system represents a valuable opportunity for the regional district.

It's not unusual for improvement districts to retain a role in operations and/or administration after converting to a regional district service. As a local example, a transition committee was established to assist with conversion of the Royston Improvement District (RID) to a regional district service in 2010. The committee included representation from former RID Trustees and, though established as a temporary body for a three-year time period, members played an important role in the conversion process, providing valuable input and advice to the CVRD Board.

In the case of Denman Island, both the GLID and the CVRD have demonstrated a willingness to consider governance options that provide for sustained, direct involvement by local volunteers in the operations and administration of the water system. The analysis included in this report therefore focuses on options for establishing a more permanent governance body with delegated responsibilities.

Committees & Commissions

Section 229 of the *Local Government Act (LGA)* provides regional district boards with the authority to delegate responsibility for the operation and administration of services to its employees, committees, members or other bodies established by the local government. The two main types of "other bodies" that would apply for the purposes of this study include standing committees and local community commissions.

Standing Committees – Section 218 of the *LGA* provides that the CVRD board chair may establish standing committees (sometimes also called 'commissions') for matters the chair considers would be better dealt with by committee, and may appoint persons to those committees. At least one member of each standing committee must be a regional district director. Beyond that requirement, standing committees offer flexible membership structures that can vary over time. Members are not paid, with the exception of some reimbursed expenses. The Area A Director, as a member of the Commission, would be paid for attending the meetings.

For Denman Island, if the GLID chose to convert to a regional district service, the CVRD Board Chair could establish a standing committee comprised of the CVRD Area A Director along with non-political local representatives - these could include GLID trustees/volunteers, as well as other local stakeholders. The amount of authority delegated to the standing committee (by bylaw, in accordance with the *LGA*) would be a decision of the CVRD Board. It would range from being an advisory body with no decision-making powers to being delegated responsibilities for operations, administration and decision-making authority related to the water service. Delegation, including limitations, is discussed in more detail in the next section. Standing committees can be dissolved by the board chair, but delegation bylaws require a majority of votes cast by the regional district board to be amended or repealed. In the Province of BC's *Improvement District Conversion Guide*, regional district boards are encouraged to utilize the knowledge of trustees by appointing them to committees or commissions when conversion takes place. Where improvement districts have been dissolved elsewhere in the province, there are some examples of where the provincial government has included a stipulation in the Order in Council requiring the establishment of a temporary advisory committee to aid in the transition. This was the case in Royston – refer to Section 10 in the attached Order in Council. (see Appendix C)

Local Community Commission Section 342 of the *LGA* provides the authority for the regional district board to establish local community commissions (LCC). The main difference between a standing committee and an LCC is that committees are appointed, while LCCs are elected. The bylaw to create an LCC must be approved by the electors in the local community through a referendum. The boundaries of the local community are defined in the bylaw. If approved, elections for commissioners would be held every four years at the same time as the general local elections and the election would be administered by the CVRD.[5] The *LGA* allows for a total of either four or six commissioners in addition to the electoral area director, who also sits on the LCC. A Chair and Vice-Chair are elected at the inaugural meeting. Commission members are not paid, with the exception of some reimbursed expenses. The Area A Director, as a member of the Commission, would be paid for attending the meetings. Regional districts that have LCCs receive an additional $5,000 as part of their unconditional annual grant from the Province. The $5,000 can offset additional administration costs in having an LCC.

LCCs are not widely used in British Columbia, but where they do exist, they are typically used in communities that have distinct services or have remote locations and issues that are not well represented at the broader regional district or electoral area level. The Regional District of Okanagan-Similkameen (RDOS) has one LCC that was established in 1995 in the small community of Olalla. That LCC has been delegated administrative powers to operate the local water system, which is owned by the RDOS and serves approximately 200 properties. A copy of the establishing bylaw is attached as Appendix D.

One of the most significant challenges that LCCs typically experience is finding candidates interested in being on the commission. Though the GLID has indicated that volunteer interest and participation has not been an issue to date, the success of any commission or committee is dependent upon the desire and commitment of the community to participate.

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[5] If an LCC is preferred, the inaugural election would be held following conversion on a Saturday established by the CVRD Chief Election Officer.

	Standing Committee/Commission	Local Community Commission
Established by…	The CVRD Board Chair – the Board would need to pass a committee establishment bylaw, which does not require elector consent or approval by the Inspector of Municipalities. CVRD Policy 0540-00 would apply (Principals of an Effective Board Structure – Committees)	CVRD Board would need to pass a Local Community Establishment Bylaw, which requires elector assent (by referendum) and approval by the Inspector of Municipalities. It may be possible to combine a plebiscite regarding conversion with a referendum to establish an LCC – this would require final confirmation by the Ministry.
Membership	Appointed	Elected
# of Members	Flexible, and as set out in the Terms of Reference	Either 4 or 6 elected members, depending on the terms in the establishing bylaw
Length of Term	As set in the Terms of Reference, typically from appointment to date of next general local election unless member resigns or is removed by the Board. Reappointment for a further term(s) is allowable.	4 years, following the schedule of general local elections
Member Compensation	Unpaid, except for some reimbursed expenses.	Unpaid, except for some reimbursed expenses.
Regional District representation	Area A Director, at a minimum	Area A Director
Delegation	Delegation to standing committees/commissions is permissible under the *LGA*. The CVRD Board would set expectations by bylaw.	Delegation to an LCC is permissible under the *LGA*. The CVRD Board would set expectations by bylaw.
Funding	No additional provincial funding for Committee administration, costs would need to be funded by the service.	Regional Districts with LCCs are eligible for an additional $5000/year as part of their unconditional regional district grant from the Province; any remaining costs to be funded by the service.
Process to Disband	Establishing bylaw may be repealed by the CVRD Board (majority of votes cast).	Would require elector assent and approval of the Inspector of Municipalities.

Table 2 – Comparison Matrix: Standing Committee/Commissions vs. Local Community Commissions

Delegation

As noted, the authority to delegate responsibility for operation and administration of services comes from Section 229 of the *LGA*. Specifically, a board has the power to:

> *"… delegate its powers, duties and functions, including those specifically established by an enactment, to its officers and employees, its committees or its members, or to other bodies established by the local government."*

Some possible areas where a regional board may wish to consider delegating include:

- Planning - short and long term with respect to a service; (advisory only – Board makes decisions);
- Budgeting - service operating and capital budgets for the service and recommendations to the board; (advisory only - Board makes decisions);
- Expenditures - approving expenditures based on the budget approved by the board;
- Contracting - entering into contracts based on limits and policies established by the board;[6]
- Operational policies and procedures - establishing policies and procedures to guide the operation of the service; and
- Operational decisions – day-to-day decisions with respect to the operation of the service.

According to the provincial *Improvement District Conversion Guide,* a committee or commission helping to manage the transition of a former improvement district to a regional district service could, for example, be delegated the authority to develop budgets, recommend tax and user rates, develop capital plans, recommend service construction standards, oversee contracts, and deal with any issues related to the management and operation of the former improvement district services.

A Board may not, however, delegate the following:

- Bylaw making;
- A power or duty which is only exercisable by bylaw (for example, levying parcel taxes, expropriating property; acquiring land; and appointing officers);
- A power or duty to suspend or terminate a local government officer or an auditor;
- A power or duty to consider an action or decision where reconsideration is mandated in statute and hold a hearing;
- A power or duty established in legislation that the local government gives its consent or approval to recommendations on or acceptance of a decision or action or other matter.

Once a board has delegated a power, duty or function, the delegate (person or body) has the responsibility to act within parameters that the board has set out. This means that, in most circumstances, a board cannot "second guess" the decisions of a delegate. A board cannot interfere with a delegated body's decision making, but it can withdraw the

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[6] Contracts for GLID Operators may not be transferred to the CVRD as regional district staff positions at conversion, due to the terms of the current collective agreement with the Union. However, a standing committee or commission could be delegated authority to enter into contracts within the limits and policies established by the Board.

delegation if it is dissatisfied. To pass, delegation bylaws require an affirmative vote of at least 2/3 of the votes cast. A majority of votes cast is required for the bylaw to be amended or repealed.

4. Conversion to a Regional District Service: FINANCIAL ANALYSIS

Financial considerations will be one of the factors that residents of both the GLID and the DIWLSA systems will want to consider when evaluating options to proceed. The following highlights the financial positions of each service and the relevant fees and taxes for each service area, followed by a discussion of the potential financial implications of combining the services.

4.1 Financial Considerations – GLID

Operating Costs

The GLID's most recent financial statements from 2018 indicate that the improvement district operating costs for 2018 were $107,639[7]. GLID collected $150,979 in revenues.

In addition, the improvement district has an operating fund that acts as a contingency from which to balance the annual operations budget. At the beginning of 2019 there was an operating surplus of $29,510, including the 2018 contribution of approximately $8,260. The 2019 budget estimates an operating surplus of about $28,000 at the end of the year, which will be allocated to the renewal reserve fund. The 2019 operating budget was $94,100 with a contingency of $7,500 for a total of $101,600.

Reserves

GLID has a Renewal Reserve account. The Renewal Reserve balance was approximately $264,000 at the end of 2018. The reserves have been built up in accordance with the GLID's *Capital Works, Renewal Reserve Fund Establishment Bylaw* in part to deal with planned improvements that are required for the system. The 2018 contribution to the Renewal Reserve account was approximately $29,600, and in 2019 it is budgeted to be $27,600. Transfers to the renewal reserve fund are based on the revenues generated from both DIWLSA and GLID users. Since 2012, the CVRD notes that DIWLSA users have contributed approximately $37,000 to the renewal reserve. Where infrastructure benefits both systems in this analysis, $37,000 of the DIWLSA reserves are considered to be part of the DIWLSA reserve contribution. Inequities between reserves can be addressed either through one area contributing additional amounts, through a lump sum contribution from Community Works Funds, or by contributions over time.

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[7] Source- GLID 2018 Financials. Not including amortization expense of $5,447.

In 2012, a 10-year Capital Plan was prepared by Koers Engineering that identified a variety of improvements that would be needed. Improvements included:

- Assessment of the dam (and potential capital improvements resulting from that)
- Replacement of the dam intake
- Replacement of supply and distribution watermain and service connections (longer term project – estimated to be 10 to 15-year timeline from 2012)

The report noted that the distribution system was built circa 1970. In 2012 the cost estimates for the watermain replacements were estimated at $180,000 for the supply main, and $465,000 for the distribution main. At that time the dam assessment and intake replacement costs were estimated at $20,000 and $30,000 respectively. Ideally these estimates should be adjusted by an engineering firm based on updated conditions and current regulations, technologies and requirements. In the absence of updated costs, the capital upgrades have been adjusted to reflect 2019 dollars using a construction cost index. Construction cost indexes include many types of building materials, so are not ideal nor precise. To adjust those figures to 2019 dollars, a construction cost index results in a 22.9% increase[8]. The resulting capital costs are estimated at $571,600 and $221,300 respectively. A portion (approximately 26%) of these costs have been apportioned to DIWLSA because this watermain also serves as their supply main. The intake replacement has been adjusted to $37,000, but it is assumed a dam assessment could be completed for approximately $25,000.

Fees, Tolls and Taxes

The rate structure for GLID and DIWLSA property owners was harmonized at the end of 2017 and includes taxes of $500 for being within the service area, even if they do not use any water. If water is used, then a toll is applied in addition to the taxes. The 2019 toll for using water (regardless of the amount) is a flat fee of $900. In 2019 the water rates were $1,400 (tolls and taxes) for GLID and DIWLSA property owners. In 2018 the total revenue from GLID parcels was $90,200 (with $900 in receivables). Contributions from the DIWLSA users are calculated in addition to those revenues. In 2018 the contributions from DIWLSA were $35,435. That figure included some one-time hook-up fees. In the future the DIWLSA user contributions are estimated at $32,300.

4.2 Financial Considerations - DIWLSA

Operating Costs

The DIWLSA service recorded $54,689 in operating expenses, and $54,690 in revenues during 2018. The 2018 actuals included a $7,370 deficit from the previous year. Together the CVRD and GLID agreed to have GLID manage the day-to-day operations on behalf of

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[8] The amount used in the previous 2018 report was 19%. That amount has been increased by 3.3% based on the civil engineering construction increases between 2018 and 2019. Note that this is just an index and is not considered to be an accurate update of the 2012 estimates. While it can be used to get a ballpark of the relative impact of cost changes, it should not be considered equivalent to an updated engineering cost estimate, which would provide more accuracy to members regarding financing costs, tax limits, etc.

DIWLSA. Accordingly, budgets for the DIWLSA operations are minimal, with the primary expense being the Water Supply Agreement with GLID, plus a permit or licence, and some minor administration costs (insurance, postage, GIS and support services). In 2018 there were some one-time professional fees for a study that extended into 2019 (budget amount in 2019 is $13,729) that were funded through federal gas tax grants. 2018 also included some one-time connection fees and transfer from reserves. Beyond 2019, future expenses are budgeted at $31,900 per year.

Capital Reserves

In 2017, DIWLSA had accumulated a reserve of $12,987. That reserve was reduced to $6,700 by 2019 due to a deficit in 2018 that was covered by the reserves. The service was originally budgeted to contribute between $2,500 and $3,000 to the reserve annually, as per the 5-year financial plan, however those annual contributions have not been made to build upon the reserves. While the watermain connection to GLID was installed recently (2012), the remainder of the distribution system is of similar age to the GLID system, and was constructed in approximately 1969. Using similar rates to those estimated in 2012 for the GLID system (not including the replacement of the hydrants and associated tees and gate valves), DIWLSA might be able to anticipate renewal costs to be in the range of $206,500 (adjusted to 2019 dollars), not including a portion of the GLID supply system. However, as noted previously, because the majority of the DIWLSA system is PVC, the estimated life span used for general asset management purposes is longer. The CVRD considers an 80 year lifespan for PVC systems, which would mean the DIWLSA system would require replacement prior to 2052.

In addition to the replacement of the distribution system, given that the system relies upon the GLID water storage, DIWLSA users can expect to pay a share of the dam assessment and replacement costs.

Fees and Taxes

Up until 2017 properties within the DIWLSA service area paid $271 in parcel taxes, in addition to user rates of $6.73 per m^3 (with a $300 minimum fee). Under this system those who had average water consumption paid considerably less than within GLID (approximately $935 per year compared to $1,400), whereas the largest users paid considerably more ($1,900 compared to $1,400). However, at the end of 2017 the rates were harmonized so both GLID and DIWLSA would pay the same rate, due in part to the perceived inequity, as well as the concern that the usage-based system was leading to decreased consumption, thus affecting the predictability of revenues. DIWLSA's 2019 budget estimates a total of $30,900 in user fees (bulk water rates) to GLID.[9]

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[9] Note that DIWLSA's estimates show $30,900 per year, which is slightly lower (1 property less) than GLID's projections of $32,300.

4.3 Future Considerations

Regional districts are often asked to acquire water systems – sometimes private water systems, other times improvement district systems. Several regional districts have “Utility Acquisition Policies” or Water System Acquisition Strategies to address such requests. Many of these policies attempt to ensure that prior to the regional district assuming ownership, the condition of the system is assessed, any deficiencies (relative to the regional district standards) are identified, and the financial sustainability of the system is evaluated. Where two systems are to be amalgamated, an ideal amalgamation is when both systems are of similar age, they have been built and maintained to similar standards, and where both systems have similar reserve accounts. Where there are differences in the condition of the infrastructure, the level of service or where there are unequal reserves, then amalgamations must address the inequity of joining the two systems.

Some of the key considerations in any amalgamation between the DIWLSA and GLID are as follows:

- Condition of both systems
- Service levels of both systems
- Capital cost of upgrades to systems and related reserves
- Operating cost changes
- User fees and rate structure
- Cost recovery from future connections

Condition

The two Denman Island systems were built in a similar timeframe. Although there is no condition assessment on the DIWLSA system, the majority of the pipe is constructed of PVC, and is 150mm, which has a longer estimated lifespan for asset management purposes than AC pipe. The CVRD uses estimates of 60 years for AC pipe and 80 years for PVC pipe. Based on those estimates, the GLID system will need its upgrades earlier than the DIWLSA distribution system. The only newer pipe in the DIWLSA system is the connection between DIWLSA and GLID, built in 2012.

The capital plan estimate completed for GLID in 2012 (Koers Engineering) indicated that renewal could be required within approximately 10 to 15 years. Upgrades for the GLID system included $645,000 for replacement of 1,950 m of watermains (adjusted to approximately $792,900 in 2019 dollars). If similar values on a per linear meter basis are used for the DIWLSA system (less the costs of the hydrants and associated tees and valves not present in the DIWLSA system), a ballpark replacement cost would be $206,500, assuming adjustments to 2019 based on construction cost index. As noted previously, this estimate does not include any allocation of the GLID supply system to DIWLSA. When a proportion of the GLID supply system is added in (at 26.4% based on the proportion of users – 24 of 91 total users), the total for DIWLSA is $415,825.

Service Levels

It is worth noting that one of the differences between the two water systems in terms of level of service, is that the DIWLSA system has water meters, whereas the GLID system does not. Although both systems have adopted harmonized rates that are not based on water consumption, leading practices are to use water meters, which are an effective approach to water conservation. While adding water meters to the GLID system is something that should be considered in the future, the cost of upgrading the GLID system and installing water meters is not included in the analysis. If the two systems are to be amalgamated, addressing this discrepancy for the GLID area may need to be considered in a long-term strategy.

	GLID	DIWLSA
Watermain Replacement	$583,575	$415,825
Dam Assessment	$18,400	$6,600
Intake Replacement	$27,232	$9,768
Treatment (Option B - $750,000)	$552,000	$198,000
Total Capital Costs	$1,181,207	$630,193
Reserve amounts	$227,000	$43,700
Capital Costs less reserves	$954,207	$586,493
Number of properties	67	24
Capital Cost/Property	**$14,242**	**$24,437**

Figure 3

Capital Costs and Reserves

Currently the GLID system has approximately $264,000 in reserve accounts intended for capital projects. DIWLSA has approximately $6,700. While the difference seems inequitable, DIWLSA users have been contributing to the GLID budget that is used to build the reserves, and are therefore contributing proportionally to that reserve account. It is estimated that since 2012, DIWLSA users have contributed approximately $37,000 to the GLID reserves. The chart (Figure 3) demonstrates a snapshot of the roughly estimated capital costs for each system, including a $750,000 estimate of the water treatment costs, and taking the reserves are taken into account. The chart shows the costs per property, taking into account the reserves (and assuming a portion of the GLID reserves are allocated to DIWLSA) as well as allocating a 26.4% proportion of the GLID watermain upgrade costs to DIWLSA. A significant difference between the two suggests that residents of either system may be reluctant to join with the other (or would need to know that further contributions were coming from the other system or users to compensate for the differences). Note that it is possible to find options to have one area contribute additional amounts to balance any inequities, either through a lump sum contribution, or contributions made over time.

Note that this calculation provides a relatively simplistic snapshot, and does not take into account borrowing or timing of capital costs (i.e. that the DIWLSA system is estimated to last longer due to a majority of PVC construction, nor that DIWLSA can borrow at significantly lower rates). This calculation also does not include any of the "GLIDE" properties unless agreed to in advance. Any properties wanting to join the new service would have to pay a pre-determined fee for entering the service. The fee would represent an amount that recognizes the need to contribute toward future capital costs, as well as the existing infrastructure that both GLID and DIWLSA users have contributed to over time.

The snapshot includes the cost of upgrading the water treatment system to comply with Island Health's SWTOs. While no option has been chosen yet, three scenarios have been prepared that assume estimates of $500,000, $750,000 and $1 million respectively. This snapshot uses the middle estimate of $750,000 as a placeholder for the capital cost associated with the upgrade. In the event of any amalgamation of the two systems, the cost of the SWTO upgrade treatment option would be shared between GLID and DIWLSA. One algorithm for recovering the SWTO upgrade expense would be to allocate the cost to users based on a cost per property. This would result in an allocation of approximately 73.6% for GLID (67 users) and 26.4% for DIWLSA (24 users). Other allocation methods could also be considered. It is also assumed that other upgrades to the water treatment system or water supply infrastructure would be treated the same (i.e. the dam assessment and replacement of the intake). Note that if a lower water treatment estimate is used ($500,000), the discrepancy between the capital cost per property narrows, whereas if a higher estimate is used ($1,000,000) then the gap widens slightly.

Operating Costs

The impact on annual operating costs resulting from combining the services is expected to be minimal (e.g. utilities, treatment chemicals, etc.), relative to the operating costs for GLID in 2018 or 2019 (given that GLID has already taken on management of the DIWLSA service, and CVRD has confirmed it can and would continue to contract GLID's same service providers). Additional operating costs are anticipated from the new SWTO treatment upgrade. Some of these incremental operating costs would arise regardless of whether the systems were combined. It is important that all property owners understand that in the future, the annual cost of water is expected to rise. The biggest single factor contributing to the increase in the annual cost of water to property owners is the mandatory upgrade to the water treatment system (in order to comply with provincial requirements). Current thinking is that there would be little if any increase in the annual cost of water attributable to the service being combined or as a result of changes in governance or ownership. The scenarios looking at future costs (both separate and amalgamated) include an assumption that the new water treatment system upgrade will add approximately $10,000 per year to the operating costs. While the operating and maintenance costs for treatment may be higher, the new treatment may also reduce certain operating costs (e.g. supplies such as chemicals, operator labour associated with maintaining the current system). No extra costs for labour or supplies beyond the $10,000 that has been included in the scenarios have been assumed.

There would be some changes if the services were combined under the CVRD ownership. The accounting and administration function is assumed, in this analysis, to be handled by the CVRD, due in part to local government obligations under the provincial legislation[10] related to record keeping, data storage, information management and protection of privacy, as well as to enable seamless integration with CVRD financial software to maintain information to feed into the budget, financial plan, and the CVRD audit. Other costs would also be covered through the CVRD, such as auditing, and insurance. This change would therefore remove some of the budget items from the GLID budget (office costs, audit costs, insurance), and instead these support services would be allocated through the CVRD. The regional district allocates a portion of its overall administrative costs (everything from office space, office equipment, communications, computers, programs, photocopying, accounting services) to every service it operates. Services pay a "support services" amount based on which services they use and how often they are needed. The estimated costs of the CVRD doing administration is approximately $6,500, based on how these costs are apportioned to other CVRD services. The amount is more than offset by reductions from the "Legal and Financial" as well as "Insurance" budget categories in the GLID budget, which together totalled $10,507 in 2018 (Actual) and $13,800 in the 2019 budget. The Regional District has access to insurance coverage for directors and staff through the Municipal Insurance Association of BC. While the addition of extra committee or commission members may impact the CVRD's insurance premiums, the incremental cost is expected to be minimal.

Other changes in costs would include the cost of the committee or commission. As noted elsewhere in this report, a Local Community Commission comes with the requirement for holding elections, but is supported with provincial funding of $5,000 per year. A commission or committee with an electoral area director on it would involve the cost of compensating the director with remuneration for meeting attendance, as per the CVRDs policy, as well as expenses (i.e. ferry costs). The support services category has an added buffer to allow for items such as sending a CVRD staff member to Committee/Commission meetings for minutes, if required.

Another adjustment made to a combined operating budget is to increase the repair/maintenance budget. This is based on the understanding that currently the agreement between GLID and CVRD is that GLID coordinates and responds to issues such as breakages or leaks in the DIWLSA system, but the costs of any repairs are billed to CVRD. Therefore, in a combined scenario, any repairs to the DIWLSA distribution lines must also be considered. An extra $8,800 has been added to the GLID budgeted amount to account for some minor issues in the DIWLSA distribution lines.

There would likely be some one-time costs to convert GLID's utility data and ensure compliance with the CVRD's financial policies related to capital asset accounting; however,

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[10] Includes British Columbia's *Freedom of Information and Protection of Privacy Act, Community Charter* and the *Local Government Act*

when a Cabinet order has been approved to dissolve an improvement district and transfer responsibility for its services to a regional district, the Ministry may provide a Restructure Implementation Grant to assist with administrative costs. According to the *Improvement District Conversion Guide*, improvement districts that provide a single service (water) to less than 100 connections are eligible for a grant of $5,000, which would likely cover the cost of data conversion for the GLID properties. Grants are paid to the regional district upon completion of the conversion.

To summarize, the differences between the current GLID operational budget (2019) and the budget for a merged scenario includes the following differences:

- added $6,500 of CVRD overhead costs
- increased permits/water licences to include costs from GLID + permits from DIWLSA system
- removed legal, audit, insurance, etc. from GLID budget (now included in CVRD overhead)
- increased repairs budget to ensure there is sufficient repairs budget to cover DIWLSA repairs
- increased the studies amount to $5,000
- added $10,000 in extra operations and maintenance for the water treatment
- added $1,000 for committee costs
- contingency of $5,000

User fees and parcel taxes

The other potential change may be in how the operating costs are allocated and recovered from the service area (as discussed in the following sections). If different rate structures are used, it can change the balance of what each user is contributing and how the overall costs are recovered. These decisions are independent of the changes in the overall operating costs for the system, but can have significant impacts on individual users. For instance, if a new system was based on usage, this would increase the amount that those who use significant amounts of water would pay relative to those properties that do not use as much water. To change to this type of rate structure, meters would have to be installed on the GLID properties.

New users

Another consideration is the cost of “allowing” other users to join the service. While it would make the most sense, from an efficiency perspective, to have the GLIDE properties between the two systems hooked up to the service, having these properties join the system requires the property owner and the system owner to consent, together with agreement to pay a pre-determined fee for joining the service. While more users will contribute to higher annual operating expenditures, the overall cost to each property owner should be lower as a result of the incremental revenues attributable to each new user. The system operator must ensure that the fee to join the system takes into account a share of the cost to build the infrastructure, as well as the future capital cost to repair and replace it (and pay for the new treatment).

Funding opportunities

The last critical point to consider in any financial analysis, is the ability of a newly combined system, owned by the regional district, to obtain grants and to access loans through the Municipal Finance Authority at low interest rates. The difference in rates can be significant – the Canada Small Business Financing Loan rates are generally about 3% above prime, or above residential mortgage rates, compared to long term (20 year) lending rates from MFA of approximately 2.91%. Government grants, as well as the MFA lending rates, are not available to improvement districts.

While there is no guarantee that the regional district will be successful in obtain grants, water treatment has been an area of focus for recent grant programs. It is important to note that the existence of a grant program does not guarantee that there are funds available to be disbursed as grants. A number of different grant programs have been highlighted in subsequent sections of this report.

4.4 Analysis – Status Quo vs. Combining Systems

The first chart (Figure 4) below shows the costs for GLID and DIWLSA under a status quo model. The status quo assumes the current arrangement whereby GLID manages the DIWLSA system, would continue. The second chart (Figure 5) shows two scenarios where the two systems are amalgamated. The first has no grants, and the second assumes a grant awarded under the new Environmental Quality Investing in Canada Plan (see Section 4.6) for the water treatment plant upgrade, which requires 27% local contribution. It is useful to note that there is no option that would enable a senior government infrastructure grant with the status quo, because to receive the grant the regional district would need to own the infrastructure (rather than a grant being awarded for infrastructure owned by someone else).

The analysis relies upon the following assumptions:

1. The funds from taxes are set aside in a capital asset renewal reserve. Examples of where renewal reserve funds can be applied include: water treatment plant upgrades, watermain repair/replacement, dam assessment, intake replacement and water meters. The capital costs are assumed to be recovered over a 20-year period.

2. The operating costs are fully recovered on an annual basis through user rates. While this could be done through a combination of user fees and parcel taxes, and could also be recovered through a usage-based fee, this calculation is intended to provide an average per property. The annual operating costs are divided by the number of properties served.

3. The borrowing in the amalgamated scenarios assumes that the existing reserves would be applied to the most immediate capital project (water treatment system upgrade), to avoid any unnecessary borrowing costs. However, in order to ensure sufficient resources for unanticipated items, the analysis assumes that DIWLSA maintains a reserve of $26,000, and GLID of $74,000 (or $100,000 in the combined scenario). The amalgamated scenarios enable borrowing at MFA rates for 20 years.

4. The borrowing in the status quo scenario assumes that the GLID would have to borrow the remaining portion of the treatment costs through a financial institution. GLID has obtained a quote from RBC with an estimated rate of RBC Prime+ 1.2% for a 10-year loan. Typically rates for 20-year loans would be higher. MFA's indicative rates for longer terms than 10 years assume an increase of 0.34% over the 10-year rate, so the same differential has been assumed for the RBC loan (note that the actual rate may be higher).

5. No additional revenues have been shown from any further GLIDE properties joining the service. Any future properties joining the service would have the effect of increasing revenues and reducing the cost per property.

6. As noted previously, the new water treatment system upgrade is calculated at $500,000, $750,000 and $1 million, and the overall impact on the annual operating costs is assumed to be an increase in costs of $10,000 per annum (accounting for the cost reductions due to the change in practices, the time savings from eliminating current maintenance practices, and the replacement of that time and those costs with the new regime).

7. The grant scenario includes a grant for the water treatment system upgrade based on an application for the full cost of the upgrade in each scenario ($500,000, $750,000, and $1 million, of which the grant covers 73.33%).

GLID	STATUS QUO		
	Option A	Option B	Option C
Capital Costs			
- watermain replacement	$583,575	$583,575	$583,575
- dam assessment	$18,400	$18,400	$18,400
- intake replacement	$27,232	$27,232	$27,232
- water treatment	$368,000	$552,000	$736,000
Reserves	$227,000	$227,000	$227,000
Operating Costs	$109,000	$109,000	$109,000
** GLID 2019 budget + treatment O&M costs*			
Annual Borrowing (treatment debt 20 years)*	$254	$472	$690
Parcel tax (watermain replacement over 20 years)	$470	$626	$626
User fees (operating cost/property)	$1,627	$1,627	$1,627
Annual Cost	**$2,350**	**$2,725**	**$2,943**

DIWLSA	STATUS QUO		
	Option A	Option B	Option C
Capital Costs			
- watermain replacement	$415,825	$415,825	$415,825
- dam assessment	$6,600	$6,600	$6,600
- intake replacement	$9,768	$9,768	$9,768
- water treatment	$132,000	$198,000	$264,000
Reserves	$43,700	$43,700	$43,700
Operating Costs	$34,500	$34,500	$34,500
** DIWLSA 2019 budget (minus gas tax funded study) + treatment O&M costs*			
Annual Borrowing (treatment debt 20 years)*	$308	$487	$665
Parcel tax (watermain replacement over 20 years)	$900	$900	$900
User fees (operating cost/property)	$1,438	$1,438	$1,438
Annual Cost	**$2,646**	**$2,825**	**$3,003**

** Status Quo scenarios include $74,000 remaining untouched in GLID reserve, $26,000 in DIWLSA*

Figure 4 – Financial Analysis: Status Quo Model

MERGED SCENARIOS	NO GRANT		
	Option A	Option B	Option C
Capital Costs			
- watermain replacement	$999,400	$999,400	$999,400
- dam assessment	$25,000	$25,000	$25,000
- intake replacement	$37,000	$37,000	$37,000
- water treatment	$500,000	$750,000	$1,000,000
Reserves	$270,700	$270,700	$270,700
Grant	$0	$0	$0
Operating Costs			
Utilities including propane	$8,700	$8,700	$8,700
Water tests, chemicals and supplies	$21,400	$21,400	$21,400
CVRD overhead (office supplies, accounting, audit,	$6,500	$6,500	$6,500
Permits, water licences, lease fees, association du	$1,860	$1,860	$1,860
Legal and audit (included in O/H above)	$0	$0	$0
Insurance (included in O/H above)	$0	$0	$0
Repairs and maintenance	$50,000	$50,000	$50,000
Miscellaneous	$2,600	$2,600	$2,600
Studies	$5,000	$5,000	$5,000
Committee/Commission	$1,000	$1,000	$1,000
Contingency	$5,000	$5,000	$5,000
Added Treatment O&M	$10,000	$10,000	$10,000
SUBTOTAL	$112,060	$112,060	$112,060
Annual Borrowing (treatment debt 20 years)**	$234	$412	$590
Parcel tax (watermain replacement over 20 years)	$549	$549	$549
User fees (operating cost/property)	$1,231	$1,231	$1,231
Annual Cost	**$2,015**	**$2,193**	**$2,371**

MERGED SCENARIOS	WITH GRANT		
	Option A	Option B	Option C
Capital Costs			
- watermain replacement	$999,400	$999,400	$999,400
- dam assessment	$25,000	$25,000	$25,000
- intake replacement	$37,000	$37,000	$37,000
- water treatment	$500,000	$750,000	$1,000,000
Reserves	$270,700	$270,700	$270,700
Grant	($366,650)	($549,975)	($733,300)
Operating Costs			
Utilities including propane	$8,700	$8,700	$8,700
Water tests, chemicals and supplies	$21,400	$21,400	$21,400
CVRD overhead (office supplies, accounting, audit,	$6,500	$6,500	$6,500
Permits, water licences, lease fees, association du	$1,860	$1,860	$1,860
Legal and audit (included in O/H above)	$0	$0	$0
Insurance (included in O/H above)	$0	$0	$0
Repairs and maintenance	$50,000	$50,000	$50,000
Miscellaneous	$2,600	$2,600	$2,600
Studies	$5,000	$5,000	$5,000
Committee/Commission	$1,000	$1,000	$1,000
Contingency	$5,000	$5,000	$5,000
Added Treatment O&M	$10,000	$10,000	$10,000
SUBTOTAL	$112,060	$112,060	$112,060
Annual Borrowing (treatment debt 20 years)**	$0	$21	$68
Parcel tax (watermain replacement over 20 years)	$549	$549	$549
User fees (operating cost/property)	$1,231	$1,231	$1,231
Annual Cost	**$1,781**	**$1,802**	**$1,849**

*** Merged scenarios include retention of $100,000 in reserve accounts for borrowing calculation*

Figure 5 – Financial Analysis: Amalgamated Scenarios (Grant / No Grant)

4.5 Financial Conclusions

The financial analysis suggests that an amalgamated scenario should result in savings for both systems, even in the event that no grant is available. This is largely due to the savings in the operating costs of merging the two systems, and sharing the costs equally amongst 90 users. The amalgamated scenarios also enable less borrowing, and the use of the MFA 20 year rates for whatever borrowing is needed.

It is emphasized that this level of analysis is very preliminary, and is based upon many assumptions regarding the costs of treatment, operational costs for that new treatment option. The numbers therefore suggest there is some value to exploring an amalgamation between the two systems further, and in additional detail, due to the potential savings for both GLID and DIWLSA users.

4.6 Infrastructure Grants

The two most significant sources of grant funding for drinking water projects include the federal Gas Tax programs (*Community Works Fund* and *Strategic Priorities Fund* – both administered by the Union of BC Municipalities) and programs that combine federal, provincial and local government contributions – these are typically administered by the provincial government and program names have varied over time depending on which federal infrastructure package they fall under.

In 2017, the Government of Canada and Province of BC signed an agreement under the new *Investing in Canada Plan*, which is a 10-year program that will fund projects in four key areas:

1. Community, Culture and Recreation Infrastructure
2. Rural and Northern Communities Infrastructure
3. Green Infrastructure
4. Public Transit

Drinking water projects are eligible under the Green Infrastructure component, as part of the *"Environmental Quality"* program. A second intake to this component is now open and applications are begin accepted until February 26, 2020.

It is possible for the CVRD to submit a funding application to this program on behalf of the GLID; however, an approval would be conditional on the GLID converting to a regional district service. Projects that improve the treatment and management of drinking water are eligible – this would include water treatment system upgrades. For this particular program, the Government of Canada will fund up to 40% of eligible project costs, and the Province of BC will fund up to 33.33%. The applicant (local government) must fund the remaining 26.67% along with any ineligible costs and/or cost overruns. Drinking water projects require applicants to have a Board/Council-endorsed Water Conservation Plan. Where a water system is being transferred to a local government, a commitment should be included to extend the local government's water conservation activities to the transferred system. It is unknown at this time whether there will be any additional/future intakes for this particular program.

As for Gas Tax, drinking water projects are an eligible project category under the *Community Works Fund*. Under this program, federal funds are transferred automatically to local governments on an annual basis – there is no application process involved. Local governments then allocate funds to various projects based on Board/Council priorities, in accordance with the rules of the program. While drinking water is an eligible project category, the availability of funds depends on the Board's priorities. *Community Works Funds* were utilized by the DIWLSA in 2016/2017 for the chloramination project, as well as for the current water treatment study.

The *Strategic Priorities Fund* is another component of the Gas Tax program but is application-based. The last intake to this program was in 2017. The timing of the next intake is unknown at this time; however, the current Gas Tax agreement between the Government of Canada and the Province of British Columbia will expire in 2024.

5. Next Steps

Longer-term water system sustainability on Denman Island through access to infrastructure grants and low-interest borrowing, along with improved operational efficiencies are two reasons for the GLID and the CVRD to consider conversion of the GLID to a regional district service. Based on the findings of this report, the consultants recommend proceeding to the next phase of the Conversion Study, including public consultation.

If the GLID ultimately decides to proceed with conversion, implementation would either require the CVRD to pass a *service area establishment bylaw* or an amendment to the service establishing (conversion) bylaw for the Denman Island water local service area. In either case, there are legislative requirements related to participant consent and/or elector approval that are important to consider. In some instances, the Minister of Municipal Affairs and Housing may be authorized to waive requirements where there is evidence of a thorough public consultation process and the owners/residents affected have indicated strong support for the conversion. Conversion of the Sandwick Waterworks District is a recent, local example of a public consultation process that satisfied the Minister, and the requirement for elector approval was waived. It is therefore further recommended that the public consultation plan prepared as part of the next phase of the Governance Study be shared with Ministry staff (Governance and Structure Branch) for input, prior to implementation.

The consultants also recommend the following for consideration:

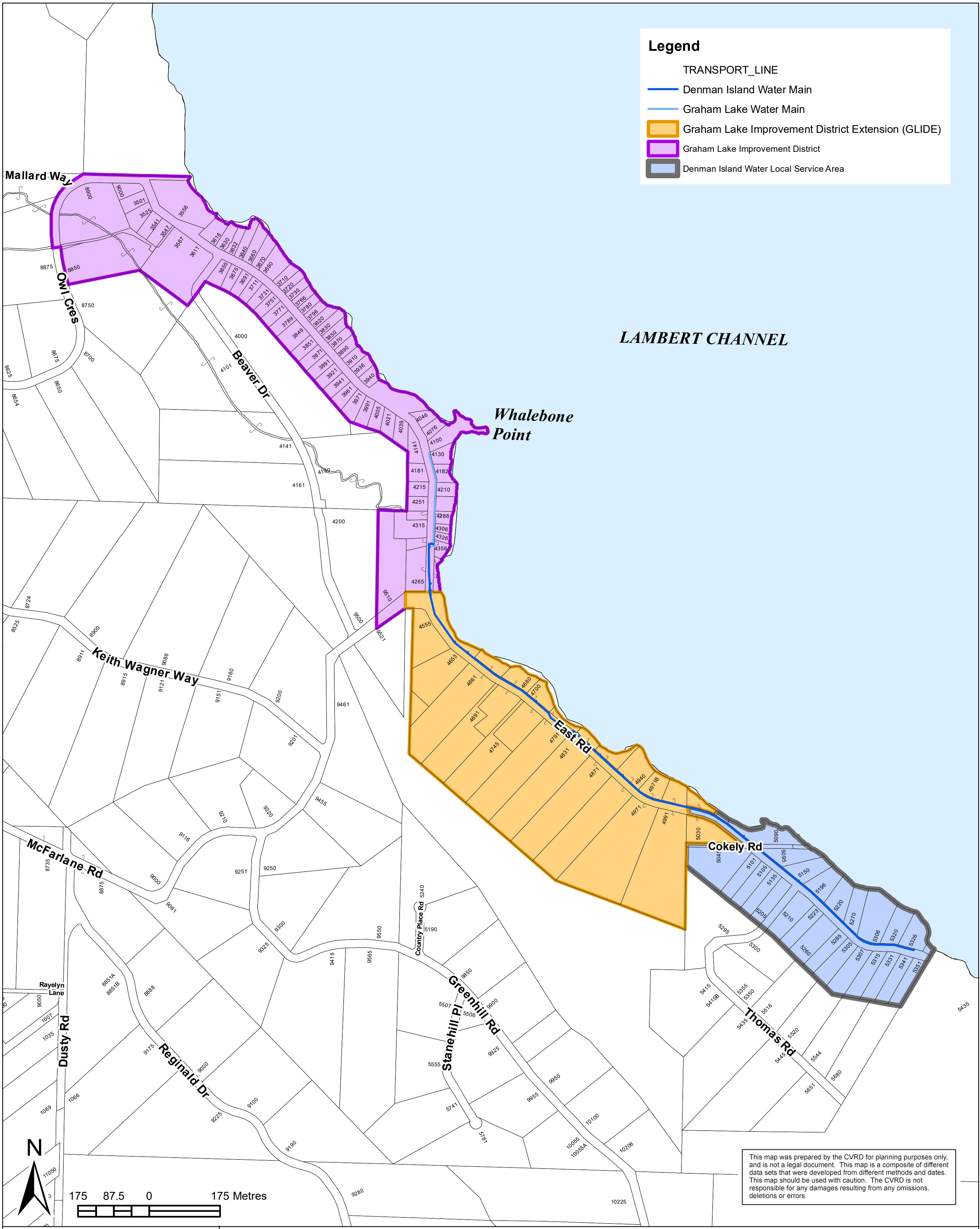
- THAT the GLID and the CVRD discuss and consider preferred options related to governance structure and delegation prior to public consultation so that a more detailed summary assessment of the anticipated impacts related to decision-making, operations, administration and customer service can be presented to residents as part of the consultation process. The CVRD Legislative Services department should be engaged early in the process for input, advice and guidance regarding the appropriate legislative process, bylaw requirements, elector assent and any related considerations.

- THAT the financial analysis included in this report be refined prior to public consultation based on:

  a) final selection of the preferred water treatment system upgrade solution and its acceptance by Island Health;
  b) confirmation by the CVRD regarding the requirement for water meters; *RESOLVED – water meters would will not be required as a condition of conversion. References/cost assumptions removed accordingly.*
  c) confirmation by the CVRD human resources department regarding possible contracting of the operator and relief operator positions and any related requirements related to compensation; *RESOLVED – may be contracted (confirmed by Human Resources).*
  d) confirmation by the CVRD finance department regarding the amount to allow annually for regional district administration, and what services will be included. *RESOLVED – allowed $6,500 (confirmed with Financial Services).*

- THAT the GLID and CVRD continue to monitor grant opportunities.

APPENDIX A – Current Boundaries Map



This map was prepared by the CVRD for planning purposes only, and is not a legal document. This map is a composite of different data sets that were developed from different methods and dates. This map should be used with caution. The CVRD is not responsible for any damages resulting from any omissions, deletions or errors.

Path: R:\Projects\Services\EnviroHealth\DenmanIsland\DenmanLSA_GrahamLake.mxd

Comox Valley
REGIONAL DISTRICT

Denman Island Water LSA & Graham Lake Improvement District

Date Saved: 2019-11-21 11:57:39 AM

APPENDIX B– GLID 2017 Operating Permit

vancouver
island health
authority

APPENDIX A

WATER SYSTEM OPERATING CONDITIONS FOR
GRAHAM LAKE IMPROVEMENT DISTRICT

3567 East Road
Denman Island, BC, V)R 1T0

Terms and Conditions

1. Water must be treated in accordance with Drinking Water Treatment Objectives for Surface Water Supplies in British Columbia to achieve the following:
   - 4 log removal/inactivation of viruses.
   - 3 log removal/inactivation of Giardia cysts and Cryptosporidium oocysts.
   - 2 treatment processes.
   - 1 NTU turbidity (maximum) in finished water.

2. Compliance with the following timelines:

Tasks	Completion Date
a) Maintain an ongoing water quality monitoring program acceptable to the Drinking Water Officer. This water quality monitoring program should be reviewed annually with the Drinking Water Officer and revised accordingly.	Ongoing
b) Identify potential treatment options.	October 1, 2018
c) Select a final treatment technology.	January 1, 2019
d) Obtain a Permit to Construct or Waiver from the Vancouver Island Health Authority (VIHA) Public Health Engineer. This permit is for the construction of all works necessary to meet the VIHA Surface Water Quality Treatment Objectives.	July 1, 2019
e) Construct and Commission all works necessary to meet the Island Health Surface Water Treatment Objectives.	October 1, 2021

3. Maintain routine monitoring to ensure the efficacy of disinfection and/or treatment technology according to industry standards. Maintain records of all monitoring conducted, deviations from standard operating procedures, and customer complaints.

4. Maintain maintenance and operating procedures that abide by BCWWA standards or equivalent. Maintenance and Operating Procedures shall include:
    - o Monitoring of source, and intake.
    - o Maintenance and monitoring of disinfection equipment, and treatment equipment.
        - o Location/availability of spare equipment and parts.
        - o Maintenance and monitoring of distribution lines.

5. Adhere to Sampling Program as approved by the Drinking Water Officer. The Sampling Program is to include the following:
        - o Bacteriological Testing on a frequency established by the Drinking Water Officer.
        - o General Chemical Testing at a minimum of every 5 years that addresses the VIHA Guidelines for Approval for Waterworks.

6. Annually review and as required update the water system 'Emergency Response Plan'. Provide Drinking Water Officer a notice of review and updated copy.

6. Provide an operator with training acceptable to the DWO to operate the water system at all times, or provide the DWO with written semi-annual reports outlining the effort that has been made to meet this requirement.

Date: July 31, 2017

John D. Hillis
Environmental Health Officer

island health

HEALTH PROTECTION

PERMIT

to OPERATE

A WATER SUPPLY SYSTEM

Water System Name:	**GRAHAM LAKE IMPROVEMENT DISTRICT**
Premises Number:	1410233
Premises Address:	3567 East Road Denman Island, BC V0R 1T0
Water System Owner:	Graham Lake Improvement District

Graham Lake Improvement District is hereby permitted to operate the above potable water supply system and is required to operate this system in accordance with the Drinking Water Protection Act and in accordance with the conditions set out in this operating permit and conditions established as part of any construction permit.

The water supply system for which this operating permit applies is generally described as:

Service Delivery Area:	Denman Island North
Source Water:	Graham Lake Intake
Water Treatment methods are:	Rapid Sand Filtration
Water Disinfection methods are:	UV and Chloramination
Number of Connections	15-300 (DWC)

Operating conditions specific to this water supply system are in Appendix A.

Date: July 31, 2017

Issued By:
Environmental Health Officer

This permit must be displayed
in a conspicuous place and is not transferable

Place Decal Here

APPENDIX C – Order in Council to Dissolve Royston Improvement District

PROVINCE OF BRITISH COLUMBIA

ORDER OF THE LIEUTENANT GOVERNOR IN COUNCIL

Order in Council No. 626 *, Approved and Ordered* NOV 26 2009

Lieutenant Governor

Executive Council Chambers, Victoria

On the recommendation of the undersigned, the Lieutenant Governor, by and with the advice and consent of the Executive Council, orders that, effective January 1, 2010, the attached Royston Improvement District Order is made.

Minister of Community and Rural Development

Presiding Member of the Executive Council

(This part is for administrative purposes only and is not part of the Order.)

Authority under which Order is made:

Act and section:-	*Local Government Act*, R.S.B.C. 1996, c. 323, ss. 14.2, 735, 735.1, 735.2, 781 and 782.1
Other (specify):-	OIC 163/55

November 5, 2009

O/870/2009/12

ROYSTON IMPROVEMENT DISTRICT ORDER

Definitions

1 In this order:

"improvement district" means the Royston Improvement District;

"municipality" means The Corporation of the City of Courtenay;

"regional district" means the Comox Valley Regional District.

Letters Patent revoked

2 The Letters Patent issued on January 21, 1955 incorporating the improvement district are revoked.

Transfer of rights, property and assets

3 (1) Subject to subsection (2), the rights, property and assets of the improvement district are transferred to and vested in the regional district.

(2) The rights, property and assets of the improvement district that relate to the waterworks service of the improvement district and that are located within the boundaries of municipality are transferred to and vested in the municipality.

Transfer of obligations

4 (1) Subject to subsection (2), the obligations of the improvement district are transferred to and assumed by the regional district.

(2) The obligations of the improvement district that relate to that portion of the waterworks service of the improvement district that serves an area within the area of the municipality are transferred to and vested in the municipality.

Continuation of waterworks service by municipality

5 (1) The portion of the waterworks service of the improvement district that serves an area within the area of the municipality is continued as a local area service of the municipality.

(2) The boundaries of the local area service referred to in subsection (1) are the boundaries of that portion of the improvement district that was within the boundaries of the municipality immediately before the improvement district is dissolved.

(3) For the purposes of section 14.2 (6) of the *Local Government Act* in relation to the service continued under subsection (1) of this section, the specified date is December 31, 2010.

Continuation of services by regional district

6 (1) The following services of the improvement district are continued as services of the regional district:

(a) waterworks, except for that portion of the service continued under section 5;

(b) street lighting;

(c) collection and disposal of garbage.

(2) The boundaries of the service area for each service continued under subsection (1) are the boundaries of that portion of the improvement district that is not within the boundaries of the municipality immediately before the improvement district is dissolved.

(3) For the purposes of section 781 (4) of the *Local Government Act* in relation to the services continued under subsection (1) of this section, the specified date is March 31, 2010.

Continuation of bylaws

7 (1) The bylaws of the improvement district continue in force as bylaws of the regional district applicable to the area of the regional district to which they applied as bylaws of the improvement district until those bylaws are amended or repealed by the board of the regional district.

(2) The bylaws of the improvement district respecting the waterworks service continue in force as bylaws of the municipality applicable to the area of the municipality to which they applied as bylaws of the improvement district until those bylaws are amended or repealed by the council of the municipality.

References to improvement district

8 (1) A reference to the improvement district in any commercial paper, lease, license, permit or other contract, instrument or document that is transferred under section 3 (1) or 4 (1) or that relates to rights, property, assets or obligations transferred under section 3 (1) or 4 (1) is deemed to be a reference to the regional district.

(2) A reference to the improvement district in any commercial paper, lease, license, permit or other contract, instrument or document that is transferred under section 3 (2) or 4 (2) or that relates to rights, property, assets or obligations transferred under section 3 (2) or 4 (2) is deemed to be a reference to the municipality.

Waterworks service

9 Until otherwise agreed to by the municipality and the regional district,

(a) the regional district must supply water to the waterworks service continued under section 5 (1), and

(b) the municipality must pay to the regional district on or before December 31 of each year an amount equal to the fees and charges collected in the year in respect of the waterworks service continued under section 5 (1).

Waterworks service advisory committee

10 (1) On or before March 31, 2010, the board of the regional district must establish a committee to advise the board until March 31, 2013 on all matters relating to the waterworks service continued under section 6 (1) (a).

(2) The board of the regional district must appoint as members of the committee those individuals who are members of the board of trustees of the improvement district immediately before the improvement district is dissolved.

APPENDIX D – Olalla Local Community Establishment Bylaw

Bylaw No. 1609, 1995

Olalla Local Community Establishment Bylaw

Consolidated for convenience purposes.

Includes all amendments to the text up to:

December 13, 2007

Summary of Amendments

Bylaw No.	**Adopted**	**Amendment**	**Purpose**
1771, 1997	December 11, 1997	Replace Sections 6.0, 6.1 and 10.3	Provision for the inaugural election of commissioners to be held on a day set by the Chief Election Officer
2030, 2000	January 25, 2001	Replace map	Extend boundaries
1609.01	December 13, 2007	Replace Section 10.4	Amend the number of meetings held per year

REGIONAL DISTRICT OF OKANAGAN-SIMILKAMEEN

BYLAW NO. 1609, 1995

Consolidated for Convenience Only

A bylaw to establish within a portion of Electoral Area 'G', the Olalla Local Community and Olalla Local Community Commission.

WHEREAS pursuant to Section 817 of the Municipal Act, the Regional District of Okanagan-Similkameen may, by bylaw, establish a local community to be administered by a local community commission;

AND WHEREAS the Board of Directors of the Regional District of Okanagan-Similkameen has been requested to establish a local community at Olalla;

AND WHEREAS pursuant to Section 817 of the Municipal Act, the Board of Directors of the Regional District of Okanagan-Similkameen, has obtained the assent of the electors of the Olalla Local Community;

NOW THEREFORE the Board of Directors of the Regional District of Okanagan-Similkameen in open meeting assembled, ENACTS as follows:

LOCAL COMMUNITY

1.0 The Board of Directors of the Regional District of Okanagan-Similkameen hereby establishes within a portion of Electoral Area ^{1}**O**^{1} a local community to be known as the Olalla Local Community.

BOUNDARIES OF THE LOCAL COMMUNITY

2.0 The boundaries of the Olalla Local Community are a portion of Electoral Area “G” ”as outlined on Schedule 'A' attached to and forming part of this bylaw.[1]

LOCAL COMMUNITY COMMISSION

3.0 The Board of Directors of the Regional District of Okanagan-Similkameen ("Regional District") hereby establishes a local community commission, to be known as the Olalla Local Community Commission ("Commission"), which shall have the authority set out in this bylaw.

---

[1] Bylaw No. 2030, 2000 Olalla Local Community Establishment Bylaw

ANNUAL GENERAL MEETING

4.0 The Commission shall hold its annual general meeting on the first Wednesday of each December.

4.1 Notice of the day, hour and place of the annual general meeting of the Commission shall be given at least one month prior to the time of the meeting by mailing a notice to each property owner in the Local Community.

4.2 Notice of the day, hour and place of the annual general meeting of the Commission shall be published once in a newspaper circulating in the local community not more than one month prior to the annual general meeting.

STRUCTURE OF THE LOCAL COMMUNITY COMMISSION

5.0 The Olalla Local Community Commission shall consist of:

(a) 4 elected commissioners, all of whom must reside in the local community and have the qualifications to hold office as a director, and

(b) the director for Electoral Area 'G'.

ELECTIONS FOR COMMISSIONERS[2]

6.0 Inaugural elections for the local community commissioners shall be held on a Saturday set by the Chief Election Officer as appointed by the Regional District of Okanagan-Similkameen. Subsequent elections shall be held every three years in conjunction with general local elections.

6.1 Part 3 of the *Municipal Act* applies to the holding of an election for the local community commissioners

TERM OF OFFICE

7.0 The term of office for elected commissioners is to be 3 years or until their successors are elected, whichever is later.

ELECTION OF CHAIR AND VICE-CHAIR

8.0 The Commissioners shall elect a Chair and Vice Chair at the meeting held on the first Wednesday of December in each year.

---

[2] Bylaw No. 1771, 1997 Olalla Local Community Establishment Bylaw Amendment Bylaw

REMUNERATION

9.0 The elected Commissioners shall serve without remuneration, but shall be entitled to reimbursement for expenses reasonably incurred in connection with the performance of their duties.

ADMINISTRATIVE POWERS

10.0 The powers and duties of the Olalla Local Community Commission shall include the delegation of administrative powers, by the Regional District with respect to the supply, treatment, conveyance, storage and distribution of water. These administrative powers do not include any of the responsibilities of the Treasurer as defined in Section 245 of the *Municipal Act.*

10.1 The Commission shall prepare a proposed provisional budget for the Olalla Water System Local Service established within the Olalla Local Community and submit this budget to the Board of Directors of the Regional District by September 30th in each year. The Commission shall submit proposed amendments to the provisional budget to the Board of Directors of the Regional District by February 28th in each year.

10.2 The Commission shall have the ability to approve payment of all current accounts for the Olalla Water System Local Service within the constraints of the provisional and final budgets adopted by the Regional District and to submit these accounts to the Treasurer of the Regional District for payment.

10.3 The procedure that is to be followed for the conduct of its business is governed by the bylaw adopted by the Regional District of Okanagan-Similkameen pursuant to section 794 of the *Municipal Act*, RBC 1996, Chapter 323.[3]

10.4 The Commission shall hold at least one meeting per year. The Chair or any two Commissioners may summon a meeting of the Commission by giving at least two days' notice in writing to each Commissioner, stating the time, place and purpose for which the meeting is called.[4]

---

[3] Bylaw No. 1771, 1997 Olalla Local Community Establishment Bylaw Amendment Bylaw

[4] Bylaw No. 1609.01, 2007 Olalla Local Community Establishment Amendment Bylaw

CITATION

11..0 This bylaw may be cited for all purposes as the "Olalla Local Community Establishment Bylaw No.1609, 1995".

READ A FIRST, SECOND AND THIRD TIME this 20th day of July, 1995.

I hereby certify that this is a true and correct copy of the "Olalla Local Community Establishment Bylaw No. 1609, 1995.", as read a third time by the Regional Board of the Regional District of Okanagan-Similkameen, on the 20th day of July, 1995.

DATED this 20th day of July, 1995.

Administrator/Secretary

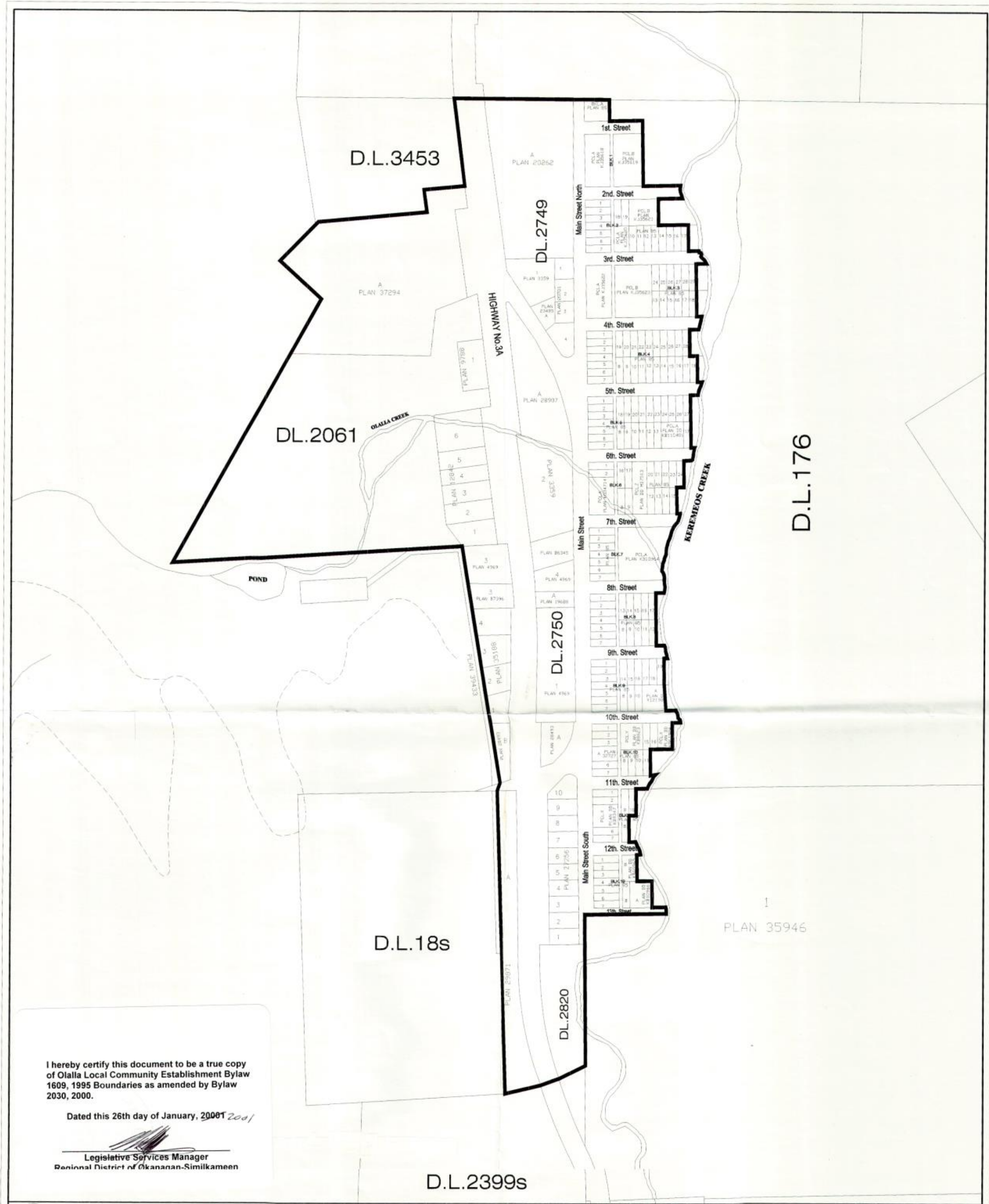
APPROVED BY THE INSPECTOR OF MUNICIPALITIES
this 5th day of September, 1995.

THE ASSENT OF THE ELECTORS in the Local Community was obtained
this 16th day of September, 1995.

RECONSIDERED, PASSED AND FINALLY ADOPTED
This 17th day of April, 1997

~~Administrator/Secretary~~ Deputy
Secretary

FILED WITH THE INSPECTOR OF MUNICIPALITIES
this 21st day of April, 1997



I hereby certify this document to be a true copy of Olalla Local Community Establishment Bylaw 1609, 1995 Boundaries as amended by Bylaw 2030, 2000.

Dated this 26th day of January, ~~20001~~ 2001

Legislative Services Manager
Regional District of Okanagan-Similkameen

PRODUCED AND AVAILABLE FROM
Regional District of Okanagan Similkameen
PLANNING DEPARTMENT
101 MARTIN STREET PENTICTON, B.C. V2A 5J9

DRAWING TYPE
DRAWING NUMBER
NORTH

DATE OF LAST REVISION
PLOT DATE 01/22/00
DRAWING SCALE 1:3500

Appendix B

GRAHAM LAKE IMPROVEMENT DISTRICT
REPORT NUMBER:

WATER TREATMENT SYSTEM OPTIONS ASSESSMENT

NOVEMBER 15, 2019

CONFIDENTIAL

WATER TREATMENT SYSTEM OPTIONS ASSESSMENT

GRAHAM LAKE IMPROVEMENT DISTRICT

FINAL
CONFIDENTIAL

PROJECT NO.: D-C6100.00
DATE: NOVEMBER 15, 2019

WSP
210 – 889 HARBOURSIDE DRIVE
NORTH VANCOUVER, BC V7P 3S1

T: +1 604-990-4800
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Date Nov 15, 2019

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Title Senior Process Engineer

Date Nov 15 2019

PROFESSIONAL
PROVINCE OF BRITISH COLUMBIA
T.F. MUNDING
Nov 15 2019
ENGINEER

APPROVED BY *(must be reviewed for technical accuracy prior to approval)*

CMCampbell

Name, Designation Carol Campbell
Title Sr. Project Manager

Date Nov 15, 2019

WSP Canada Group Limited prepared this report solely for the use of the intended recipient, Graham Lake Improvement District, in accordance with the professional services agreement. The intended recipient is solely responsible for the disclosure of any information contained in this report. The content and opinions contained in the present report are based on the observations and/or information available to Graham lake Improvement District at the time of preparation. If a third party makes use of, relies on, or makes decisions in accordance with this report, said third party is solely responsible for such use, reliance or decisions. WSP Canada Group Limited does not accept responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken by said third party based on this report. This limitations statement is considered an integral part of this report.

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TABLE OF CONTENTS

TABLES

FIGURES

1 INTRODUCTION

1.1 SETTING

The Graham Lake Improvement District (GLID) obtains its water from Graham Lake, located in the middle of the southern end of Denman Island. The water system was originally constructed around 1970 and has been upgraded a number of times.

1.2 DESCRIPTION OF EXISTING SYSTEM

The Graham Lake Improvement District (GLID) consists of:

- A dam on Graham Lake;
- a submerged raw water intake;
- approximately 750 m of 150 mm diameter AC supply main;
- a water treatment and booster pumping system building;
- a concrete reservoir (clearwell) storage of 4,500 Igal (20.5 m^3);
- distribution watermains consisting of 100 mm diameter and 150 mm diameter AC watermains and hydrants.

The submerged intake structure consists of six vertical 0.9 m long 150 mm (6") PVC pipes, with 0.04 inch slots, supported by an alumimun frame.

Water flows by gravity from the lake to the treatment/pumping building, where it is filtered by two parallel sand filters, each with a reported capacity of 8.9 L/s (117 Igpm), and then passes through two parallel banks of Ultra-Violet (UV) lights, also rated at 8.9 L/s. The water is then injected with 12% sodium hypochlorite and passes through a stainless steel 3.2 m^3 baffled chlorine contact tank. As the water flows out of the chlorine contact tank, it is injected with ammonia which combines with the chlorine to create chloramine for secondary disinfection, and then flows into the concrete storage reservoir.

Treated water is pumped into the distribution system by a continuously operating 3 hp pump, pressurizing the system to 50 psi. A second pump automatically engages when the system demand exceeds 55 USgpm. A third pump is a back-up and is used if one of the others is out of service.

The water distribution system has a flush-out system that automatically operates for one hour each day, between 2 am and 3 am, turning over the entire volume of water in the main between the pumphouse and the flush-out point, a volume of approximately 4,000 USgal.

A propane generator with an automatic transfer switch backs-up the treatment and pumping system during power outages.

1.3 OBJECTIVES

This assessment is being undertaken as a step by GLID towards becoming compliant with VIHA's *Health Protection and Environmental Services Policy 3.3 Treatment Objectives for Surface Water Supplies and the Drinking Water Treatment Objectives (Microbiological) for Surface Water Supplies in British Columbia (SWTOMSWSBC).* This policy requires that potable water derived from surface water have at least two processes of operation acceptable to the Vancouver Island Health Authority that together will achieve a 4-log removal/inactivation of viruses and a 3-log removal/inactivation of *Giardia* cysts and *Cryptosporidium* oocysts, and produce a finished water with less than 1 NTU turbidity and 0 coliforms.

Water from Graham Lake has high levels of organics and is subject to disinfection by-products (DBP) formation caused by the reaction between the chlorine used for disinfection and the naturally occurring organic matter in the water. DBP formation also leads to loss of chlorine residual for secondary disinfection. Because of these concerns, an ammonia addition system was installed at the treatment facility in 2014. The addition of ammonia converts the chlorine used for disinfection to a less reactive chloramine that provides residual disinfection while reducing DBP formation.

Although filtration is required for compliance with the SWTOMSWSBC, if the driving factor for filtration is the removal of disinfection by-products forming organics, the necessary turbidity reduction will also be achieved. The technologies designed with the primary purpose of removing organics provide overall high levels of treatment, as organics are smaller than turbidity and are often in a dissolved state. Therefore, most processes that remove organics also remove turbidity.

There is no sanitary sewer close to the treatment facility, so treatment residuals disposal is an important consideration in the selection of a treatment process.

We note that in addition to becoming compliant with VIHA requirements, the GLID systems faces the challenge of being supported by a small community, and that the proposed treatment upgrades will be entirely funded by GLID member households.

2 RAW WATER QUALITY AND TREATMENT OBJECTIVES

2.1 RAW WATER QUALITY

Table 2-1 below summarizes the key water quality parameters and target water quality objectives, based on water quality records provided by GLID. The number of values provided for each parameter is dependent on FLID water testing frequency for that parameter.

Table 2-1: Raw Water Quality and Treatment Objectives

PARAMETER	VALUE	TARGET
Turbidity (NTU)	1.76, 2.8, 0.72,1.59,0.88	<1
Alkalinity	17.2,15.6,20.5,15.9	
UV Transmissivity (%)	59.4, 70.1, 66.6	N/A
Total Organic Carbon (mg/L)	5.32, 3.67, 4	< 3
Dissolved Organic Carbon (mg/L)	4.93, 3.36, 3.7	<3
True Colour (Colour units)	36.2	< 15 CU
Apparent Colour (Colour Units)	40, 23.4	< 15 CU
pH	7.52, 7.35, 7.07, 7.29, 7.43, 7.61, 7.42	7.5-8.0
Iron (µg/L)	284, 266,164,	<300
Manganese (µg/L)	6.8, 4.5, 58.5	<50

2.2 TREATMENT OBJECTIVES

British Columbia regulates municipal drinking water quality through its *Drinking Water Protection Act* (DWPA) and *Drinking Water Protection Regulation* (DWPR). The Act and Regulation on Vancouver Island are administered by VIHA who mandate that the "4-3-2-1-0" treatment objective for surface water supplies as follows:

- 4-log (99.99%) reduction or inactivation in viruses, normally achieved through chlorine disinfection with contact time.
- 3-log (99.9%) reduction or inactivation in protozoa (Giardia cysts and Cryptosporidium oocysts), typically achieved through filtration, or UV disinfection, or both.
- 2 treatment processes for surface water; combining more than one process for treatment allows for a multi-barrier approach against a range of microorganisms.
- 1 NTU turbidity or less; well established filtration technologies can consistently reduce turbidity in the water to <0.1 to 1 NTU.

- No detectable E.coli, fecal coliforms, and total coliforms, typically achieved through disinfection (such as chlorination and/or UV disinfection) or a combination of disinfection and filtration.

In addition to the 4-3-2-1-0 objective, the treatment system must also address the potential for elevated concentrations of disinfection by-products in the water following chlorination.

Therefore, the treatment objectives for the Graham Lake Water System are the following:

1. Organics reduction (or reduction of potential for formation of DBPs).
2. Turbidity reduction.
3. Pathogen reduction: 4-log (99.99%) removal/inactivation of viruses; 3-log (99.9%) removal/inactivation of protozoa (Giardia cysts and Cryptosporidium oocysts); 0 cfu/100 mL of total coliforms, and 0 cfu/100 mL of E.coli.
4. Secondary disinfection.

3 DESIGN PARAMETERS

3.1 WATER DEMAND

GLID requested that the project be based on the following customer base:

- 67 existing GLID connections
- 14 potential additional GLID connections (future)
- 23 potential DIWLSA connections
- Up to 10 potential future connections on vacant land
- BC Ferries Denman East Terminal connection (future).

Based on water records provided for the current connections, Table 3-1 below summarizes the water demand information based on the data provided for three years (2014-2016). We note that additional data for 2017 – 2018 was provided but were not complete. This data was used to confirm the 2014 – 2016 data and was also useful to determine the maximum day demand.

Table 3-1: Current Average Water Demands

WATER DEMANDS

# existing connections	56	
Total Demand per year	6,455,400	USG/year
Flushed volume per year	1,362,667	USG/year
DIWLSA consumption per year	445,795	USG/year
Demand excl. flushed water and DIWLSA	4,646,939	USG/year
Demand excl. flushed water and DIWLSA	17,588,664	L/year
Demand excl. flushed water and DIWLSA	48,188	L/day
Demand excl. flushed water and DIWLSA	0.56	L/s
Demand per connection per year	82,981	USG/year
Demand per connection per day	227	USG/day
Demand per connection per day	861	L/day

The following table shows the maximum day demand from records provided for 2016-2018:

Table 3-2: Current Maximum Water Demands

WATER DEMANDS

# existing connections	56	
Maximum Day (2016)	50,290	USG/day
Flushed volume per day	3,200	USG/day
DIWLSA consumption on maximum day	4,933*	USG/day
Demand excl. flushed water and DIWLSA	42,157	USG/day
Demand excl. flushed water and DIWLSA	159,565	L/day
Demand excl. flushed water and DIWLSA	1.85	L/s
Demand per connection per day	2,849	L/day

*based on MDD to ADD ratio of 3.5

Because GLID suspects that their flowmeter is not accurate, the demand from the 56 GLID connections was increased by 10% to account for the inaccuracy. Projecting to the ultimate number of connections (113 connections) gives the following future projected average daily demand and maximum day demand:

Table 3-3: Future Water Demands

ESTIMATED FUTURE WATER DEMANDS

Average Daily Demand		
Ultimate # of connections	113	
Average demand per day per connection	982	L/day
Total average demand per day for all connections	106,960	L/day
BC Ferries connection	2,271	L/day
Flushing water	4,864	L/day
Total average demand per day	114,095	L/day
Total average demand per day	1.32	L/s
Maximum Day Demand		
Maximum Day Demand per connection	3,134	L/day
Maximum day demand per day for all connections	354,177	L/day
BC Ferries connection	7,949	L/day
Flushing water	4,864	L/day

ESTIMATED FUTURE WATER DEMANDS

Total maximum day demand	366,990	L/day
Total maximum day demand	255	L/min
Total maximum day demand	4.25	L/s

*based on MDD to ADD ratio of 3.5 applied

Peak hour can be estimated by applying a factor to average day demand. For communities with a population below 500 people, peak hour factors can be expected to range between 5 and 7.5 applied to average daily demand, with higher factors being applied to smaller communities. Assuming a peak hour factor of 7.5 results in a peak hour demand as follows:

7.5 x 1.32 L/s = 9.9 L/s for future expansion

The current treatment system has a capacity of 8.9 L/s, well above the current and projected average day demand but close to the estimated future peak hour demand.

DESIGN PARAMETER

Future Average Daily Demand = 1.3 L/s
Future Maximum Day Demand = 4.3 L/s
Future Peak Hour Demand = 9.9 L/s

3.2 WATER STORAGE

Providing storage of treated water will balance peak demands, allowing the treatment system capacity to be sized to meet maximum day demand with peak demands provided by the balancing storage. (For the same reason, water storage could also be used for firefighting.)

As well, the treatment system can operate with fewer flow fluctuations, and fewer stop-start cycles. Without storage, a treatment and pumping system can have added complexity to address highly variable demands.

The minimum recommended storage capacity for systems that do not provide fire protection is the average daily consumption, which equates to a storage volume of 114,095 L for the future expanded system. The existing reservoir/clearwell has a capacity of 20,500 L and, therefore, the storage shortfall is 93,595 L.

This capacity needed can be reduced when the source and treatment can meet the peak hour demand. This is the current strategy at GLID where the treatment capacity at 8.9 L/s is well above the peak hour demand.

DESIGN PARAMETER

Treated Water Storage Volume Required = 114,095 L

3.3 PUMPING

Presently, water is pumped from the clearwell to the distribution system via three pumps each with a separate suction line from the storage reservoir.

3.4 CHLORINE CONTACT

Chlorination and contact time are required by VIHA to provide 4-log inactivation of viruses. For water at 0.5 °C temperature, a minimum concentration·time (CT) value of 12 mg·min/L is needed to provide 4-log inactivation of viruses. Chlorine disinfection will also provide a residual chlorine concentration in the distribution system for suppression of bacterial growth. Chlorine residuals in the distribution system must be above 0.2 mg/L, but residuals should not be above 0.8 mg/L for aesthetic reasons.

If the disinfection system will provide a minimum target concentration of 0.8 mg/L for treated water (at the discharge from the CT tank), and using a baffling factor of 0.7 for Superior Baffling (the factor for serpentine basin baffles), to achieve a CT of 12.0 mg·min/L, a chlorine contact time of 21.4 minutes is required:

12.0 mg·min/L = 0.8 mg/L x 0.7 x t minutes

t = 21.4 minutes

At a design flow rate of 4.3 L/s, the volume of the contact tank needed is 5,521 L, calculated as follows:

4.3 L/s x 60 s/min x 21.4 minutes = 5,521 L

The existing CT tank volume is 3,200 L. An additional 958 L of contact time is available in the distribution pipe before the first connection (info provided by GLID). Therefore, the existing contact time in the system is insufficient for the maximum day flow of 4.3 L/s.

A portion of the existing clearwell, which has a volume of 20,500 liters, could also be dedicated to additional CT.

The chlorine residual should be measured downstream of the chlorine contact tank and be maintained above the value of 0.8 mg/L.

DESIGN PARAMETER

Minimum Chlorine Contact Volume = 5,521 L (assuming a residual of 0.8 mg/L chlorine at discharge)

4 TREATMENT OPTIONS

4.1 FILTRATION SYSTEM OPTIONS

Historically, water treatment facilities for surface waters were designed to remove turbidity. This led to the implementation of coagulation based media filtration and membrane technologies. Over time, as organics reduction came to be recognized as a significant health issue due to the formation of disinfection by-products when combined with chlorine, conventional chemical treatment processes were modified to include organics removal. This technology became known as enhanced coagulation.

Conventional filtration technologies for organics reduction include sedimentation, dissolved air flotation (DAF), direct filtration, and ultrafiltration (UF) membranes, following the injection of a chemical coagulant and a coagulation/flocculation step.

The use of chemical coagulants for organic reduction is typically limited to around 50% of the raw organic level. DAF and UF membrane processes are typically able to achieve the GCDWQ objectives, but are highly dependent on coagulant dosing for effective organics reduction to reduce DBP's to below GCDWQ limits. Furthermore, DAF and UF are both relatively complex treatment technologies, requiring an experienced operator.

Granulated Active Carbon (GAC) is also effective at removing organics and is very simple to implement. However, both Opus[1] and BIPurewater[2] previously reviewed the option of GAC for organics reduction and both concluded that the amount of GAC media that would be needed would incur unreasonably high operational costs.

As well, high levels of organics lower UVT values which impact the effectiveness of the UV disinfection system.

There are other newer and innovative technologies that focus on organics removal that are becoming more readily available that don't use chemical coagulants.

The primary considerations for selecting a treatment system for GLID, aside from meeting the water treatment objectives, are cost and residuals handling and disposal. The size of the treatment equipment is also a consideration, as it is desirable to install the equipment within the existing building, or within an addition to the building, which will reduce building construction costs, and because there is limited available land within the current easement.

We have selected the following treatment technologies to review:

1. Nanofiltration membranes + UV
2. Ceramic Ultra-Filtration Membrane + UV
3. Ion Exchange Resin + UV
4. Direct filtration (coagulation/flocculation/filtration) + UV, with dewatering for backwash water
5. Ozone + biofiltration + UV
6. Cartridge filtration + UV

These technologies have the potential for achieving organics and turbidity removal with less dependency on chemical usage than that of DAF and UF filtration. Reductions in residuals waste streams over other technologies are also expected through these technologies.

All technologies would be sized to meet the maximum day demand and would, therefore, require reservoir storage to be built, except for the direct filtration and cartridge filtration options which could be sized to meet peak hour demand without significant space requirements compared to a system size for maximum day demand.

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[1] Denman Island Disinfection By-product Removal, Opus DaytonKnight Consultants Ltd, Nay 7, 2014

[2] Engineering Report, BIPurewater, May 3, 2017

4.2 HOLLOW FIBRE NANOFILTRATION MEMBRANE (HFNF)

BIPurewater's report for GLID provides a detailed proposal for this option using Pentair HFW1000 nanofiltration membranes.

Membrane filtration is an established water treatment process that uses a physical barrier to retain any particulates greater than the barrier's pore size. Membrane filtration is a pressure (or vacuum) driven sieve process that removes particles and microorganisms by forcing water through a semi-porous surface. Modern membranes can remove silt and clay particles, bacteria, and protozoa such as *Giardia* and *Cryptosporidium*. Some membranes can remove viruses as well. Membranes can be classified based on their pore size as follows:

Table 4-1: Types of Membrane Filtration

MEMBRANE TYPE	PORE SIZE	CONSTITUENTS REMOVED
Microfiltration (MF)	>50 nm	Silt, protozoa and some bacteria and viruses
Ultrafiltration (UF)	2-50 nm	Large molecules, clay, most bacteria and some viruses
Nanofiltration (NF)	<2 nm	Small molecules, viruses and some dissolved metals (hardness)
Reverse Osmosis (RO)	<2 nm	Very small molecules, colour, hardness, ions

For organic reduction, nanofiltration is the minimum barrier pore size to filter organics without the use of a coagulant. Nanofiltration membranes have extremely small pore sizes which filter large molecular weight organic molecules as well as suspended solids in one process step, without the need for any chemical coagulation. It is anticipated that the retained organics and solids can be discharged to the environment as there are no chemical additions.

Pentair HFW1000[3], proposed by BIPurewater, is a hollow fibre nanofiltration technology composed of Polyethersulfone (PES) and modified PES material. This membrane can reduce feed water turbidity from a maximum value of 25 NTU to less than 0.1 NTU and reduce colour to less than 5 TCU with typical removal of 80% to 90% of dissolved organic carbon (DOC).

Since no chemicals are required for pre-treatment, neither the chemical nor the mineral composition of the water is altered. Feed water is pumped through the NF membrane fibres' interior (inside-out) in a crossflow arrangement to minimize fouling occurrence on the membrane surface. A small reject stream is continuously wasted from the membrane system to control solids concentration and to optimize permeate quality.

Cross-flow filtration is different from dead-end filtration, in which the feed is applied perpendicular through the filter, and particles smaller than the effective pores size pass through as filtrate, and the larger particles build up as a cake layer on the filter. In cross-flow filtration, most of the feed flow travels tangentially *across* the surface of the filter, rather than into the filter. As the feed flows across the membrane surface, filtrate passes through while concentrate accumulates at the opposite end of the membrane. The principal advantage of this is that the filter cake is washed away during the filtration process, increasing the length of time that a filter unit can be operational. It also prevents irreversible fouling of the membrane which can potentially result in shorter membrane lifespan.

To be able to reject the organic molecules, the membranes have a very tight pore structure which results in low membrane flux (filtrate flow per unit membrane surface area) and permeability (rate of flow through the membrane for a given pressure), thus requiring a large number of membranes to treat the required water demand. This results

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[3] Engineering Report, BIPurewater, May 3, 2017

in large system footprint and high system cost. As well, the membranes are prone to breakage and frequent repair and have an expected life of about 5 to 10 years (typically 7 years) after which they must be replaced at a high cost.

The membranes are maintained by frequent backwashing where treated water is applied to the membrane in the reverse filtration direction (outside-in) to dislodge any retained particles in the membrane pores. Aside from the elevated solids and colour concentrations, the backwash stream is free of chemicals and environmental discharge may be viable. The recovery ratio (the volume of filtrate water produced per unit feed water supplied) is limited to about 75% requiring 25% of the feed water to be discharged from the WTP as reject waste water. This large volume of waste (1/3 of the volume of treated water) will likely have significant impact if discharged to ground as currently done for the sand filter backwash.

The membranes periodically must be chemically cleaned using a chlorine, sodium hydroxide and/or hydrochloric acid solution. High pH chemically enhanced cleaning is typically performed every 3 to 4 days. Low pH cleans are also required about every 13 weeks. The resultant chemical wastes constitute less than 0.1% of the total treatment flow and are the only waste stream that requires special handling and disposal. It may be possible to neutralize these cleaning solutions and then discharge them blended with the reject stream to the environment.

If the membranes are verified by daily membrane integrity tests, then UV-disinfection is not required as 4-log reduction of G*iardia* and C*ryptosporidium* is credited through the NF process and would then be considered a disinfection method and provide the 2nd barrier of the required dual barrier approach. BIPurewater's proposal includes UV disinfection, and does not provide for daily integrity testing, but states that integrity testing can be provided.

Figure 4-1 below shows a typical process flow diagram of a NF membrane process.

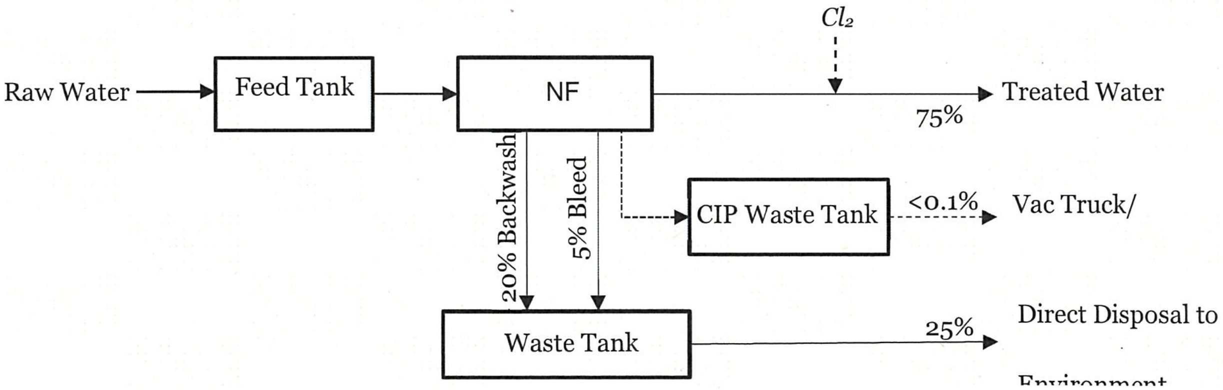

Figure 4-1: Typical Process diagram of nanofiltration membrane system

Post NF treatment, the filtered water would be chlorinated and discharged to the existing contact chamber. Chlorine disinfection will provide 4-log removal of viruses and a chlorine residual for secondary disinfection and delivered to the distribution network via the existing distribution pumps. Ammonia addition to produce chloramines will no longer be needed and can be removed as the organics would be reduced.

The amount of chlorine addition is expected to be minimized as the organics present in the water after filtration will be substantially reduced.

The main power demands in this process are the NF circulation pumps, backwash pumps and forward flush pumps. Other operational costs would be cleaning chemicals and membrane replacements.

The treatment system would consist of the following processes:

1 Strainer remove large particles
2 Pentair nanofiltration system
3 UV disinfection (if integrity testing not provided)
4 Chlorination + contact time

We note that BIPurewater's proposal is for a system with a capacity of 1.2 L/s, which is approximately equal to the current average day demand.

4.3 CERAMIC ULTRAFILTRATION MEMBRANE (CUF)

Ceramic ultrafiltration (CUF) is a water treatment technology that combines treatment ideologies from ceramic filtration and membrane ultrafiltration (UF). In ceramic ultrafiltration, the ceramic barrier is manufactured to have a pore size similar to a UF membrane. The ceramic media is typically 100% silicon carbide (SiC), which makes it very resistant to abrasion as well as chemical and biological reactions. The fine UF pore size in the media allows it to reject particles, colloidal material, bacteria, and pathogens. Due to these characteristics, CUF also has the highest operational flow rate (flux) of all UF membrane systems and lowest footprint requirements per volume of water treated. The robust material of the membrane allows it to have a membrane lifespan in excess 25 years.

The use of ceramic membranes in municipal drinking water application is still emerging as ceramic membrane costs are becoming competitive with polymeric membranes. Presently, there are two operating drinking water ceramic membrane plants in the United States that use a Purifics Ceramic Ultrafiltration system, in Delaware (3,800 m^3/day) and Mississippi (3,300 m^3/day). One other ceramic membrane plant is being designed for the Cache Creek Casino in Brooks, CA using the Kruger Ceramic Membrane (KCM) of Kruger. Two CUF pilot studies are currently in operation, the 180 MLD Choa Chung Kang Waterworks Plant in Singapore and 9.5 MLD City of Watsonville Water Treatment plant in California.

CUF treatment requires pre-screening of the raw water to remove any coarse particles. Following the screening, coagulant is added at the inlet to the high solids contact reactor (HSCR), where rapid mixing is used for effective mixing. Coagulation is required for the removal of organics and improved turbidity reduction.

From the HSCR tank, water is pumped into the membrane module in a cross flow arrangement. After passing through the membrane, the filtered water would be disinfected and sent to distribution. A waste stream is generated during membrane cleaning through an automatic maintenance cleaning cycle. A percentage of the waste stream water is circulated back to the HSCR in order to reduce the volume of wastewater and to produce a high concentrate solids, which would then be dewatered to a 3% to 10% solids sludge using a dewatering system. Waste volume is anticipated to be 0.3% of the overall process volume, compared to 10% for DAF/ultrafiltration. As such, the produced sludge can be locally stored for off-site disposal by vacuum truck. Overall system efficiency is therefore expected to exceed 99.7%. Figure 4-1 shows a typical process flow diagram of a CUF membrane WTP.

A frequent automatic maintenance cleaning of the CUF is conducted to dislodge any foulants that are attached to the membrane. Occasionally, a full maintenance cycle is activated through a combination of heat, high cross-flow flux (similar to a backwash), as well as chemical applications of acid and/or caustic which will scrub and dissolve residual foulants from the membrane. Overall, this chemical waste constitutes less than 0.1% of the total treatment flow. Disposal of this waste can be combined with the waste from the dewatering system and contained for vacuum truck disposal. Alternatively, a neutralization stage can be added to treat the chemical waste which will enable the plant to directly discharge to the environment, such as through a rock pit.

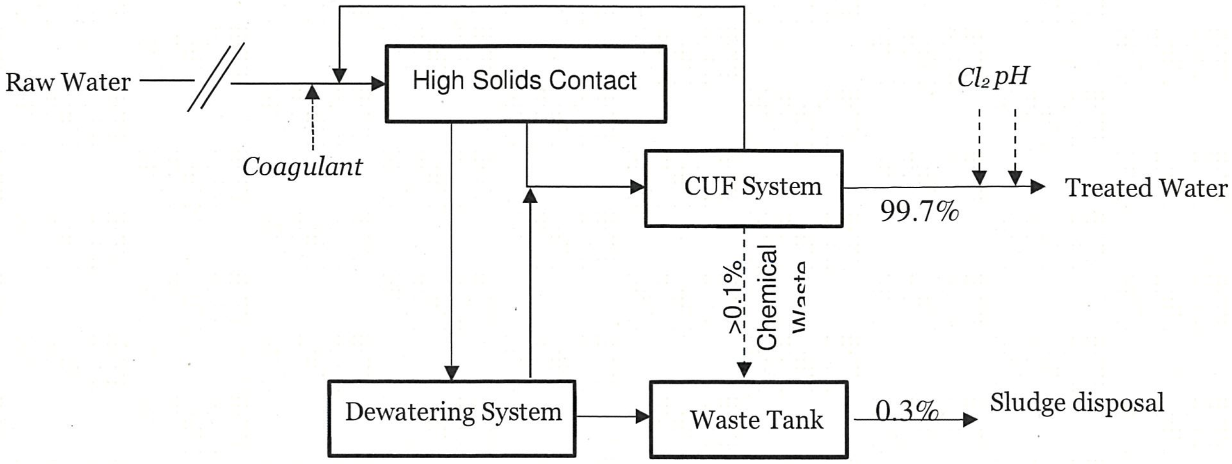

Figure 4-2: Typical process diagram of ceramic ultrafiltration membrane

Post CUF treatment, chlorine disinfection is required to provide 4-log removal of viruses and chlorine residual for secondary disinfection. However, the amount of chlorine addition is expected to be minimized as the organics present in the water after filtration will be substantially reduced. pH adjustment would likely be required post-treatment due to the reduction in alkalinity following coagulation.

A feed pump will likely be required. The spent TMP rinse solutions from the CUF will be neutralized inside the CUF unit and can then be discharged to the existing backwash disposal system. The solids discharge from the DeWRS could be discharged to a 1200 L covered bin for periodic disposal (truck away or local land application). The treated water from the CUF/DeWRS would be discharged into a small bin that can be hualed out by hand using a hand-dolly. The treated water from the CUF/DeWRS would be discharged to the existing contact chamber and then delivered to the distribution network via existing distribution pumps.

The CUF and dewatering system is fully automated and will start and stop automatically when required to meet the varying water demand and will perform its periodic membrane cleaning function without operator intervention or attention. The system performance is logged on its SCADA operator interface and can be remotely accessed via high speed internet connection (either land-line or cellular service is required).

The waste sludge from the WTP may need to be hauled off the island for disposal. However, during Bowen Island pilot testing at Grafton Lake (similar water quality as Graham Lake) an environmental analysis of the waste sludge was performed and found to be suitable for disposal by local ground application.

The CUF unit will perform an automatic membrane cleaning every 1 to 2 weeks that will generate approximately 500 L of neutralized waste water that could be disposed of to the existing backwash drain manhole. Otherwise it could be hauled off the island with the waste sludge for disposal.

The system will require a larger back-up generator to provide power to their pumps, air compressor and controls.

While the CUF & DeWRS system can be operated at reduced flow rates, it is typically run at or near its full design capacity to provide for its most energy efficient operation. Reductions in daily flow consumption is met by running the system intermittently to fill a reservoir volume between some start and stop levels.

The operator(s) will be required to perform the following tasks:

- Remove the collected waste sludge from the DeWRS (swap-out full sludge bin with an empty sludge bin); there is expected to be between 10 to 100 L/day of waste sludge produced.
- Clean-out the raw feed water strainer, estimated once per week.
- Perform a manual membrane Direct Integrity Test (DIT) once per week. This entails initiating the DIT procedure on the SCADA interface and adding a small amount of marker fluid (containing titanium dioxide particles) to the CUF unit.

- Replace the 210 L (55 gallon) ACH coagulant drum when it gets used up; each 210 L ACH drum is expected to last from between 1 to 6 months.
- Replace the four (4) x 19 L (5 gallon) chemical carboy jugs (caustic soda, sulfuric acid, sodium hypochlorite and calcium thiosulfate) used for membrane cleaning; these chemical jugs are each expected to last 6 months to a year.
- Perform manual membrane cleaning of the DeWRS ceramic plate membranes possibly once or twice per year; this entails wiping the easily accessible ceramic plates with a cloth and cleaning solution.
- Provide regular maintenance such as; air compressor air filter replacement and lubrication, instrument calibration and sensor & reagents replacements, pumps/valve/actuator lubrication & seals replacements, general cleaning and housekeeping.
- Respond to alarm conditions & notifications and provide trouble shooting to resolve.
- Periodic monitoring and review of system performance.

4.4 ION EXCHANGE RESIN

There are many ion exchange (IX) resins available that are designed specifically for the adsorption of Natural organic matter (NOM) from drinking water supplies and can achieve up to 90% removal of TOC. These resins are typically regenerated with a sodium chloride brine solution. The source water is first filtered to remove suspended solids that could foul (plug) the ion exchange resin media beads. The filtered water is then passed through the media where organic molecules are adsorbed onto the media surface by exchange with chloride ions from the media to the water. When the media's capacity for organics adsorption has been exhausted, it is regenerated using a concentrated salt brine solution during which chloride ions replace the organic molecules on the media surface, releasing the organics for discharge with the waste brine.

Small ion exchange systems are similar to home water softeners and are very easy to operate and maintain as their operation, including regeneration, can be automated. However, they generate a large volume of waste brine solution that needs to be disposed of. The ion exchange system will also require periodic backwashing to remove fine suspended solids that may collect on the media, followed by a short period of treated water rinse and discharge to waste each time the filter is started, to flush the water that was 'standing' in the media. The system should also have post filtration to ensure the treated water turbidity remains below 1 NTU, and UV disinfection for pathogen reduction.

The following are the operational tasks for the system:

- Load bags of salt into the brine saturation tank; during peak summer demand, approximately 3 to 5 bags (20 kg each) of salt per week; during the minimum winter demand 1 bag of salt every 1 or 2 weeks.
- Cartridge filter cleaning or replacements for the pre-filter and post filter (estimate one time per week for each filter).
- Transfer of waste brine collected in a waste tank discharge to waste truck. 7,000 L transfer to waste truck, one time every three months (winter) to three times per month (summer).
- Clean-out the raw feed water strainer, maybe once per week.
- Provide regular maintenance such as; instrument calibration and sensor & reagents replacements, pumps/valve/actuator lubrication & seals replacements, general cleaning and housekeeping.
- Respond to alarm conditions & notifications and provide trouble shooting to resolve.

The system would consist of the following processes:

1. Pre-filtration
2. Ion exchange filters
3. Post filtration (cartridge filter)
4. UV disinfection
5. Chlorination + contact time

4.5 DIRECT FILTRATION

Direct filtration consists of passing water through sand or other media filter by gravity or pumping. A preliminary coagulation and flocculation stage is required where process chemicals are added to destabilize the surface charge of suspended solids and dissolved organics allowing them to combine into larger particles prior to filtration. The filter media may consist of specially graded sand or be a layered multi-media system.

Organics removal of between 30% to 50% and effective colour removal can be achieved using coagulation followed by direct dual media filtration. The larger organic molecules (such as those that cause colour) are more readily bound to floc formed by coagulation which are then captured by the media filtration. Media filtration can be expected to produce water with turbidity < 0.3 NTU and colour < 15 CU. Media filters are very easy to operate and maintain, like the existing sand filters and can have their backwash sequence automated.

To maintain efficient operation, these filters must be backwashed periodically and thus produce a high volume of dirty backwash water containing the coagulation chemicals. Because this backwash water can't be disposed to ground, we propose providing a Purifics DeWRS dewatering recovery system as described in the ceramic membrane section which may produce a sludge solid enough for local land disposal[4], or which can be stored and disposed of periodically. To minimize waste water generation, the 'filter-to-waste' water produced during the initial stage of filter operation should be recycled back to the head of the treatment system along with any treated backwash recovery water. The system should also have cartridge filtration after the media filters to catch any media fines.

One advantage of direct filtration systems is that it is a well-established technology. Operating costs are typically low. The primary disadvantage is that flocculation and coagulation are most effective in a continuously operated system. Also, the formation of adequate floc is highly sensitive to raw water quality, and turbidity spikes and other changes in water quality and temperature must be managed. Frequent monitoring by an experienced operator would be required to adjust the chemical feed rates as required.

Based on the GCDWQ supporting documentation, direct filtration systems are credited with 2.5-log reduction of *Giardia* and *Cryptosporidium.* Additional protection with a UV disinfection system is required to achieve the required total 3-log reduction of cysts and oocysts. Direct filtration will also provide 2-log removal of viruses.

Residuals from this process are backwash water containing coagulation chemicals.

For the GLID system, we recommend installing the coagulant injection system near the lake, requiring a small shed with power, and replacing the existing sand filters. The travel time between the lake and the treatment/pumping building will provide time for the coagulation and flocculation of the organics and turbidity to take place, however, the effectiveness of this arrangement for organics removal will need to be confirmed through pilot testing.

The chlorimination system would not be needed as the organics would be reduced.

The major O&M costs associated with direct filtration treatment are coagulation chemicals and pumping of backwash water. Operator(s) will be required to perform the following tasks:

- Remove the collected waste sludge from the DeWRS (swap-out full sludge bin with an empty sludge bin); between 20 to 100 L/day of waste sludge is estimated to be produced.
- Replace the 210 L (55 gallon) ACH coagulant drum when used up; each 210 L ACH drum is expected to last from between 2 weeks to 4 months.
- Cartridge filter replacements and cleaning for the post filter (estimated once per week).
- Clean-out the raw feed water strainer, estimated once per week.

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[4] During pilot testing, testing of Grafton Lake water (with similar water quality as Graham Lake), for the new Bowen Island treatment plant, an environmental analysis of the waste sludge was performed and found to be suitable for disposal by local ground application.

- Provide regular maintenance such as; instrument calibration and sensor & reagents replacements, pumps/valve/actuator lubrication & seals replacements, general cleaning and housekeeping.
- Respond to alarm conditions & notifications and provide trouble shooting to resolve.

The system would consist of:

1. Coagulation/flocculation
2. Filtration
3. UV disinfection
4. Chlorination + contact time
5. Dewatering of backwash

4.6 OZONE + BIOFILTRATION

This option is an emerging technology that is becoming more common in North America and has been in use for some time in Europe. This technology uses ozone to break down the organic compounds in the water which is then passed through GAC filters where bacterial growth in the filters is promoted and maintained. The bacteria in the filter will assimilate the organic carbon. The system works well for low alkalinity waters, which is the case for the water from Graham Lake.

Ozone oxidation of colour and organics followed by biofiltration is in use in many small and large treatment plants, mainly in Europe and North America. An on-site ozone generator is used to dose ozone gas into the raw feed water, followed by an ozone contact tank to provide reaction time for the ozone with the organics in the water. Ozone when dissolved in water produces highly reactive hydroxyl free radicals which readily oxidize the colour and larger organic molecules of natural organic matter (NOM). The NOM typically found in surface waters primarily consists of large organic molecules that are not ready bio-available (recalcitrant organics that have not been consumed by microbes in the environment). Oxidation of these molecules by ozone transforms them into smaller organic molecules that are readily bio-available.

The water and oxidized organics leaving the ozone contact tank is then passed through a media filter (usually GAC media) which is allowed to become colonized by naturally occurring bacteria from the source water. These bacteria consume the bio-available organics (BDOC). The bio-film formed on the media also provides an excellent medium for capture of suspended solids as the water filters through it. The result is that the treated water leaving the biofilters will have highly effective removal of colour (< 15 TCU), reduction in TOC (20% to 30% reduction) and reduced turbidity (< 0.3 NTU). The treated water from a biofilter will be biologically stable and thus reduce regrowth potential in the distribution system.

As the bio-mass grows and suspended solids are captured on the media in the biofilters, the void spaces between the media become reduced resulting in increased pressure drop through the filter. Periodically, excess bio-mass and captured suspended solids will need to be backwashed from the filters. Under normal operation the filters need to be backwashed with un-chlorinated water, however, occasionally a biofilter may need to be backwashed with chlorinated water to supress the growth of filamentous (bulking) bacteria that could cause excessive filtration head-loss. An air scour step is also commonly required in the backwash sequence to dislodge bacteria colonies and biofilm from the media surface before backwashing the loosened material out.

Granular Active Carbon (GAC) is commonly used as the biofilter media because it provides a very high surface area to support a large number of bacteria providing good biofilter performance in cold water. It typically takes several months for a biofilter to become colonized with bacteria to the point where they can consume the BDOC. During this bacteria establishment phase, the GAC will typically provide good adsorption of the organics from the water to produce good treated water quality.

The ozone-biofiltration process is typically easy to operate. The ozone generators and dosing can be automated and do not typically require much attention and the biofilters are operated (and backwashed) much like typical media filters. However, maintaining the correct conditions to promote the growth of preferred types of bacteria (and avoid problematic bacteria) will likely be an on-going challenge. The biofilters will need to be maintained in continuous operation by modulating the plant capacity to meet the required daily demand. If the filters are stopped for an extended time, the bacteria can turn anaerobic and consume each-other, degrading the filter performance and imparting foul odour to the water.

To avoid anaerobic conditions, the biofilters must be provided with sufficient supply of dissolved oxygen at all times. This can be accomplished by recirculation of aerated water through the biofilters during times of little to no water demand. In some instances, biofilters may require addition of nutrients to control the Carbon:Nitrogen:Phosphorus balance and promote useful bacteria growth to maintain optimum biofilter performance. While control of the biofilter operating conditions, or addition of nutrients is not at all difficult or costly, the analysis and evaluation of the biofilter, the make-up of its biomass and the determination of which course of actions may be required could be challenging (ie. how to figure out what the bacteria need when the process is not operating well). It may take some time to develop an understanding and history of how to best maintain the biofiltration system operation through changing operating conditions (like WTP demand, raw water quality and temperature).

Ozone is an unstable gas, and therefore, ozone must be generated on-site, typically by corona discharge using concentrated oxygen as feed gas. Natural organic matter is partly oxidized when treated with ozone and becomes more easily biodegradable. The combined treatment of ozone with a biofilter can result in DOC reductions of 40-60%.

The biofilters must be periodically backwashed to remove accumulated suspended solids and bio-mass growth. Since no pre-treatment chemicals are required, the backwash water can likely be discharged to the environment. However, the volume of dirty backwash water from biofiltration could be a challenge. The backwash water is expected to be quite dirty containing suspended solids, carbon media fines and bacteria colonies and will most likely not be suitable for discharge into the existing backwash pit. Biofilter backwash water is typically easily settleable or filterable so it would likely be possible to filter-out most of the dirt from the backwash water to either reclaim the water (or some portion of it) back to the head of the WTP, or to discharge the filtered backwash water to the existing backwash pit. Settling or filtration of the backwash water may require the addition of a polymer flocculant aid chemical and would require disposal of the solids waste sludge collected.

Ozone-biofiltration is highly conducive to incremental expansion of the plant capacity. Additions to the plant capacity could be accommodated simply by adding additional biofilter vessels as required to meet an expected increase in demand with the rest of the process equipment sized for the full build-out capacity.

The biofilters should include a gravel bed and sand layer under the carbon media to filter-out any bacteria that slough-off the media during operation.

As this is an emerging technology, likely post cartridge filtration and additional protection with a UV disinfection system will be required to assure total 3-log reduction of *Giardia* cysts and *Cryptosporidium* oocysts.

The chloramination system would not be needed as the organics would be reduced.

For an ozone-biofiltration system the operator(s) will be required to perform the following tasks:

- Regular monitoring and review of system performance.
- Remove the collected waste sludge from the backwash recovery bag filter (ie swap-out filter bags and dispose of solids). There is expected to be between 2 to 20 kg/day of waste solids produced.
- Clean-out the raw feed water strainer, maybe once per week.
- Initiate backwash of the biofilters, maybe once per week to once per month each.
- Provide regular maintenance such as; oxygen concentrators air filter replacement and lubrication, instrument calibration and sensor & reagents replacements, pumps/valve/actuator lubrication & seals replacements, general cleaning and housekeeping.
- Respond to alarm condition & notifications and provide trouble shooting to resolve.

Backwash waste management (filtering or settling, recirculation or discharge, solids collection and disposal) will likely need to be determined during the plant operation due to uncertainty in the volume and character of the biofilter backwash waste.

The system would consist of:

1. Ozonation
2. Bio-Filtration
3. UV disinfection
4. Chlorination + contact time
5. Backwash filtering

4.7 CARTRIDGE FILTRATION

Cartridge filtration can be used to reduce turbidity in some water supplies and is well suited for small systems because it has a low capital cost, is operationally simple, does not produce any residuals to be disposed of, and has a compact footprint. When cartridges become clogged, they must be replaced, so the operational cost of replacing cartridges must be considered. Replacement frequency of cartridges can be anywhere from days to months, depending on the quality of the source water. Considering the characteristics of Graham lake and its water quality analysis, it is highly recommended that a pilot test of the performance of cartridge filtration should be performed in order to determine the achievable treated water turbidity reduction as well as the rate of solids loading of the cartridge filters.

Washable filter cartridges are available in 5 micron or larger filtration size as pleated surface filtration media. These can be used as pre-filters to reduce load and increase the service life of downstream finer filters that are not washable (are discarded after each use).

Cartridge filtration will not remove the organics from the water so formation of disinfection by products and loss of disinfectant residual would continue to be a problem in the distribution system.

Cartridge filters are rated by one of two systems: nominal or absolute. An absolute particle size rating does not allow any particles larger than the specified size to pass, whereas a nominal rating refers to the average particle size retained. For turbidity particles smaller than 1 microns, the absolute particle size rated filters are required.

There are no prescriptive federal or BC provincial guidelines for cartridge filtration. However, under Alberta guidelines, 1-micron absolute cartridge filters are credited with 2-log removal of *Giardia lamblia* cysts and *Cryptosporidium* oocysts. Some reviewing authorities may require higher log removals, so this must be discussed with VIHA.

For pathogen reduction, the Alberta Waterworks Standards require cartridge filters to undergo challenge testing, and require a treated water turbidity below 0.3 NTU, allowing up to 1.0 NTU for a maximum of 15 minutes per day. Since any particles breaching the 1-micron absolute filter are smaller than *Giardia* and *Cryptosporidium* cysts, protection of cysts by suspended particles is not considered to be a concern.

UV disinfection must be added to the treatment system and will provide 3-log removal of *Giardia* and *Cryptosporidium*, which meets the pathogens reduction target, and then the filtration system would not be relied upon for pathogen reduction. A minimum UVT of 70% is required for UV disinfection to be effective, and Graham Lake water UVT has been measured (3 samples) with values ranging from 60% -70%. It is possible that the cartridge filters would improve UVT, but this can only be confirmed by pilot testing. It would also be prudent to conduct pilot testing to determine how frequently the cartridges would need to be changed out.

Cartridge filtration provides some protection against viruses and bacteria, but the UV disinfection and subsequent chlorination and contact time would be relied upon for virus and bacteria inactivation.

Chlorination and ammonia addition to create chloramines for residual disinfection would still be required.

Cartridge filtration will have the lowest capital cost and smallest footprint that would easily fit into the existing WTP building but will not realize the treatment goal of meeting Island Health's drinking water objectives.

The primary operational costs for this system would be the cost of replacing cartridges.

The system would consist of the following processes:

1. Pre-treatment to remove large particles
2. 1 micron (absolute) cartridge filtration

3. UV disinfection
4. Chlorination + contact time
5. Ammonia addition (to create chloramine for secondary disinfection).

4.8 TREATMENT OPTIONS ASSESSMENT

The following matrix provides a comparison of the filtration options:

Table 4-2: Comparison of Filtration Options

CRITERION	HFNF PENTAIR	CERAMIC ULTRA-FILTRATION	ION EXCHANGE	DIRECT FILTRATION	OZONE + BIOFILTER	CARTRIDGE FILTER
System Complexity	Moderate	Moderate	Low	Moderate	Moderate	Low
Technology	Established	Established	Established	Established	Emerging	Established
Process Risk	Negligible	Negligible	Low	Need to establish and adjust coagulation and assess	May need regular attention to assess bio activity and adjust	High
Maintenance	Low (highly automated)	Low (highly automated)	Low	High	High	Low
Reliability	High likelihood of frequent membrane breakage & repair	Robust	High	Proven reliability, but requires attention	High	Robust
Residuals	25% reject water direct discharge to environment, spent cleaning chemicals	Thickened sludge, dispose at landfill, or possibly to land	Backwash and rinse water / Brine waste from regeneration	Thickened sludge with DeWRS, dispose at landfill, or possibly to land	Backwash with concentrated water and biomass	None
Disinfection Requirements	Chlorine (+ UV if no integrity testing)	Chlorine + UV	Chlorine + UV	Chlorine + UV	Chlorine + UV	Chlorine + Ammonia + UV
Chemicals	— Membrane cleaning chemicals	— Requires coagulant dosing — Membrane cleaning chemicals	Uses salt for regeneration	Requires coagulant dosing	None	None

CRITERION	HFNF PENTAIR	CERAMIC ULTRA-FILTRATION	ION EXCHANGE	DIRECT FILTRATION	OZONE + BIOFILTER	CARTRIDGE FILTER
Expandability	No	No	Yes	Yes	Yes	Yes
Footprint	Large, significant addition needed	Small (will fit in existing building)	Small	Small	Moderate	Small (will fit in existing building)
Reservoir storage needed	Yes	Yes	Yes	No	Yes	No
Other	— Large power rq'mt — Will need larger backup generator	— Large power rq'mt — Will need larger backup generator			— Need to maintain continuous flow with fresh oxygen supply to biofilters to prevent going anaerobic — Occasional replacement of GAC	— Pilot testing recommended to determine effectiveness and filter replacement frequency — Highly unlikely will meet VIHA requirements due to low UVT
Capital Cost	$1,860,000	$1,180,000	$360,000 ($480,000)	$800,000	690,000	$220,000
Monthly operational costs	$2,050	$1,636	$2,860 ($470)*	$1,170	460	$1,970**
20-year Life Cycle Costs	$2,167,000	$1,425,000	$788,000 ($550,000)*	$975,000	759,000	$515,000**

*Numbers in brackets are for system that has ocean disposal of brine water

**could increase substantially if more frequent cartridge replacement required.

5 COST ESTIMATES

The Class 'D' cost estimate for each option including 40% contingency, as well as O&M estimates and life cycle costs are detailed in Appendix A attached.

6 LAYOUTS AND SCHEMATICS

Layouts for ion exchange, direct filtration and ozone and biofiltration are attached in Appendix B. Schematics for ceramic ultra-filtration, ion exchange, direct filtration and ozone-biofiltration are attached in Appendix C.

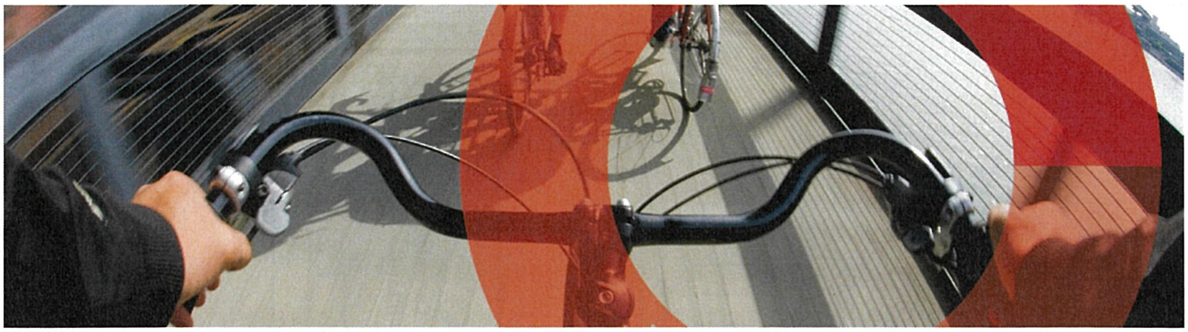
APPENDIX

APPENDIX A

Cost Estimates

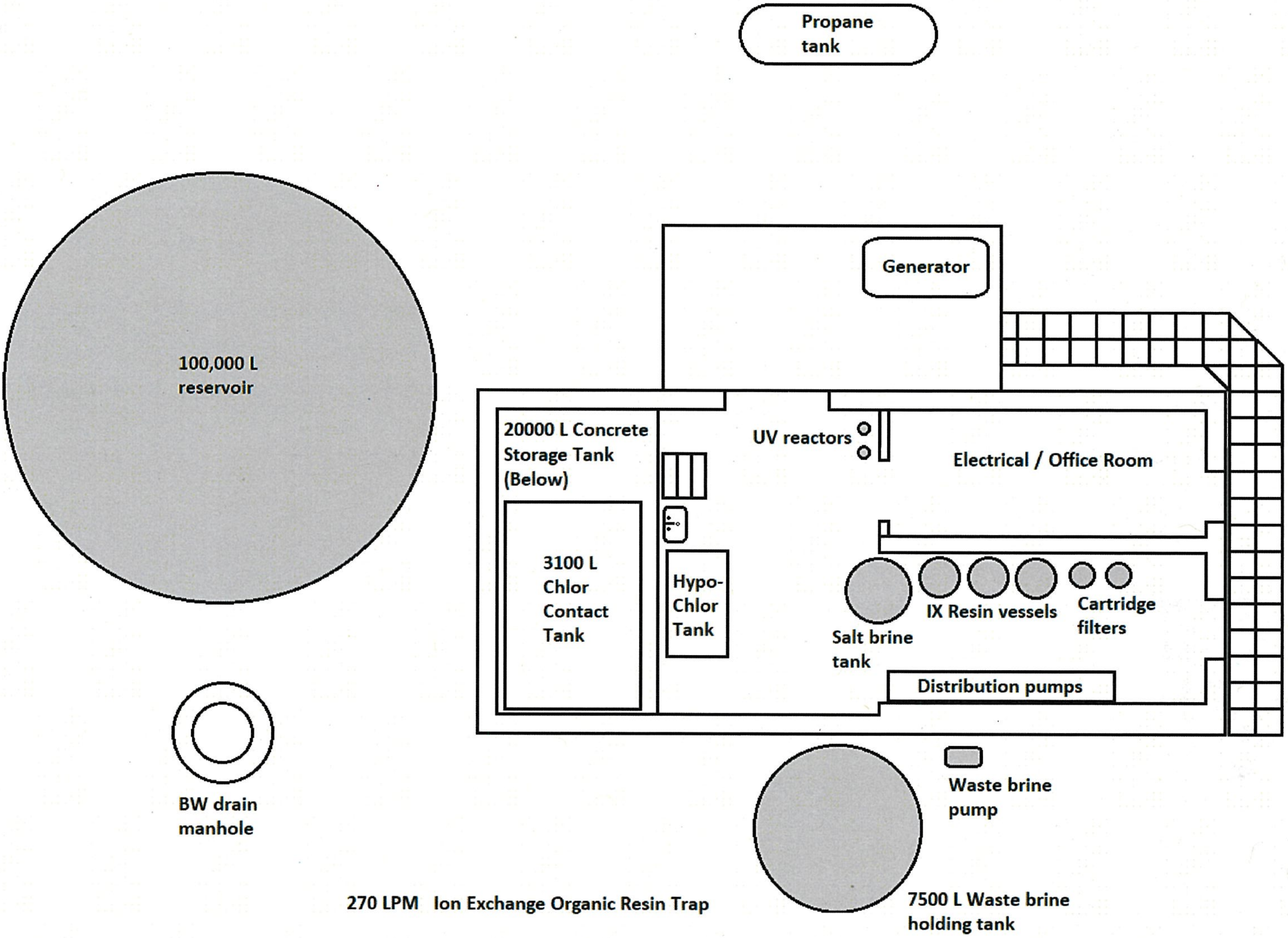
(Capital, O&M and Life Cycle Costs)

In keeping with procurement best practices, the detailed cost estimates for each of the treatment options have been removed from this document.

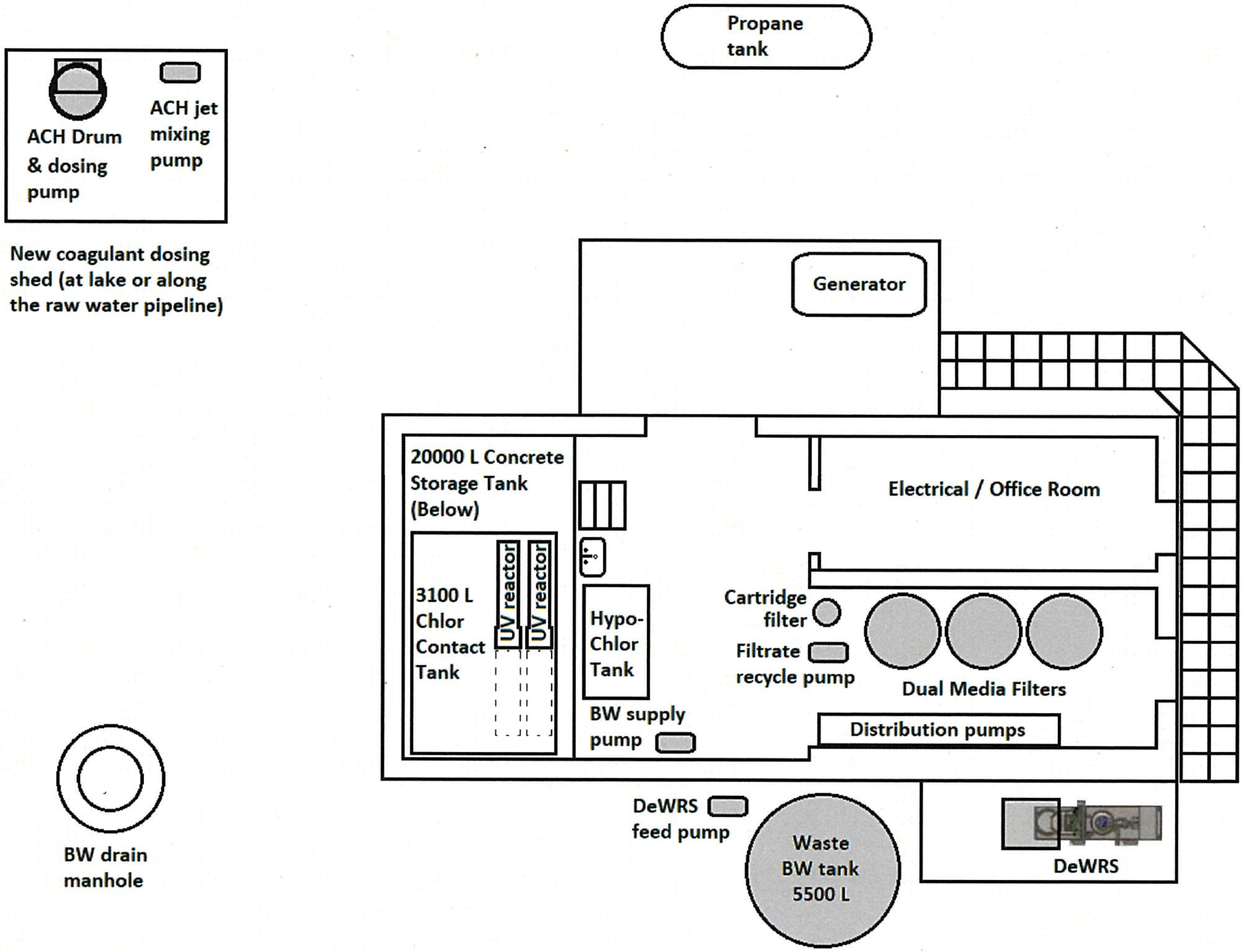


APPENDIX B

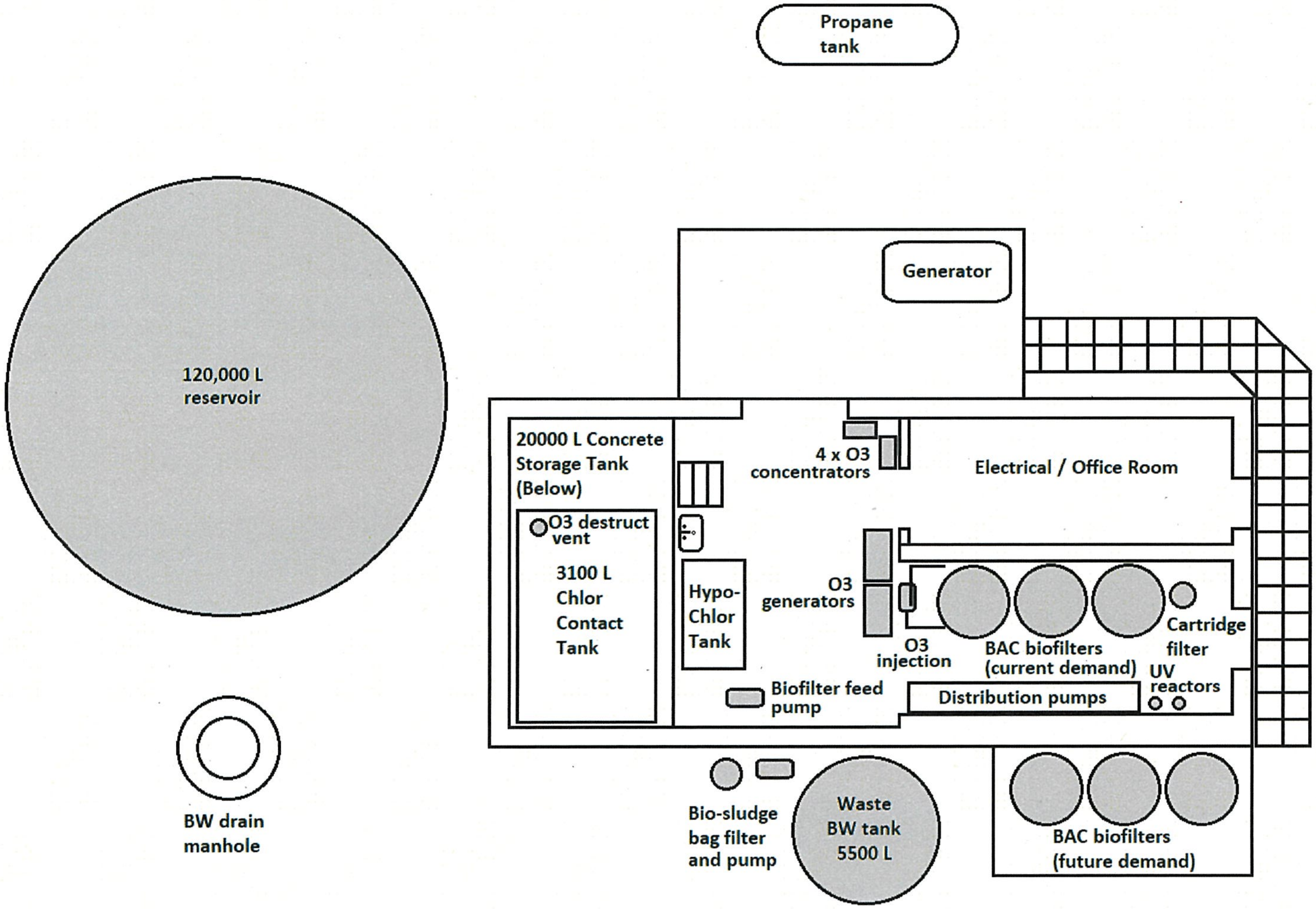
Layouts



270 LPM Ion Exchange Organic Resin Trap



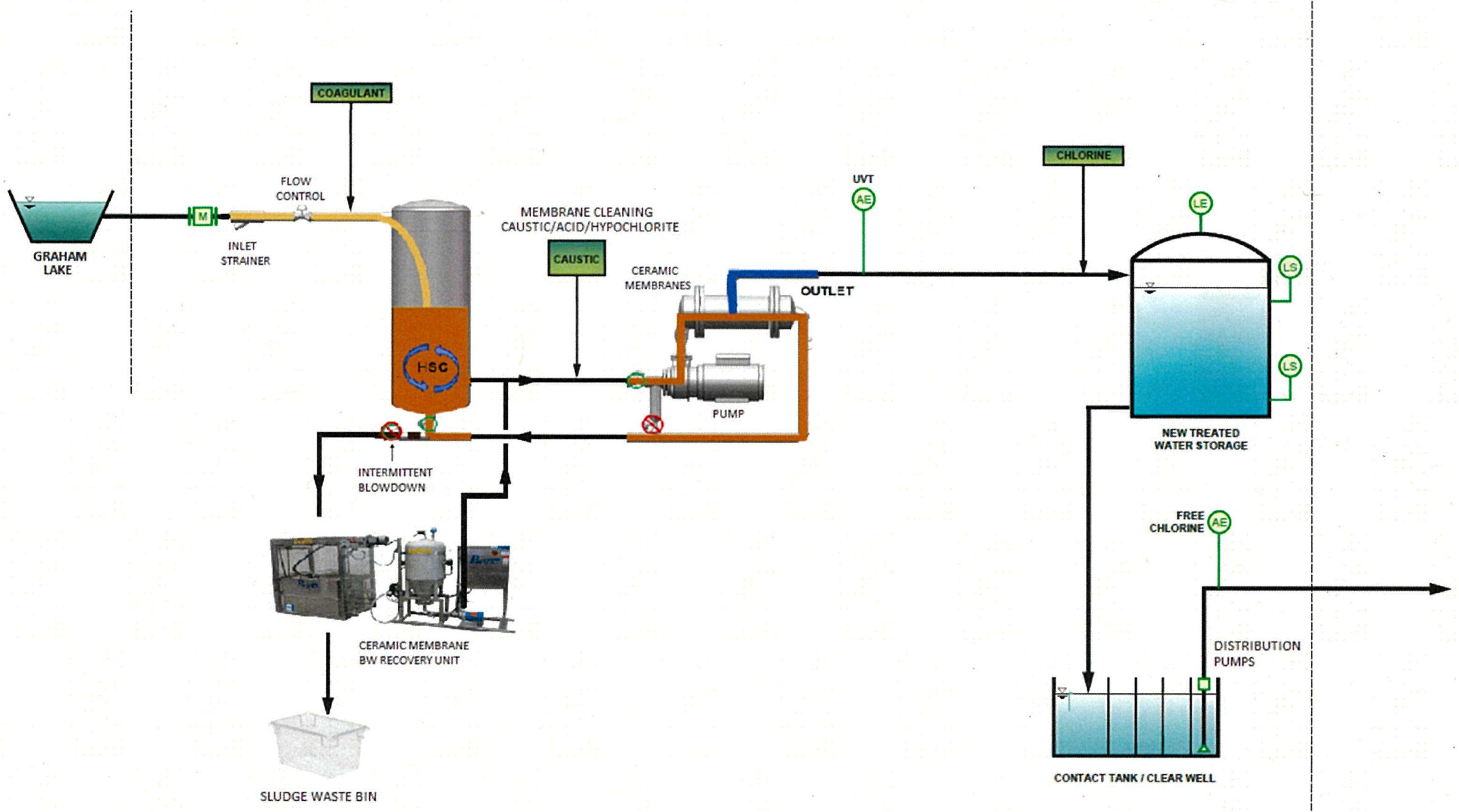
680 LPM Direct Filtration with DeWRS M8



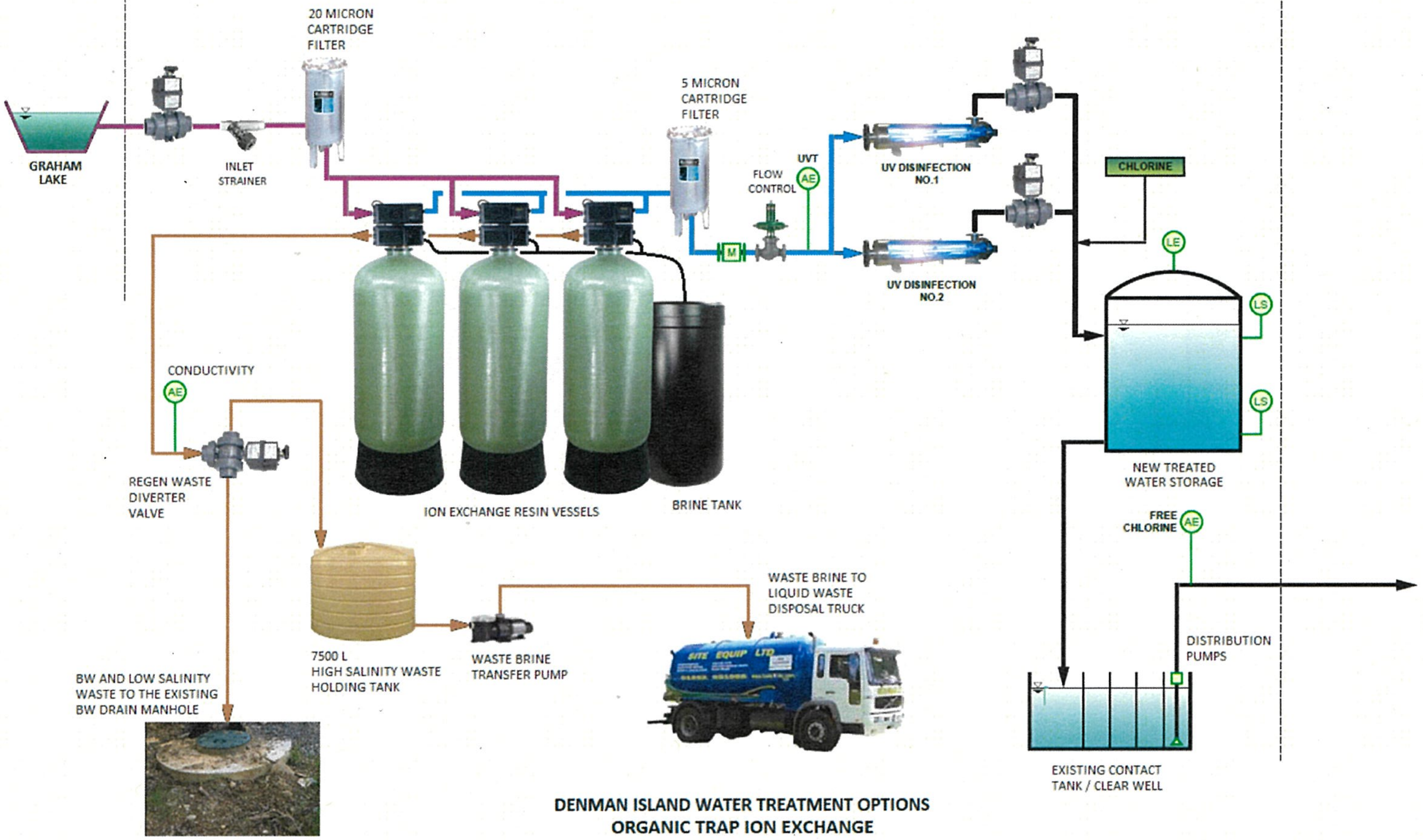
270 LPM Ozone Oxidation with Bio-Filtration

APPENDIX C

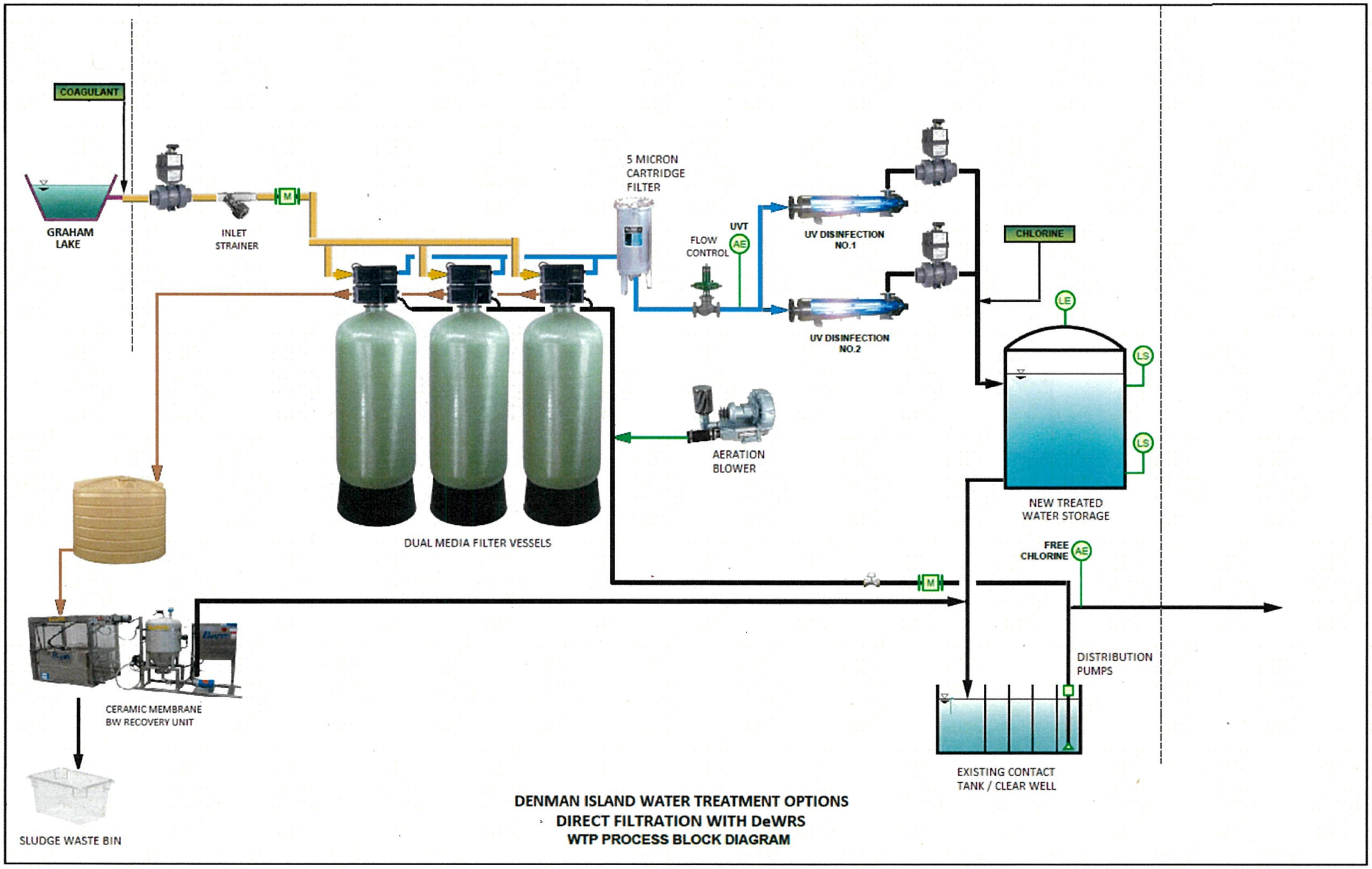
Schematics



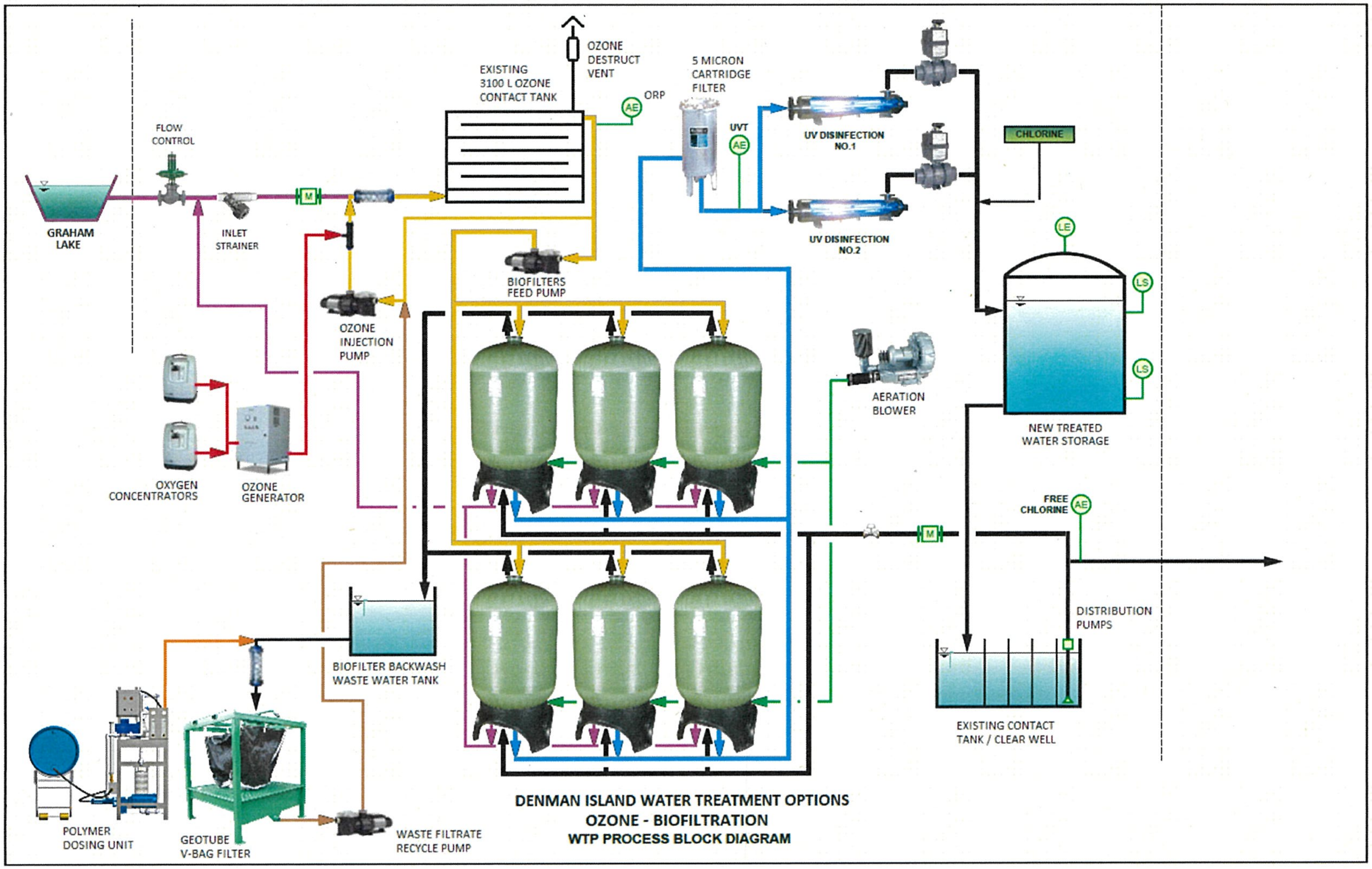
DENMAN ISLAND WATER TREATMENT OPTIONS
CERAMIC MEMBRANES FILTRATION
WTP PROCESS BLOCK DIAGRAM



DENMAN ISLAND WATER TREATMENT OPTIONS
ORGANIC TRAP ION EXCHANGE
WTP PROCESS BLOCK DIAGRAM



DENMAN ISLAND WATER TREATMENT OPTIONS
DIRECT FILTRATION WITH DeWRS
WTP PROCESS BLOCK DIAGRAM



DENMAN ISLAND WATER TREATMENT OPTIONS
OZONE - BIOFILTRATION
WTP PROCESS BLOCK DIAGRAM