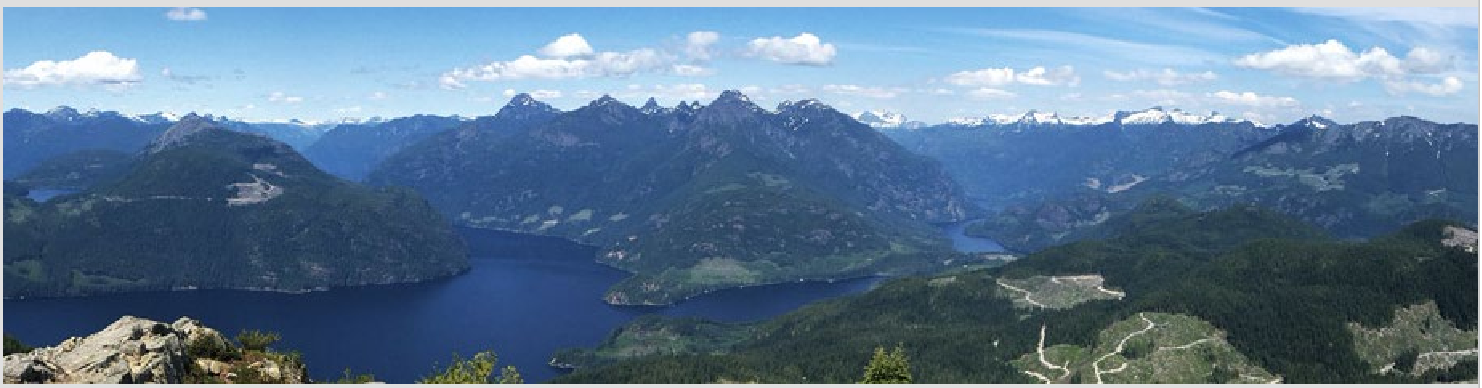
Report For:

Lund Waterworks District

Engineering Consultant Cost Review

Date: May 8, 2023



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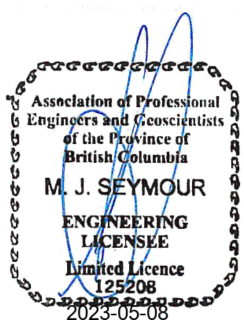

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1.0 Introduction

Basis of Project Review

Lund Waterworks District (LWD) is a British Columbia Improvement District with Tom Day, as Receiver. The Province, the Receiver and the qathet Regional District are working together to transfer the water system from the jurisdiction of an Improvement District to a qathet Regional District (qRD) function.

qRD recommended improvements are outlined in an engineering study from September 2022 prepared by McElhanney in support of a grant funding application. The scale of the recommended improvements makes the local funding unaffordable to the approximately 120 properties served by the water system. LWD requested MSR Solutions to assist the Receiver to reassess the project to make it affordable to the community by providing a recommendation of Needs and Wants, or Core and Discretionary Spending.

Background

The Receiver, Operator and a resident Advisory Committee are considering the following to reduce costs:

- Locating new treatment plant and primary reservoirs in the same locations as the current infrastructure;
- Acquiring a package treatment plant complete with suppliers' certification for meeting drinking water standards;
- Reducing storage volumes;
- Examining storage construction design and methods for savings and supplier engineering; and
- Prioritizing distribution system improvements

The purpose of this update is to address water treatment options, storage considerations, and unintended impacts because of the treatment improvements.

2.0 Understanding of the Works

We have referenced the report dated October 24, 2022, from McElhanney Ltd., and NAC Constructors Ltd. We offer the following comments for consideration, which demonstrates our understanding of the system, as well as considerations and options which present opportunity for cost savings, while addressing municipal design standards, which could be relaxed for a small community need, from the standpoint of long term operation and maintenance, without impacting the integrity of the water system.

Water Chemistry

We have reviewed the water chemistry provided by the operator from 2016 – 2022, with the following noted.

Table 1 - Historical Water Quality Data

Item/Date	2010-12-07	2015/07/13	2016-09-28	2017-05-08	2018-11-21	2022-12-07
Total Organic Carbon (C) mg/L	7.4	6.37	6.42	5.9	13	5.9
True Colour	50	80.5	17.1	32.6	59.6	23.7
Total Iron (Fe) mg/L	0.703	0.284	0.222	0.167	0.734	0.371
Total Manganese (Mn) mg/L	0.01	0.0322	0.0246	0.0048	0.13	0.01
Turbidity	0.7	0.39	0.65	0.44	1.89	2.2

Previous reports dismissed Iron and Manganese, and we believe consideration for removal is important to meet current regulatory requirements, which can be achieved with a pressure vessel green sand solution or similar treatment option.

Water Demands

The water demands are noted to vary from an average of 275 m^3/day upwards to a maximum of 465 m^3/day. There is also a note of system leakage in the marine crossing, and the design basis is on a dual treatment train of 350 m^3/day. We have reviewed the flow data, and offer the following.

- We come up with an overall average of 266 m3/day, and with system leak repairs, the average has decreased since January 2019 to 258 m3/day.
- The maximum months are typically June through August, coinciding with boating season and is 360 m3/day (also reduced in 2021 post pandemic). The Maximum Month is typically 1.4 x Average Day Flow, showing this appears to be in line.
- This suggests a maximum day flow of 520 m3/day, as current flow, and I would suggest the leakage issue should allow us to work on the idea of a smaller plant than currently proposed. (See December 2021 repairs of submarine line).

Reservoir Storage and Fire Flow

The current proposal is for a 430 m^3 (fire plus demand plus balancing) bolted steel tank reservoir at an elevation of 57 m. This requires pumping such as at Larson Road and Finn Bay, due to elevations of 35 m and higher. Typical water pressures should be in excess of 35 psi (25 m elevation difference) so the reservoir placement is not ideal to achieve gravity flow in the area. With estimated costs of the reservoir at $1.5 million, alternatives could be suggested. Currently, the existing situation is noted as follows.

- Reservoir #1 Pad is at elevation 57.1 m.
- Boar's Nest Road, existing Reservoir of 23.3 m3 is at elevation 81.5 m.
- Alannah Road Reservoir #3 of 70 m3 is at elevation 37.9 m. This is dedicated fire storage only and does not connect to the distribution system.

Distribution System

A majority of the water system was installed in the 1970's, and consists of 100 mm and 150 mm diameter pipe. From discussions with the operator, it is understood all mains are PVC pipe (anticipated to be equivalent to C900 Blue Brute). In our experience, water services are typically steel strapped and threaded, which are subject to corrosion and failure over time, and would be replaced with double strapped stainless steel fittings for new connections, as repairs are warranted, or with replacement and upgrading.

There are also several water services crossing properties which are substandard, unprotected, and without easements, which are to be corrected.

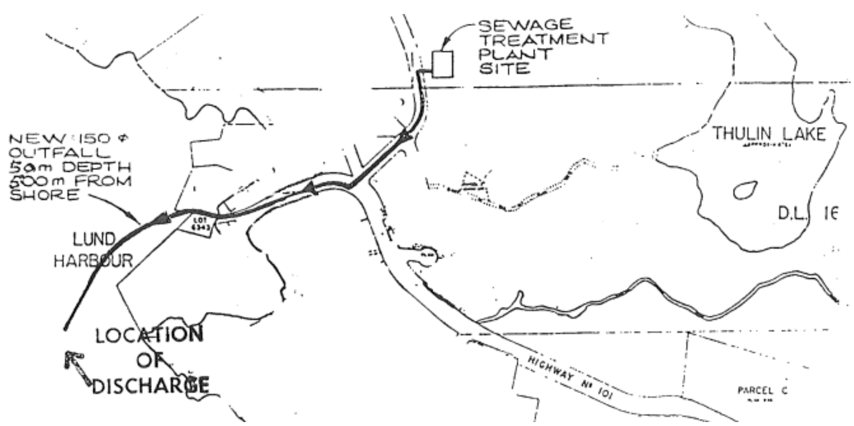
3.0 Other Regulatory Considerations (Unintended Impacts)

Existing Water License

Lund Waterworks Improvement District has a water license for storage on Thulin Lake (F010408), allowing for the storage of 50 acre feet of water (62,000 m3) or about 516 m3/day during the dry summer 120 days. Water License 10408 allows for the diversion of 100,000 gpd (455 m3/day). It is likely the result of new works will require an amendment to the water licences for both storage and diversion. Consideration on limiting the maximum day flow until this is addressed should be part of the discussion.

Wastewater Treatment and Disposal Permit

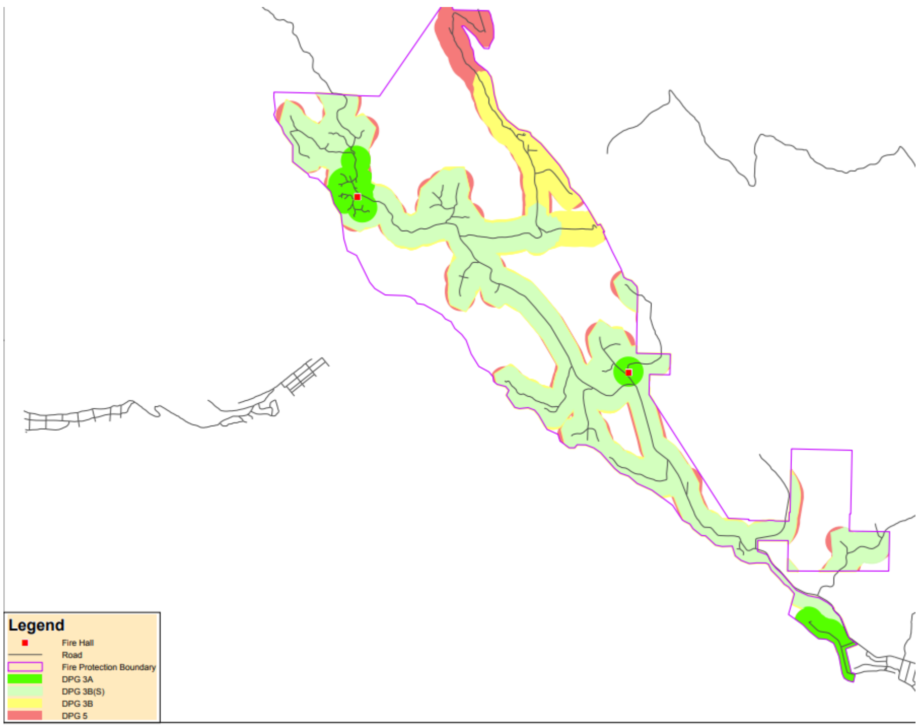
The Lund Sewer System has been owned, operated, and maintained by the qRD since its construction in 1993 and serves approximately 100 households and several businesses. The system is governed by Effluent Discharge Permit PE-12860 from the Ministry of Environment. The Permit allows a maximum discharge of 230 m3/day from secondary treatment (Rotating Biological Contactor (RBC)) to a marine outfall 500 metres from the foreshore and at a depth of 50 metres.



There is a development cost charge of $2,068 per single family equivalent (SFE) for any new connections, and an annual sewer fee of $568 per SFE. A connection to this system based on about 100 SFE's would include an additional charge of $207,000 which might be waived with a new facility. Operating costs would be an additional $57,000 annually for the water system, suggesting an onsite solution is much more cost effective.

Fire Protection Area and Water Storage

The Northside Volunteer Fire Department (NVFD) has been providing fire and emergency response services since 1968. The NVFD relies on the commitment of local volunteers. The NVFD has attained Superior Tanker Shuttle Service Accreditation, which is the ability to provide a sustained pumping rate of 1,000 Lpm (250 gpm) through a shuttle system from other sources than the water distribution system. Many properties in the service area qualify for "equivalent to fire hydrant protection" on their insurance policies. The Fire Underwriter Survey (FUS) has updated the Canadian Fire Insurance Grading Index to show the Dwelling Protection Grade for properties that qualify within the service area.

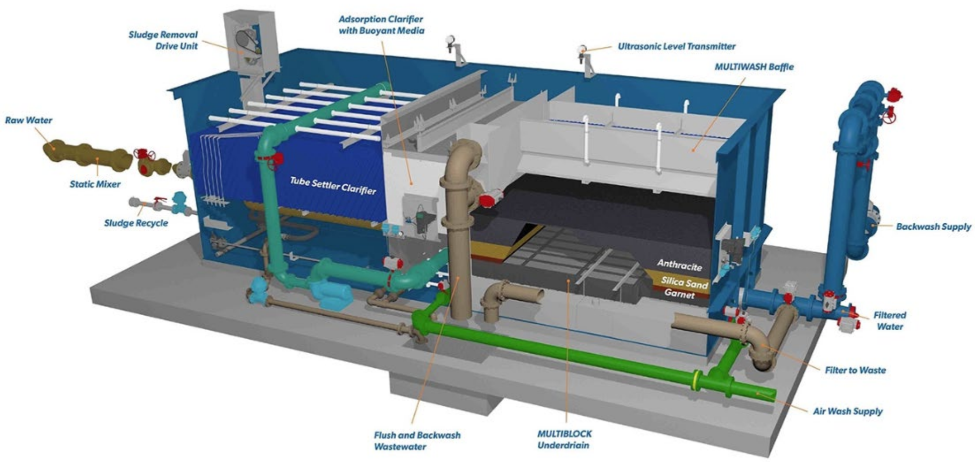


It is noted that existing areas served by a fire hydrant (green), should meet general FUS requirements for a fire flow based on the Table 7 Simple Method for One and Two Family Dwellings Up To 450 sq. m, which is typically between 3,000 to 4,000 Lpm for a duration of 1.5 hours. This is different from the BC Building Code, which notes a minimum fire flow of 1,100 Lpm for 30 minutes until a fire department arrives. Fire flow storage is desired for a minimum of 360 m^3.

4.0 Water Treatment Options

Four treatment technologies were considered for the Lund water system and are reviewed below. As noted in the water analysis, iron and manganese removal is required, along with organic carbon, colour, and turbidity. This generally requires multiple treatment processes and additional complexity related to chemical usage, differing treatment technologies or steps, and having dual systems for reliability and varying water demand.

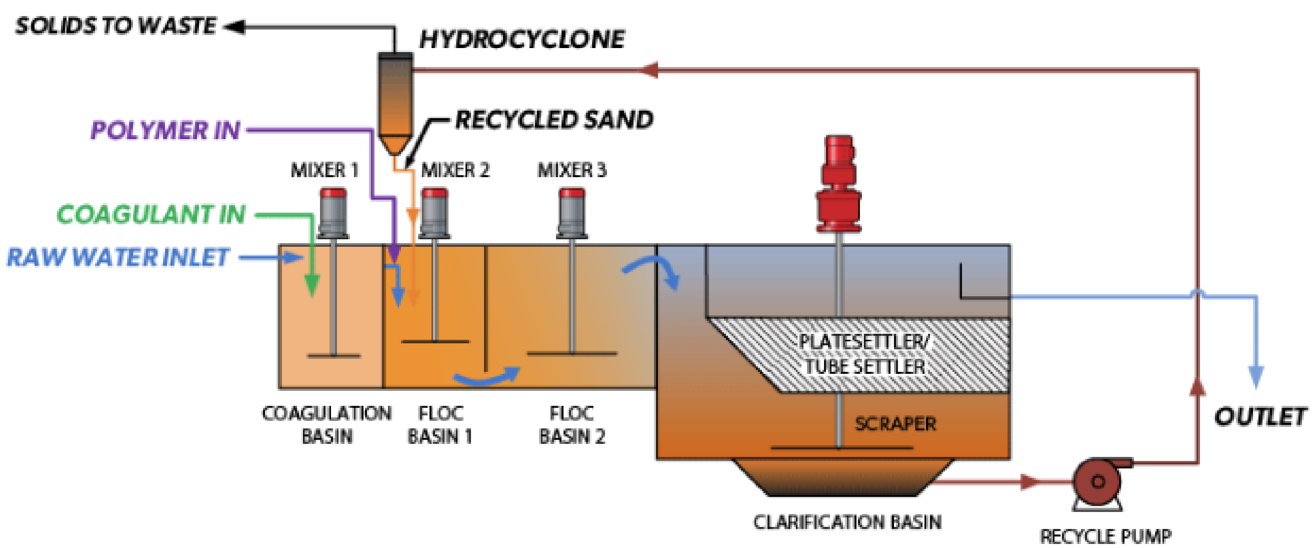
- **Enhanced Slow Sand Filtration**
  - This option relies upon construction of a large filter assembly on site and is not easily containerized due to the footprint required.
  - Coagulation and Flocculation through an upflow clarifier would be required for iron and manganese removal.
  - It is not efficient at removing colour to regulatory requirements and would require additional treatment through granular activated carbon.
  - In general, this option if considered would be based on an upflow clarifier, and down flow sand and carbon filter, which can be a package plant option.



- **Dissolved Air Floatation (DAF) and Rapid Sand Filtration**
  - Dissolved Air Flotation (DAF) is a proven and effective physical/chemical technology for treating a variety of industrial and municipal process and wastewater streams. DAF systems are commonly used to meet a variety of treatment goals including solids and colour.
  - A two step process is required, which increases the footprint, and a separate control building
  - Other concerns include the cost of chemicals and a moderate complexity of operation.

- **Direct Nanofiltration (dNF) membranes**
  - Systems designed for nanofiltration (NF) are based on the use of membrane elements. The systems generate a strong pressure gradient to drive water through the semi-permeable membrane contained inside the element. In this process, salts and other larger molecules are left behind in a concentrated brine stream while a purified permeate stream is produced.
  - The dNF process still requires an iron/manganese filter ahead of this treatment process.
  - The single pass process results in a concentrated reject water at about 20% of the treated flow, which must be discharged to the environment through an onsite treatment process, or the wastewater treatment facilities.
  - This system has the smallest footprint, and can have capacity provided to allow for future expansion at minor additional cost.
  - In general, this process appears to have the least operator involvement due to simplification of the coagulation, flocculation and filtration process occurring in the membranes, without additional chemical

- **Ballasted Flocculation and Rapid Sand Filtration**
  - The ballasted flocculation system is a high-rate clarification process using rapid mixing and multi-stage flocculation, followed by sedimentation.
  - This process includes coagulation with chlorine or ferric-chloride; flocculation with a polymer such as poly-aluminum chloride (PAC), clarification by settling, and final separation through sand and a hydro cyclone to separate and recirculate the sand.
  - Our concerns remain with the size of the unit, requiring dual systems and a separate control building.
  - Other concerns include the cost of chemicals and a moderate complexity of operation.



5.0 Water Treatment Consideration and Budgetary Costing

Based on the four treatment options considered, our preliminary recommendation is to consider the direct Nano-Filtration procees. We have experience with BI Purewater in the provision of skid mounted treatment systems. They provide manufacturing out of Surrey, BC and have a certified welding and CSA shop to provide fully certified equipment with a good service life. There are other capable suppliers in the area as well, however our experience is to consider BI Purewater as reliable and cost effective in overall comparison.

We received a budgetary proposal to consider a nano-filtration water treatment system with iron removal and costs anticipated in the $1.6 million range, including a CSA approved structure, housing the equipment and controls. Consideration for a review of equipment should be undertaken to determine if you want better equipment standards as opposed to lowest capital cost. The following items are not included and are separate site specific and regulatory requirements.

- Site preparation and building pad foundation.
  - With a pre-packaged skid mounted unit, a gravel foundation with concrete piers should be adequate and an allowance of $50,000 is appropriate.
- Building to house equipment
  - BI Purewater proposes a skid mounted system with a CSA approved insulated building.
  - This results in a shorter equipment lifespan as you are dealing with plastic and a metal building with a life cycle of 30-35 years. The potential for a building and equipment at a 50 year life cycle should be considered as part of the preliminary design, as there are benefits to building better now.
- UV Disinfection

- An allowance of $200,000 is recommended for dual Trojan Swift UV modules with self cleaning wipers.
- This is subject to determination with the Public Health Engineer in the total log removal of pathogens with nano filtration, and the multi-barrier approach recommended.

- Auxiliary Generator
    - Three phase power exists at the site, and no improvements are considered.
    - Generator, assumed to be sized for full capacity at 125kW. - $120,000 diesel with 72 hours storage and transfer switch.
- Reject Water Disposal
    - We recommend that the reject water be diverted back to the creek by means of a vertical slow sand filter, for filtering of all but colour from the reject water, and then returned to the creek. Allow for a gravity block structure with rubber media (EPDM) liner and two basins. Estimated cost will be in the $100,000 area.
    - The alternative of a discharge to the qRD wastewater treatment plant will result in major upgrade costs, including a new Registration. Order of magnitude costs for a maximum day flow of 100 m3/day would be in the order of $2 million plus PST and GST.
- Cleaning Water Disposal
    - There is a sewer system installed at Emil Road, which could be upgraded with a small lift station. An allowance of $100,000 should suffice to ensure cleaning water is provided with tankage, pH neutralizing and discharge pumps.
    - It may be possible that this could also be discharged with the reject water subject to some minor treatment beyond pH adjustment.
- Confirmation of siting within easement or new location
    - We understand this has been partially addressed, and may be changed depending on choice of location. An allowance should be carried forward.
- Additional Treatment Capacity
    - It is proposed to slightly oversize treatment components to allow for some future growth as determined in detailed design. This will have some impact on the size of the iron/manganese filter.
    - The nano-filtration system will consist of future space holders, which can be added as required with short term allowance based on increased operating hours from the standard 20 hours to potentially 22 hours (10% flow increase). We will consider 80% capacity of membranes in the detailed design, with the bracketing supporting 20% future additional flow.

The McElhanney construction allowance of $4.2 million is based on a full municipal style facility, excluding a resolution of wastewater discharge. BI Purewater has proposed a commercial grade quality system and costs are noted above at $2.2 million plus GST, engineering design and approvals, commissioning, and spare parts.

6.0 Water Storage

Water storage requirements are based on daily water demands as well as fire flow demands. Total water storage does not impact the capacity of the water treatment flows, as the additional capacity required for a fire event is generally static. Other sources for fire storage may also require treatment and were a well source to be considered separate to Thulin Lake, it would have to be able to provide a sustained flow of at least 250 gpm.

There are conflicting issues with regards to providing and adequate fire flow, which impact the ability to convey the fire flow. The village core appears to be supplied with at least 150 mm PVC pipe, suggesting a maximum recommended fire flow through the pipes can be considered at 3,000 Lpm (850 gpm), and outside of this area, where 100 mm PVC pipe appears prevalent, the maximum fire flow is around 1,400 Lpm (375 gpm), which exceeds the Shuttle Service requirements. On this basis, we can consider the following.

- Maximum Day Demand is proposed at 520 m3/day
- Balancing Storage is 25% of MDD or 130 m3
- Fire Storage varies from 126 m3 – 270 m3
- Emergency Storage is an additional 25% of the above, or about 64 m3 – 100 m3
- Total reservoir storage could reasonably be considered at a minimum of 320 m3, and more reliably at 500 m3, which is as suggested by McElhanney.

Considering the limitations of the distribution system, and identified reservoir areas, we offer the following for consideration, as opposed to a single reservoir site. The tank proposal does not provide for post disaster standards, but does provide for 3 locations and multiple tanks to allow for some consideration of a partial system remaining post disaster.

- Boar's Nest Road, can provide water back to the village, in addition to providing for the upper pressure area. Consideration of 3 – 10,000 gallon poly tanks will provide approximately 113 m3 of storage. The booster station will be provided with a generator auxiliary power supply to keep the reservoir full. A bypass valve will allow the reservoir to feed back to the community for fire flow.
- Alannah Road Reservoir #3 of 70 m3 is at elevation 37.9 m. This is dedicated fire storage only and does not connect to the distribution system. A booster station with auxiliary generator and connection to the distribution system will provide for fire and balancing flow. Provision for new booster tanks to provide 4 – 10,000 gallon poly tanks will provide for the minimum fire flow in this area at 151 m3 of storage.
- Reservoir #1 Pad is at elevation 57.1 m, and provides storage from the water treatment, and a fire flow for the village. The two satellite storage areas will reduce this storage requirement to a minimum of balancing and emergency storage with installation of 3 – corrugated steel 25,000 gallon tanks (285 m3)

The above compares to the centralized bolted steel tank to post disaster construction in accordance with the latest building code, requiring a concrete foundation, as opposed to a gravel grade ring. This still requires improvements.

7.0 Distribution System

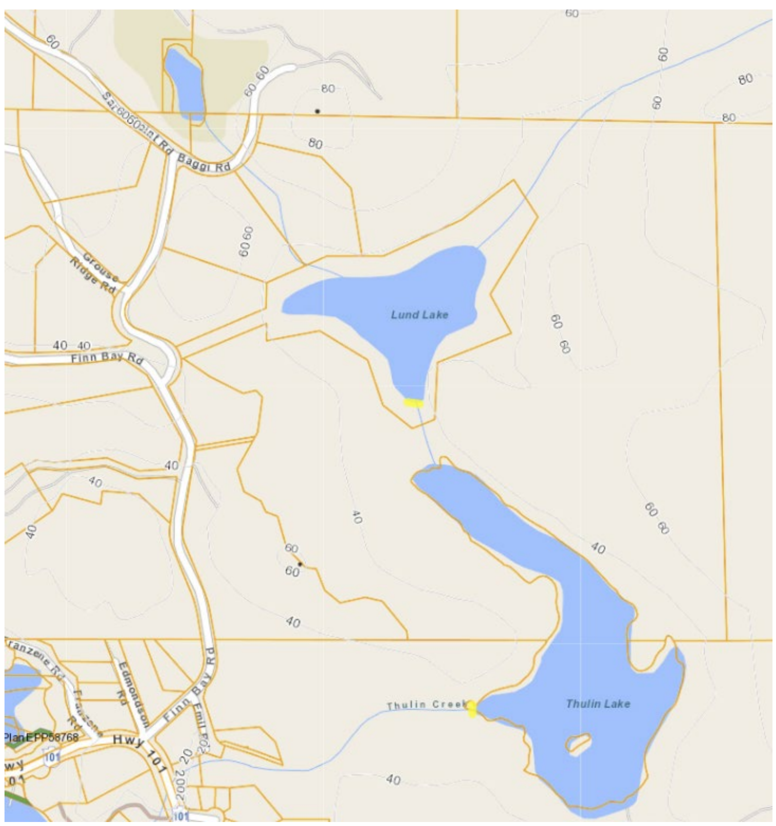
The distribution system as noted relies on 1970's piping, which is approaching end of practical life in the next 10-25 years. The marine section continues to be of the highest concern. We also note that Sevilla Island is a rock outcrop and has overland unprotected services.

It is proposed to upgrade the marine line as the primary backbone to the system, as it is the least disruptive. We have reviewed with Great Pacific Engineering and Environment for support in costing and viability and this offers the best routing. Looping of the system along Highway 101 is a desirable option for system improvements and can be considered pending budget allocation. Similarly considerations for upgrading to 150 mm PVC pipe should only be considered where line renewal is required for end of life.

Sevilla Island is proposed to operate off a single water meter, with multiple services using insulated pipe over the road allowance to each home. Meters are proposed as per the qRD requirements.

8.0 Thulin Lake and Lund Lake Dam Assessments

The LWD receives water from Thulin Lake which is controlled by a concrete dam named Thulin Lake Dam. Upstream of Thuling Lake is an additional structure at the outlet of Lund Lake named Lund Lake Dam, as shown in the figure below.



The Thulin (Upper) Lake, or Lund Lake dam was constructed in 1939 and upgraded in 1972, and is an earth fill dam with a dam height of 2.4 m. It is noted as a high failure consequence dam. Thulin Lake Dam was constructed in 1966, with a dam height of 3.7 m and a crest length of 22.9 m. It is a regulated dam with a high failure consequence.

Tetra Tech completed the Dam Safety Reviews (DSR) for Thulin and Lund Lake Dams in 2012. Lund Waterworks is requested to conduct new DSR's by the end of 2023. Tetra Tech last visited the dams on August 17, 2017, to assess the existing conditions and to discuss potential remedial measures with the LWD. In the 2017 site visit, the seepage increase was observed when the top log was in place. Maintaining the lake level at the low point was noted to reduce seepage, and, as a short-term solution, it was recommended to not re-install the stop logs and leave Low Level Outlet (LLO) open until further and long-term remediation.

The impact of the lower water level has not caused a shortage of water during summertime the past few years, which suggests it may not be required. The upper lake dam does not appear to be licensed for storage and some clarity is required on this. The Water License in 1975 notes 50-acre feet per annum (61,700 m3) for the maximum storage, and overall storage of 200 acre feet per annum (247,000 m3). The maximum allowed withdrawal is 100,000 gpd (454.5 m3/day). A review of various maps available, appears to show Thulin Lake with a surface area of about 77,500 m2. This suggests a storage depth of about 0.8 m is allowed for the maximum storage of 50 ac.ft. Evaporation and Free Board are an additional 0.45+0.6m minimum. Based on this storage dam height, which would provide about 137 days as maximum summer demand suggests there may be some flexibility in how we view the dams, and what is required.

In August 2019, BC FLNRO audited Lund and Thulin Lake Dams. The high level of FLNRO comments and observation for Thulin Lake notes:

- Seepage from the left and right abutments of the concrete dam observed.
- There is growth along the log booms.
- The right log boom appears to be smaller and may not work as intended.

Both Lund Lake and Thulin Lake Dams have been assigned a High Consequence classification. According to Schedule 2 of the Dam Safety Regulation, the dam safety review must be carried out and the report should submit the Dam Safety Officer every 10 years for High consequence dams. The FLNRO received the previous DSR report in 2013; therefore, in 2023 the new DSR for both dams should be submitted.

In general, the following works are required from a regulatory perspective, and from a water storage requirement to ensure a long-term viable water supply.

- Seismic stability analysis to assess improvements required to meet the current seismic standards, which are much greater than the dams were designed originally.
- Spillway major improvements to ensure the design peak storm event can pass through the spillway without causing erosion, or downstream damage.
- Replace log debris booms as they are aging and not functioning adequately.
- Staff gauges to provide a visual impact of lake level for recording and reporting purposes.

- Emergency Response Plan (ERP) and documentation to address regulatory compliance and operator knowledge.
- An allowance for dam improvements is included as work will be required.

A review of costs for Lund Waterworks has been minimal with the dams. However, without the dam on Thulin Lake, there is insufficient storage for the summer dry period and high water demand. It is recommended costs be included and works undertaken to plan for decommissioning Lund Lake dam (or allowing for a lower level to maintain trails appeal), and for repairing and improving the Thulin Lake Dam. This will also address current seismic standards, and environmental discharges to Thulin Creek. It is recommended the works be undertaken as a design-build initiative as there is sufficient information to outline the general scope and condition of the works to allow the geotechnical considerations occurring as the works are repaired.

9.0 Other

There is noted to be miscellaneous construction debris, including asbestos and other special wastes to be hauled from the various sites and considered within the project costs as the works are located on private lands. There are also issues related to site survey and legal survey to support the creation of works. We recommend an allowance be carried forward to clean up all construction debris remaining on private property and disposal of contaminated waste to approved facilities.

10.0 Estimates of Construction Costs

The following summarizes previous costs, along with recommended changes to the works, and the resulting savings in identified costs. The priority considers a need (1), a recommendation (2), and a consideration (3). The following table represents order of magnitude costs for those items addressed as a need.

Table 2 - Order of Magnitude Estimates

Lund Improvement District - Order of Magnitude Estimates for Regulatory Compliance, and Life Cycle Improvements					
Item	**Description**	**Reason for Upgrade**	**Original Estimated Cost**	**MSR Consideration**	**Revised Estimated Cost**
	Mobilization & Demobilization		$ 967,000	7% of Construction Cost for items such as barge and equipment from Vancouver, etc	$ 476,000
	Insurance & Bonding		$ 836,000	3% of Construction Cost. Risk can be waived by community	$ 204,000
	Water Treatment Plant		$ 4,163,000		$ 1,400,000
	Shipping and Installation	Not considered		Site Preparation, electrical and site piping allowance	$ 250,000

	UV Disinfection	included in overall cost		Separate consideration based on total log removal calculation	$ 200,000
	Auxiliary Generator	Not considered		To maintain water treatment operation	$ 120,000
	Reject Water Disposal	Not considered		Proposed alternating slow sand filter	$ 100,000
	Cleaning Water Disposal	Not considered		Discharge to community WWTP with sewer extension as opposed to sand filter	$ 100,000
	Thulin Lake Dam	Minor Consideration	$ 324,000	Upgrade and Intake Improvements	$ 800,000
	Lund Lake Dam	Not considered		Decommission and remove	$ 350,000
1.2	Reservoir		$ 1,426,000	3 – 25,000 gallon galvanized lined tanks on gravel pad	$ 480,000
1.3	Submarine Line through Finn Bay	Upgrade existing pipes and metallic fittings that are at risk of leakage, corrosion, and failure.	$ 4,120,000	Review from Great Pacific Engineer and Environment, specialists in marine engineering with assumption needed within 10 years and only water source pipe	$ 1,372,000
1.5	Alannah Road	Piping Upgrades	$ 127,000	New tanks, pumps, generator and piping to connect to system for balancing	$ 127,000
3.1	North Finn Bay Rd	Upgrade existing pipes as well as valves, hydrants, and blow off that not currently working.	$ 420,000	Maintain as 100 mm and repair hydrants and valves, etc	$ 150,000
3.7	Hwy 101 to South	New Line to service properties currently connected by a 25mm Line through private property	$ 734,000	Consider reduced length, with expansion by future development at their cost	$ 620,000
4.1	Larson Road Pumping Station	Consider adding a 60 L/s fire pump at booster station to supply fire flow	$ 106,000	Add auxiliary power and 3 – 10,000 gal Poly Tanks at Boar's Head	$ 210,000
4.2	Hydrant Replacements	Replace 12-15 hydrants that have reached their service life	$ 71,000	Four identified by Operator as needing replacement	$ 36,000

4.3	Valves, Standpipes & Blow Offs	Replace appurtenances that have reached their service life	$ 169,000	Consideration based on Operator input for partial replacement	$ 80,000
4.4	Residential Water Meters	Supply and Install up to 80 new water meters at existing connections	$ 226,000	Required by qRD as condition of creating Water Service Area	$ 226,000
	Sevilla Island	Not considered		Single service with insulated services to lots on rock surface	$ 73,000
	Demolition	Not considered		Allowance for removal of debris and Asbestos on property	$ 100,000
Subtotal Construction			$ 13,689,000		$ 7,474,000
Legal Survey and Legal Fees			$ 250,000	Reduced Expectations	$ 100,000
Land Acquisition for SRW's			$ 500,000	Reduced Expectations	$ 250,000
qRD Project Management & Admin (5%)			$ 684,000		$ 374,000
Consulting Engineering Design and Construction (15%)			$ 2,053,000		$ 1,121,000
Regulatory Approval Processes (3%)			$ 411,000		$ 224,000
Commissioning, Verification and Training				To fully support operator training and system verification of performance and support	$ 75,000
Contingency Allowance (30%)			$ 4,107,000	Allowed under Grant and can consider reduction based on need	$ 2,242,000
Project Order of Magnitude (excluding GST)			$ 21,694,000		$ 11,860,000

11.0 Operating Costs

We have reviewed operating costs for the direct Nano Filtration process and note the commercial BC Hydro rate is $0.1284, which we have used. The following is our estimated costs for annual operations.

Table 3 - Operating Cost Estimates

Green Sand and Nano Filtration Annual Operating Costs	
Consumables	Estimated Costs
Hydrochloric Acid (for Clean in Place)	$2,100
Hypochlorite (12%) Flocculation and Disinfection	$6,500
Caustic Soda for pH adjustment	$700
Allowance for Membrane Replacement (7 years)	$24,000
Allowance for Media (sand, carbon every 5 years)	$2,500
Energy Consumption	
Treatment Plant	$14,400
Other equipment needs	$1,000
Telephone/Internet	$1,500
Maintenance	
Operating staff time for O&M (14 hours/week)	$62,400
General equipment maintenance allowance	$48,000
Total annual average costs	$163,100

12.0 Summary

An entire water cycle and project understanding has addressed all requirements for improvements to the Lund water system. We have proposed an equipment supply with a CSA approved housing for placing on the existing water easement from BI Purewater.

We have proposed improvements to Thulin Lake, as well as considering decommissioning Lund Lake to ensure there is a viable long-term water supply to current standards.

The reservoir storage is split into three areas without Post Disaster Standards on the expectation of a partial system remaining after a design seismic event. The water distribution system is upgraded as required where services are at end of life, and not upgrading for increase fire protection beyond 3,000 Lpm.

The original estimated costs of $26 million were reduced to about $13.2 million as an equivalent value, including additional scope items not considered in the terms of reference. With a reduction in some pipe replacement, the current order of magnitude estimates is $11.9 million, which includes a 30% contingency for unforeseen and unknown items, and does not include GST.

The annual operating cost including equipment allowances is estimated at $163,100.

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