# Lund Water System Assessment

# Final Report

October 24, 2022

Mr. Tom Day, Receiver, Lund Waterworks District

qathet Regional District

#202 – 4675 Marine Avenue, Powell River, BC, V8A 2L2

Prepared by McElhanney Ltd.


**Contact**
Mark DeGagné, PEng
778-560-2001
mdegagne@mcelhanney.com

**Address**
500 – 3960 Quadra Street,
Victoria BC Canada, V8X 4A3


# Your Challenge.

# Our Passion.

## The Fine Print

This report was prepared by McElhanney Ltd. ("McElhanney") for the particular site, design objective, development, and purpose (the “Project”) described in this report and for the exclusive use of the client identified in this report (the “Client”). The data, interpretations and recommendations pertain to the Project and are not applicable to any other project or site location and this report may not be reproduced, used, or relied upon, in whole or in part, by a party other than the Client, without the prior written consent of McElhanney. The Client may provide copies of this report to its affiliates, contractors, subcontractors, and regulatory authorities for use in relation to and in connection with the Project provided that any reliance, unauthorized use, and/or decisions made based on the information contained within this report are at the sole risk of such parties. McElhanney will not be responsible for the use of this report on projects other than the Project, where this report or the contents hereof have been modified without McElhanney’s consent, to the extent that the content is in the nature of an opinion, and if the report is preliminary or draft. This is a technical report and is not a legal representation or interpretation of laws, rules, regulations, or policies of governmental agencies.

This report was prepared with the degree of care, skill, and diligence as would reasonably be expected from a qualified member of the same profession, providing a similar report for similar projects, and under similar circumstances, and in accordance with generally accepted engineering/planning/etc and scientific judgments, principles, and practices. McElhanney expressly disclaims any and all warranties in connection with this report.

McElhanney has relied in good faith on information provided by the Client and third parties noted in this report and has assumed such information to be accurate, complete, reliable, non-fringing, and fit for the intended purpose without independent verification. McElhanney accepts no responsibility for any deficiency, misstatements or inaccuracy contained in this report as a result of omissions or errors in information provided by third parties or for omissions, misstatements or fraudulent acts of persons interviewed.

All evaluations and conclusions stated in this report are based on facts, observations, site-specific details, legislation, and regulations as they existed at the time of the site assessment/report preparation. Some conditions are subject to change over time and the Client recognizes that the passage of time, natural occurrences, and direct or indirect human intervention at or near the site may substantially alter such evaluations and conclusions.

McElhanney will not be responsible for the independent conclusions, interpretations, interpolations and/or decisions of the Client, or others, who may come into possession of this report, or any part thereof. This restriction of liability includes decisions made to purchase, finance, or sell land or with respect to public offerings for the sale of securities.

The probable cost estimate has been prepared using the design and technical information currently available, and without the benefit of Survey, Geotechnical, or Environmental information. Furthermore, McElhanney cannot predict the competitive environment, weather or other unforeseen conditions that will prevail at the time that contractors will prepare their bids. The cost estimate is therefore subject to factors over which McElhanney has no control, and McElhanney does not guarantee or warranty the accuracy of such estimates.


Contents

# Executive Summary


The qathet Regional District (qRD) is considering taking over the ownership and operations of the Lund Water District assets, which are now in receivership of the Province of BC. NAC and McElhanney were requested to review the latest budgets and scope of work required to bring the Lund Water System (LWS) into compliance with required regulation, as well as up to a modern standard for engineering and construction of materials and system components. The assessment reviewed previous reports on the system and provides recommendations to consider alternate treatment technologies and alternate sites for the treatment plant, given complexities with current tenure and statutory rights-of-way.

Previous assessments show a fairly consistent water source from the lake, which does have elevated organic carbon levels in it, which leads to the problem of disinfection by-products when chlorine is used for disinfection. THMs have been tested in the system and routinely exceed the Canadian Drinking Water Quality Guidelines (CDWQG) of 0.1 mg/l. Previous reporting documented elevated iron and manganese concentrations, but current testing shows low levels of these constituents, which is in line with expected surface water sources in the region.

The LWS is currently maintained by a qualified and diligent operator, but the age of the infrastructure, as well as some of its original construction methods leads to continual issues with leakage and water loss. The LWS has excellent consumption records which were reviewed to arrive at a recommended treatment plant size of 350 cubic metres per day, firm capacity provided by redundant treatment trains per Vancouver Coastal Health requirements. This would provide a peak capacity of 700 cubic metres per day for those days where more water maybe needed above the typical maximum day demand.

In terms of water storage, the estimated required total storage volume is calculated to be 525 cubic metres, which includes 118 $m^3$ for balancing storage, 105 $m^3$ for emergency storage and 300 $m^3$ for fire fighting requirement. From the assessment of existing storage, it is recommended to construct a new 430 cubic metre storage reservoir at the existing Thulin Lake site, connect the existing 70 cubic metre storage tanks above Alannah Road to the entire system, and maintain the existing 23.3 cubic metres of storage at Boar's Nest Road for daily consumption in that area of the community. It is also recommended to add a fire pump at the Larson Road pumphouse to ensure delivery of adequate fire flow (60 l/s) to those properties above it, rather than build a larger reservoir at the top of Boar's Nest Road.

Given advances in water treatment technology since the last review (2009), the following four treatment technologies were explored in this assessment.

1. Enhanced Slow Sand Filtration
2. Dissolved Air Floatation (DAF) and Rapid Sand Filtration
3. Direct Nanofiltration (dNF) Membranes
4. Ballasted Flocculation and Rapid Sand Filtration

A comparative analysis was completed based on 11 factors from regulatory compliance, ease of operation and maintenance to capital and life cycle costs, which are summarized in the table below.

*Probable Cost Summary*

| | Enhanced Slow Sand Filtration | DAF / Rapid Sand Filtration | Direct Nanofiltration | Ballasted Flocculation / Sand Filtration |
|---|---|---|---|---|
| ***Estimated Capital Costs*** | $5,516,000 | $5,574,000 | $4,163,000 | $4,827,000 |
| ***NPV for 20 Years of Operation*** | $1,888,000 | $2,494,000 | $2,771,000 | $2,415,000 |
| ***Capital Costs + Net Present O&M Costs*** | $7,404,000 | $8,068,000 | $6,934,100 | $7,242,000 |

Based on the overall costs and comparative score, the Direct Nanofiltration (dNF) technology is recommended for water treatment at LWS.

Two alternative sites were explored for the construction of the water treatment plant. The first (Alternative 1) would be near the existing Thulin Lake Pumphouse utilizing the existing piping from the Lake, up to the existing reservoir (to be replaced/upgraded) and then into the general distribution system. The second would be located on fully owned public property near the new Cellular Tower up hill of the existing sewage treatment plant. A cost comparison of these two alternatives was produced and included a list of distribution piping upgrades and extensions to ensure that the distribution system properly supports existing customer and any future growth in the community.

The total probable cost for the Alternative 1 site and system upgrades is $26,608,900, as compared to the Alternative 2 site, which is estimated to cost $29,299,400. The costs are considered to be a Class C level estimate and carry a 30% contingency, plus allowances for administration, engineering, and land tenure issues.

# 1. Introduction

## 1.1. BACKGROUND

NAC Constructors Limited (NAC) and McElhanney Limited (McElhanney) has been retained by qathet Regional District (qRD) to review the Lund water system. The Lund water system is currently operated by the Lund Water Improvement District (LWID) under receivership of the Province. The qRD is in discussions with the Province to potentially take over ownership and operation of the Lund water system. The intent of this report is to update previous studies and cost estimates in support of the qRD's request for funding of capital upgrades to bring the water system up to a suitable level of service standard consistent with present design standards, and to ensure that the system will provide reliable, safe potable water to the citizens of Lund well into the future. Emphasis has been given to the water treatment plant siting and a review of the technologies available to treat the water effectively. The goal is to provide an updated and accurate assessment of the communities capital requirements for upgrades.

## 1.2. SCOPE OF THE STUDY

The intent of the project was

- To visit the community and review the system requirements in light of the current day condition.
- Review previous recommendations for water treatment plant technologies, and make recommendations for implementation, updating the previous recommendations provided in 2009 as deemed appropriate.
- To review previous reports and estimates and provide updated cost estimates in support of the latest grant application to the province.

## 1.3. ACKNOWLEDGEMENTS

In preparation of this report, acknowledgement of the following is warranted for the generosity of time in assisting with the understanding of the water system and conditions/constraints unique to the community of Lund.

1. Tom Day, Receiver, Lund Waterworks District
2. Caleb Allen, GIS/Survey Technician, qathet Regional District
3. Courtney Robertson, Operator for the Lund Waterworks District

# 2. Existing Components of the Lund Water System

A site visit was conducted by Mark DeGagné, PEng., of McElhanney Limited (ML) and Ronan Deane of North American Contractors (NAC).

## 2.1. THE CONTROL STRUCTURES

The community of Lund gets their water from a Thulin Lake, a freshwater lake just east of the harbour. Water levels in Thulin Lake are controlled by a concrete dam complete with an overflow weir, with the intake extending about 200m east of the concrete structure to the deepest part of the Lake. During the site visit the Dam was briefly inspected, and after reviewing the previous Dam Safety Assessments, concurrence with previous conclusions that the structure is in relatively good condition is warranted.

*Photo 1: Thulin Lake Dam*

Minor repairs at the outlet, which requires a new valve at the structure itself, plus a new isolation valve arrangement just downstream of the dam. Previous reports mention a new log boom, which should be put into place, as well as improved lake level monitoring systems. These improvements are not costly and can be accomplished without interruption to the water supply system.

The actual intake screen and structure should be inspected by lifting it out of the water and thoroughly cleaning it. This would be an opportune time to replace the knife gate valve at the dam, and then in in turn the vale box structure just downstream. Lump Sum Allowances for the repairs to the dam have been made in the cost estimates.

*Photo 2: Lund Lake Dam*

Upstream of Thulin Lake is an additional control structure at the outlet to Lund Lake. This earthen dam is of unknown construction, and the previous Dam Safety Review has highlighted a number of concerns, including the overall stability of the structure and the need to improve the spillway to pass the required flood of 28.8 $m^3/s$. During the 2022 site visit, there was no apparent issues noted with high seepage or the current overflow rate at the dam, but the recommendations of the previous assessments should be followed, starting with a thorough geotechnical investigation and assessment program of the dam, followed by any remedial measures required to improve the dam. Previous cost estimates include a $1 million allowance for dam improvements, but this number can not be relied upon for any accuracy, as there are no firm recommendations for any required upgrades. It is recommended that the District, carry an allowance of $200,000 to complete the geotechnical investigation and study to fully determine the extent of required upgrades, which could be considerably more, and may lead to other conclusions like decommissioning the dam altogether.

## 2.2. THE WATER QUALITY

Previous assessments show a fairly consistent water source from the lake, which does have elevated organic carbon levels in it, which leads to the problem of disinfection by-products when chlorine is used for disinfection. THMs have been tested in the system and routinely exceed the Canadian Drinking Water Quality Guidelines (CDWQG) of 0.1 mg/l. Previous reporting documented elevated iron and manganese concentrations, but current testing shows low levels of these constituents, which is in line with expected surface water sources in the region.

On this basis, water treatment system technologies applicable for this water are in line with previous reports, which have been updated based on new technologies, and are provided in the Section 3.

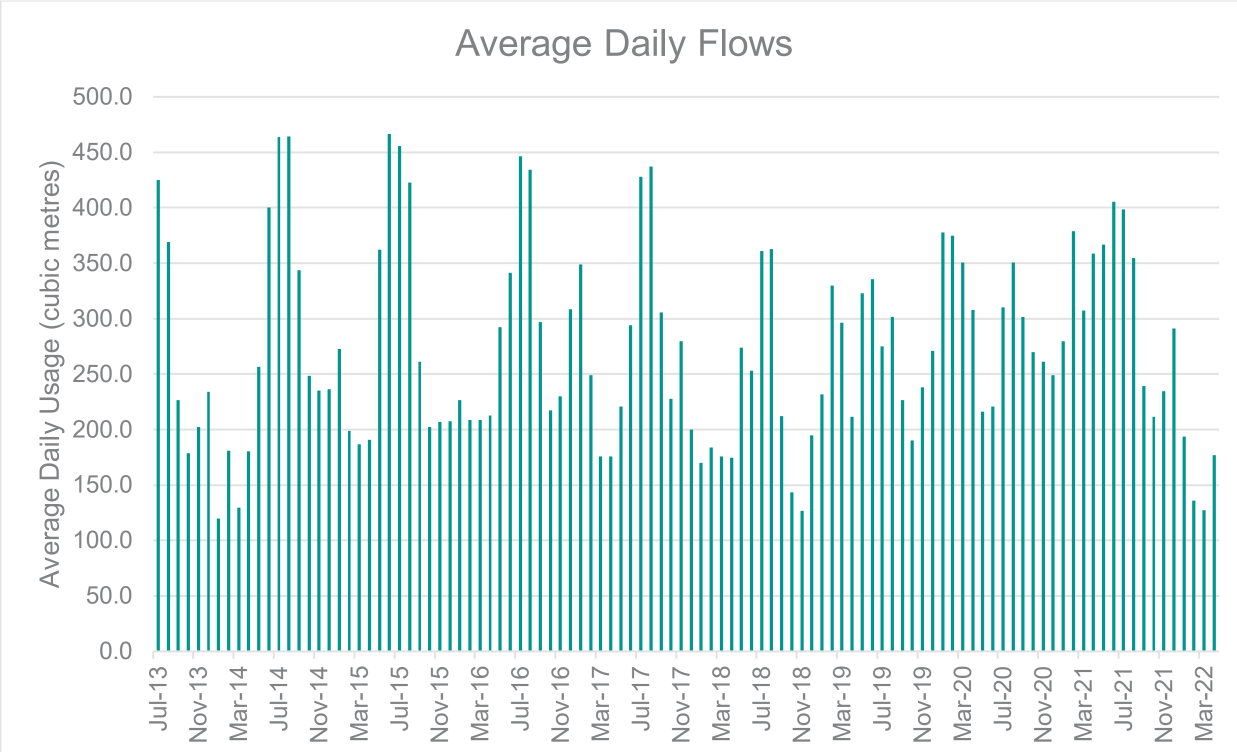
*Table 1: Water Quality Results for May 3, 2022*

| Parameter | UNITS | Value | MAC | AO | Comments |
|---|---|---|---|---|---|
| **Total Organic Carbon (C)** | mg/L | 5.8 | 2 | | Recommended Criteria by BC MoE. Normal Surface water is Approx. 10 mg/L, MAC is for treated water |
| **True Colour** | Col. Unit | 37.6 | 15 | | Recommended Criteria by BC MoE |
| **Iron** | mg/L | 0.219 | | 0.3 | No MAC |
| **Manganese** | mg/L | 0.0033 | 0.12 | 0.02 | |
| **Trihalomethanes** | mg/L | 0.17 | 0.1 | | |
| **Turbidity** | NTU | 0.29 | 1 | | |

## 2.3. WATER DEMANDS

A brief review of the community's demands was completed based on the records provided by the system operator. **Figure 1** shows the average daily usage in the community since 2013, which fluctuates seasonally, with peaks in the summer due to the many tourists that visit the harbour in the summer. It can be deduced from the numbers that the average usage over the past several years has been about 275 cubic metres per day. With a maximum of about 465 cubic metres per day, which occurred in 2015. The system operator reported that system leakage is a problem from time to time, especially for the marine crossing which has metallic fittings below sea level, which tend to corrode rapidly, and can only be assessed for condition when diving inspections are competed on an annual basis. Nonetheless, it is recommended to consider a water treatment plant that will treat 350 cubic metres per day in one train, with a second train for redundancy and to ensure that peak flow days can be supplied with potable water. This will allow the community growth and is consistent with previous recommendations by others.

*Figure 1: Water Consumption Records – Lund 2013 to 2022*




## 2.4. WATER TREATMENT

Water treatment at Lund consists solely of disinfection by injection of sodium hypochlorite (NaOCl) at the existing pump station 175 metres from the dam location. Because the source water contains elevated organic concentrations, injection of the chlorine causes the formation of chemical by-products known as trihalomethanes (THMs) and haloacetic acids (HAAs), which are known carcinogens.

The current treatment system does not meet the current BC Drinking Water Treatment Guidelines for surface water sources, which must meet the 4-3-2-1-0 drinking water objective, as follows:

- 4 log inactivation of viruses
- 3 log removal or inactivation of Giardia Lamblia and Cryptosporidium
- 2 refers to two treatment processes for all surface drinking water systems
- 1 for less than 1 NTU of turbidity with a target of 0.1 NTU
- 0 total and fecal coliforms and E. Coli

A new water treatment facility will need to be constructed to meet the above objective, and to ensure the long-term health of the community.

## 2.5. WATER PUMPING STATIONS

The Lund Water District has three pumping stations, the primary one is located near Thulin Lake at the end of the driveway to the site. The equipment inside the pumphouse was well maintained, but it is likely that any new water treatment facility will require new pumps that will be able to meet design demands and pressures for the chosen treatment technology.

The other two pumping stations are in fairly good condition. The first is located on Larson Road, boosting the line pressure to ensure water is properly conveyed to the Boars Nest Rd reservoir. The other is located at Finn Bay Road north of Alannah Rd, and feed water to the new reservoirs at the top end of Alannah Road, which are disconnected from the distribution system as described below.

The addition of a fire pump at the Larson Road pumping station should be considered to ensure that there is enough flow in the lines to fight any fires which may occur above this location on Larson Road and/or Boars Nest Road.

## 2.6. WATER STORAGE

In terms of water storage, the estimated required total storage volume is calculated to be 525 cubic metres, which includes 118 $m^3$ for balancing storage, 105 $m^3$ for emergency storage and 300 $m^3$ for fire storage in accordance with the BC Design Guidelines for Rural Residential Community Water Systems (BC FLNRORD, 2012). This differs from previous estimates (KWL, 473 $m^3$, 2009) which calculated a smaller fire flow storage requirement.

Given that the Community has storage at Boar's Nest Rd (23,335 litres), and above the end of Alannah Road (23,335 x 3 tanks, 70 cubic metres), the required storage for the main area near the water treatment plant is about 430 cubic metres.

It should be noted that the 3 tanks above the end of Alannah Road do not feed water back into the distribution system, but rather the outlet is connected to a single hydrant on Finn Bay Road opposite the Tidal Arts Centre. These tanks should be connected to the broader distribution system through a loop along Finn Bay Road connected back to the existing main adjacent to the sewage treatment plant.

The existing storage tanks near Thulin Lake are at the end of their useful life and need replacement. The site could accommodate a larger reservoir with minor ground improvements required for the above storage requirements. The estimated costs for replacement consider this site as option 1, and an alternate site (Telus Cellular Tower Site) at a similar elevation as Option 2.

*Table 2: Water Storage Capacity and Requirements*

| Reservoir Location & Number | Available Storage Volume (cu.m.) | Condition | Recommendations |
|---|---|---|---|
| **Reservoir 1, Near Thulin Lake** | 82.0 | 2 tanks at this location need replacement | 430 cubic metres in one new bolted steel reservoir, Item 1.2 of Cost Estimate |
| **Reservoir 2, Off Alannah Road** | 70.0 | New plastic tanks but piing and connections need improvement | Item 1.3 in Cost Estimate Address needs for piping and site improvements |
| **Reservoir 3, Boars Nest Road** | 23.3 | New Condition | No improvements or upgrades required |

# 3. Water Treatment Options

A review of the previous technologies presented was completed, plus an additional alternative is presented for consideration. Previously, others provided an assessment of three treatment technologies:

1. Enhanced Slow Sand Filtration
2. Dissolved Air Floatation (DAF) and Rapid Sand Filtration
3. Ultrafiltration (UF) Membranes

The intent of each of the above technologies is to remove the colour and dissolved organic matter in the water to reduce the formation of THMs and HAAs in the final drinking water product. Only the DAF plant requires chemical addition of coagulants to ensure that the dissolved and suspended solids are flocculated into larger sized particles, big enough to be floated and then retained on the filter media sand. The UF membrane system requires chemicals for cleaning cycles which occur automatically and at regular intervals. All plants require the addition of UV and Chlorine disinfection to ensure conformance to the BC 4-3-2-1-0 rule for surface water treatment.

For a small and remote community such as Village of Lund, it is important that the WTP is less complex, easy to operate, less chemical handling, automatic and less expensive. On this basis, new membrane technology now exists which is viewed as a better option than UF membranes, which require a more laborious clean-in-place (CIP) process that consumes more chemicals, time, and energy than newer system such as the hollow fiber membrane filtration system which is a direct Nanofiltration (dNF) system and replaces UF/NF with a one step process. This results in significant reduced capital and reasonable operating cost while reducing the footprint of the installation. These membranes are NSF/ANSI 61 certified for drinking water system and are particularly suitable for raw water with high colour and organics which a traditional UF may not be able to meet. Other advantage of dNF is that the CIP step can be skipped which often becomes problematic for operators. The CIP step is replaced with a CEF (chemical enhanced flushing) step which is completely automatic and requires little or no operator attention. In summary the direct NF offers the benefits of both UF and NF in a single membrane configuration with less complexity which makes it particularly attractive for small communities.

Other technologies were explored, and one was selected as suitable for this application. It is called Ballasted Flocculation / Sand Filtration and is described in more detail below (Section 3.4). To recap the four technologies reviewed for application to the Lund source water are.

1. Enhanced Slow Sand Filtration
2. Dissolved Air Floatation (DAF) and Rapid Sand Filtration
3. Direct Nanofiltration (dNF) Membranes
4. Ballasted Flocculation and Rapid Sand Filtration

## 3.1. ENHANCED SLOW SAND FILTRATION

The estimated size for the slow sand filter is 2 x 60 square metres, plus headworks, roughing filters, and clear wells. This technology provides robust passive filtration but does require operation and maintenance to backwash the roughing filters and remove the “schmutzdecke” biological layer from time to time. The large footprint would be difficult to fit into the existing right-of-way available at the Thulin Lake Pumping/Disinfection Station, and land tenure agreements would be required with the landowners. Energy consumption would be limited to the distribution pumps, as water could flow to and through the plant by gravity. There is a similar plant at the near by community of Sliammon.

Given the large footprint the estimated capital costs for an enhanced slow sand filtration plant are the highest among all options, but the forecasted annual operations and maintenance costs are estimated to be the lowest. Each of these estimates is provided in Table 3 and 4 without any contingencies or optional allowances.

*Table 3: Estimated Capital Costs for the Conceptual Enhanced Slow Sand Filtration Plant*

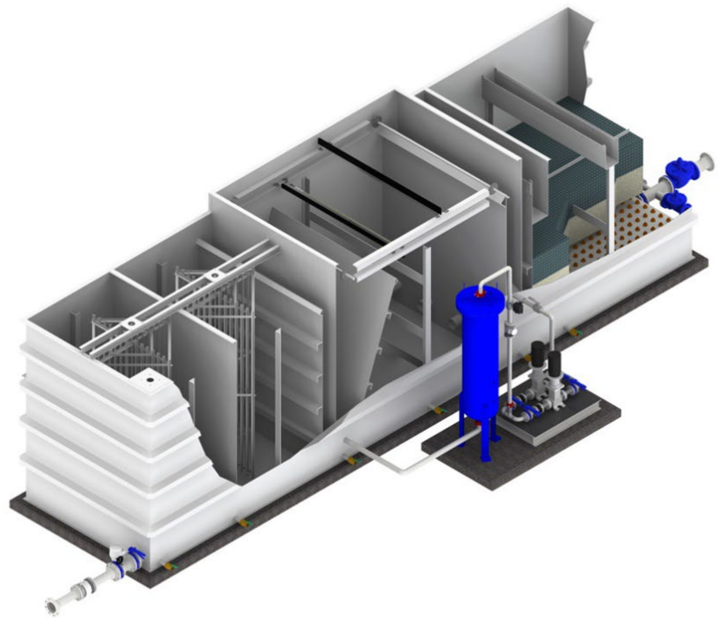
| **Enhanced Slow Sand Filtration** | |
|---|---|
| ***Item Description*** | ***Cost*** |
| Connect intake to New Plant | $42,398 |
| Main Tankage (120 sq. m. x 3m High) | $2,713,482 |
| Auxiliary Concrete Works at Head End and for Clear Tank | $483,339 |
| HVAC and Plumbing | $89,036 |
| Pre-Engineered Steel Building | $394,303 |
| Mechanical Piping and Underdrain Systems | $555,416 |
| Electrical instrumentation and Controls | $89,036 |
| BC Hydro Allowance | $161,113 |
| Supply and Install UV Reactors | $521,497 |
| New Sodium Hypochlorite System | $84,796 |
| Distribution Pumps | $84,796 |
| Commissioning | $296,787 |
| *Subtotal* | *$5,516,000* |

*Table 4: Estimated Life Cycle Costs for Operations and Maintenance – Enhanced Slow Sand Filtration*

| **Slow Sand Filtration** | |
|---|---|
| ***Consumables*** | |
| Coagulant | $1,800 |
| Sodium Hypochlorite (12%) - Disinfection | $5,500 |
| Replace Sand Media every 10 years | $5,000 |
| ***Energy Consumption*** | |
| Pumping Systems | $7,000 |
| Other equipment needed | $1,000 |
| ***Maintenance*** | |
| Operating staff time for O&M | $62,400 |
| General equipment maintenance allowance | $56,250 |
| | |
| Total annual average costs | $138,950 |
| Net Present Value for 20 Years of Operation | $1,888,376 |

## 3.2. DAF WITH RAPID SAND FILTRTION

*The D*issolved Air Flotation (DAF) process is used widely throughout the west coast area. Rather than settle the solids as in the clarifier, air bubbles are introduced with the raw water that attach to solids as the bubbles rise. Influent is injected with site-specific flocculant and dissolved compressed air before flowing into the main tank. Microbubbles will attach to the flocculated particles and float them to the top where they are skimmed off the top and into a sludge hopper. Heavier particles will fall to bottom and be pumped into a storage tank for disposal. The disposal is assumed to be off site – similar to the clarifier.



This approach is typically used with raw water ranging between 30 – 50 NTU, which suits the water quality from Thulin Lake. The real strength of this system is treating waters that are more affected with colour. This technology is very effective as the floc produced with colour is very light and more likely to float rather than settle.

Capital and Net Present Value O&M costs for the DAF plant concept are provided on Tables 5 and 6, respectively.

*Table 5: Estimated Capital Costs for the Conceptual Dissolved Air Floatation Plant*

| **DAF, Rapid Sand Filtration** | |
|---|---|
| ***Item Description*** | ***Cost*** |
| Connect intake to New Plant | $44,915 |
| Foundations (slab on grade, 15m x 20m) | $507,544 |
| Pre-Engineered Steel Building | $521,019 |
| HVAC and Plumbing | $139,238 |
| Supply and Install Package DAF Plant (2 Trains) | $2,694,923 |
| Mechanical Piping | $256,018 |
| Electrical instrumentation and Controls | $368,306 |
| BC Hydro Allowance | $166,187 |
| Supply and Install UV Reactors | $552,459 |
| New Sodium Hypochlorite System | $89,831 |
| Distribution Pumps | $94,322 |
| Commissioning | $139,238 |
| *Subtotal* | *$5,574,000* |

*Table 6: Estimated Life Cycle Costs for Operations and Maintenance – DAF, Rapid Sand Filtration Plant*

| DAF / Filtration Annual Costs | |
|---|---|
| ***Consumables*** | |
| Coagulant | $1,800 |
| Polymer | $1,000 |
| Sodium Hydroxide | $1,000 |
| Sodium Hypochlorite (12%) - Disinfection | $5,500 |
| Replace Sand Media every 10 years | $5,000 |
| ***Energy Consumption*** | |
| Pumping, Mixing, and Backwash Systems | $10,000 |
| Other equipment needed | $1,000 |
| ***Maintenance*** | |
| Operating staff time for O&M | $83,200 |
| General equipment maintenance allowance | $75,000 |
| | |
| Total annual average costs | $183,500 |
| Net Present Value for 20 Years of Operation | $2,493,825 |

## 3.3. NANOFILTRATION MEMBRANES

Given the relatively low turbidity of the source water membrane filtration is seen as a viable alternative. Ultrafiltration is typically arranged as parallel vertical vessel arrays. The system requires higher pressures to ensure the water passes through the membranes and requires automation for backwashing and less frequent clean-in-place cycles. This results in more chemical usage and slightly higher energy consumption, as well as a greater understanding of the slightly more complex operations by the operator.

The units are pre-packaged to a great extent and include proven controls, so the startup and commissioning are well managed with the assistance of the supplier. This system will not require a clarifier thus it represents the smallest of the proposed options.

Estimated costs for the dNF system as a package plant within a pre-engineered building of rough dimensions of about 8m x 10m are provided below (Table 7) without any contingencies. The estimated capital costs are followed by estimated annual costs for operations and maintenance, which are then presented as a net present value for a 20-year life cycle assessment (Table 8).

*Table 7: Estimated Capital Costs for the Conceptual Direct Nanofiltration Plant*

| **Direct Nanofiltration** | |
|---|---|
| ***Item Description*** | ***Cost*** |
| Connect intake to New Plant | $47,040 |
| Foundations (slab on grade, 8m x 15m) | $211,678 |
| Pre-Engineered Steel Building | $437,468 |
| HVAC and Plumbing | $103,487 |
| Supply and Install Package dNF Plant (2 Trains) | $1,890,990 |
| Mechanical Piping | $192,862 |
| Electrical instrumentation and Controls | $192,862 |
| BC Hydro Allowance | $178,750 |
| Supply and Install UV Reactors | $573,882 |
| New Sodium Hypochlorite System | $98,783 |
| Distribution Pumps | $94,079 |
| Commissioning | $141,119 |
| *Subtotal* | *$4,163,000* |

*Table 8: Estimated Life Cycle Costs for Operations and Maintenance – Direct Nanofiltration*

| **Direct Nanofiltration Annual Costs** | |
|---|---|
| ***Consumables*** | |
| Sulfuric Acid | $1,000 |
| Sodium Hydroxide | $2,000 |
| Sodium Hypochlorite (12%) - Disinfection | $5,500 |
| Replace Nano Units every 10 years | $45,000 |
| ***Energy Consumption*** | |
| Pumping, Backwash and CIP systems | $12,000 |
| Other equipment needed | $1,000 |
| ***Maintenance*** | |
| Operating staff time for O&M | $62,400 |
| General equipment maintenance allowance | $75,000 |
| | |
| Total annual average costs | $203,900 |
| Net Present Value for 20 Years of Operation | $2,771,068 |

## 3.4. BALLASTED FLOCULATION AND SAND FILTRATION

Ballasted flocculation provides excellent efficiency in clarifying the water by rapidly mixing coagulant and flocculant chemicals prior to the clarification stage, which features a specially graded sand that acts as a ballast, allowing the flocs to stick to the sand and settle vary rapidly. The clarifier would be followed by a rapid sand filter., such as what is seen in the adjacent photo. The sand is recycled through a cyclone separator at the top of the flocculant tank, and sand loss is minimal throughout the process.

The entire system is between 5 and 30 times smaller than other systems of similar capacity. The 15-minute start up time would allow for a bypass configuration to direct filtration during low-turbidity times; this would provide long-term chemical consumption savings. The systems for this size are provided as a package. Thus, the installation and commissioning are similar to the other packaged plant technologies.

Probable capital costs and net present value costs for the ballasted flocculation option are presented on Tables 9 and 10. Again, these estimates are presented without any contingencies for comparison to the other options

*Table 9: Estimated Capital Costs for the Conceptual Ballasted Flocculation and Sand Filtration Plant*

| **Ballasted Flocculation, Rapid Sand Filtration** | |
|---|---|
| ***Item Description*** | ***Cost*** |
| Connect intake to New Plant | $27,504 |
| Foundations (slab on grade, 10m x 18m) | $316,299 |
| Pre-Engineered Steel Building | $458,405 |
| HVAC and Plumbing | $91,681 |
| Supply and Install Package Clarifier Units (Ballasted Flocculation x2) | $1,292,701 |
| Supply and Install Package Rapid Sand Filter (x2) | $861,801 |
| Mechanical Piping | $256,707 |
| Electrical instrumentation and Controls | $449,236 |
| BC Hydro Allowance | $169,610 |
| Supply and Install UV Reactors | $563,838 |
| New Sodium Hypochlorite System | $91,681 |
| Distribution Pumps | $96,265 |
| Commissioning | $151,274 |
| *Subtotal* | *$4,827,000* |

*Table 10: Estimated Life Cycle Costs for Operations and Maintenance – Ballasted Flocculation, Rapid Sand Filtration*

| Ballasted Flocculation / Filtration Annual Costs | |
|---|---|
| ***Consumables*** | |
| Coagulant | $2,200 |
| Polymer | $1,000 |
| Sodium Hypochlorite (12%) - Disinfection | $5,500 |
| Replace Sand Media every 10 years | $5,000 |
| ***Energy Consumption*** | |
| Pumping, Mixing, and Backwash Systems | $10,000 |
| Other equipment needed | $1,000 |
| ***Maintenance*** | |
| Operating staff time for O&M | $78,000 |
| General equipment maintenance allowance | $75,000 |
| | |
| Total annual average costs | $177,700 |
| Net Present Value for 20 Years of Operation | $2,415,001 |

In summation of costs, the following Table 11 provides a comparison of the estimated total capital and O&M costs for each of the above four options.

*Table 11: Probable Cost Summary*

| | Enhanced Slow Sand Filtration | DAF / Rapid Sand Filtration | Direct Nanofiltration | Ballasted Flocculation / Sand Filtration |
|---|---|---|---|---|
| ***Estimated Capital Costs*** | $5,516,000 | $5,574,000 | $4,163,000 | $4,827,000 |
| ***NPV for 20 Years of Operation*** | $1,888,000 | $2,494,000 | $2,771,000 | $2,415,000 |
| ***Capital Costs + Net Present O&M Costs*** | $7,404,000 | $8,068,000 | $6,934,100 | $7,242,000 |

## 3.5. COMPARISON OF TREATMENT TECHNOLOGIES

The treatment system for Lund needs to be reliable, relatively easy to operate and maintain and be relatively compact, given the space limitations of the possible sites for construction, especially the existing site near Thulin Lake. A comparative assessment of the options is presented on **Table 12** below, which ranks each treatment technology in 11 categories, each with a factored level of importance. The importance factors (IF) are multiplied by the performance rating (PR) and the cumulative score is presented at the bottom. Based on the site specific factors for the community, the Membrane filtration plant scores the highest, and although these types of plants are somewhat complex, the automation and redundancy built into the technology, makes them fairly easy to operate and maintain, and they provide the most robust approach to treatment efficacy for the given water source, which is relatively low in organics and colour.

*Table 3: Comparison of Water Treatment Technologies*

| Options Analysis Parameter | IF | (1) Enhanced Slow Sand Filtration | PR | (2) Dissolved Air Flotation (DAF) | PR | (3) Membrane (dNF) Filtration | PR | (4) Ballasted Flocculation | PR | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| Robust efficacy of filtration in meeting **1** NTU for the 4-3-2-**1**-0 Rule | 10 | Can lag in efficacy as the system starts up and after removal of the biofilm layer | 8 | Relies on stable water source, but should be relatively consistent if chemical addition is properly monitored and optimized | 9 | Fully automated process with reliable, consistent results | 10 | Better reaction times to varying raw water quality, efficient nutrient, organic and dissolved solids removal | 9 | All plants can meet the 4,3,2,1,0 rule, but some require more attention than others |
| Pathogen removal for fecal coliform, viruses, bacteria , cryptosporidium and giardia for meeting **4,3,2** and **0** criteria for **4-3-2**-1-**0** | 10 | Generally good in pathogen control. Well proven. | 10 | Generally good in pathogen control. Well proven. Many installations in the region | 10 | Generally good in pathogen control. Well proven. Several installations in the region | 10 | Generally good in pathogen control. Well proven. Only a few installations in the region | 10 | All systems must be designed and operated to meet the 4-3-2-1-0 rule. |
| Operability, complexity of controls (SCADA) and level of operation intervention | 8 | Easiest to operate, but most labour intensive when filter sand requires removal/cleaning or replacement | 9 | Change to influent WQ will have a much more immediate impact. Thus operation staff will need to be even more attentive and more time in plant is anticipated. The saturation system is more complex thus requiring a higher level of service support. There can be more reliance on outside support | 6 | Fully automated: commissioning and operation should be relatively straightforward. Operator attendance required during CIP process on a monthly to bi-monthly basis | 8 | The advantage of this system is it starts and stops very quickly without upset to treated water quality. The experience level in the province for this technology is very limited. This risk is offset by strong support provided by the Process Suppliers. | 7 | The selected process must be aligned to operator's experience and capacity. In addition, can staff understand the process and address issues themselves or is outside support required. Can remote controls and monitoring be used to allow simple adjustments to address warnings and alarms? |
| Mechanical and Control Complexity and differences in operational cost | 5 | This process has the least moving parts and the least degree of automated controls | 9 | The saturation tank, air compressor, surface skimmer add several moving parts to treatment and control complexity | 7 | This is the most complicated system with the most moving parts. The automation includes membrane integrity testing plus a backwash system that cycles every 15 to 30 minutes. The membranes must be periodically washed with a clean in place system. | 6 | The introduction of the Microsand and the recirculation system adds several wear parts plus the system includes more automation to maintain the treatment. | 7 | As a rule of thumb, the less moving parts, the lower the operational cost as there are less wear items. Fewer controls and instrument have a similar affect of operational costs as each instrument requires continual calibration and periodic replacement. |
| Chemical consumption | 7 | No chemical addition for clarification/filtration | 10 | Requires chemical addition for coagulation/flocculation. May require additional chemicals for pH adjustment | 7 | The membranes will likely have some chemical enhancement for treatment plus the cost of CIP chemicals. The dose for treatment should be lower than clarifiers but the CIP chemicals should result in a equal level of chemical cost. | 7 | This process uses the most chemical as polymer is added to the Microsand. The raw water solids attach to the sand that rapidly settle in the specialized clarifier. The Microsand is continually recycled and is not a large impact on operational cost | 6 | Chemical costs are an important consideration. Limited time is allocated to this comparison due to the detailing required. During detailed design, this could be the difference between options as chemical costs are incurred every day to potentially make a considerable change in the overall selection. |
| Energy Consumption | 7 | Lowest as can be fed by gravity | 9 | Moderate to High | 7 | Highest | 6 | Moderate to High | 7 | Options 2, 3 and 4 all require mixing motors, and re-circulation/backwash pumps. UF requires a pressure pump to drive the water through the membranes |
| Redundancy | 9 | The tank will be split into two cells (trains) for redundancy and ensure plant operation during maintenance | 10 | Two 100% DAF units will be included with standby pumps and full redundancy in chemical feed | 10 | System comes in modules that are specifically engineered to meet full redundancy requirements. | 10 | Two 100% ballasted floc units will be included with all the ancillary elements including the floc tank, maturation tank and clarifier. All pumps will include a redundant spare. There will be full redundancy in chemical feed | 10 | All process must have redundancy of the process elements. This will be a part of the approval process and technology selected must meet Ministry guidelines |
| Relative Capital Costs | 7 | Most Expensive Options, but fully customizable to the site, Operations and Maintenance Costs will likely be the least | 5 | Comparable to UF and Ballasted Flocculation, but traditionally slightly higher O&M. | 6 | Smallest Footprint and therefore Capital Cost, but higher O&M costs with larger energy requirements | 9 | Slightly favoured over DAF for slightly lower capital, and O&M costs | 7 | |
| Residuals (sludge) Handling | 4 | Least residual volume | 10 | High levels of residuals | 7 | Moderate level of residuals | 8 | The highest level of residuals in terms of volume, but manageable due to typically low turbidity values | 7 | The solids captured must be removed. Given the amount of expected residuals is low, best to create a holding tank for periodic pump out |
| Technology fits on current site | 7 | The largest foot print of all options. Likely not suitable for present site without significant expansion of SRW | 1 | Largest option of the package plant. Building size required is in the order of 15m wide by 20m long | 5 | The most compact of all options. Building size is likely to be 8m x 15m | 10 | Smaller than DAF, but building about the same size | 8 | Existing right-of-way is very limited and would need to be expanded regardless of the chosen technology |
| | | **602** | | **566** | | **640** | | **595** | | |
| | | **Slow Sand Filtration** | | **DAF** | | **Direct Nanofiltration** | | **Ballasted Flocculation** | | |

## 3.6. TREATMENT PLANT SITING

The Lund Water District (LWD) and qathet Regional District (qRD) have indicated a concern with the location of the existing Thulin Lake pumphouse and disinfection facility, which is located on lands owned by the Tla'Amin First Nation. There is a statutory right-of-way (SRW), in this area, but it is not known whether the existing pumphouse is within the legal property boundary of the SRW. On this basis, it was requested that an alternate site be considered adjacent to the new Telus Cellular Tower, approximately 300m due north of the present pump house site. The attached conceptual requirements plan shows the Alternative #2 site.

There is good access to Site #2, and the facilities would be solely contained on land owned by the District. There is added cost, however, as this option requires a new intake into Thulin Lake, a new pumphouse at the edge of the lake, and new transmission main into and out of the WTP and reservoir. Costs are compared in Section 5.0 of the report.

# 4. Additional System Improvements

In order for the assets of the Lund Water District to be turned over to the qRD, the qRD prefers that the system first be brought to a reasonable level of service standard that meets typical design guidelines such as those used in the Master Municipal Construction Documents (MMCD). In the review of previous reports and the system a number of additional items need to be considered to bring the water system up to date. As these items have been identified in the past and confirmed within this assessment, only a brief list of the scope is provided below and are shown on the attached Conceptual Requirements figure.

Per previous reports and confirmed through the recent site visit, there are several areas where pipe improvements based on size and/or condition require replacing, and it is recommended to build some redundancy into the system, as follows:

- The submarine line through Finn Bay, requires replacement and upsizing to a minimum 150mm diameter. There are metallic fittings below high tide level which are susceptible to premature corrosion nd at risk of leakage or pipe failure. A new 150mm submarine pipeline should be installed with 100mm fused branch lines to create a monolithic plastic pipe throughout the bay. This requires about 990 lineal metres of new weighted HDPE pipe.
- Looping the existing water system from the sewage treatment plant to the north end of Finn Bay along Finn Bay Road provides redundancy and the opportunity to connect the north end storage tanks to the system as a whole. Reducing the need for additional storage and utilizing the water in the tank for more than just fire flow. The recommendation is to create this loop with a minimum 150mm diameter C900 PVC pipe complete with hydrants and valves over the 1150 lineal metres
- An additional 650 lineal metres of 150mm diameter C900 PVC pipe is required to eliminate the small water service piping from the existing Thulin Reservoir through private property to service three lots south of Larson Road on Hwy 101. This extension would create opportunity for additional servicing along the highway and provide required fire flows to the existing and future residences along the way.
- North of Finn Bay, the water line runs along the Road for several hundred metres at a current diameter of 100mm, between two sections of 150mm pipe. This estimated 350m pipe section should be updated with new C900 PVC pipe, valves, and hydrants. In addition, the blow off at the end of the run needs to be replaced as it is not currently working.
- There are a number of distribution piping issues that have been previously documented and still need to be addressed, as follows:
    - Install a new 200mm C900 PVC pipe for 310 lineal metres on HWY 101 to decommission the water main that goes through private property near Emil Road.
    - Install a new 150mm C900 PVC pipe for 90 lineal metres at Quarry Place to decommission the water main that goes through private property.
    - Install a new 150mm C900 PVC pipe for 160 lineal metres at Murray Road to upgrade the existing 100mm pipe.
    - Install a new 150mm C900 PVC pipe for 410 lineal metres at Larson Road and Sorenson Rd to upgrade the existing 100mm pipe.

- Currently, the system cannot supply enough fire flow to the top end of Larson Road and Boar's Nest Road. Consideration for a fire pump at the arson Road pumping station should be made as a basic system requirement.
- The piping into and out of the Alannah Road Reservoirs needs to be updated with proper pipe insulation and connectivity, as the piping is susceptible to freezing and cracking.
- An allowance for 12-15 new hydrants to replace old infrastructure is required throughout the community. In addition, the same number of valves should be accommodated, and three new system blow offs at current distribution piping dead ends.
- The number of residential water meters required to provide universal metering to all connections is approximately 80

A summary of the additional system improvements is provided on Table 4 below.

*Table 4: Additional System Improvements*

| Cost Item | Description | Estimated Length (m) | Size (mm) | Comments |
|---|---|---|---|---|
| **1.4** | New Submarine Line through Finn Bay | 990 | 150 | Necessary to upgrade existing 100mm with metallic fittings |
| **3.1** | North Finn Bay Rd | 350 | 150 | Necessary to upgrade existing 100mm pipe |
| **3.2** | Loop along Finn Bay Road from STP to Alannah | 1150 | 150 | Recommended to create a looped system and opportunity to connect Reservoir No. 2 |
| **3.3** | Emil Road | 310 | 200 | Required to eliminate private property conflict |
| **3.4** | Quarry Place | 90 | 150 | Necessary to upgrade existing 100mm pipe |
| **3.5** | Murray Road | 160 | 150 | Necessary to upgrade existing 100mm pipe |
| **3.6** | Larson / Sorenson Road | 410 | 150 | Necessary to upgrade existing 100mm pipe |
| **3.7** | Hwy 101 to South | 650 | 150 | New Line to service properties currently connected by a 25mm Line through private property |
| | | | | |
| **4.1** | Larson Road Pumping Station | | | Consider adding a 60 l/s fire pump at booster station |
| | | | | |
| **4.2** | Hydrant Replacements | | | Replace 12-15 hydrants that have reached their service life |
| **4.3** | Valves, Standpipes & Blow Offs | | | Replace appurtenances that have reached their service life |
| **4.4** | Residential Water Meters | | | Supply and Install up to 80 new water meters at existing connections |

# 5. Cost Estimates

The estimated costs carry contingencies consistent with generally accepted principles for conceptual designs and studies where a general contingency of 30-50% is considered reasonable due to the lack of sufficient detail in the study to produce a higher level of accuracy. In addition, inflationary and/or administrative contingencies can be added for future risks associated with the financial risks involved in long-term planning projects. This Class C estimate is based on little or no site-specific engineering but provides magnitude of order or 'ballpark' estimates and is derived from lump sum or unit costs from comparable projects of similar magnitude. This category is used in developing long term capital plans and for comparing conceptual options.

Table 7 provides a summary of the Class C estimates for each alternative siting of the new water treatment plant and reservoir plus all the required distribution system work.

*Table 7: Summary of Estimated Costs*

| Item No. | Description | Quantity | Unit | Size | Alternative 1 | Alternative 2 |
|---|---|---|---|---|---|---|
| *0.0* | *GENERAL* | | | | | |
| 0.1 | Mobilization & Demobilization | 1 | LS | | $967,000 | $1,067,000 |
| 2 | Insurance & Bonding | 1 | LS | | $836,000 | $918,000 |
| *1.0* | *Alternative 1 (Base Scope Items)* | | | | | |
| 1.1 | Water Treatment Plant - dNF | 1 | LS | | $4,163,000 | $4,725,000 |
| 1.2 | New Reservoir 1 - Thulin Reservoir | 1 | LS | | $1,427,000 | |
| 1.3 | New 150mm Marine Crossing | 990 | LM | 150 | $4,120,000 | $4,120,000 |
| 1.4 | Intake - Inspect / Clean Out | 1 | LS | | $324,000 | |
| 1.5 | Misc Piping Upgrdaes at Reservoir 2 - Alannah Road | 1 | LS | | $127,000 | $127,000 |
| *2.0* | *Alternative 2 (exclusive items)* | | | | | |
| 2.1 | New Intake | 1 | LS | | | $742,000 |
| 2.2 | New Pump Station | 1 | LS | | | $56,000 |
| 2.3 | New Line from PS to Res | 250 | LM | 100 | | $282,000 |
| 2.4 | New Reservoir | 1 | LS | | | $1,426,000 |
| 2.5 | WTP to Distribution | 200 | LM | 150 | | $226,000 |
| *3.0* | *DISTRIBUTION SCOPE* | | | | | |
| 3.1 | North Finn Bay Road Replace 4" with 6" | 350 | LM | 150 | $420,000 | $420,000 |
| 3.2 | Finn Bay & Alannah Road new 8" | 1150 | LM | 150 | $1,623,000 | $1,623,000 |
| 3.3 | Hwy 101 (Emil Road) install and Demo | 310 | LM | 150 | $438,000 | $438,000 |
| 3.4 | Quarry Place install and Demo | 90 | LM | 150 | $108,000 | $108,000 |
| 4.5 | Murray Rd Replace 4" with 6" | 160 | LM | 150 | $192,000 | $192,000 |
| 3.6 | Larson Road Replace 4" with 6" | 410 | LM | 150 | $492,000 | $492,000 |
| 3.7 | Hwy 101 - CO -Connection | 650 | LM | 150 | $734,000 | $734,000 |
| *4.0* | *OTHER SCOPE* | | | | | |
| 4.1 | Upgrade Larson Road Pump Station with Fire Pump | 1 | LS | | $106,000 | $106,000 |
| 4.2 | Hydrants | 1 | LS | | $71,000 | $71,000 |
| 4.3 | Valves | 1 | LS | | $169,000 | $169,000 |
| 4.4 | Metering (estimated at 80 units) | 1 | LS | | $226,000 | $226,000 |
| | **Subtotal Construction Cost** | | | | **$16,543,000** | **$18,268,000** |
| *5.0* | *DISTRICT ADMINISTRATION COSTS* | | | | | |
| 5.1 | Legal Survey and Legal Fees | | | | $250,000 | $250,000 |
| 5.2 | Land Acquisition for SRW's | | | | $500,000 | $500,000 |
| 5.3 | Districts Project Management & Administration (5%) | | | | $1,325,000 | $1,459,000 |
| *6.0* | *ENGINEERING AND CONTINGENCY* | | | | | |
| 6.1 | Design Engineering | | | | $3,028,000 | $3,342,000 |
| 6.2 | Contingency Allowance (30%) | | | | $4,962,900 | $5,480,400 |
| | **PROJECT TOTAL (excl. GST/ HST)** | | | | **$26,608,900** | **$29,299,400** |

# 6. Project Implementation

Given the scope of the required improvements of the system, the implementation of all the work should be phased over a practical amount of time to ensure that the improvements are not overly disruptive to the water system and the village of Lund itself. Also, there is likely limited resources within the qRD and Lund water district staff to manage the large scope of improvements and maintain the existing systems at the same time. On this basis, a phased approach has been envisioned for project implementation, focussing on the need to first deliver safe potable water through the existing system then completing necessary improvements to allow for better distribution and operations.

The proposed schedule is shown on Figure 2 (next page) and allows for design and approvals from regulatory agencies, assuming that there are only minor environmental concerns associated with the development of a small water treatment plant adjacent to the existing chlorination building, and that land tenure issues can be solved within the same time frame as the other approvals. The schedule is based on an October 2022 start date, which is not likely realistic, but the general timeline would simply be shifted based on when the decision to proceed is made.

Distribution system upgrades have been considered in 4 main tasks spread over three to four construction seasons. The marine crossing improvements would be designed for construction in 2023. Various system repairs like hydrants and valve replacements would also be accomplished within the first year of the program (2023), followed by the pipe upgrades to those streets that require upsizing for improved operations and to meet minimum standards. New pipe loops and extensions would be reserved for the second and third year of the program, and the upgrades to the Larson Road Pumping Station would be completed last under the schedule presented.

The implementation schedule is presented in realistic components of work but would of course be subject to funding and priorities set by the Owner or qRD or both.

There are existing supply chain issues that require some longer lead times for equipment such as electrical backup generators, speciality equipment like control panels and PLCs, and to some extent the water treatment process equipment, but to a lesser extent. Final implementation strategies should be cognizant and account for these realities in the planning and scheduling of the program work.

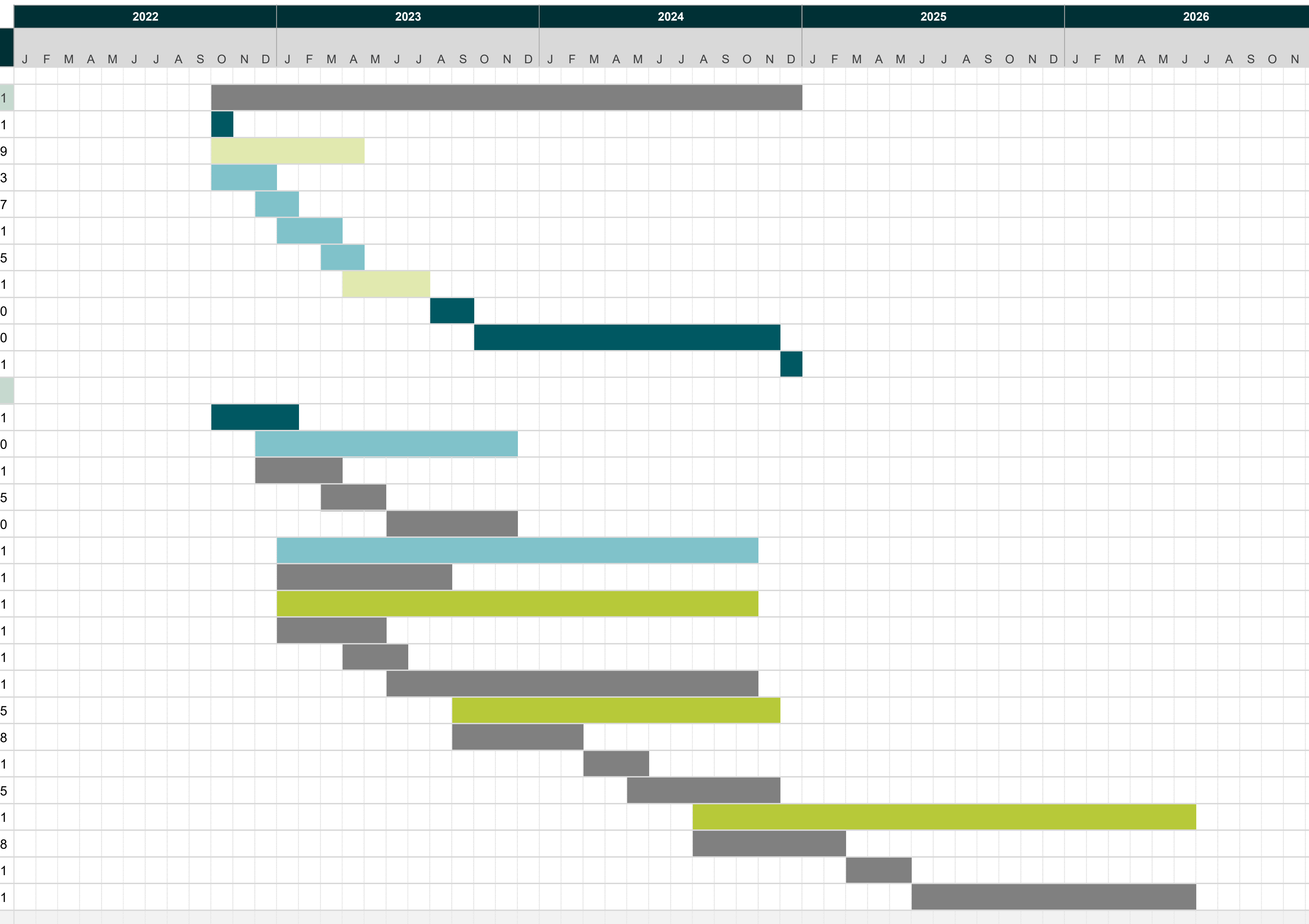
*Figure 2: Implementation Plan*

## Implementation Schedule

McElhanney

qathet Regional District -Lund Water System Upgardes Project Implementation

| TASK DESCRIPTION | PLAN START | PLAN END |
|---|---|---|
| **New WTP and Reservoir(s) including Intake Repairs and Misc Piping** | 2022-10-03 | 2024-12-31 |
| Task 1: Site Requirements Survey and Geotechnical, Land Tenure Plans | 2022-10-03 | 2022-10-31 |
| Task 2: Engage Regulators on Proposed Improvements and Design Requirements | 2022-10-11 | 2023-04-09 |
| Task 3: Process Confirmation and Piloting | 2022-10-11 | 2022-12-23 |
| Task 4: General Arrangement and Civil Design | 2022-12-05 | 2023-01-17 |
| Task 5: Process Mechanical and Electrical | 2023-01-02 | 2023-03-31 |
| Task 6: Structural and Building Systems | 2023-03-01 | 2023-04-15 |
| Task 7: Health Authority Permit Application, Secure Right-of-ways | 2023-04-22 | 2023-07-21 |
| Task 8: Tendering | 2023-08-01 | 2023-09-30 |
| Task 9: Construction | 2023-10-14 | 2024-11-30 |
| Task 10: Commissioning | 2024-12-01 | 2024-12-31 |
| **System Upgrades - Piping and Fire Pump Station** | | |
| Task 1: Site Requirements Survey and Geotechnical | 2022-10-03 | 2023-01-01 |
| Task 2: Marine Crossing | 2022-12-01 | 2023-11-30 |
| Task 2.1: Design | 2022-12-01 | 2023-03-31 |
| Task 2.2: Approvals | 2023-03-15 | 2023-05-15 |
| Task 2.3: Construction | 2023-06-01 | 2023-11-30 |
| Task 3: Distribution System Upgrades | 2023-01-01 | 2024-10-31 |
| Task 3.1: Hydrant and Valve Replacements as Maintenace Contract | 2023-01-01 | 2023-08-31 |
| Task 3.2: Distribution Pipe Upgrades - Finn Bay Rd, Emil Rd, Quarry Pl, Murray Rd, Larson Rd | 2023-01-01 | 2024-10-31 |
| Task 3.1: Design | 2023-01-01 | 2023-05-31 |
| Task 3.2: Approvals | 2023-04-15 | 2023-06-01 |
| Task 3.3: Construction (2 Construction Seasons) | 2023-06-01 | 2024-10-31 |
| Task 4: Design New Hwy 101 and Finn Bay Road Loop | 2023-09-01 | 2024-11-15 |
| Task 4.1: Design | 2023-09-01 | 2024-02-28 |
| Task 4.2: Approvals | 2024-03-01 | 2024-05-01 |
| Task 4.3: Construction (2024) | 2024-05-15 | 2024-11-15 |
| Task 5: Upgrade Larson Road Pumping Station | 2024-08-01 | 2026-06-01 |
| Task 5.1: Design | 2024-08-01 | 2025-02-28 |
| Task 5.2: Approvals | 2025-03-01 | 2025-05-31 |
| Task 5.3: Construction (2024-2025) | 2025-06-01 | 2026-06-01 |



# 7. Conclusions and Recommendations

The following conclusions and recommendations are provided based on the conceptual treatment plant assessments and the review of the previous reports and results of the most recent site investigation.

1. Estimated required total water storage volume is calculated to be 525 cubic metres, which includes 118 $m^3$ for balancing storage, 105 $m^3$ for emergency storage and 300 $m^3$ for fire storage.
2. Four water treatment technologies were explored for the application of improving the water delivered to the residents of Lund the recommended option is the Direct Nanofiltration, which provides the best value over a 20-year life cycle and has the smallest footprint to fit the site available. It is also viewed as one of the easiest technologies to operate and maintain as the control system is fully automated.
3. Provided the District can negotiate appropriate land tenure rights-of-way with the landowner where the existing plant and reservoir is currently located, this is the preferred location to build the water treatment plant and upgraded reservoir.
4. Cost estimates at the conceptual stage of study carry significant contingency, as limited site-specific information and investigation has been completed. Costs range from $26.6 to $29.3M. These estimates include capital costs for the new water treatment plant, reservoir, and general distribution upgrades including allowance to implement a universal metering initiative.
5. Once funding sources are secured, preliminary and detailed design for the system improvements should commence. The current treatment of the source water is limited to chlorine disinfection, which does not meet the BC Drinking Water Objectives for surface waters, and a more robust approach is required. Priority should be given to the treatment plant and storage reservoir to ensure safe potable water is delivered to Lund water users. System distribution elements can be designed and constructed independently, as opportunities arise.

# 8. Closure

We thank you for the opportunity to study the Lund Water System and its unique set of constraints and opportunities for improvements. We understand that there is Provincial support for moving this project forward and we hope our assessments and estimates lead to an informed funding decision that will provide the necessary means to upgrade the und Water System for safe, reliable service for years to come.

Please do not hesitate to call the undersigned at your earliest convenience should you have any questions or require additional information.

Sincerely,

McElhanney Ltd.

Mark DeGagné, MSc, PEng
Senior Municipal Engineer, McElhanney
mdegagne@mcelhanney.com | 778-560-2001

Ronan Deane, PEng., MIEI
Project Development Manager, NAC Constructors
rdeane@nacsworld.com

# FIGURES

User Name: CAllen
Date Saved: 6/22/2022 11:07 AM
Document Path: M:\qRD_GIS\04 PRO\Lund Water 2022\Lund Water 2022.aprx


qathet REGIONAL DISTRICT

# LUND WATER SYSTEM UPGRADES

CONCEPTUAL REQUIREMENTS

NOTES:

1. AN ALLOWANCE FOR THE REPLACEMENT OF UP TO 12 HYDRANTS SHOULD BE INCLUDED
2. AN ALLOWANCE FOR xx RESIDENTIAL METERS SHOULD BE INCLUDED
3. AN ALLOWANCE FOR UP TO THREE NEW BLOW OFFS AND SAMPLING STATIONS SHOULD BE INCLUDED

## Legend

### Hydrants & Standpipes

- Hydrants
- Standpipes
- Standpipes Approx.
- Lund Waterworks Service Area
- Water System Structure Footprints

### Lund Lidar

### Contours

- Index Contour (10m)
- Contour (2m)

**Contact**
Mark DeGagné, PEng
778-560-2001
mdegagne@mcelhanney.com