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Cowichan Valley Regional District

Phase 2, Stage 1 CVRD South Cowichan Liquid Waste Management Plan Amendment Study

McElhanney

McElhanney Consulting Services Ltd.
Suite 500 – 3960 Quadra Street
Victoria, BC
V8X 4A3

Contact: Dragan Rokic, P.Eng.
Phone: 250-370-9221
Email: drokic@mcelhanney.com

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Glossary of Terms and Acronyms

ADWF	Average Dry Weather Flow
BOD_5	Biochemical Oxygen Demand after 5 Days
CVRD	Cowichan Valley Regional District
EIS	Environmental Impact Study
FN	First Nation
GHG	Green House Gas
IRM	Integrated Resources Management
LWMP	Liquid Waste Management Plan
MBR	Membrane Bioreactor
MDF	Maximum Day Flow
MOE	BC Ministry of Environment and Climate Change Strategy
OCP	Official Community Plan
O&M	Operation and Maintenance
RIAM	Rapid Impact Assessment Matrix
RIB	Rapid Infiltration Basin
ROW	Right of Way
SBES	Shawnigan Beach Estates Sewer
SCLWMP	South Cowichan Liquid Waste Management Plan
STEG	Septic Tank Effluent Gravity (septic tank discharging effluent by gravity)
STEP	Septic Tank Effluent Pump (septic tank followed by a wet well housing an effluent pump)
TCAG	Technical and Community Advisory Group
Triple Bottom Line	Option evaluation method considering financial, environmental, and social impacts
TSS	Total Suspended Solids
UCB	Urban Containment Boundary
UF	Ultrafiltration
WWTF	Wastewater Treatment Facility
WWTP	Wastewater Treatment Plant

Executive Summary

McElhanney has completed Phase 2 of Stage 1 of the CVRD's South Cowichan Liquid Waste Management Plan (SCLWMP) Amendment Study (the Study) on behalf of the CVRD. The updated Master Plan will guide investments in wastewater systems to support the CVRD's projected growth to year 2050 and beyond. The SCLWMP area includes the Shawnigan Creek watershed, the Malahat Benchlands watershed, and the Satellite Channel watershed and covers all, or portions of, Electoral Areas A (Mill Bay / Malahat), B (Shawnigan Lake), and C (Cobble Hill).

A number of CVRD objectives for community growth and stewardship of the environment provide context for this Study, as expressed in:

- South Cowichan Official Community Plan;
- Sustainability Principles and Community Vision;
- 1998 Liquid Waste Management Plan;
- Solid Waste Management Plan;
- South Cowichan Water Study;
- CVRD Asset Management Strategy; and
- Other key documents.

The liquid waste management planning process involves the following steps:

- develop growth plan;
- forecast demand;
- assess capacity;
- identify servicing alternatives;
- evaluate servicing alternatives;
- develop action plan and programs; and
- implement action plan and programs.

The LWMP uses a watershed-based planning approach with due consideration for climate change, asset management, and energy conservation.

The liquid waste management study emphasizes methods of lowering the effective "cost threshold" for initiation of community servicing, based on the premise that once initiated, the further development of the servicing system can be self-supporting due to lifting of development constraints imposed by an insufficient population base.

The major objectives of this Study are to:

- identify and evaluate wastewater servicing options for the CVRD's South Cowichan area;
- inform the liquid waste management planning process and sewer servicing decisions;
- assist with the development of short- and long-term strategic implementation plans;
- provide sustainable wastewater management within South Cowichan;
- allow for further growth with expandable and/or modular wastewater treatment design;
- provide opportunities for effluent re-use; and
- protect and replenish the receiving ground water aquifers with Class A high-quality effluent.

Several population growth and flow scenarios were developed for the Study that assume different ratios of urban to rural population in South Cowichan.

Thirty-five existing wastewater management systems were assessed for the purposes of this Study, to evaluate their potential for integration into the South Cowichan's long-term wastewater management strategy. Twelve of these systems are community sewer systems owned and operated by the CVRD. The remainder is a mix of systems of smaller sizes owned and operated by private entities, stratas, school districts, or commercial and light industrial operators. Twenty systems are in Electoral Area A, eight systems are located in Electoral Area B, and seven systems are in Electoral Area C.

The most significant community assets are wastewater treatment and effluent disposal sites at Mill Springs, Sentinel Ridge, Shawnigan Beach Estates, Cobble Hill, and Arbutus Ridge.

Thirty servicing options were initially considered for the Study – 14 options in Electoral Area A, 12 options in Electoral Area B, and four options in Electoral Area C.

Fourteen evaluation criteria were identified for the Study classified in four categories:

- financial category – 2 criteria;
- technical category – 5 criteria;
- social category – 5 criteria; and
- environmental category – 2 criteria.

Viable wastewater servicing options were evaluated by using a triple bottom line approach and the Rapid Impact Assessment Matrix (RIAM) method.

In Electoral Area A, Options A-OP2, A-OP3A, A-OP1, A-OP6, and A-OP7C are recommended for further assessment in Stage 2 of the liquid waste management planning process thus reducing the total number of initial options from 14 to five viable options. Any of these options will be complemented by Option A-OP5 in the overall wastewater management strategy (refer to Table 1).

In Electoral Area B, Options B-OP1A, B-OP2A, and B-OP5A are recommended for further assessment in Stage 2 thus reducing the total number of initial options from 12 to three viable options. Any of these options will be complemented by Options B-OP3 and B-OP4 in the overall wastewater management strategy (refer to Table 1).

In Electoral Area C, Option C-OP3B (out of four initial options) is recommended for further assessment in Stage 2. Either Option C-OP3B or B-OP5A may be able to meet the wastewater servicing needs of Electoral Area C and would complement Options C-OP1 and C-OP2 (refer to Table 1).

The summary of options recommended for Stage 2 assessment with implementation timeline is provided in Table 1. Option descriptions are provided in Section 9.

Table 1 Options Recommended for Assessment in Stage 2 with Implementation Timeline

		OPTION COMPONENTS			Implementation Timeline						
Option Ref. #	Electoral Area	Collection System	WWTP Site	Effluent Discharge	2020	2025	2030	2035	2040	2045	2050
A-OP1	A	Mill Bay UCB	Mill Bay	Mill Springs	Further Assessment Required in Stage 2						
A-OP2	A	Mill Bay UCB	Mill Springs	Mill Springs	Further Assessment Required in Stage 2						
A-OP3A	A	Mill Bay UCB	Pioneer Square	Mill Springs	Further Assessment Required in Stage 2						
A-OP5	A	Sentinel Ridge	Sentinel Ridge	Sentinel Ridge	Complementary Option						
A-OP6	A	Mill Bay UCB + Malahat FN	Mill Springs	Mill Springs	Further Assessment Required in Stage 2						
A-OP7C	A + B	Mill Bay UCB + Shawnigan Village UCB + Corridor	Mill Springs	Mill Springs					Further Assessment Required in Stage 2		
B-OP1A	B	Shawnigan Village UCB	SBES Lagoons (Septage)	SBES	Further Assessment Required in Stage 2						
B-OP2A	B	Shawnigan Village UCB	Shawnigan Village (Septage)	SBES	Further Assessment Required in Stage 2						
B-OP3	B	Arbutus Mountain	Arbutus Mountain	Arbutus Mountain	Complementary Option						
B-OP4	B	Elkington Forest	Elkington Forest	Elkington Forest	Complementary Option						
B-OP5A	B + C	Shawnigan Village UCB + Cobble Hill UCB + Corridor	SBES Lagoons (Septage)	SBES					Further Assessment Required in Stage 2		
C-OP1	C	Cobble Hill UCB + Maple Hills	Twin Cedars	Twin Cedars + Galliers Rd	Complementary Option						
C-OP2	C	Arbutus Ridge	Arbutus Ridge	Arbutus Ridge	Complementary Option						
C-OP3B	C	Arbutus Ridge + Pauquachin FN	Arbutus Ridge (New)	New (TBD)					Further Assessment Required in Stage 2		

Notes:
WWTP - Wastewater Treatment Plant
UCB - Urban Containment Boundary
A-OP2 - Electoral area A, Option 2
SBES - Shawnigan Beach Estate Sewer
TBD - to be determined
FN - First Nation

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1. Context of the Study

The Cowichan Valley Regional District (CVRD) is conducting Phase 2 of Stage 1 of the CVRD's South Cowichan Liquid Waste Management Plan (SCLWMP) Amendment Study (the Study). The updated Master Plan will guide investments in wastewater systems to support the CVRD's projected growth to year 2050 and beyond. The SCLWMP area includes the Shawnigan Creek watershed, the Malahat Benchlands watershed, and the Satellite Channel watershed and covers all, or portions of, Electoral Areas A (Mill Bay / Malahat), B (Shawnigan Lake), and C (Cobble Hill). All Electoral Areas consist of low-density rural developments and urban areas with increased density, identified as Urban Containment Boundaries (UCBs).

The original LWMP, developed in 1998, was based on a centralized wastewater treatment plant (WWTP) in Mill Bay and effluent discharge through a marine outfall at Hatch Point. Practice has shown that this LWMP is only of an administrative nature. In reality, it has never been implemented for a variety of issues; primarily being:

a) insufficient population density to support substantial funding needs for LWMP implementation; and
b) changes to provincial policy, regulation, and guidelines.

Due to the extent of changes considered and substantial recent population growth in the area, the CVRD initiated a three-stage liquid waste management planning process, including a public consultation, to amend the 1998 LWMP and meet the requirements of relevant legislation and ministerial sign-off.

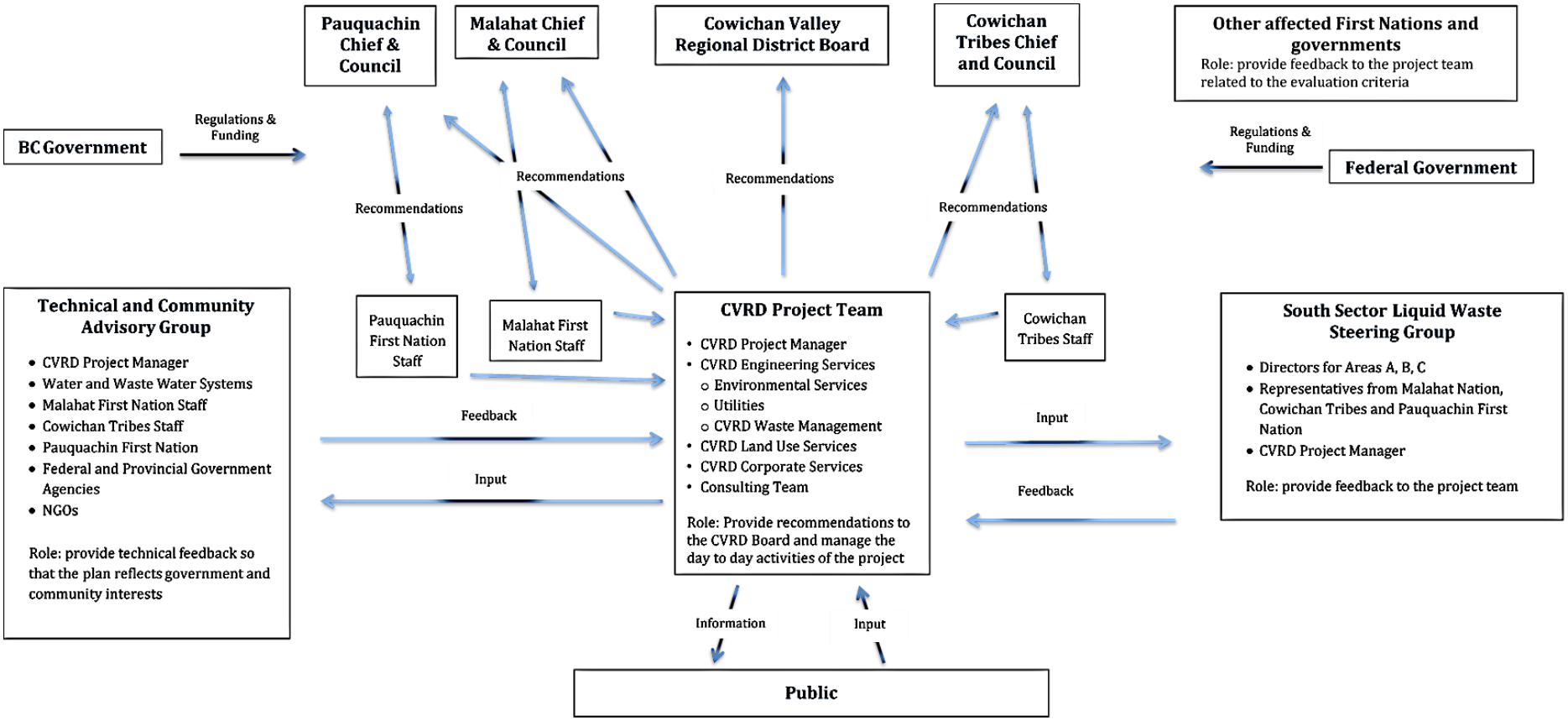
The Stage 1 program has included the following key components:

- project governance structure (refer to Figure 1);
- general land use and environmental policy scan;
- watershed and receiving environment characterization;
- population and growth scenario development;
- flow projections based on the population growth scenarios;
- existing wastewater infrastructure status and assessment;
- development of viable wastewater management options;
- development and refinement of evaluation criteria; and
- high-level options analysis.

The LWMP process requires a joint effort of the Technical and Community Advisory Group (TCAG), including the CVRD engineering staff, engineering consultant, and the public input to accomplish the following objectives:

- summarize the problem statement;
- identify opportunities to address liquid waste management issues in the plan area;
- model wastewater flows under various growth scenarios for the planned facilities;
- provide technical support where needed to the consultation process;
- provide input to the development, assessment, and review of the evaluation criteria;
- develop the preliminary long list of wastewater management options; and
- make recommendations on programing for the subsequent stages of the liquid waste management planning process to inform required resourcing to complete the SCLWMP update for provincial review.

Figure 1: Project Organizational Structure



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The LWMP study requires creative options for servicing of existing communities and future developments within South Cowichan, i.e., options that will be based on the unique area features, infrastructure inventory, and local context. There is an opportunity to take an integrated resource management approach, to look for synergies between the issue of wastewater management and related issues of water conservation (including supply of non-potable water), wastewater source control, environmental protection, energy conservation, solid waste management, and greenhouse gas emission reductions. The integrated approach may identify options that will provide greater community benefits when implemented in concert, than would otherwise be possible with separate solutions. For example, effluent re-use would lessen the demand on the domestic water supply and reduce the volume of water requiring treatment, thereby reducing energy costs and demand on the groundwater aquifer. As the volume of treated wastewater flow increases with future phases of the proposed developments and existing systems connecting to the treatment facility, the potential to introduce district energy may also become a viable alternative. Principles of integrated resource management are typically implemented where applicable and to the extent possible, such as in the areas with increased population densities delineated by UCBs.

The objective of the Phase 2, Stage 1 is to develop and evaluate viable cost-effective options, consistent with the vision of the community, that will facilitate the CVRD's goal of encouraging integration and expansion of what are today decentralized servicing areas.

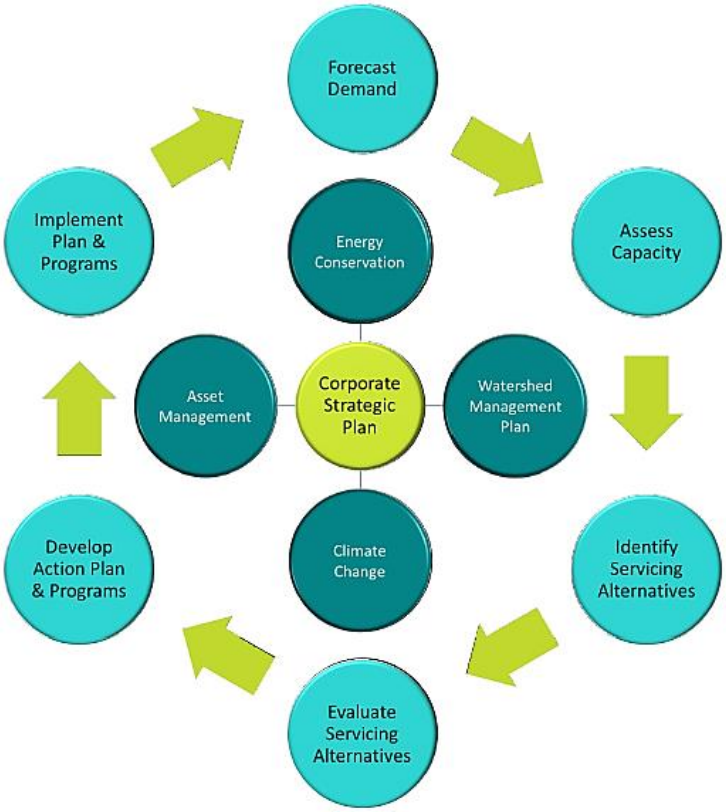
A number of CVRD objectives for community growth and stewardship of the environment provide context for this Study, as expressed in:

- South Cowichan Official Community Plan (OCP);
- Sustainability Principles and Community Vision;
- 1998 Liquid Waste Management Plan;
- Solid Waste Management Plan;
- South Cowichan Water Study; and
- CVRD Asset Management Strategy.

The CVRD's approach to the plan amendment is guided by the Corporate Strategic Plan and other key documents outlined above. The liquid waste management planning process involves the following steps (Figure 2):

- develop growth plan;
- forecast demand;
- assess capacity;
- identify servicing alternatives;
- evaluate servicing alternatives;
- develop action plan and programs; and
- implement action plan and programs.

Figure 2: CVRD's Approach to LWMP Amendment



The LWMP uses a watershed-based planning approach with consideration for climate change, asset management, and energy conservation.

The Study emphasizes methods of lowering the effective "cost threshold" for initiation of community servicing, based on the premise that once initiated, the further development of the servicing system can be self-supporting due to lifting of development constraints imposed by an insufficient population base. Amalgamation of decentralized community systems will allow developments consistent with CVRD's vision by providing fees and tax base to support further expansion of the systems while protecting the receiving environment, including ground and surface water.

The key issue is to provide an amendment to the CVRD's SCLWMP consistent with the South Cowichan community vision, values, and reality, such that the LWMP is realistic and implementable, toward encouraging and accommodating future community growth and development proposals. Understanding this issue is critical to the successful completion of the Stage 1 SCLWMP process.

The amended LWMP will be compatible with the Province of BC's Guidelines for Preparing Liquid Waste Management Plans and with the Municipal Wastewater Regulation.

2. Objectives

The major objectives of this Study are to:

- identify and evaluate wastewater servicing options for the CVRD's South Cowichan area;
- inform the liquid waste management planning process and sewer servicing decisions;
- assist with the development of short- and long-term strategic implementation plans;
- provide sustainable wastewater management within South Cowichan, which supports environmental protection;
- allow for further growth with expandable and/or modular wastewater treatment design;
- provide opportunities for effluent re-use; and
- protect and replenish the receiving ground water aquifers with Class A high-quality effluent.

The options are to be evaluated using a triple bottom line approach, where economic factors are to be considered alongside environmental and social factors. The identified servicing options are to be consistent with the community visions and sustainability principles.

This Study is designed to answer the following questions (to mention just a few) of specific interest for the liquid waste planning process:

- What are the wastewater servicing options to support and facilitate the creation of complete compact communities and village centres?
- What are the costs, advantages, and disadvantages of each option taking a triple bottom line approach?
- Is a connection to a community sewer system necessary to serve existing developments?
- Is it necessary to have community-wide sewer systems to promote the development of compact communities?
- Should there be different wastewater treatment options for existing and new developments?
- What are the environmental, social, and economic costs and benefits of each wastewater servicing option?
- Is it possible to offset part of the cost of localized wastewater treatment by means of revenues that could be realized from sales of reclaimed effluent or heat?
- How do we address existing impacts in rural areas?

Village centres and urban areas with higher population densities are of specific interest for wastewater management. In addition to planning policies, infrastructure improvement and/or upgrades within these areas will provide a pre-condition for, and promote, further growth. Development of self-contained village centres will also promote conditions for the protection of the natural environment by:

- protecting the area's aquifers as failing septic fields are replaced with advanced wastewater treatment;
- reducing demand on natural resources such as stressed and depleted groundwater resources;
- reducing greenhouse gas emissions caused by driving to larger centres for amenities;
- reducing greenhouse gas emissions arising from septic systems; and
- allowing resources, such as reclaimed effluent, to be recovered and used for the benefit of the village and surrounding areas.

The results of this study are intended to inform the liquid waste management planning process and sewer servicing decisions. This engineering report is provided in support of the final LWMP Stage 1 report and submission to the BC Ministry of Environment and Climate Change Strategy (MOE).

3. Scope of Work

The scope of work in this Study has been tailored to address the following:

- identify opportunities to address liquid waste management issues in the CVRD's South Cowichan area;
- estimate population projections for UCBs and rural areas;
- model wastewater flows under various growth scenarios for the planned facilities;
- provide input to the development, assessment, and refinement of the evaluation criteria;
- develop the preliminary long list of waste management options;
- evaluate wastewater servicing options specific to each watershed and Electoral Areas;
- score and rank the servicing options through a triple bottom line evaluation;
- identify short-listed alternatives; and
- make recommendations on programing for the subsequent stages of the liquid waste management planning process to inform required resourcing to complete the SCLWMP update for provincial review.

3.1. Tasks and Activities

The following tasks and activities were accomplished during work on this study:

- review of background technical documentation, reports, and studies;
- visits to, and visual assessment of, 35 wastewater treatment facilities of specific interest for the Study;
- preliminary discussions regarding potential treatment facility and ground disposal field location options;
- capacity assessment of existing wastewater treatment facilities and ground disposal sites for treated effluent;
- review of applicable regulations;
- development of design criteria and cursory evaluation of wastewater treatment options;
- establishment of effluent quality targets based on available environmental impact studies (EIS), the Official Community Plan, *Federal Wastewater Systems Effluent Regulations (WSER, 2015),* and the *BC Ministry of Environment and Climate Change Strategy (MOE) Municipal Wastewater Regulation (MWR, 2012)*;
- conceptual design of a typical wastewater treatment facility (WWTF) producing Class A effluent quality;
- evaluation and comparison of site servicing options employing a triple bottom line approach; and
- financial evaluation of wastewater management options by developing study-level, Class D capital cost estimates.

4. Assumptions

The work in this Study is based on the following assumptions:

- stormwater management issues and issues related to the treatment and management of contaminated sites and/or soil dumping are currently excluded from the work scope and will be addressed under separate future planning processes at a later date;
- in compliance with the OCP, all communal wastewater treatment options contemplate ground discharge of treated effluent;
- process configuration of all communal wastewater treatment facilities is based on the ultrafiltration membrane (MBR) technology meeting Class A effluent quality criteria for ground discharge. Part 5 of the MWR specifies Class A effluent quality criteria for ground discharge for daily flows up to 2 x ADWF (average dry weather flow) as (Table 2):

Table 2 Class A Effluent Quality Criteria for Ground Discharges

Parameter	Class A Effluent Quality Requirements
BOD_5 (mg/L) (Note 1)	Max. ≤ 10
TSS (mg/L) (Note 2)	Max. ≤ 10
Turbidity (NTU) (Note 3)	Average ≤ 2 Any sample ≤ 5
Total Nitrogen (mg/L)	Max. ≤ 20
Nitrate Nitrogen (mg/L)	Max. ≤ 10
Fecal Coliforms (MPN/100 mL) (Note 4)	Median ≤ 2.2 Any sample ≤ 14
pH	6 - 9

Notes:
Note 1: BOD – Biochemical Oxygen Demand
Note 2: TSS – Total Suspended Solids
Note 3: NTU – Nephelometric Turbidity Units
Note 4: MPN – Most Probable Number

- a typical MBR wastewater treatment configuration consists of the following components:
  - headworks (e.g., screen and screenings removal/handling);
  - aerated equalization tanks;
  - equalized flow transfer to the secondary/advanced treatment module;
  - anoxic, aerobic, and membrane bioreactors;
  - internal flow recycles;
  - effluent UV disinfection;
  - odour control;
  - sludge management;
  - operations building with blower and electrical rooms;
  - instrumentation and process controls; and
  - emergency power supply.

- financial evaluation and comparison of wastewater servicing options is based on a study-level, Class D cost. The Class D capital cost estimates are based on the conceptual design, combination of technology/material quotes, parametric estimates, and analogous pricing (i.e., historical costs) from previous experiences with similar past projects. An accuracy range of Class D capital cost estimate is expected to be within ±30-50% with a confidence interval of 90% in accordance with *Budget Guidelines for Consulting Engineering Services, Consulting Engineers of British Columbia, 2009*.

5. Strategy and CVRD's Approach to LWMP Amendment

The main purpose of the Master Plan amendment is to determine the wastewater infrastructure requirements needed to support the growth forecast for South Cowichan up to year 2050 and beyond, and to develop a long-term strategy that should enable the CVRD to continue to serve its residents in an environmentally and economically sustainable manner. The SCLWMP uses a watershed-based planning approach with consideration for climate change, asset management, and energy conservation.

5.1.1. Watershed-Based Planning

The CVRD has developed, or is developing/updating, watershed management plans to preserve watershed health, while also meeting community needs to facilitate future growth and development within the CVRD area. These plans investigate issues related to the quality and quantity of stormwater runoff, flood protection, environmental protection of aquatic resources, wildlife and their habitats, land use, greenways, and recreation. They also outline cost-effective and scientifically defendable solutions with implementation and maintenance plans supported by the public and endorsed by the environmental agencies. A watershed-based planning approach is used as the basis for the SCLWMP process with consideration for climate change, asset management, and energy conservation.

5.1.2. Climate Change

Extreme precipitation events, anticipated shifts in storm intensities and frequency, increased temperatures, and longer dry periods can put a strain on existing water and wastewater infrastructure. While drier summers and receding groundwater levels may impact water supplies from groundwater aquifers, increased vertical separation between ground disposal fields and aquifers may result in a better residual treatment of effluent from wastewater treatment facilities due to a longer residence time in soil. Environmental discharges of high-quality effluent to ground, such as Class A effluent, can augment strained and depleted ground water resources.

On the other hand, sewage collection systems and wastewater treatment facilities may struggle to keep up with increasing flows during sustained rainfall events due to inflow and infiltration (I/I). The significant I/I component can negatively affect the wastewater treatment resulting in reduced efficiencies, operational issues associated with the loss of the biomass from bioreactors, and diminishing level of treatment resulting in increasing costs and the need for system upgrades to be able to adapt to the effects of climate change. The potential effects of climate change and corresponding remedial action are nowadays integrated into almost any infrastructure engineering design and/or system retrofit with asset functionality and longevity in mind.

5.1.3. Asset Management

Asset management provides public entities, utility managers, and decision-makers with critical information on capital assets and timing of investments. Some key steps of asset management involve making an inventory of critical assets, evaluating their condition and performance, and developing plans to maintain, repair, and replace assets, and to fund these activities. It is the practice of managing infrastructure capital assets to minimize the total cost of owning and operating these assets while delivering the desired service levels.

The CVRD uses the asset management program to pursue and achieve sustainable infrastructure. Of specific importance are physical and capacity data on existing wastewater related infrastructure, including available capacities for conveyance, treatment, and effluent disposal systems, the number and locations of onsite wastewater management systems, system configuration and type of treatment, and discharge permit requirements. All of this information is essential for the successful completion of the LWMP process.

5.1.4. Energy Conservation

Experience shows that, in general, a great number of existing wastewater treatment facilities were designed with little consideration for energy conservation. At the time when the majority of these facilities were constructed, 20, 30, or 40 years ago, the thought of an energy crisis was a remote possibility. Today, energy conservation in wastewater treatment facilities is a prominent consideration, ranging from utilization of energy efficient devices/equipment to reclaimed water use/conservation and integrated resources recovery.

6. Population and Flow Projections

Population and flow projections combined with the assessment of capacities of the existing wastewater treatment facilities and effluent discharge sites, servicing respective catchment areas, form the basis for the evaluation of wastewater servicing options.

6.1. Population Projections

The design horizon considered for the Study is 40 years (i.e., Year 2057). Several population growth scenarios were developed for the Study (Appendix A). The two main scenarios are:

- Scenario 1 – this scenario assumes that the current relative population distribution in urban and rural areas will not change significantly. While the ratio of urban to rural population is specific to each Electoral Area, the split of urban to rural population is currently 50/50 considering the entire South Cowichan area. The summary population projections for Scenario 1 are provided in Tables 3, 4, and 5;
- Scenario 2 – this scenario assumes that infrastructure improvements and further expansion and/or amalgamation of sewer servicing within UCBs may stimulate faster population growth in UCBs after the initial five years. This scenario predicts that the ratio of urban to rural population will gradually shift above 60% and up to 75% in favour of the urban population. The summary population projections for Scenario 2 are provided in Tables 6, 7, and 8.

Other developed scenarios build on Scenario 1; however, they also include the needs of First Nation communities residing in South Cowichan, specifically:

- Malahat First Nation housing needs and potential housing development; and
- Pauquachin First Nation housing plans for Hatch Point.

All scenarios assume that the entire projected population within UCBs will be connected to communal wastewater management systems, although that assumption may not fully materialize. These projections are also based on the permanent population in South Cowichan, while the transient population (for example, during the summer season) is accounted for adequately in the infrastructure systems planning and design, through the use of peaking factors.

Table 3 Scenario 1 - Population and Flow Summary for Mill Bay and Shawnigan Lake UCBs

		Population	ADWF (m^3/d)	MDF (m^3/d)	Population	ADWF (m^3/d)	MDF (m^3/d)	Population	ADWF (m^3/d)	MDF (m^3/d)
Year	#	Mill Bay	Mill Bay	Mill Bay	Shawnigan Lake	Shawnigan Lake	Shawnigan Lake	MB + SL	MB + SL	MB + SL
		UCB	UCB	UCB	UCB	UCB	UCB	UCBs	UCBs	UCBs
2018	0	3,005	751	1,503	3,976	994	1,988	6,981	1,745	3,491
2028	10	3,710	927	1,855	4,136	1,034	2,068	7,846	1,961	3,923
2038	**20**	**4,579**	**1,145**	**2,290**	**4,302**	**1,076**	**2,151**	**8,881**	2,221	**4,441**
2048	30	5,653	1,413	2,826	4,475	1,119	2,238	10,128	2,532	5,064
2057	39	6,833	1,708	3,416	4,637	1,159	2,318	11,470	2,867	5,734
Total Growth		3,828			661			4,489		

Notes:
UCB - Urban Containment Boundary
ADWF - Average Dry Weather Flow
MDF - Maximum Day Flow
MB+SL - Mill Bay + Shawnigan Lake
Shawnigan Lake UCB population excludes the rural area around the lake

Table 4 Scenario 1 - Population and Flow Summary for Shawnigan Lake and Cobble Hill UCBs

Year	#	Population Shawnigan Lake UCB	ADWF (m^3/d) Shawnigan Lake UCB	MDF (m^3/d) Shawnigan Lake UCB	Population Cobble Hill UCB	ADWF (m^3/d) Cobble Hill UCB	MDF (m^3/d) Cobble Hill UCB	Population SL + CH UCBs	ADWF (m^3/d) SL + CH UCBs	MDF (m^3/d) SL + CH UCBs
2018	0	3,976	994	1,988	992	248	496	4,968	1,242	2,484
2028	10	4,136	1,034	2,068	1,201	300	600	5,337	1,334	2,668
2038	**20**	**4,302**	**1,076**	**2,151**	**1,454**	**363**	**727**	**5,756**	1,439	**2,878**
2048	30	4,475	1,119	2,238	1,760	440	880	6,235	1,559	3,118
2057	39	4,637	1,159	2,318	2,090	523	1,045	6,727	1,682	3,363
Total Growth		661			1,098			1,759		

Notes:
UCB - Urban Containment Boundary
ADWF - Average Dry Weather Flow
MDF - Maximum Day Flow
SL+CH - Shawnigan Lake + Cobbe Hill
Shawnigan Lake UCB population excludes the rural area around the lake

Table 5 Scenario 1 - Population and Flow Summary for Cobble Hill UCB and Arbutus Ridge

Year	#	Population Cobble Hill UCB	ADWF (m^3/d) Cobble Hill UCB	MDF (m^3/d) Cobble Hill UCB	Population Arbutus Ridge UCB	ADWF (m^3/d) Arbutus Ridge UCB	MDF (m^3/d) Arbutus Ridge UCB	Population CH + AR UCBs	ADWF (m^3/d) CH + AR UCBs	MDF (m^3/d) CH + AR UCBs
2018	0	992	248	496	1,095	274	548	2,087	522	1,044
2028	10	1,201	300	600	1,270	318	635	2,471	618	1,235
2038	**20**	**1,454**	**363**	**727**	**1,473**	**368**	**737**	**2,927**	731	**1,464**
2048	30	1,760	440	880	1,709	427	854	3,469	867	1,734
2057	39	2,090	523	1,045	1,953	488	977	4,043	1,011	2,022
Total Growth		1,098			858		429	1,956		

Notes:
UCB - Urban Containment Boundary
ADWF - Average Dry Weather Flow
MDF - Maximum Day Flow
CH+AR - Cobbe Hill + Arbutus Ridge

Table 6 Scenario 2 - Population and Flow Summary for Mill Bay and Shawnigan Lake UCBs

Year	#	Population Mill Bay UCB	ADWF (m^3/d) Mill Bay UCB	MDF (m^3/d) Mill Bay UCB	Population Shawnigan Lake UCB	ADWF (m^3/d) Shawnigan Lake UCB	MDF (m^3/d) Shawnigan Lake UCB	Population MB + SL UCBs	ADWF (m^3/d) MB + SL UCBs	MDF (m^3/d) MB + SL UCBs
2018	0	3,005	751	1,503	3,976	994	1,988	6,981	1,745	3,491
2028	10	3,894	974	1,947	4,176	1,044	2,088	8,070	2,018	4,035
2038	**20**	**5,213**	**1,303**	**2,606**	**4,415**	**1,104**	**2,207**	**9,628**	2,407	**4,813**
2048	30	6,977	1,744	3,489	4,667	1,167	2,334	11,645	2,911	5,823
2057	39	9,071	2,268	4,536	4,907	1,227	2,453	13,978	3,495	6,989
Total Growth		6,066			931			6,997		

Notes:
UCB - Urban Containment Boundary
ADWF - Average Dry Weather Flow
MDF - Maximum Day Flow
MB+SL - Mill Bay + Shawnigan Lake
Shawnigan Lake UCB population excludes the rural area around the lake

Table 7 Scenario 2 - Population and Flow Summary for Shawnigan Lake and Cobble Hill UCBs

Year	#	Population Shawnigan Lake UCB	ADWF (m^3/d) Shawnigan Lake UCB	MDF (m^3/d) Shawnigan Lake UCB	Population Cobble Hill UCB	ADWF (m^3/d) Cobble Hill UCB	MDF (m^3/d) Cobble Hill UCB	Population SL + CH UCBs	ADWF (m^3/d) SL + CH UCBs	MDF (m^3/d) SL + CH UCBs
2018	0	3,976	994	1,988	992	248	496	4,968	1,242	2,484
2028	10	4,176	1,044	2,088	1,255	314	628	5,432	1,358	2,716
2038	**20**	**4,415**	**1,104**	**2,207**	**1,636**	**409**	**818**	**6,051**	1,513	**3,025**
2048	30	4,667	1,167	2,334	2,133	533	1,067	6,800	1,700	3,401
2057	39	4,907	1,227	2,453	2,708	677	1,354	7,615	1,904	3,807
Total Growth		931			1,716			2,647		

Notes:
UCB - Urban Containment Boundary
ADWF - Average Dry Weather Flow
MDF - Maximum Day Flow
SL+CH - Shawnigan Lake + Cobbe Hill
Shawnigan Lake UCB population excludes the rural area around the lake

Table 8 Scenario 2 - Population and Flow Summary for Cobble Hill UCB and Arbutus Ridge

Year	#	Population Cobble Hill UCB	ADWF (m^3/d) Cobble Hill UCB	MDF (m^3/d) Cobble Hill UCB	Population Arbutus Ridge UCB	ADWF (m^3/d) Arbutus Ridge UCB	MDF (m^3/d) Arbutus Ridge UCB	Population CH + AR UCBs	ADWF (m^3/d) CH + AR UCBs	MDF (m^3/d) CH + AR UCBs
2018	0	992	248	496	1,095	274	548	2,087	522	1,044
2028	10	1,255	314	628	1,315	329	657	2,570	643	1,285
2038	**20**	**1,636**	**409**	**818**	**1,615**	**404**	**808**	**3,252**	813	**1,626**
2048	30	2,133	533	1,067	1,984	496	992	4,118	1,029	2,059
2057	39	2,708	677	1,354	2,388	597	1,194	5,096	1,274	2,548
Total Growth		1,716			1,293		646	3,009		

Notes:
UCB - Urban Containment Boundary
ADWF - Average Dry Weather Flow
MDF - Maximum Day Flow
CH+AR - Cobbe Hill + Arbutus Ridge

The population data indicate that the highest population density is anticipated in the Mill Bay UCB followed by the Shawinigan Lake and Cobble Hill/Arbutus Ridge UCBs. The Shawinigan Lake UCB has the lowest UCB/total population ratio followed by the Cobble Hill/Arbutus Ridge UCBs.

6.2. Flow Projections

The system flows were developed based on the population projections and identified catchment areas. Subsequently, capacities of existing wastewater treatment facilities, servicing respective areas, were compared to flow estimates and evaluated considering wastewater treatment performance indicators. Options for upgrade, expansion, and/or amalgamation of several servicing (i.e., catchment) areas were evaluated to support the further community growth and meet increasingly more stringent effluent criteria for environmental discharge.

The Average Dry Weather Flow (ADWF) and Maximum Day Flow (MDF) of sanitary wastewater for the Study were developed based on the population projections and are summarized in Tables 3 through to 8. Details are provided in Appendix B. The ADWF is used for the process design of a wastewater treatment facility (WWTF), while the MDF is used for the WWTF hydraulic design. The MDF is also used for the design of collection systems and effluent disposal sites.

Wastewater flow estimates are based on an average daily flow generation rate of 250 L/capita/day and home occupancy of 2.5 people/home[1]. A peak day flow factor of 2.0 was used to estimate the MDF[2] as a regulatory requirement. However, prior knowledge of the wastewater management systems within the South Cowichan area indicate that a typical range of the peak flow factor within South Cowichan varies from 1.4 to 2.0 depending on the area. This information has been considered in the capacity assessment of existing wastewater infrastructure. The peak day flow factor allows for a moderate amount of surficial runoff inflow and ground water infiltration (I/I) into the collection system.

The range of ADWFs and MDFs is estimated for each UCB. These estimates assume that conditions will be provided so that the entire permanent population within UCBs, including the First Nation communities, would be able to connect to community wastewater systems. The transient population (for example, during the summer season) is accounted for adequately in the infrastructure systems design through the use of peaking factors.

[1] ADWF = population x daily flow generation rate
[2] MDF = peak day flow factor x ADWF

7. Wastewater Infrastructure Inventory

The Study has used physical and capacity data on existing wastewater related infrastructure compiled by the CVRD, including available capacities for conveyance, treatment, and disposal systems, the number and locations of onsite wastewater management systems, system configuration and type of treatment, and discharge permit requirements (*South Sector Liquid Waste Facilities Information, CVRD, 2018*) (Appendix C). This information was used in the assessment of the existing wastewater management systems, their capacities and expansion potential, and the ability to meet Class A effluent criteria for environmental discharge.

The total of 35 systems were assessed and toured for the purposes of this Study. Twelve of these systems are community sewer systems owned and operated by the CVRD. The remainder is a mix of systems of smaller sizes owned and operated by private entities, stratas, school districts, or commercial and light industrial operators. Twenty systems are in Electoral Area A, eight systems are located in Electoral Area B, and seven systems are in Electoral Area C.

The systems with flow rates exceeding 5,000 Igpd (22.7 m^3/day) are registered with the MOE while smaller systems with design flows less than 22.7 m^3/day are registered with the Ministry of Health.

All these systems were originally sized to meet the needs of respective developments or operations as a precondition and minimum requirement for any development within the CVRD. Considering the wastewater treatment capacities, suitability for upgrade/technology retrofit, and potential of effluent disposal sites for additional capacity expansion, the infrastructure components identified in Table 9 are potential candidates for integration into community wastewater servicing solutions, specifically within UCBs.

Data in Table 9 indicate that the most significant South Cowichan community assets are wastewater treatment and disposal sites at Mill Springs, Sentinel Ridge, Shawnigan Beach Estates Sewer (SBES), Cobble Hill, and Arbutus Ridge. They can support long-term wastewater management solutions.

Smaller systems that are in regulatory compliance can continue to serve the existing customer base and/or commercial and light industrial establishments, while non-compliant systems will have an option to connect to community systems.

Individual, septic systems are not of interest for communal solutions and will have the same options as smaller systems above.

Table 9 Potential Candidates for Community Servicing Solutions

Wastewater Treatment / Discharge Site	Electoral Area	WWTP Capacity (m^3/day) (Note 1)	Capacity of Effluent Disposal Site (m^3/day) (Note 2)
Mill Springs	A	565 (permitted) > 5,000 (potential) (Note 3)	565 (permitted) 4,800 (potential) (Note 3) > 4,800 (requires additional land acquisition) (Note 4)
Sentinel Ridge	A	162 (permitted) 486 (future) (Note 3)	162 (permitted) 486 (future) (Note 3)
Shawnigan Beach Estates Sewer (SBES)	B	485 (permitted) > 1,600 (potential) (Note 3)	485 (permitted) 1,600 (potential) (Note 3) > 1,600 (potential) (Note 4)
Arbutus Mountain Estates	B	147 (permitted)	147 (permitted) > 147 (potential) (Note 4)
Cobble Hill (Twin Cedars)	C	700 (maximum)	700 (Twin Cedars + Galliers Rd combined maximum)
Arbutus Ridge	C	500 (maximum)	500 (maximum)

Notes:

WWTP – Wastewater Treatment Plant
Note 1 – Potential capacity can be realized with a technology retrofit and facility expansion.
Note 2 – Potential capacity can be realized with a conventional trench field conversion to rapid infiltration basins (RIBs) and expansion.
Note 3 – Confirmed capacity
Note 4 – Capacity to be confirmed

8. Membrane Bioreactor (MBR)

In the interest of understanding the wastewater treatment technology contemplated by this Study, a brief description and benefits of the technology are provided herein. The ultrafiltration membrane (MBR) technology producing Class A effluent quality is considered in this work.

The CVRD operates several wastewater treatment systems in South Cowichan based on the flat plate MBR technology producing Class A effluent quality, such as: Arbutus Ridge, Cobble Hill (Twin Cedars), Arbutus Mountain, and Sentinel Ridge. The Mill Springs WWTF is currently using a conventional extended aeration activated sludge (EAAS) technology, while the SBES system treats wastewater from the pertinent catchment area in a lagoon system. Both the Mill Springs and SBES WWTFs are suitable for retrofits with the MBR technology.

The MBR technology provides numerous benefits, such as:

- the capacity increase within the existing footprint and tankage with modest process control upgrades;
- superior effluent quality compared to conventional systems;
- consistency of treatment; and
- significant costs savings and lower capital costs due to the ability of the technology to adapt to existing wastewater treatment infrastructure.

The MBR technology combines the activated sludge (AS) process with solids removal by ultrafiltration membranes. These membranes have the nominal pore size of 0.08 microns. The MBR process consistently produces high-quality effluent and has a high removal efficiency of suspended solids and organic contaminants, such as: nutrients (nitrogen, phosphorus), bacteria, biochemical oxygen demand (i.e., organic carbon), and total suspended solids (TSS). The MBR process also coincidentally removes a significant amount of emerging contaminants, such as pharmaceuticals and endocrine disrupting substances. Various studies demonstrated removal in the order of 60% to 70% on average.

The MBR bioreactors operate at higher organic loading rates which result in lower hydraulic retention times and less space compared to conventional AS systems. MBRs have often been operated with longer solids residence time (SRT), which results in a lower sludge production rate and partial to full stabilization resulting in effective odour control.

The MBR filtration system can replace a secondary clarifier and polishing sand filters in conventional activated sludge treatment systems, thus resulting in a more compact system configuration and smaller footprint. Membrane filtration allows a higher biomass concentration in the bioreactor, thereby allowing smaller bioreactors to be used and providing a more robust treatment.

The high-quality effluent produced by MBRs makes them particularly suitable for reuse applications and ground discharges into sensitive environments requiring low organic loading, TSS concentrations, and nutrient (nitrogen and phosphorus) removal. This technology produces near-potable-water effluent quality. Effluent discharges of Class A effluent to ground provide the benefit of augmenting stressed and depleted ground water resources.

The MBR treatment is the system of choice in treatment applications that require high effluent quality and treatment reliability. The MBR process is also the preferred wastewater treatment technology by the provincial regulatory agency in environmentally sensitive applications.

There are a variety of commercially available membrane types. Typically, ultrafiltration membranes are used for wastewater treatment, mainly flat plate (Figure 3) or hollow fibre membranes (Figure 4). The CVRD uses the flat plate membranes in several WWTFs within the district.

Figure 3 Flat Plate Membranes (Toray Industries Inc.; 2019)

Figure 4 Hollow Fibre Membranes (Suez Water Technologies and Solutions; 2019)

9. Wastewater Servicing Options

One of the main objectives of this Study is to provide long-term wastewater management strategies able to:

- stimulate further population growth in UCBs;
- continue to service existing and future residential developments and commercial/industrial establishments;
- protect the receiving environment including groundwater and surface water (fresh and marine); and
- create conditions for connections of failing small on-site wastewater treatment and/or septic systems.

Strategically positioned decentralized wastewater treatment facilities, relying on the existing infrastructure assets within South Cowichan and producing reclaimed water quality, could service the projected customer base and provide effluent for the irrigation of green fields and groundwater recharge.

The total of 30 servicing options were initially considered for the Study – 14 options in Electoral Area A (Table 10), 12 options in Electoral Area B (Table 11), and four options in Electoral Area C (Table 12). Additional information concerning each option is provided in Appendix D. The South Cowichan area map showing all options is also provided in Appendix D. Color coding in Tables 10, 11, and 12 is provided for easy option identification in the area map (Appendix D).

Table 10 Electoral Area A – Wastewater Servicing Options

		OPTION COMPONENTS								
Option Ref. #	Electoral Area	Collection System	WWTP Site	Effluent Discharge	Catchment Areas (Colour Coding)					
	Electoral Area A				UCB	EXIST	COR	SL-E	SL-W	FN
A-OP1	Electoral Area "A"	Mill Bay UCB	Mill Bay	Mill Springs						
A-OP2	Electoral Area "A"	Mill Bay UCB	Mill Springs	Mill Springs						
A-OP3A	Electoral Area "A"	Mill Bay UCB	Pioneer Square	Mill Springs						
A-OP3B	Electoral Area "A"	Mill Bay UCB	Pioneer Square	Frances Kelsey School						
A-OP4A	Electoral Area "A"	Mill Bay UCB	Frances Kelsey School (Septage)	Frances Kelsey School						
A-OP4B	Electoral Area "A"	Mill Bay UCB (Limited Coverage)	Frances Kelsey School (Septage)	Frances Kelsey School						
A-OP5	Electoral Area "A"	Sentinel Ridge	Sentinel Ridge	Sentinel Ridge						
A-OP6	Electoral Area "A"	Mill Bay UCB + Malahat FN	Mill Springs	Mill Springs						
A-OP7A	Electoral Areas " A" and "B"	Mill Bay UCB + Shawnigan Village UCB + Corridor	Pioneer Square	Mill Springs						
A-OP7B	Electoral Areas " A" and "B"	Mill Bay UCB + Shawnigan Village UCB + Corridor	Mill Bay	Mill Springs						
A-OP7C	Electoral Areas " A" and "B"	Mill Bay UCB + Shawnigan Village UCB + Corridor	Mill Springs	Mill Springs						
A-OP8A	Electoral Areas " A" and "B"	Mill Bay UCB + Shawnigan Village UCB + Corridor + Lake Perimeter	Pioneer Square	Mill Springs						
A-OP8B	Electoral Areas " A" and "B"	Mill Bay UCB + Shawnigan Village UCB + Corridor + Lake Perimeter	Mill Bay	Mill Springs						
A-OP8C	Electoral Areas " A" and "B"	Mill Bay UCB + Shawnigan Village UCB + Corridor + Lake Perimeter	Mill Springs	Mill Springs						

Notes:
WWTP - Wastewater Treatment Plant
UCB - Urban Containment Boundary
COR - Corridor
SBES - Shawnigan Beach Estates Sewer
A-OP3A - Electoral area A, Option 3A
SL-E - Shawnigan Lake East
SL-W - Shawnigan Lake West
TBD - to be determined
FN - First Nation
EXIST - Existing water and sewer services outside UCBs

Table 11 Electoral Area B – Wastewater Servicing Options

Option Ref. #	Electoral Area	OPTION COMPONENTS: Collection System	WWTP Site	Effluent Discharge	Catchment Areas (Colour Coding)					
	Electoral Area B				UCB	EXIST	COR	SL-E	SL-W	FN
B-OP1A	Electoral Area "B"	Shawnigan Village UCB	SBES Lagoons (Septage)	SBES						
B-OP1B	Electoral Area "B"	Shawnigan Village UCB + Eastern Lake Boundary	SBES Lagoons (Septage)	SBES						
B-OP1C	Electoral Area "B"	Shawnigan Village UCB + Lake Perimeter	SBES Lagoons (Septage)	SBES						
B-OP2A	Electoral Area "B"	Shawnigan Village UCB	Shawnigan Village (Septage)	SBES						
B-OP2B	Electoral Area "B"	Shawnigan Village UCB + Eastern Lake Boundary	Shawnigan Village (Septage)	SBES						
B-OP2C	Electoral Area "B"	Shawnigan Village UCB + Lake Perimeter	Shawnigan Village (Septage)	SBES						
B-OP3	Electoral Area "B"	Arbutus Mountain	Arbutus Mountain	Arbutus Mountain						
B-OP4	Electoral Area "B"	Elkington Forest	Elkington Forest	Elkington Forest						
B-OP5A	Electoral Areas "B" and "C"	Shawnigan Village UCB + Cobble Hill UCB + Corridor	SBES Lagoons (Septage)	SBES						
B-OP5B	Electoral Areas "B" and "C"	Shawnigan Village UCB + Cobble Hill UCB + Corridor	Shawnigan Village (Septage)	SBES						
B-OP6A	Electoral Areas "B" and "C"	Shawnigan Village UCB + Cobble Hill UCB + Corridor + Lake Perimeter	SBES Lagoons (Septage)	SBES						
B-OP6B	Electoral Areas "B" and "C"	Shawnigan Village UCB + Cobble Hill UCB + Corridor + Lake Perimeter	Shawnigan Village (Septage)	SBES						

Notes:
WWTP - Wastewater Treatment Plant
UCB - Urban Containment Boundary
COR - Corridor
SBES - Shawnigan Beach Estates Sewer
A-OP3A - Electoral area A, Option 3A
SL-E - Shawnigan Lake East
SL-W - Shawnigan Lake West
TBD - to be determined
FN - First Nation
EXIST - Existing water and sewer services outside UCBs

Table 12 Electoral Area C – Wastewater Servicing Options

Option Ref. #	Electoral Area	OPTION COMPONENTS: Collection System	WWTP Site	Effluent Discharge	Catchment Areas (Colour Coding)					
	Electoral Area C				UCB	EXIST	COR	SL-E	SL-W	FN
C-OP1	Electoral Area "C"	Cobble Hill UCB + Maple Hills	Twin Cedars	Twin Cedars + Galliers Rd						
C-OP2	Electoral Area "C"	Arbutus Ridge	Arbutus Ridge	Arbutus Ridge						
C-OP3A	Electoral Area "C"	Arbutus Ridge + Pauquachin FN	Arbutus Ridge	Arbutus Ridge						
C-OP3B	Electoral Area "C"	Arbutus Ridge + Pauquachin FN	Arbutus Ridge (New)	New (TBD)						

Notes:
WWTP - Wastewater Treatment Plant
UCB - Urban Containment Boundary
COR - Corridor
SBES - Shawnigan Beach Estates Sewer
A-OP3A - Electoral area A, Option 3A
SL-E - Shawnigan Lake East
SL-W - Shawnigan Lake West
TBD - to be determined
FN - First Nation
EXIST - Existing water and sewer services outside UCBs

Each option in the summary tables above has three main components:

- collection system. It should be noted that community servicing does not necessarily imply that sewer mains would have to be installed along every street within UCBs, just that mains are provided such that connection distances for new or redeveloped properties, as well as any existing properties electing to connect, would be reasonable;
- wastewater treatment plant; and
- effluent discharge site.

The options are self-explanatory. For example:

- Option A-OP2 – This option is considered for Electoral Area A. It includes the Mill Bay UCB catchment area, wastewater treatment at the Mill Springs WWTP, and effluent disposal at Mill Springs.
- Option A-OP7A – This option contemplates servicing of Electoral Areas A and B. Its catchment area includes the Mill Bay and Shawnigan Village UCBs and the corridor between the UCBs, wastewater treatment at the Pioneer Square WWTP, and effluent disposal at Mill Springs.
- Option B-OP1B - This option is considered for Electoral Area B. Its catchment area includes the Shawnigan Village UCB and eastern Shawnigan Lake boundary, wastewater treatment at the SBES lagoons, and effluent disposal at the SBES site. “Septage” means that the wastewater treatment site is suitable for integration of a septage receiving facility.
- Option C-OP1 - This option is considered for Electoral Area C. Its catchment area includes the Cobble Hill UCB and Maple Hills development, wastewater treatment at the Twin Cedars WWTP, and effluent disposal at Twin Cedars and Galliers Rd.

10. Evaluation Criteria

Development and refinement of evaluation criteria was accomplished through a public consultation process over the period of five months. The total of 14 evaluation criteria were identified for the Study classified in four categories:

- financial category – 2 criteria with the maximum score of 100 (27% of the total) (Table 13);
- technical category – 5 criteria with the maximum score of 100 (27% of the total) (Table 14);
- social category – 5 criteria with the maximum score of 70 (19% of the total) (Table 15); and
- environmental category – 2 criteria with the maximum score of 100 (27% of the total) (Table 16).

Each discrete criterion was assigned a weighting factor, as indicated in the tables below. The weighting factors were assigned based on feedback received from various stakeholders and community groups. All the factors and differentiators that were considered in the evaluation process are also summarized in the tables.

Table 13 Evaluation Criteria – Financial Category

Ref. #	Weighting Factor	Evaluation Criteria	Factors and Differentiators to Consider in the Assessment	Comments
Financial Category	100			
F1	50	Capital cost	Construction cost to consider new infrastructure vs. upgrade of the existing infrastructure (e.g., new WWTP vs. existing WWTP upgrade); may require and will consider phased approach to match population projections	of importance to capital funding/investments related to federal and provincial funding, grants, or other funding sources for alignment with service areas and public/private financial participation/contributions - important for infrastructure planning purposes
F2	50	O&M Cost	Has an impact on annual O&M budgets and ongoing operations, e.g., impact of integration/amalgamation of existing WWTPs on O&M efforts/costs vs. new facilities	of importance for setting realistic annual O&M budgets for infrastructure maintenance, servicing, repairs, ongoing operations, etc. - important for planning ongoing infrastructure O&M operations

Notes:
O&M - Operations and maintenance
WWTP - Wastewater treatment plant
IRM - Integrated resources management
STEP - Septic Tank Effluent Pump
STEG - Septic Tank Effluent Gravity
CVRD - Cowichan Valley Regional District
UCB - Urban Containment Boundary
ROW - Right of way
GHG - Green house gas
CT - Cowichan Tribes
TBD - to be discussed
FN - First Nation

Table 14 Evaluation Criteria – Technical Category

Ref. #	Weighting Factor	Evaluation Criteria	Factors and Differentiators to Consider in the Assessment	Comments
Technical Category	100			
T1	20	Technical advantages and disadvantages	Factors to consider: (a) capacity requirements and level of service required to meet service demand; (b) collection system alignments to maximize service areas and improve the overall quality/reliability of service; (c) level (extent) of utilization/reuse of the existing wastewater systems/infrastructure that affects the infrastructure feasibility/suitability for incremental expansion and long-term future use; (d) Integrated Resource Management opportunities including recovery of energy, water, heat, effluent and sludge conversion to compost; (e) ability of system to mitigate environmental impacts; and (f) management complexity of system.	e.g., configuration requirements (e.g., size, footprint, volume, layout - depending on the system component), reuse potential or continued use of the existing infrastructure vs. building new infrastructure, potential to increase service areas and/or population densities due to infrastructure improvements and/or layouts, etc.
T2	20	Technology	Factors to consider: a) Conventional systems - drawing on a combination of physical, chemical, and biological processes and operations to remove solids, organic matter, nutrients; b) Nanofiltration systems - to provide filtration at the molecular level which allows filtering out hardness, iron, tannins and other contaminants that conventional filtration cannot remove; and c) Other technology options (e.g., advanced oxidation).	
T3	20	Risk consideration	Factors to consider: (a) safeguarding of wastewater collection, treatment, and discharge systems to security and climate risks including stormwater infiltration, flood, sea level rise, and slope failure (b) impacts and reliability of gravity (i.e., deep collection or STEG) systems vs. pumping stations and STEP systems.	Wastewater system security and reliability
T4	20	Difficulties of construction	Options are to consider stream and road/highway crossings, impacts on the riparian areas and existing utilities/infrastructure, impacts on private properties and commercial operations	This criterion may have impact on schedule/implementation, permitting process with various agencies/stakeholders, construction techniques, constructability, or other complexities.
T5	20	Phasing suitability and expandability	Factors to consider: (a) staged growth and maximizing the use of the existing and planned infrastructure; and (b) incremental expansions as they relate to growth or late comers from outside the electoral areas.	This criteria was slightly modified based on the feedback received from Cowichan Tribes, Malahat FN, and Pauquachin FN.

Notes:

O&M - Operations and maintenance
WWTP - Wastewater treatment plant
IRM - Integrated resources management
STEP - Septic Tank Effluent Pump
STEG - Septic Tank Effluent Gravity
CVRD - Cowichan Valley Regional District
UCB - Urban Containment Boundary
ROW - Right of way
GHG - Green house gas
CT - Cowichan Tribes
TBD - to be discussed
FN - First Nation

Table 15 Evaluation Criteria – Social Category

Ref. #	Weighting Factor	Evaluation Criteria	Factors and Differentiators to Consider in the Assessment	Comments
Social Category	70			
S1	15	Impacts related to the opportunity and/or requirements for land development	Encourage growth within UCBs to support sustainable infrastructure, and maximize the opportunity for population density specifically in UCBs to enable the financial support for infrastructure.	
S2	10	Impact on local residents/businesses and disruptions wrt status quo	Options are to consider impacts, such as: noise, dust/air pollution, traffic disruptions during and after construction, workers parking, odour, ROWs/easements, visual aesthetics, etc.	
S3	10	Community support	Consider likely community support/perception, long-term community benefits, sharing of services, and financial participation/contribution.	
S4	20	Impacts on archaeological and heritage resources	Requires a map of known archaeological sites	
S5	15	Impacts on First Nations (FN) cultural and traditional use sites	Consider and evaluate impacts to FN cultural/traditional use sites (e.g., spiritual/sacred or subsistence/harvesting areas), or FN access to those sites/areas.	This criterion was added based on the feedback received from Cowichan Tribes and will be refined in further stages of work as specific routing issues are explored.

Notes:
O&M - Operations and maintenance
WWTP - Wastewater treatment plant
IRM - Integrated resources management
STEP - Septic Tank Effluent Pump
STEG - Septic Tank Effluent Gravity
CVRD - Cowichan Valley Regional District
UCB - Urban Containment Boundary
ROW - Right of way
GHG - Green house gas
CT - Cowichan Tribes
TBD - to be discussed
FN - First Nation

Table 16 Evaluation Criteria – Environmental Category

Ref. #	Weighting Factor	Evaluation Criteria	Factors and Differentiators to Consider in the Assessment	Comments
Environmental Category	100			
E1	50	Impact of the existing and proposed infrastructure to the environment	Impacts include the effects of effluent collection and treatment to vegetation, aquatic resources, fisheries, wildlife habitat, soil contamination	Qualitative impact from the environmental perspective
E2	50	Impacts of effluent discharge to the receiving environment	Impacts include the effects of discharge to ground and surface water resources.	This criterion is specific to the CVRD South Sector due to several creeks in the study area: Shawnigan Creek, Hollings Creek, Handysen Creek, and other smaller creeks and tributaries.

Notes:
O&M - Operations and maintenance
WWTP - Wastewater treatment plant
IRM - Integrated resources management
STEP - Septic Tank Effluent Pump
STEG - Septic Tank Effluent Gravity
CVRD - Cowichan Valley Regional District
UCB - Urban Containment Boundary
ROW - Right of way
GHG - Green house gas
CT - Cowichan Tribes
TBD - to be discussed
FN - First Nation

Many social considerations are also addressed under the financial, technical, and environmental categories.

11. Methodology

The various wastewater servicing options were assessed by using a triple bottom line approach and the Rapid Impact Assessment Matrix (RIAM) method.

11.1. Rapid Impact Assessment Matrix (RIAM)

The project team employed the use of RIAM, which is a structured EIA method and software tool developed in Denmark (*Pastakia, C. 1998. The Rapid Impact Assessment Matrix (RIAM) - A New Tool for Environmental Impact Assessment*.). RIAM is in use globally by institutions such as the World Bank to evaluate project alternatives and financing priorities in cases where potential environmental and social impacts (whether positive or negative) are prominent considerations. Its use has been adopted into planning regulations by a number of countries and multilateral agencies, such as Council on Environmental Quality (Washington, DC), Council of the European Union, Danish International Development Agency, and European Bank for Reconstruction and Development.

From a functional perspective, RIAM is not dissimilar from any typical environmental evaluation matrix approach. The advantages of RIAM, however, are that environmental, social, and economic criteria are pre-populated and its graphical and alpha-numeric output options are pre-configured. These criteria are categorized under four categories: physical and chemical, biology and ecology, sociology and culture, and economics and operations, thus embracing the principles of a triple bottom line.

Comparative evaluation of technical alternatives has been implemented through several complimentary steps. Technically applicable solutions, accounting for community stakeholders' priorities, concerns and local, site-specific conditions were evaluated in the following decision-making process:

- Step 1 - Bounding and scoping of technical alternatives identified through public consultations and in technical sessions with the TCAG. The bounding/scoping consists of identification of:
    a) the project spatial and temporal boundaries, and
    b) technically viable, scale-applicable, environmentally sound, site-specific, and cost-effective alternatives to be subsequently evaluated through a technical-economic (i.e., cost-benefit) comparative assessment.
- Step 2 - Relative technical evaluation of discrete infrastructure system components considering site-specific environmental conditions and constraints, and the local context. The focus of initial technical evaluation phase is on the relative technical-economic comparison based on the principal technical characteristics, applicability, advantages/disadvantages, and relative costs of each servicing option. Discrete system components (i.e., catchment areas, collection systems, treatment plants, integrated resource recovery, effluent discharge systems) are evaluated against a set of carefully selected evaluation criteria with the objective to shortlist superior options from a long list of initial options.
- Step 3 - Assembling and evaluation of a long list of composite wastewater servicing options in the context of current regulation, local environmental conditions, and constraints. Composite alternatives are subsequently assembled by combining the most advantageous, discrete system components identified in the previous evaluation stages.

- Step 4 - Holistic Environmental Impact Assessment (EIA) qualitative comparative evaluation of composite alternatives. This assessment is based on the definition of important environmental impacts/effects/components/aspects and establishing comparative evaluation criteria to provide an accurate, realistic, independent, and less subjective (i.e., less biased) evaluation system for each evaluated condition. The evaluated project options are scored against a pre-defined set of objective criteria, and the scores are then transposed into ranges qualitatively describing the degree of positive or negative impacts/changes. The method is particularly suited to EIAs employing a multi-disciplinary approach and when the project data base is either poor or incomplete. A profile of impact conditions is effectively developed, allowing rapid comparison of the analyzed alternatives and assessment of mitigation strategies (specifically for negative impacts). This profile can be re-assessed at any time in the future if/when more information/data becomes available.

Step 1 is an introductory step to Steps 2 and 3. Step 3 involves the, so called, "Rational Comparative Evaluation" wherein the primary objective of this evaluation phase is to reduce the long list of technical alternatives (i.e., composite servicing options) that will be subsequently evaluated in more detail in a less biased RIAM analysis (Step 4). The rational comparative evaluation is a 3-step process encompassing the following procedures:

1. setting rational objectives,
2. assigning weighting factors, and
3. scoring and ranking alternatives.

The Rational Method evaluates the extent to which each option fulfills the triple bottom line evaluation criteria used in the evaluation process and involves:

- estimating environmental, financial, and social costs and benefits of each option;
- completing a high-level conceptual design for the top-ranked options, in order to estimate their capital costs more accurately, as well as their ongoing O&M costs and benefits, and
- assessing any constraints that may be imposed by the existing federal and provincial regulations.

The Rational Method of analysis uses a system of relative weighting factors, ranging from 1 to 10, for an unlimited number of pre-selected objectives that the systems should meet. An evaluated condition for the highest-ranking alternative is always assigned a score of 10. Other alternatives are ranked relative to the highest ranked alternative.

Each alternative is assigned a score (ranking) relative to the evaluation criteria. The score for each alternative is then multiplied by the weighting factor to obtain a weighted score. These are subsequently added for a comparative aggregated score between alternatives. The higher score indicates a superior alternative. Typically, a difference of 10% in weighted score, or greater, indicates a significantly better choice with respect to the higher scored alternative. However, site-characteristic conditions, specific considerations and/or identified anomalies can often shift the margin of acceptance to include additional technical alternatives for subsequent assessments particularly due to inconclusive results of the previous evaluation stage.

Only the shortlisted alternatives, resulting from the analyses in Steps 1 through to 3, are evaluated in Step 4.

Steps 1 through to 3 were implemented in the Phase 2, Stage 1 of the LWMP process while Step 4, i.e., a more detailed evaluation of shortlisted alternatives through a complementary RIAM analysis, will be implemented in the Stage 2 of the LWMP process.

12. Results of Option Assessments

Detailed scoring, ranking, and the results of options analysis are provided in Appendix E. The summary results for Electoral Areas A and B are provided in Tables 17 and 18.

12.1. Electoral Area A

Options A-OP2, A-OP3A, and A-OP1 seem to be the most promising wastewater servicing options for the Mill Bay UCB. The main differentiators for these options are potential WWTP locations, while they all share the same effluent disposal site at Mill Springs. Any of these options would be able to service the Mill Springs UCB up to 2040 and beyond.

Option A-OP5 complements any of Options A-OP2, A-OP3A, or A-OP1 and will be required in the overall wastewater management strategy in Electoral Area A. In this option, the catchment area, wastewater treatment, and effluent disposal are limited to the Sentinel Ridge development until its full build-out. Any of Options A-OP2, A-OP3A, or A-OP1 will cover the remainder of the Mill Bay UCB area.

Option A-OP6 requires further evaluation to verify assumptions used in the options assessment due to incomplete database as specific issues related to the location of Malahat First Nation community infrastructure assets, forcemain routing, and environmental impacts will be further explored.

Options A-OP3B, A-OP4A, and A-OP4B should be excluded from further assessment at this time due to the lack of interest of Frances Kelsey School to participate in the community wastewater servicing strategy and share or upgrade the school's wastewater infrastructure assets to serve a larger population base.

Option A-OP7C is a viable servicing option that could integrate the Mill Bay UCB with portions of the Shawnigan Lake UCB and the corridor between the two UCBs after 2040. Options A-OP7A and A-OP7B are inferior to Option A-OP7C and should be excluded from further assessment.

Options A-OP8A, A-OP8B, and A-OP8C should be excluded from further assessment at this time due to the lack of interest and resistance of the Shawinigan Lake residents, living around the lake perimeter, to participate in the community wastewater servicing strategy.

Options A-OP2, A-OP3A, A-OP1, A-OP6, and A-OP7C are recommended for further assessment in Stage 2 of the liquid waste management planning process thus reducing the total number of initial options from 14 to five viable options. Any of these options will be complemented by Option A-OP5 in the overall wastewater management strategy.

12.2. Electoral Area B

Options B-OP1A and B-OP2A seem to be the most promising wastewater servicing options for the Shawnigan Village UCB. The main differentiators for these options are potential WWTP locations while they all share the same effluent disposal site at SBES. Any of these options would be able to service the Shawnigan Village UCB up to 2040. The SBES system is currently located outside the Shawnigan Village UCB.

Options B-OP3 and B-OP4 are complementary to Options B-OP1A or B-OP2A and will be required in the overall wastewater management strategy in Electoral Area B. In Options B-OP3 and B-OP4, the catchment area, wastewater treatment, and effluent disposal are limited to the Arbutus Mountain and Elkington Forest developments, respectively, until their full buildouts. The Arbutus Mountain WWTP and disposal field may have additional capacity to accommodate proposed nearby developments. The Arbutus Mountain and Elkington Forest developments are located outside UCBs.

Option B-OP5A is a viable servicing option that could integrate the Shawnigan Village UCB with portions of the Cobble Hill UCB and the corridor between the two UCBs after 2040. In this option, a portion of the treatment capacity at the SBES site would have to be freed up to accept additional flows from Cobble Hill by diverting flow from select areas of the Shawnigan Village UCB to the Mill Bay UCB (refer to Option A-OP7C). Option B-OP5B is inferior to Option B-OP5A and should be excluded from further assessment.

Options B-OP1B, B-OP1C, B-OP2B, B-OP2C, B-OP6A, and B-OP6B should be excluded from further assessment at this time due to the lack of interest and resistance of the Shawinigan Lake residents, living around the lake perimeter, to participate in the community wastewater servicing strategy. It is possible that sewer servicing around the Lake could be explored as longer term options as the CVRD continues to track development patterns, population growth, and receiving environment.

Options B-OP1A, B-OP2A, and B-OP5A are recommended for further assessment in Stage 2 of the liquid waste management planning process thus reducing the total number of initial options from 12 to three viable options. Any of these options will be complemented by Options B-OP3 and B-OP4 in the overall wastewater management strategy.

12.3. Electoral Area C

Options C-OP1 and C-OP2 complement each other and are both required in the overall wastewater management strategy for Electoral Area C. While Option C-OP1 services the Cobble Hill UCB and Maple Hills development, Option C-OP2 services the Arbutus Ridge development. Both options together will be able to cover the area needs up to 2040. The Maple Hills and Arbutus Ridge developments are currently located outside the Cobble Hill UCB.

Option C-OP3A cannot meet the needs of the Pauquachin First Nation's (PFN) long-term housing plans for Hatch Point. The existing Arbutus Ridge system has a limited capacity to accept additional flows and organic loads. While some limited capacity may be available, specifically for initial phases of the proposed development, the remainder of the PFN's development would require its own wastewater management system. Option C-OP3A may not be of interest for further assessment as the PFN may be interested in developing its own wastewater management system.

Either Option C-OP3B or B-OP5A may be able to meet the wastewater servicing needs of Electoral Area C and would complement Options C-OP1 and C-OP2 after 2040.

Option C-OP3B is recommended for further assessment in Stage 2 of the liquid waste management planning process.

Table 17 Electoral Area A – Summary of Options Evaluation

		System Component	PHASE I						COMPLEMENTARY OPTION	PHASE I	PHASE II					
		Collection	Mill Bay UCB	Mill Bay UCB	Mill Bay UCB	Mill Bay UCB	Mill Bay UCB	Mill Bay UCB (Limited Coverage)	Sentinel Ridge	Mill Bay UCB + Malahat FN	**Mill Bay UCB + Shawnigan Village UCB + Corridor**	Mill Bay UCB + Shawnigan Village UCB + Corridor	Mill Bay UCB + Shawnigan Village UCB + Corridor	Mill Bay UCB + Shawnigan Village UCB + Corridor + Lake Perimeter	Mill Bay UCB + Shawnigan Village UCB + Corridor + Lake Perimeter	Mill Bay UCB + Shawnigan Village UCB + Corridor + Lake Perimeter
		Treatment	Mill Bay WWTP	Mill Springs	Pioneer Square	Pioneer Square	Frances Kelsey School (Septage)	Frances Kelsey School (Septage)	Sentinel Ridge	Mill Springs	Pioneer Square	Mill Bay	Mill Springs	Pioneer Square	Mill Bay	Mill Springs
		Effluent Discharge	Mill Springs	Mill Springs	Mill Springs	Frances Kelsey School	Frances Kelsey School	Frances Kelsey School	Sentinel Ridge	Mill Springs	Mill Springs	Mill Springs	Mill Springs	Mill Springs	Mill Springs	Mill Springs
Score																
Ref. #	**Weighting** Factor (x10%)	**Evaluation Criteria**	**A-OP1** Weighted Score	**A-OP2** Weighted Score	**A-OP3A** Weighted Score	**A-OP3B** Weighted Score	**A-OP4A** Weighted Score	**A-OP4B** Weighted Score	**A-OP5** Weighted Score	**A-OP6** Weighted Score	**A-OP7A** Weighted Score	**A-OP7B** Weighted Score	**A-OP7C** Weighted Score	**A-OP8A** Weighted Score	**A-OP8B** Weighted Score	**A-OP8C** Weighted Score
Financial Category		Max. 100 points (27% of total)	**95**	**100**	**95**	**90**	**90**	**25**	**25**	**85**	**75**	**75**	**80**	**60**	**60**	**60**
Technical Category		Max. 100 points (27% of total)	**90**	**95**	**92**	**92**	**92**	**75**	**75**	**92**	**82**	**83**	**83**	**75**	**76**	**76**
Social Category		Max. 70 points (19% of total)	**65**	**64**	**65**	**55**	**55**	**48**	**57**	**64**	**63**	**63**	**62**	**58**	**58**	**57**
Environmental Category		Max. 100 points (27% of total)	**86**	**97**	**94**	**96**	**96**	**100**	**100**	**95**	**94**	**86**	**97**	**93**	**85**	**96**
		Total Score	**336**	**356**	**346**	**333**	**333**	**248**	**257**	**336**	**314**	**307**	**322**	**287**	**279**	**288**
		Relative Score	**0.94**	**1.00**	**0.97**	**0.93**	**0.93**	**0.70**	**0.72**	**0.94**	**0.88**	**0.86**	**0.90**	**0.80**	**0.78**	**0.81**
		Option Summary and Go / No-Go	**3rd Best**	**Best**	**2nd Best**	**No-Go Exclude**	**No-Go Exclude**	**No-Go Exclude**	**Complementary Option**	**Requires further detailed evaluation**	**Inferior to A-OP7C**	**Inferior to A-OP7C**	**Best of A-OP7 options**	**No-Go Exclude**	**No-Go Exclude**	**No-Go Exclude**

Table 18 Electoral Area B – Summary of Options Evaluation

		System Component	PHASE I						COMPLEMENTARY OPTIONS		PHASE II			
		Collection	Shawnigan Village UCB	Shawnigan Village UCB + SL-E	Shawnigan Village UCB + Lake Perimeter	Shawnigan Village UCB	Shawnigan Village UCB + SL-E	Shawnigan Village UCB + Lake Perimeter	Arbutus Mountain	Elkington Forrest	Shawnigan Village UCB + Cobble Hill UCB + Corridor	Shawnigan Village UCB + Cobble Hill UCB + Corridor	Shawnigan Village UCB + Cobble Hill UCB + Corridor + Lake Perimeter	Shawnigan Village UCB + Cobble Hill UCB + Corridor + Lake Perimeter
		Treatment	SBES Lagoons (Septage)	SBES Lagoons (Septage)	SBES Lagoons (Septage)	Shawnigan Village (Septage)	Shawnigan Village (Septage)	Shawnigan Village (Septage)	Arbutus Mountain	Elkington Forrest	SBES Lagoons (Septage)	Shawnigan Village (Septage)	SBES Lagoons (Septage)	Shawnigan Village (Septage)
		Effluent Discharge	SBES	SBES	SBES	SBES	SBES	SBES	Arbutus Mountain	Elkington Forrest	SBES	SBES	SBES	SBES
Score														
Ref. #	**Weighting** Factor (x10%)	**Evaluation Criteria**	**B-OP1A** Weighted Score	**B-OP1B** Weighted Score	**B-OP1C** Weighted Score	**B-OP2A** Weighted Score	**B-OP2B** Weighted Score	**B-OP2C** Weighted Score	**B-OP3** Weighted Score	**B-OP4** Weighted Score	**B-OP5A** Weighted Score	**B-OP5B** Weighted Score	**B-OP6A** Weighted Score	**B-OP6B** Weighted Score
Financial Category		Max. 100 points (27% of total)	**100**	**85**	**75**	**90**	**80**	**70**	**25**	**25**	**85**	**75**	**60**	**60**
Technical Category		Max. 100 points (27% of total)	**98**	**95**	**91**	**97**	**93**	**89**	**75**	**75**	**63**	**62**	**58**	**57**
Social Category		Max. 70 points (19% of total)	**70**	**67**	**64**	**70**	**67**	**63**	**58**	**58**	**35**	**35**	**35**	**35**
Environmental Category		Max. 100 points (27% of total)	**100**	**98**	**96**	**96**	**94**	**92**	**100**	**100**	**50**	**50**	**50**	**50**
		Total Score	**368**	**345**	**326**	**352**	**334**	**315**	**258**	**258**	**233**	**222**	**203**	**202**
		Relative Score	**1.00**	**0.94**	**0.88**	**0.96**	**0.91**	**0.85**	**0.70**	**0.70**	**0.63**	**0.60**	**0.55**	**0.55**
		Option Summary and Go / No-Go	**Best**	**No-Go Exclude**	**No-Go Exclude**	**2nd Best**	**No-Go Exclude**	**No-Go Exclude**	**Complementary Option**	**Complementary Option**	**Best of B-0P5 options**	**Inferior to B-OP5A**	**No-Go Exclude**	**No-Go Exclude**

13. Recommendations for Next Steps

We recommend that further option assessment in Stage 2 of the liquid waste management planning process should be focused on a more detailed evaluation of the most viable options identified in Stage 1, specifically:

- Options A-OP2, A-OP3A, A-OP1, A-OP6, and A-OP7C, in Electoral Area A;
- Options B-OP1A, B-OP2A, and B-OP5A in Electoral Area B; and
- Option C-OP3B in Electoral Area C.

The option implementation timeline is shown graphically in Table 19.

Table 19 Option Implementation Timeline

Option Ref. #	Electoral Area	OPTION COMPONENTS: Collection System	OPTION COMPONENTS: WWTP Site	OPTION COMPONENTS: Effluent Discharge	Implementation Timeline: 2020	2025	2030	2035	2040	2045	2050
A-OP1	A	Mill Bay UCB	Mill Bay	Mill Springs	Further Assessment Required in Stage 2						
A-OP2	A	Mill Bay UCB	Mill Springs	Mill Springs	Further Assessment Required in Stage 2						
A-OP3A	A	Mill Bay UCB	Pioneer Square	Mill Springs	Further Assessment Required in Stage 2						
A-OP5	A	Sentinel Ridge	Sentinel Ridge	Sentinel Ridge	Complementary Option						
A-OP6	A	Mill Bay UCB + Malahat FN	Mill Springs	Mill Springs	Further Assessment Required in Stage 2						
A-OP7C	A + B	Mill Bay UCB + Shawnigan Village UCB + Corridor	Mill Springs	Mill Springs					Further Assessment Required in Stage 2		
B-OP1A	B	Shawnigan Village UCB	SBES Lagoons (Septage)	SBES	Further Assessment Required in Stage 2						
B-OP2A	B	Shawnigan Village UCB	Shawnigan Village (Septage)	SBES	Further Assessment Required in Stage 2						
B-OP3	B	Arbutus Mountain	Arbutus Mountain	Arbutus Mountain	Complementary Option						
B-OP4	B	Elkington Forest	Elkington Forest	Elkington Forest	Complementary Option						
B-OP5A	B + C	Shawnigan Village UCB + Cobble Hill UCB + Corridor	SBES Lagoons (Septage)	SBES					Further Assessment Required in Stage 2		
C-OP1	C	Cobble Hill UCB + Maple Hills	Twin Cedars	Twin Cedars + Galliers Rd	Complementary Option						
C-OP2	C	Arbutus Ridge	Arbutus Ridge	Arbutus Ridge	Complementary Option						
C-OP3B	C	Arbutus Ridge + Pauquachin FN	Arbutus Ridge (New)	New (TBD)					Further Assessment Required in Stage 2		

Notes:
WWTP - Wastewater Treatment Plant
UCB - Urban Containment Boundary
A-OP2 - Electoral area A, Option 2
SBES - Shawnigan Beach Estate Sewer
TBD - to be determined
FN - First Nation

14. Stage 2 Proposed Scope of Work

The following terms of reference are proposed for Stage 2:

- continue public and First Nation consultation process;
- prepare summary of Stage 1 for inclusion in the Stage 2 report;
- update the project database and fill data gaps;
- advance further work to a conceptual design stage to:
  - increase the accuracy of cost estimates; and
  - assess impact of costs on taxpayer of options carried forward from Stage 1;
- further refine and evaluate recommended options for sewage treatment, effluent disposal, use of reclaimed water, and sludge/septage management;
- continue work on hydrogeological and environmental impact studies to confirm capacities of ground disposal field areas and assess environmental impacts of effluent discharge with a specific focus on preferred options;
- complete option assessment and recommend the wastewater management strategy for implementation;
- review policies regulating wastewater discharges from non-point sources;
- provide technical details to allow preparation of operational certificates for wastewater treatment facilities;
- finalize Stage 2 report (draft) and submit to the TCAG for review and comments;
- incorporate comments received from the TCAG and submit to the CVRD board for review and approval;
- incorporate comments received from the CVRD board and finalize Stage 2 report for submission to the MOE;
- submit Stage 2 report to the ministry for review; and
- develop Stage 3 terms of reference and review with the MOE.

15. Closure

Should you have any additional questions or require further clarifications, please do not hesitate to contact the undersigned at your convenience.

Sincerely,

McELHANNEY LTD.

Prepared by:

Dragan Rokić, P.Eng., LEED AP, MCPM, PMP
Senior Project Engineer

Reviewed by:

Ian Whitehead, P.Eng.
Vice President, Vancouver Island and QA/QC

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Appendix A – Population Growth Scenarios

Scenario 1 **(less optimistic)**

Annual Growth Rate (%/yr)	2.13%	0.40%	1.93%	1.49%

		Population				
Year	#	Mill Bay UCB	Shawnigan Lake UCB	Cobble Hill UCB	Arbutus Ridge UCB	Total of UCBs
2018	0	3,005	3,976	992	1,095	9,068
2019	1	3,069	3,992	1,011	1,111	9,183
2020	2	3,134	4,007	1,031	1,128	9,300
2021	3	3,201	4,023	1,051	1,145	9,420
2022	4	3,269	4,039	1,071	1,162	9,541
2023	5	3,339	4,055	1,091	1,179	9,665
2024	6	3,410	4,071	1,113	1,197	9,790
2025	7	3,482	4,087	1,134	1,215	9,919
2026	8	3,557	4,103	1,156	1,233	10,049
2027	9	3,632	4,120	1,178	1,251	10,181
2028	10	3,710	4,136	1,201	1,270	10,317
2029	11	3,789	4,152	1,224	1,289	10,454
2030	12	3,869	4,169	1,248	1,308	10,594
2031	13	3,952	4,185	1,272	1,328	10,736
2032	14	4,036	4,202	1,296	1,348	10,881
2033	15	4,122	4,218	1,321	1,368	11,029
2034	16	4,209	4,235	1,347	1,388	11,179
2035	17	4,299	4,252	1,373	1,409	11,333
2036	18	4,390	4,268	1,399	1,430	11,488
2037	19	4,484	4,285	1,426	1,452	11,647
2038	20	4,579	4,302	1,454	1,473	11,809
2039	21	4,677	4,319	1,482	1,495	11,973
2040	22	4,776	4,336	1,511	1,518	12,141
2041	23	4,878	4,353	1,540	1,540	12,311
2042	24	4,982	4,371	1,569	1,563	12,485
2043	25	5,088	4,388	1,600	1,587	12,662
2044	26	5,196	4,405	1,631	1,611	12,842
2045	27	5,307	4,423	1,662	1,635	13,026
2046	28	5,420	4,440	1,694	1,659	13,213
2047	29	5,535	4,458	1,727	1,684	13,403
2048	30	5,653	4,475	1,760	1,709	13,597
2049	31	5,773	4,493	1,794	1,735	13,795
2050	32	5,896	4,511	1,829	1,760	13,996
2051	33	6,022	4,528	1,864	1,787	14,201
2052	34	6,150	4,546	1,900	1,814	14,410
2053	35	6,281	4,564	1,937	1,841	14,622
2054	36	6,415	4,582	1,974	1,868	14,839
2055	37	6,551	4,600	2,012	1,896	15,060
2056	38	6,691	4,619	2,051	1,924	15,284
2057	39	6,833	4,637	2,090	1,953	15,513
Total Growth		3,828	661	1,098	858	6,445

Annual Growth Rate (%/yr)	0.57%	1.61%	0.41%

		Population			
Year	#	Rural Area A	Rural Area B	Rural Area C	Total of Rural
2018	0	1,873	4,763	3,025	9,661
2019	1	1,884	4,840	3,037	9,761
2020	2	1,894	4,918	3,050	9,862
2021	3	1,905	4,997	3,062	9,964
2022	4	1,916	5,077	3,074	10,068
2023	5	1,927	5,159	3,087	10,173
2024	6	1,938	5,242	3,099	10,279
2025	7	1,949	5,326	3,112	10,387
2026	8	1,960	5,412	3,124	10,497
2027	9	1,972	5,499	3,137	10,608
2028	10	1,983	5,588	3,150	10,720
2029	11	1,994	5,677	3,163	10,834
2030	12	2,006	5,769	3,175	10,950
2031	13	2,017	5,862	3,188	11,067
2032	14	2,029	5,956	3,201	11,186
2033	15	2,040	6,052	3,214	11,306
2034	16	2,052	6,149	3,227	11,428
2035	17	2,064	6,248	3,240	11,552
2036	18	2,075	6,349	3,253	11,678
2037	19	2,087	6,451	3,267	11,805
2038	20	2,099	6,555	3,280	11,934
2039	21	2,111	6,660	3,293	12,064
2040	22	2,123	6,767	3,306	12,197
2041	23	2,135	6,876	3,320	12,332
2042	24	2,148	6,987	3,333	12,468
2043	25	2,160	7,099	3,347	12,606
2044	26	2,172	7,214	3,360	12,746
2045	27	2,185	7,330	3,374	12,888
2046	28	2,197	7,448	3,388	13,033
2047	29	2,210	7,568	3,401	13,179
2048	30	2,222	7,689	3,415	13,327
2049	31	2,235	7,813	3,429	13,477
2050	32	2,248	7,939	3,443	13,630
2051	33	2,261	8,067	3,457	13,784
2052	34	2,273	8,197	3,471	13,941
2053	35	2,286	8,328	3,485	14,100
2054	36	2,300	8,463	3,499	14,261
2055	37	2,313	8,599	3,513	14,425
2056	38	2,326	8,737	3,527	14,590
2057	39	2,339	8,878	3,542	14,759
Total Growth		466	4,115	517	5,098

Annual Growth Rate (%/yr)	1.61%	1.11%	0.99%

		Population			
Year	#	UCB+Rural Area A	UCB+Rural Area B	UCB+Rural Area C	Total of UCB+Rural
2018	0	4,878	8,739	5,112	18,729
2019	1	4,956	8,836	5,163	18,955
2020	2	5,036	8,933	5,214	19,183
2021	3	5,117	9,032	5,266	19,415
2022	4	5,199	9,132	5,318	19,649
2023	5	5,282	9,233	5,371	19,886
2024	6	5,367	9,335	5,424	20,126
2025	7	5,453	9,438	5,478	20,370
2026	8	5,541	9,543	5,532	20,616
2027	9	5,630	9,648	5,587	20,865
2028	10	5,720	9,755	5,643	21,118
2029	11	5,812	9,863	5,699	21,374
2030	12	5,905	9,972	5,756	21,633
2031	13	6,000	10,082	5,813	21,895
2032	14	6,096	10,194	5,870	22,160
2033	15	6,194	10,306	5,929	22,429
2034	16	6,294	10,420	5,988	22,701
2035	17	6,395	10,535	6,047	22,977
2036	18	6,497	10,652	6,107	23,256
2037	19	6,602	10,770	6,168	23,539
2038	20	6,708	10,889	6,229	23,825
2039	21	6,815	11,009	6,291	24,115
2040	22	6,925	11,131	6,353	24,409
2041	23	7,036	11,254	6,416	24,706
2042	24	7,149	11,379	6,480	25,007
2043	25	7,263	11,504	6,544	25,312
2044	26	7,380	11,632	6,609	25,621
2045	27	7,498	11,760	6,675	25,934
2046	28	7,619	11,890	6,741	26,250
2047	29	7,741	12,022	6,808	26,571
2048	30	7,865	12,155	6,876	26,896
2049	31	7,992	12,289	6,944	27,225
2050	32	8,120	12,425	7,013	27,558
2051	33	8,250	12,562	7,083	27,895
2052	34	8,383	12,701	7,153	28,237
2053	35	8,517	12,842	7,224	28,583
2054	36	8,654	12,984	7,296	28,934
2055	37	8,793	13,127	7,368	29,289
2056	38	8,934	13,272	7,441	29,648
2057	39	9,078	13,419	7,515	30,012
Total Growth		4,200	4,680	2,403	11,283

Scenario 2 **(more optimistic)**

Annual Growth Rate	(%/yr)	2.13%	0.40%	1.93%	1.49%	
		Population				
Year	#	Mill Bay UCB	Shawnigan Lake UCB	Cobble Hill UCB	Arbutus Ridge UCB	Total of UCBs
2018	0	3,005	3,976	992	1,095	9,068
2019	1	3,069	3,992	1,011	1,111	9,183
2020	2	3,134	4,007	1,031	1,128	9,300
2021	3	3,201	4,023	1,051	1,145	9,420
2022	4	3,269	4,039	1,071	1,162	9,541
Annual Growth Rate	(%/yr)	2.96%	0.56%	2.69%	2.08%	
2023	5	3,366	4,062	1,100	1,186	9,713
2024	6	3,465	4,084	1,129	1,211	9,890
2025	7	3,568	4,107	1,159	1,236	10,071
2026	8	3,674	4,130	1,191	1,262	10,256
2027	9	3,782	4,153	1,223	1,288	10,446
2028	10	3,894	4,176	1,255	1,315	10,641
2029	11	4,009	4,199	1,289	1,342	10,840
2030	12	4,128	4,223	1,324	1,370	11,045
2031	13	4,250	4,246	1,359	1,398	11,254
2032	14	4,376	4,270	1,396	1,428	11,469
2033	15	4,505	4,294	1,433	1,457	11,690
2034	16	4,639	4,318	1,472	1,488	11,916
2035	17	4,776	4,342	1,511	1,519	12,148
2036	18	4,917	4,366	1,552	1,550	12,386
2037	19	5,063	4,390	1,594	1,582	12,629
2038	20	5,213	4,415	1,636	1,615	12,879
2039	21	5,367	4,440	1,680	1,649	13,136
2040	22	5,526	4,464	1,726	1,683	13,399
2041	23	5,689	4,489	1,772	1,718	13,668
2042	24	5,858	4,514	1,819	1,754	13,945
2043	25	6,031	4,539	1,868	1,790	14,229
2044	26	6,209	4,565	1,918	1,828	14,520
2045	27	6,393	4,590	1,970	1,866	14,819
2046	28	6,582	4,616	2,023	1,904	15,125
2047	29	6,777	4,641	2,077	1,944	15,440
2048	30	6,977	4,667	2,133	1,984	15,762
2049	31	7,184	4,693	2,190	2,026	16,093
2050	32	7,396	4,720	2,249	2,068	16,433
2051	33	7,615	4,746	2,310	2,111	16,782
2052	34	7,841	4,772	2,372	2,155	17,139
2053	35	8,073	4,799	2,435	2,200	17,507
2054	36	8,312	4,826	2,501	2,245	17,883
2055	37	8,557	4,853	2,568	2,292	18,270
2056	38	8,811	4,880	2,637	2,340	18,667
2057	39	9,071	4,907	2,708	2,388	19,074
Total Growth		6,066	931	1,716	1,293	10,006

Annual Growth Rate	(%/yr)	0.57%	1.61%	0.41%	
		Population			
Year	#	Rural Area A	Rural Area B	Rural Area C	Total of Rural
2018	0	1,873	4,763	3,025	9,661
2019	1	1,884	4,840	3,037	9,761
2020	2	1,894	4,918	3,050	9,862
2021	3	1,905	4,997	3,062	9,964
2022	4	1,916	5,077	3,074	10,068
Annual Growth Rate	(%/yr)	0.31%	0.87%	0.22%	
2023	5	1,922	5,121	3,081	10,125
2024	6	1,928	5,166	3,088	10,182
2025	7	1,934	5,211	3,094	10,240
2026	8	1,940	5,257	3,101	10,298
2027	9	1,946	5,302	3,108	10,356
2028	10	1,952	5,349	3,115	10,415
2029	11	1,958	5,395	3,121	10,475
2030	12	1,964	5,442	3,128	10,535
2031	13	1,970	5,490	3,135	10,595
2032	14	1,976	5,538	3,142	10,656
2033	15	1,983	5,586	3,149	10,717
2034	16	1,989	5,635	3,155	10,779
2035	17	1,995	5,684	3,162	10,841
2036	18	2,001	5,733	3,169	10,903
2037	19	2,007	5,783	3,176	10,966
2038	20	2,013	5,834	3,183	11,030
2039	21	2,020	5,885	3,190	11,094
2040	22	2,026	5,936	3,197	11,159
2041	23	2,032	5,988	3,204	11,224
2042	24	2,039	6,040	3,211	11,289
2043	25	2,045	6,093	3,218	11,355
2044	26	2,051	6,146	3,224	11,421
2045	27	2,058	6,199	3,231	11,488
2046	28	2,064	6,253	3,238	11,556
2047	29	2,070	6,308	3,246	11,624
2048	30	2,077	6,363	3,253	11,692
2049	31	2,083	6,418	3,260	11,761
2050	32	2,090	6,474	3,267	11,831
2051	33	2,096	6,531	3,274	11,901
2052	34	2,103	6,588	3,281	11,971
2053	35	2,109	6,645	3,288	12,042
2054	36	2,116	6,703	3,295	12,114
2055	37	2,122	6,762	3,302	12,186
2056	38	2,129	6,821	3,309	12,259
2057	39	2,135	6,880	3,317	12,332
Total Growth		262	2,117	292	2,671

Annual Growth Rate	(%/yr)	1.61%	1.11%	0.99%	
		Population			
Year	#	UCB+Rural Area A	UCB+Rural Area B	UCB+Rural Area C	Total of UCB+Rural
2018	0	4,878	8,739	5,112	18,729
2019	1	4,956	8,836	5,163	18,955
2020	2	5,036	8,933	5,214	19,183
2021	3	5,117	9,032	5,266	19,415
2022	4	5,199	9,132	5,318	19,649
Annual Growth Rate	(%/yr)	2.14%	0.73%	1.25%	
2023	5	5,310	9,199	5,384	19,893
2024	6	5,424	9,266	5,452	20,141
2025	7	5,540	9,334	5,519	20,393
2026	8	5,658	9,402	5,588	20,648
2027	9	5,779	9,470	5,658	20,908
2028	10	5,903	9,540	5,729	21,171
2029	11	6,030	9,609	5,800	21,439
2030	12	6,159	9,679	5,872	21,710
2031	13	6,290	9,750	5,945	21,986
2032	14	6,425	9,821	6,020	22,266
2033	15	6,563	9,893	6,095	22,550
2034	16	6,703	9,965	6,171	22,839
2035	17	6,846	10,038	6,248	23,132
2036	18	6,993	10,111	6,325	23,430
2037	19	7,143	10,185	6,404	23,732
2038	20	7,295	10,259	6,484	24,039
2039	21	7,452	10,334	6,565	24,351
2040	22	7,611	10,410	6,647	24,668
2041	23	7,774	10,486	6,730	24,990
2042	24	7,940	10,562	6,814	25,316
2043	25	8,110	10,640	6,898	25,648
2044	26	8,284	10,717	6,984	25,986
2045	27	8,461	10,796	7,072	26,328
2046	28	8,642	10,874	7,160	26,676
2047	29	8,827	10,954	7,249	27,030
2048	30	9,016	11,034	7,339	27,389
2049	31	9,209	11,114	7,431	27,754
2050	32	9,406	11,196	7,524	28,125
2051	33	9,607	11,277	7,617	28,502
2052	34	9,813	11,360	7,712	28,885
2053	35	10,023	11,443	7,808	29,274
2054	36	10,238	11,526	7,906	29,670
2055	37	10,457	11,610	8,004	30,071
2056	38	10,681	11,695	8,104	30,480
2057	39	10,909	11,781	8,205	30,895
Total Growth		6,031	3,042	3,093	12,166

Scenario 3 **ADJUSTED UCB - BASED ON MALAHAT HOUSING NEEDS AND POTENTIAL HOUSING DEVELOPMENT - MALAHAT CDP**

Annual Growth Rate (%/yr)		2.13%	0.40%	1.93%	1.49%			
		Population						
Year	#	Mill Bay UCB	Shawnigan Lake UCB	Cobble Hill UCB	Arbutus Ridge UCB	Malahat Members	Adjusted UCB+Malahat	Total of UCBs
2018	0	3,005	3,976	992	1,095	171	3,148	9,211
2019	1	3,069	3,992	1,011	1,111	185	3,226	9,340
2020	2	3,134	4,007	1,031	1,128	198	3,305	9,471
2021	3	3,201	4,023	1,051	1,145	212	3,386	9,604
2022	4	3,269	4,039	1,071	1,162	226	3,468	9,740
2023	5	3,339	4,055	1,091	1,179	240	3,551	9,877
2024	6	3,410	4,071	1,113	1,197	254	3,636	10,017
2025	7	3,482	4,087	1,134	1,215	268	3,722	10,158
2026	8	3,557	4,103	1,156	1,233	282	3,810	10,303
2027	9	3,632	4,120	1,178	1,251	295	3,900	10,449
2028	10	3,710	4,136	1,201	1,270	309	3,991	10,598
2029	11	3,789	4,152	1,224	1,289	323	4,084	10,749
2030	12	3,869	4,169	1,248	1,308	337	4,178	10,903
2031	13	3,952	4,185	1,272	1,328	351	4,275	11,059
2032	14	4,036	4,202	1,296	1,348	365	4,373	11,218
2033	15	4,122	4,218	1,321	1,368	378	4,472	11,380
2034	16	4,209	4,235	1,347	1,388	392	4,574	11,544
2035	17	4,299	4,252	1,373	1,409	406	4,677	11,711
2036	18	4,390	4,268	1,399	1,430	420	4,783	11,881
2037	19	4,484	4,285	1,426	1,452	434	4,890	12,053
2038	20	4,579	4,302	1,454	1,473	448	4,999	12,229
2039	21	4,677	4,319	1,482	1,495	462	5,111	12,407
2040	22	4,776	4,336	1,511	1,518	475	5,224	12,588
2041	23	4,878	4,353	1,540	1,540	489	5,340	12,773
2042	24	4,982	4,371	1,569	1,563	503	5,457	12,961
2043	25	5,088	4,388	1,600	1,587	517	5,577	13,151
2044	26	5,196	4,405	1,631	1,611	531	5,699	13,345
2045	27	5,307	4,423	1,662	1,635	545	5,824	13,543
2046	28	5,420	4,440	1,694	1,659	559	5,951	13,744
2047	29	5,535	4,458	1,727	1,684	572	6,080	13,948
2048	30	5,653	4,475	1,760	1,709	586	6,211	14,156
2049	31	5,773	4,493	1,794	1,735	600	6,346	14,367
2050	32	5,896	4,511	1,829	1,760	614	6,482	14,582
2051	33	6,022	4,528	1,864	1,787	628	6,622	14,801
2052	34	6,150	4,546	1,900	1,814	642	6,764	15,023
2053	35	6,281	4,564	1,937	1,841	655	6,909	15,250
2054	36	6,415	4,582	1,974	1,868	669	7,056	15,480
2055	37	6,551	4,600	2,012	1,896	683	7,207	15,715
2056	38	6,691	4,619	2,051	1,924	697	7,360	15,954
2057	39	6,833	4,637	2,090	1,953	711	7,516	16,196
Total Growth		3,828	661	1,098	858	540	4,368	6,985

Annual Growth Rate (%/yr)		0.57%	1.61%	0.41%	
		Population			
Year	#	Rural Area A	Rural Area B	Rural Area C	Total of Rural
2018	0	1,873	4,763	3,025	9,661
2019	1	1,884	4,840	3,037	9,761
2020	2	1,894	4,918	3,050	9,862
2021	3	1,905	4,997	3,062	9,964
2022	4	1,916	5,077	3,074	10,068
2023	5	1,927	5,159	3,087	10,173
2024	6	1,938	5,242	3,099	10,279
2025	7	1,949	5,326	3,112	10,387
2026	8	1,960	5,412	3,124	10,497
2027	9	1,972	5,499	3,137	10,608
2028	10	1,983	5,588	3,150	10,720
2029	11	1,994	5,677	3,163	10,834
2030	12	2,006	5,769	3,175	10,950
2031	13	2,017	5,862	3,188	11,067
2032	14	2,029	5,956	3,201	11,186
2033	15	2,040	6,052	3,214	11,306
2034	16	2,052	6,149	3,227	11,428
2035	17	2,064	6,248	3,240	11,552
2036	18	2,075	6,349	3,253	11,678
2037	19	2,087	6,451	3,267	11,805
2038	20	2,099	6,555	3,280	11,934
2039	21	2,111	6,660	3,293	12,064
2040	22	2,123	6,767	3,306	12,197
2041	23	2,135	6,876	3,320	12,332
2042	24	2,148	6,987	3,333	12,468
2043	25	2,160	7,099	3,347	12,606
2044	26	2,172	7,214	3,360	12,746
2045	27	2,185	7,330	3,374	12,888
2046	28	2,197	7,448	3,388	13,033
2047	29	2,210	7,568	3,401	13,179
2048	30	2,222	7,689	3,415	13,327
2049	31	2,235	7,813	3,429	13,477
2050	32	2,248	7,939	3,443	13,630
2051	33	2,261	8,067	3,457	13,784
2052	34	2,273	8,197	3,471	13,941
2053	35	2,286	8,328	3,485	14,100
2054	36	2,300	8,463	3,499	14,261
2055	37	2,313	8,599	3,513	14,425
2056	38	2,326	8,737	3,527	14,590
2057	39	2,339	8,878	3,542	14,759
Total Growth		466	4,115	517	5,098

Annual Growth Rate (%/yr)		1.61%	1.11%	0.99%	
		Population			
Year	#	UCB+Rural Area A	UCB+Rural Area B	UCB+Rural Area C	Total of UCB+Rural
2018	0	5,021	8,739	5,112	18,872
2019	1	5,102	8,836	5,163	19,100
2020	2	5,183	8,933	5,214	19,331
2021	3	5,267	9,032	5,266	19,565
2022	4	5,351	9,132	5,318	19,801
2023	5	5,437	9,233	5,371	20,041
2024	6	5,524	9,335	5,424	20,284
2025	7	5,613	9,438	5,478	20,530
2026	8	5,703	9,543	5,532	20,778
2027	9	5,795	9,648	5,587	21,030
2028	10	5,888	9,755	5,643	21,286
2029	11	5,982	9,863	5,699	21,544
2030	12	6,078	9,972	5,756	21,806
2031	13	6,176	10,082	5,813	22,071
2032	14	6,275	10,194	5,870	22,339
2033	15	6,376	10,306	5,929	22,611
2034	16	6,478	10,420	5,988	22,886
2035	17	6,582	10,535	6,047	23,165
2036	18	6,688	10,652	6,107	23,447
2037	19	6,795	10,770	6,168	23,733
2038	20	6,904	10,889	6,229	24,022
2039	21	7,015	11,009	6,291	24,315
2040	22	7,128	11,131	6,353	24,612
2041	23	7,242	11,254	6,416	24,912
2042	24	7,358	11,379	6,480	25,217
2043	25	7,476	11,504	6,544	25,525
2044	26	7,596	11,632	6,609	25,837
2045	27	7,718	11,760	6,675	26,154
2046	28	7,842	11,890	6,741	26,474
2047	29	7,968	12,022	6,808	26,798
2048	30	8,096	12,155	6,876	27,127
2049	31	8,226	12,289	6,944	27,459
2050	32	8,358	12,425	7,013	27,796
2051	33	8,492	12,562	7,083	28,137
2052	34	8,628	12,701	7,153	28,483
2053	35	8,767	12,842	7,224	28,833
2054	36	8,908	12,984	7,296	29,187
2055	37	9,051	13,127	7,368	29,546
2056	38	9,196	13,272	7,441	29,910
2057	39	9,344	13,419	7,515	30,278
Total Growth		4,323	4,680	2,403	11,406

Scenario 4 **ADJUSTED UCB - BASED ON MALAHAT HOUSING NEEDS AND POTENTIAL HOUSING DEVELOPMENT - MALAHAT CDP**

Annual Growth Rate (%/yr)	2.13%	0.40%	1.93%	1.49%

		Population							
Year	#	Mill Bay UCB	Shawnigan Lake UCB	Cobble Hill UCB	Arbutus Ridge UCB	Malahat Members	Housing Developed by Malahat	Adjusted M. Bay UCB + Malahat	Total of UCBs
2018	0	3,005	3,976	992	1,095	171	0	3,148	9,211
2019	1	3,069	3,992	1,011	1,111	185	0	3,226	9,340
2020	2	3,134	4,007	1,031	1,128	198	53	3,358	9,524
2021	3	3,201	4,023	1,051	1,145	212	107	3,492	9,711
2022	4	3,269	4,039	1,071	1,162	226	160	3,628	9,900
2023	5	3,339	4,055	1,091	1,179	240	213	3,764	10,090
2024	6	3,410	4,071	1,113	1,197	254	267	3,903	10,283
2025	7	3,482	4,087	1,134	1,215	268	320	4,043	10,479
2026	8	3,557	4,103	1,156	1,233	282	374	4,184	10,676
2027	9	3,632	4,120	1,178	1,251	295	427	4,327	10,876
2028	10	3,710	4,136	1,201	1,270	309	480	4,471	11,078
2029	11	3,789	4,152	1,224	1,289	323	534	4,618	11,283
2030	12	3,869	4,169	1,248	1,308	337	587	4,765	11,490
2031	13	3,952	4,185	1,272	1,328	351	640	4,915	11,700
2032	14	4,036	4,202	1,296	1,348	365	694	5,066	11,912
2033	15	4,122	4,218	1,321	1,368	378	747	5,219	12,127
2034	16	4,209	4,235	1,347	1,388	392	801	5,374	12,345
2035	17	4,299	4,252	1,373	1,409	406	854	5,531	12,565
2036	18	4,390	4,268	1,399	1,430	420	907	5,690	12,788
2037	19	4,484	4,285	1,426	1,452	434	961	5,851	13,014
2038	20	4,579	4,302	1,454	1,473	448	1,014	6,013	13,243
2039	21	4,677	4,319	1,482	1,495	462	1,067	6,178	13,474
2040	22	4,776	4,336	1,511	1,518	475	1,121	6,345	13,709
2041	23	4,878	4,353	1,540	1,540	489	1,174	6,514	13,947
2042	24	4,982	4,371	1,569	1,563	503	1,227	6,685	14,188
2043	25	5,088	4,388	1,600	1,587	517	1,281	6,858	14,432
2044	26	5,196	4,405	1,631	1,611	531	1,334	7,034	14,680
2045	27	5,307	4,423	1,662	1,635	545	1,388	7,211	14,930
2046	28	5,420	4,440	1,694	1,659	559	1,441	7,392	15,185
2047	29	5,535	4,458	1,727	1,684	572	1,494	7,574	15,442
2048	30	5,653	4,475	1,760	1,709	586	1,548	7,759	15,703
2049	31	5,773	4,493	1,794	1,735	600	1,601	7,947	15,968
2050	32	5,896	4,511	1,829	1,760	614	1,654	8,137	16,237
2051	33	6,022	4,528	1,864	1,787	628	1,708	8,330	16,509
2052	34	6,150	4,546	1,900	1,814	642	1,761	8,525	16,785
2053	35	6,281	4,564	1,937	1,841	655	1,815	8,723	17,065
2054	36	6,415	4,582	1,974	1,868	669	1,868	8,924	17,348
2055	37	6,551	4,600	2,012	1,896	683	1,921	9,128	17,636
2056	38	6,691	4,619	2,051	1,924	697	1,975	9,334	17,928
2057	39	6,833	4,637	2,090	1,953	711	2,028	9,544	18,224
Total Growth		3,828	661	1,098	858	540	2,028	6,396	9,013

Annual Growth Rate (%/yr)	0.57%	1.61%	0.41%

		Population			
Year	#	Rural Area A	Rural Area B	Rural Area C	Total of Rural
2018	0	1,873	4,763	3,025	9,661
2019	1	1,884	4,840	3,037	9,761
2020	2	1,894	4,918	3,050	9,862
2021	3	1,905	4,997	3,062	9,964
2022	4	1,916	5,077	3,074	10,068
2023	5	1,927	5,159	3,087	10,173
2024	6	1,938	5,242	3,099	10,279
2025	7	1,949	5,326	3,112	10,387
2026	8	1,960	5,412	3,124	10,497
2027	9	1,972	5,499	3,137	10,608
2028	10	1,983	5,588	3,150	10,720
2029	11	1,994	5,677	3,163	10,834
2030	12	2,006	5,769	3,175	10,950
2031	13	2,017	5,862	3,188	11,067
2032	14	2,029	5,956	3,201	11,186
2033	15	2,040	6,052	3,214	11,306
2034	16	2,052	6,149	3,227	11,428
2035	17	2,064	6,248	3,240	11,552
2036	18	2,075	6,349	3,253	11,678
2037	19	2,087	6,451	3,267	11,805
2038	20	2,099	6,555	3,280	11,934
2039	21	2,111	6,660	3,293	12,064
2040	22	2,123	6,767	3,306	12,197
2041	23	2,135	6,876	3,320	12,332
2042	24	2,148	6,987	3,333	12,468
2043	25	2,160	7,099	3,347	12,606
2044	26	2,172	7,214	3,360	12,746
2045	27	2,185	7,330	3,374	12,888
2046	28	2,197	7,448	3,388	13,033
2047	29	2,210	7,568	3,401	13,179
2048	30	2,222	7,689	3,415	13,327
2049	31	2,235	7,813	3,429	13,477
2050	32	2,248	7,939	3,443	13,630
2051	33	2,261	8,067	3,457	13,784
2052	34	2,273	8,197	3,471	13,941
2053	35	2,286	8,328	3,485	14,100
2054	36	2,300	8,463	3,499	14,261
2055	37	2,313	8,599	3,513	14,425
2056	38	2,326	8,737	3,527	14,590
2057	39	2,339	8,878	3,542	14,759
Total Growth		466	4,115	517	5,098

Annual Growth Rate (%/yr)	1.61%	1.11%	0.99%

		Population			
Year	#	UCB+Rural Area A	UCB+Rural Area B	UCB+Rural Area C	Total of UCB+Rural
2018	0	5,021	8,739	5,112	18,872
2019	1	5,102	8,836	5,163	19,100
2020	2	5,183	8,933	5,214	19,331
2021	3	5,267	9,032	5,266	19,565
2022	4	5,351	9,132	5,318	19,801
2023	5	5,437	9,233	5,371	20,041
2024	6	5,524	9,335	5,424	20,284
2025	7	5,613	9,438	5,478	20,530
2026	8	5,703	9,543	5,532	20,778
2027	9	5,795	9,648	5,587	21,030
2028	10	5,888	9,755	5,643	21,286
2029	11	5,982	9,863	5,699	21,544
2030	12	6,078	9,972	5,756	21,806
2031	13	6,176	10,082	5,813	22,071
2032	14	6,275	10,194	5,870	22,339
2033	15	6,376	10,306	5,929	22,611
2034	16	6,478	10,420	5,988	22,886
2035	17	6,582	10,535	6,047	23,165
2036	18	6,688	10,652	6,107	23,447
2037	19	6,795	10,770	6,168	23,733
2038	20	6,904	10,889	6,229	24,022
2039	21	7,015	11,009	6,291	24,315
2040	22	7,128	11,131	6,353	24,612
2041	23	7,242	11,254	6,416	24,912
2042	24	7,358	11,379	6,480	25,217
2043	25	7,476	11,504	6,544	25,525
2044	26	7,596	11,632	6,609	25,837
2045	27	7,718	11,760	6,675	26,154
2046	28	7,842	11,890	6,741	26,474
2047	29	7,968	12,022	6,808	26,798
2048	30	8,096	12,155	6,876	27,127
2049	31	8,226	12,289	6,944	27,459
2050	32	8,358	12,425	7,013	27,796
2051	33	8,492	12,562	7,083	28,137
2052	34	8,628	12,701	7,153	28,483
2053	35	8,767	12,842	7,224	28,833
2054	36	8,908	12,984	7,296	29,187
2055	37	9,051	13,127	7,368	29,546
2056	38	9,196	13,272	7,441	29,910
2057	39	9,344	13,419	7,515	30,278
Total Growth		4,323	4,680	2,403	11,406

Scenario 5 **ADJUSTED UCB - BASED ON PAUQUACHIN FIRST NATION HOUSING PLANS FOR HATCH POINT NOTED IN COMMENTS RECEIVED JULY 10, 2019**

Annual Growth Rate (%/yr)		2.13%	0.40%	1.93%	1.49%			
		Population						
Year	#	Mill Bay UCB	Shawnigan Lake UCB	Cobble Hill UCB	Arbutus Ridge UCB	Pauquachin FN Member Housing	Adjusted C. Hill UCB+Pauquachin	Total of UCBs
2018	0	3,005	3,976	992	1,095	0	992	9,068
2019	1	3,069	3,992	1,011	1,111	0	1,011	9,183
2020	2	3,134	4,007	1,031	1,128	0	1,031	9,300
2021	3	3,201	4,023	1,051	1,145	0	1,051	9,420
2022	4	3,269	4,039	1,071	1,162	0	1,071	9,541
2023	5	3,339	4,055	1,091	1,179	29	1,120	9,693
2024	6	3,410	4,071	1,113	1,197	57	1,170	9,848
2025	7	3,482	4,087	1,134	1,215	86	1,220	10,004
2026	8	3,557	4,103	1,156	1,233	114	1,270	10,163
2027	9	3,632	4,120	1,178	1,251	143	1,321	10,324
2028	10	3,710	4,136	1,201	1,270	171	1,372	10,488
2029	11	3,789	4,152	1,224	1,289	200	1,424	10,654
2030	12	3,869	4,169	1,248	1,308	229	1,476	10,822
2031	13	3,952	4,185	1,272	1,328	257	1,529	10,994
2032	14	4,036	4,202	1,296	1,348	286	1,582	11,167
2033	15	4,122	4,218	1,321	1,368	314	1,636	11,343
2034	16	4,209	4,235	1,347	1,388	343	1,690	11,522
2035	17	4,299	4,252	1,373	1,409	371	1,744	11,704
2036	18	4,390	4,268	1,399	1,430	400	1,799	11,888
2037	19	4,484	4,285	1,426	1,452	429	1,855	12,076
2038	20	4,579	4,302	1,454	1,473	457	1,911	12,266
2039	21	4,677	4,319	1,482	1,495	486	1,968	12,459
2040	22	4,776	4,336	1,511	1,518	514	2,025	12,655
2041	23	4,878	4,353	1,540	1,540	543	2,083	12,854
2042	24	4,982	4,371	1,569	1,563	571	2,141	13,057
2043	25	5,088	4,388	1,600	1,587	600	2,200	13,262
2044	26	5,196	4,405	1,631	1,611	629	2,259	13,471
2045	27	5,307	4,423	1,662	1,635	657	2,319	13,683
2046	28	5,420	4,440	1,694	1,659	686	2,380	13,899
2047	29	5,535	4,458	1,727	1,684	714	2,441	14,118
2048	30	5,653	4,475	1,760	1,709	743	2,503	14,340
2049	31	5,773	4,493	1,794	1,735	771	2,565	14,566
2050	32	5,896	4,511	1,829	1,760	800	2,629	14,796
2051	33	6,022	4,528	1,864	1,787	829	2,692	15,029
2052	34	6,150	4,546	1,900	1,814	857	2,757	15,267
2053	35	6,281	4,564	1,937	1,841	886	2,822	15,508
2054	36	6,415	4,582	1,974	1,868	914	2,888	15,753
2055	37	6,551	4,600	2,012	1,896	943	2,955	16,002
2056	38	6,691	4,619	2,051	1,924	971	3,022	16,256
2057	39	6,833	4,637	2,090	1,953	1,000	3,090	16,513
Total Growth		3,828	661	1,098	858	1,000	2,098	7,445

Annual Growth Rate (%/yr)		0.57%	1.61%	0.41%	
		Population			
Year	#	Rural Area A	Rural Area B	Rural Area C	Total of Rural
2018	0	1,873	4,763	3,025	9,661
2019	1	1,884	4,840	3,037	9,761
2020	2	1,894	4,918	3,050	9,862
2021	3	1,905	4,997	3,062	9,964
2022	4	1,916	5,077	3,074	10,068
2023	5	1,927	5,159	3,087	10,173
2024	6	1,938	5,242	3,099	10,279
2025	7	1,949	5,326	3,112	10,387
2026	8	1,960	5,412	3,124	10,497
2027	9	1,972	5,499	3,137	10,608
2028	10	1,983	5,588	3,150	10,720
2029	11	1,994	5,677	3,163	10,834
2030	12	2,006	5,769	3,175	10,950
2031	13	2,017	5,862	3,188	11,067
2032	14	2,029	5,956	3,201	11,186
2033	15	2,040	6,052	3,214	11,306
2034	16	2,052	6,149	3,227	11,428
2035	17	2,064	6,248	3,240	11,552
2036	18	2,075	6,349	3,253	11,678
2037	19	2,087	6,451	3,267	11,805
2038	20	2,099	6,555	3,280	11,934
2039	21	2,111	6,660	3,293	12,064
2040	22	2,123	6,767	3,306	12,197
2041	23	2,135	6,876	3,320	12,332
2042	24	2,148	6,987	3,333	12,468
2043	25	2,160	7,099	3,347	12,606
2044	26	2,172	7,214	3,360	12,746
2045	27	2,185	7,330	3,374	12,888
2046	28	2,197	7,448	3,388	13,033
2047	29	2,210	7,568	3,401	13,179
2048	30	2,222	7,689	3,415	13,327
2049	31	2,235	7,813	3,429	13,477
2050	32	2,248	7,939	3,443	13,630
2051	33	2,261	8,067	3,457	13,784
2052	34	2,273	8,197	3,471	13,941
2053	35	2,286	8,328	3,485	14,100
2054	36	2,300	8,463	3,499	14,261
2055	37	2,313	8,599	3,513	14,425
2056	38	2,326	8,737	3,527	14,590
2057	39	2,339	8,878	3,542	14,759
Total Growth		466	4,115	517	5,098

Annual Growth Rate (%/yr)		1.61%	1.11%	0.99%	
		Population			
Year	#	UCB+Rural Area A	UCB+Rural Area B	UCB+Rural Area C	Total of UCB+Rural
2018	0	2,865	8,739	5,112	16,716
2019	1	2,911	8,836	5,163	16,909
2020	2	2,958	8,933	5,214	17,105
2021	3	3,005	9,032	5,266	17,303
2022	4	3,053	9,132	5,318	17,504
2023	5	3,102	9,233	5,371	17,706
2024	6	3,152	9,335	5,424	17,912
2025	7	3,203	9,438	5,478	18,119
2026	8	3,254	9,543	5,532	18,329
2027	9	3,307	9,648	5,587	18,542
2028	10	3,360	9,755	5,643	18,757
2029	11	3,414	9,863	5,699	18,975
2030	12	3,468	9,972	5,756	19,196
2031	13	3,524	10,082	5,813	19,419
2032	14	3,581	10,194	5,870	19,645
2033	15	3,638	10,306	5,929	19,873
2034	16	3,696	10,420	5,988	20,104
2035	17	3,756	10,535	6,047	20,338
2036	18	3,816	10,652	6,107	20,575
2037	19	3,877	10,770	6,168	20,815
2038	20	3,940	10,889	6,229	21,057
2039	21	4,003	11,009	6,291	21,303
2040	22	4,067	11,131	6,353	21,551
2041	23	4,132	11,254	6,416	21,803
2042	24	4,199	11,379	6,480	22,057
2043	25	4,266	11,504	6,544	22,315
2044	26	4,335	11,632	6,609	22,576
2045	27	4,404	11,760	6,675	22,839
2046	28	4,475	11,890	6,741	23,106
2047	29	4,547	12,022	6,808	23,377
2048	30	4,620	12,155	6,876	23,650
2049	31	4,694	12,289	6,944	23,927
2050	32	4,769	12,425	7,013	24,207
2051	33	4,846	12,562	7,083	24,491
2052	34	4,923	12,701	7,153	24,778
2053	35	5,002	12,842	7,224	25,068
2054	36	5,083	12,984	7,296	25,362
2055	37	5,164	13,127	7,368	25,660
2056	38	5,247	13,272	7,441	25,961
2057	39	5,332	13,419	7,515	26,266
Total Growth		2,467	4,680	2,403	9,550

Appendix B – Flow Projections

Scenario 1 **(less optimistic)**

ADWF	Lpcd	250	250	250	250
Dwelling Occupancy	pph	2.5	2.5	2.5	2.5
Peak Flow Factor	f	2.0	2.0	2.0	2.0
Annual Growth Rate	(%/yr)	2.13%	0.40%	1.93%	1.49%

		Population																		
Year	#	Mill Bay UCB	Homes #	ADWF (m^3/day)	PWWF (m^3/day)	Shawnigan Lake UCB	Homes #	ADWF (m^3/day)	PWWF (m^3/day)	Cobble Hill UCB	Homes #	ADWF (m^3/day)	PWWF (m^3/day)	Arbutus Ridge UCB	Homes #	ADWF (m^3/day)	PWWF (m^3/day)	Total of UCBs	ADWF (m^3/day)	PWWF (m^3/day)
2018	0	3,005	1,202	751	1,503	3,976	1,590	994	1,988	992	397	248	496	1,095	438	274	548	9,068	2,267	4,534
2019	1	3,069	1,228	767	1,534	3,992	1,597	998	1,996	1,011	404	253	506	1,111	445	278	556	9,183	2,296	4,592
2020	2	3,134	1,254	784	1,567	4,007	1,603	1,002	2,004	1,031	412	258	515	1,128	451	282	564	9,300	2,325	4,650
2021	3	3,201	1,280	800	1,601	4,023	1,609	1,006	2,012	1,051	420	263	525	1,145	458	286	572	9,420	2,355	4,710
2022	4	3,269	1,308	817	1,635	4,039	1,616	1,010	2,020	1,071	428	268	535	1,162	465	290	581	9,541	2,385	4,771
2023	5	3,339	1,335	835	1,669	4,055	1,622	1,014	2,028	1,091	437	273	546	1,179	472	295	590	9,665	2,416	4,832
2024	6	3,410	1,364	852	1,705	4,071	1,628	1,018	2,036	1,113	445	278	556	1,197	479	299	598	9,790	2,448	4,895
2025	7	3,482	1,393	871	1,741	4,087	1,635	1,022	2,044	1,134	454	284	567	1,215	486	304	607	9,919	2,480	4,959
2026	8	3,557	1,423	889	1,778	4,103	1,641	1,026	2,052	1,156	462	289	578	1,233	493	308	617	10,049	2,512	5,024
2027	9	3,632	1,453	908	1,816	4,120	1,648	1,030	2,060	1,178	471	295	589	1,251	501	313	626	10,181	2,545	5,091
2028	10	3,710	1,484	927	1,855	4,136	1,654	1,034	2,068	1,201	480	300	600	1,270	508	318	635	10,317	2,579	5,158
2029	11	3,789	1,515	947	1,894	4,152	1,661	1,038	2,076	1,224	490	306	612	1,289	516	322	645	10,454	2,613	5,227
2030	12	3,869	1,548	967	1,935	4,169	1,667	1,042	2,084	1,248	499	312	624	1,308	523	327	654	10,594	2,648	5,297
2031	13	3,952	1,581	988	1,976	4,185	1,674	1,046	2,093	1,272	509	318	636	1,328	531	332	664	10,736	2,684	5,368
2032	14	4,036	1,614	1,009	2,018	4,202	1,681	1,050	2,101	1,296	519	324	648	1,348	539	337	674	10,881	2,720	5,441
2033	15	4,122	1,649	1,030	2,061	4,218	1,687	1,055	2,109	1,321	529	330	661	1,368	547	342	684	11,029	2,757	5,515
2034	16	4,209	1,684	1,052	2,105	4,235	1,694	1,059	2,117	1,347	539	337	673	1,388	555	347	694	11,179	2,795	5,590
2035	17	4,299	1,720	1,075	2,149	4,252	1,701	1,063	2,126	1,373	549	343	686	1,409	564	352	705	11,333	2,833	5,666
2036	18	4,390	1,756	1,098	2,195	4,268	1,707	1,067	2,134	1,399	560	350	700	1,430	572	358	715	11,488	2,872	5,744
2037	19	4,484	1,794	1,121	2,242	4,285	1,714	1,071	2,143	1,426	571	357	713	1,452	581	363	726	11,647	2,912	5,824
2038	**20**	4,579	1,832	1,145	2,290	4,302	1,721	1,076	2,151	1,454	582	363	727	1,473	589	368	737	11,809	2,952	5,904
2039	21	4,677	1,871	1,169	2,338	4,319	1,728	1,080	2,160	1,482	593	370	741	1,495	598	374	748	11,973	2,993	5,987
2040	22	4,776	1,911	1,194	2,388	4,336	1,734	1,084	2,168	1,511	604	378	755	1,518	607	379	759	12,141	3,035	6,070
2041	23	4,878	1,951	1,220	2,439	4,353	1,741	1,088	2,177	1,540	616	385	770	1,540	616	385	770	12,311	3,078	6,156
2042	24	4,982	1,993	1,245	2,491	4,371	1,748	1,093	2,185	1,569	628	392	785	1,563	625	391	782	12,485	3,121	6,243
2043	25	5,088	2,035	1,272	2,544	4,388	1,755	1,097	2,194	1,600	640	400	800	1,587	635	397	793	12,662	3,166	6,331
2044	26	5,196	2,078	1,299	2,598	4,405	1,762	1,101	2,203	1,631	652	408	815	1,611	644	403	805	12,842	3,211	6,421
2045	27	5,307	2,123	1,327	2,653	4,423	1,769	1,106	2,211	1,662	665	415	831	1,635	654	409	817	13,026	3,256	6,513
2046	28	5,420	2,168	1,355	2,710	4,440	1,776	1,110	2,220	1,694	678	424	847	1,659	664	415	830	13,213	3,303	6,606
2047	29	5,535	2,214	1,384	2,768	4,458	1,783	1,114	2,229	1,727	691	432	863	1,684	674	421	842	13,403	3,351	6,702
2048	30	5,653	2,261	1,413	2,826	4,475	1,790	1,119	2,238	1,760	704	440	880	1,709	684	427	854	13,597	3,399	6,799
2049	31	5,773	2,309	1,443	2,887	4,493	1,797	1,123	2,246	1,794	718	449	897	1,735	694	434	867	13,795	3,449	6,897
2050	32	5,896	2,358	1,474	2,948	4,511	1,804	1,128	2,255	1,829	731	457	914	1,760	704	440	880	13,996	3,499	6,998
2051	33	6,022	2,409	1,505	3,011	4,528	1,811	1,132	2,264	1,864	746	466	932	1,787	715	447	893	14,201	3,550	7,100
2052	34	6,150	2,460	1,537	3,075	4,546	1,819	1,137	2,273	1,900	760	475	950	1,814	725	453	907	14,410	3,602	7,205
2053	35	6,281	2,512	1,570	3,140	4,564	1,826	1,141	2,282	1,937	775	484	968	1,841	736	460	920	14,622	3,656	7,311
2054	36	6,415	2,566	1,604	3,207	4,582	1,833	1,146	2,291	1,974	790	493	987	1,868	747	467	934	14,839	3,710	7,419
2055	37	6,551	2,620	1,638	3,276	4,600	1,840	1,150	2,300	2,012	805	503	1,006	1,896	758	474	948	15,060	3,765	7,530
2056	38	6,691	2,676	1,673	3,345	4,619	1,847	1,155	2,309	2,051	820	513	1,025	1,924	770	481	962	15,284	3,821	7,642
2057	39	6,833	2,733	1,708	3,416	4,637	1,855	1,159	2,318	2,090	836	523	1,045	1,953	781	488	977	15,513	3,878	7,757
Total Growth		3,828	1,531	957	1,914	661	264	165	330	1,098	439	275	549	858	343	215	429	6,445	1,611	3,223

Flow calculations assume the entire population is connected to WWTPs, excluding First Nations.

Scenario 2 **(more optimistic)**

ADWF	Lpcd	250	250	250	250
Dwelling Occupancy	pph	2.5	2.5	2.5	2.5
Peak Flow Factor	f	2.0	2.0	2.0	2.0
Annual Growth Rate	(%/yr)	2.13%	0.40%	1.93%	1.49%

Population

Year	#	Mill Bay UCB	Homes #	ADWF (m^3/day)	PWWF (m^3/day)	Shawnigan Lake UCB	Homes #	ADWF (m^3/day)	PWWF (m^3/day)	Cobble Hill UCB	Homes #	ADWF (m^3/day)	PWWF (m^3/day)	Arbutus Ridge UCB	Homes #	ADWF (m^3/day)	PWWF (m^3/day)	Total of UCBs	ADWF (m^3/day)	PWWF (m^3/day)
2018	0	3,005	1,202	751	1,503	3,976	1,590	994	1,988	992	397	248	496	1,095	438	274	548	9,068	2,267	4,534
2019	1	3,069	1,228	767	1,534	3,992	1,597	998	1,996	1,011	404	253	506	1,111	445	278	556	9,183	2,296	4,592
2020	2	3,134	1,254	784	1,567	4,007	1,603	1,002	2,004	1,031	412	258	515	1,128	451	282	564	9,300	2,325	4,650
2021	3	3,201	1,280	800	1,601	4,023	1,609	1,006	2,012	1,051	420	263	525	1,145	458	286	572	9,420	2,355	4,710
2022	4	3,269	1,308	817	1,635	4,039	1,616	1,010	2,020	1,071	428	268	535	1,162	465	290	581	9,541	2,385	4,771
Annual Growth Rate	(%/yr)	2.96%				0.56%				2.69%				2.08%						
2023	5	3,366	1,346	841	1,683	4,062	1,625	1,015	2,031	1,100	440	275	550	1,186	474	297	593	9,713	2,428	4,857
2024	6	3,465	1,386	866	1,733	4,084	1,634	1,021	2,042	1,129	452	282	565	1,211	484	303	605	9,890	2,472	4,945
2025	7	3,568	1,427	892	1,784	4,107	1,643	1,027	2,054	1,159	464	290	580	1,236	494	309	618	10,071	2,518	5,035
2026	8	3,674	1,469	918	1,837	4,130	1,652	1,033	2,065	1,191	476	298	595	1,262	505	315	631	10,256	2,564	5,128
2027	9	3,782	1,513	946	1,891	4,153	1,661	1,038	2,077	1,223	489	306	611	1,288	515	322	644	10,446	2,611	5,223
2028	10	3,894	1,558	974	1,947	4,176	1,670	1,044	2,088	1,255	502	314	628	1,315	526	329	657	10,641	2,660	5,320
2029	11	4,009	1,604	1,002	2,005	4,199	1,680	1,050	2,100	1,289	516	322	645	1,342	537	336	671	10,840	2,710	5,420
2030	12	4,128	1,651	1,032	2,064	4,223	1,689	1,056	2,111	1,324	529	331	662	1,370	548	342	685	11,045	2,761	5,522
2031	13	4,250	1,700	1,063	2,125	4,246	1,699	1,062	2,123	1,359	544	340	680	1,398	559	350	699	11,254	2,814	5,627
2032	14	4,376	1,750	1,094	2,188	4,270	1,708	1,068	2,135	1,396	558	349	698	1,428	571	357	714	11,469	2,867	5,735
2033	15	4,505	1,802	1,126	2,253	4,294	1,718	1,073	2,147	1,433	573	358	717	1,457	583	364	729	11,690	2,922	5,845
2034	16	4,639	1,856	1,160	2,319	4,318	1,727	1,079	2,159	1,472	589	368	736	1,488	595	372	744	11,916	2,979	5,958
2035	17	4,776	1,910	1,194	2,388	4,342	1,737	1,085	2,171	1,511	605	378	756	1,519	607	380	759	12,148	3,037	6,074
2036	18	4,917	1,967	1,229	2,459	4,366	1,746	1,092	2,183	1,552	621	388	776	1,550	620	388	775	12,386	3,096	6,193
2037	19	5,063	2,025	1,266	2,531	4,390	1,756	1,098	2,195	1,594	637	398	797	1,582	633	396	791	12,629	3,157	6,315
2038	**20**	5,213	2,085	1,303	2,606	4,415	1,766	1,104	2,207	1,636	655	409	818	1,615	646	404	808	12,879	3,220	6,440
2039	21	5,367	2,147	1,342	2,683	4,440	1,776	1,110	2,220	1,680	672	420	840	1,649	660	412	824	13,136	3,284	6,568
2040	22	5,526	2,210	1,381	2,763	4,464	1,786	1,116	2,232	1,726	690	431	863	1,683	673	421	842	13,399	3,350	6,699
2041	23	5,689	2,276	1,422	2,845	4,489	1,796	1,122	2,245	1,772	709	443	886	1,718	687	430	859	13,668	3,417	6,834
2042	24	5,858	2,343	1,464	2,929	4,514	1,806	1,129	2,257	1,819	728	455	910	1,754	702	438	877	13,945	3,486	6,973
2043	25	6,031	2,412	1,508	3,015	4,539	1,816	1,135	2,270	1,868	747	467	934	1,790	716	448	895	14,229	3,557	7,114
2044	26	6,209	2,484	1,552	3,105	4,565	1,826	1,141	2,282	1,918	767	480	959	1,828	731	457	914	14,520	3,630	7,260
2045	27	6,393	2,557	1,598	3,197	4,590	1,836	1,148	2,295	1,970	788	493	985	1,866	746	466	933	14,819	3,705	7,409
2046	28	6,582	2,633	1,646	3,291	4,616	1,846	1,154	2,308	2,023	809	506	1,011	1,904	762	476	952	15,125	3,781	7,563
2047	29	6,777	2,711	1,694	3,388	4,641	1,857	1,160	2,321	2,077	831	519	1,039	1,944	778	486	972	15,440	3,860	7,720
2048	30	6,977	2,791	1,744	3,489	4,667	1,867	1,167	2,334	2,133	853	533	1,067	1,984	794	496	992	15,762	3,941	7,881
2049	31	7,184	2,874	1,796	3,592	4,693	1,877	1,173	2,347	2,190	876	548	1,095	2,026	810	506	1,013	16,093	4,023	8,047
2050	32	7,396	2,959	1,849	3,698	4,720	1,888	1,180	2,360	2,249	900	562	1,125	2,068	827	517	1,034	16,433	4,108	8,217
2051	33	7,615	3,046	1,904	3,808	4,746	1,898	1,186	2,373	2,310	924	577	1,155	2,111	844	528	1,055	16,782	4,195	8,391
2052	34	7,841	3,136	1,960	3,920	4,772	1,909	1,193	2,386	2,372	949	593	1,186	2,155	862	539	1,077	17,139	4,285	8,570
2053	35	8,073	3,229	2,018	4,036	4,799	1,920	1,200	2,399	2,435	974	609	1,218	2,200	880	550	1,100	17,507	4,377	8,753
2054	36	8,312	3,325	2,078	4,156	4,826	1,930	1,206	2,413	2,501	1,000	625	1,250	2,245	898	561	1,123	17,883	4,471	8,942
2055	37	8,557	3,423	2,139	4,279	4,853	1,941	1,213	2,426	2,568	1,027	642	1,284	2,292	917	573	1,146	18,270	4,568	9,135
2056	38	8,811	3,524	2,203	4,405	4,880	1,952	1,220	2,440	2,637	1,055	659	1,318	2,340	936	585	1,170	18,667	4,667	9,333
2057	39	9,071	3,629	2,268	4,536	4,907	1,963	1,227	2,453	2,708	1,083	677	1,354	2,388	955	597	1,194	19,074	4,769	9,537
Total Growth		6,066	2,427	1,517	3,033	931	372	233	465	1,716	686	429	858	1,293	517	323	647	10,006	2,502	5,003

Flow calculations assume the entire population is connected to WWTPs, excluding First Nations.

Scenario 3 **ADJUSTED UCB - BASED ON MALAHAT HOUSING NEEDS AND POTENTIAL HOUSING DEVELOPMENT - MALAHAT CDP**

ADWF	Lpcd		250	320					250				250				250						
Dwelling Occupancy	pph		2.5						2.5				2.5				2.5						
Peak Flow Factor	f		2.0						2.0				2.0				2.0						
Annual Growth Rate	(%/yr)	2.13%						0.40%				1.93%				1.49%							

													Population										
Year	#	Mill Bay	Homes	ADWF	PWWF	Malahat	Adjusted	ADWF (M. Bay + Malahat)	PWWF (M. Bay + Malahat)	Shawnigan Lake	Homes	ADWF	PWWF	Cobble Hill	Homes	ADWF	PWWF	Arbutus Ridge	Homes	ADWF	PWWF	Total of	ADWF	PWWF
		UCB	#	(m^3/day)	(m^3/day)	Members	M. Bay UCB + Malahat	(m^3/day)	(m^3/day)	UCB	#	(m^3/day)	(m^3/day)	UCB	#	(m^3/day)	(m^3/day)	UCB	#	(m^3/day)	(m^3/day)	UCBs	(m^3/day)	(m^3/day)
2018	0	3,005	1,202	751	1,503	171	3,148	806	1,612	3,976	1,590	994	1,988	992	397	248	496	1,095	438	274	548	9,068	2,267	4,534
2019	1	3,069	1,228	767	1,534	185	3,226	826	1,653	3,992	1,597	998	1,996	1,011	404	253	506	1,111	445	278	556	9,183	2,296	4,592
2020	2	3,134	1,254	784	1,567	198	3,305	847	1,694	4,007	1,603	1,002	2,004	1,031	412	258	515	1,128	451	282	564	9,300	2,325	4,650
2021	3	3,201	1,280	800	1,601	212	3,386	868	1,736	4,023	1,609	1,006	2,012	1,051	420	263	525	1,145	458	286	572	9,420	2,355	4,710
2022	4	3,269	1,308	817	1,635	226	3,468	890	1,779	4,039	1,616	1,010	2,020	1,071	428	268	535	1,162	465	290	581	9,541	2,385	4,771
2023	5	3,339	1,335	835	1,669	240	3,551	911	1,823	4,055	1,622	1,014	2,028	1,091	437	273	546	1,179	472	295	590	9,665	2,416	4,832
2024	6	3,410	1,364	852	1,705	254	3,636	934	1,867	4,071	1,628	1,018	2,036	1,113	445	278	556	1,197	479	299	598	9,790	2,448	4,895
2025	7	3,482	1,393	871	1,741	268	3,722	956	1,912	4,087	1,635	1,022	2,044	1,134	454	284	567	1,215	486	304	607	9,919	2,480	4,959
2026	8	3,557	1,423	889	1,778	282	3,810	979	1,958	4,103	1,641	1,026	2,052	1,156	462	289	578	1,233	493	308	617	10,049	2,512	5,024
2027	9	3,632	1,453	908	1,816	295	3,900	1,003	2,005	4,120	1,648	1,030	2,060	1,178	471	295	589	1,251	501	313	626	10,181	2,545	5,091
2028	10	3,710	1,484	927	1,855	309	3,991	1,026	2,053	4,136	1,654	1,034	2,068	1,201	480	300	600	1,270	508	318	635	10,317	2,579	5,158
2029	11	3,789	1,515	947	1,894	323	4,084	1,051	2,101	4,152	1,661	1,038	2,076	1,224	490	306	612	1,289	516	322	645	10,454	2,613	5,227
2030	12	3,869	1,548	967	1,935	337	4,178	1,075	2,150	4,169	1,667	1,042	2,084	1,248	499	312	624	1,308	523	327	654	10,594	2,648	5,297
2031	13	3,952	1,581	988	1,976	351	4,275	1,100	2,200	4,185	1,674	1,046	2,093	1,272	509	318	636	1,328	531	332	664	10,736	2,684	5,368
2032	14	4,036	1,614	1,009	2,018	365	4,373	1,126	2,251	4,202	1,681	1,050	2,101	1,296	519	324	648	1,348	539	337	674	10,881	2,720	5,441
2033	15	4,122	1,649	1,030	2,061	378	4,472	1,151	2,303	4,218	1,687	1,055	2,109	1,321	529	330	661	1,368	547	342	684	11,029	2,757	5,515
2034	16	4,209	1,684	1,052	2,105	392	4,574	1,178	2,356	4,235	1,694	1,059	2,117	1,347	539	337	673	1,388	555	347	694	11,179	2,795	5,590
2035	17	4,299	1,720	1,075	2,149	406	4,677	1,205	2,409	4,252	1,701	1,063	2,126	1,373	549	343	686	1,409	564	352	705	11,333	2,833	5,666
2036	18	4,390	1,756	1,098	2,195	420	4,783	1,232	2,464	4,268	1,707	1,067	2,134	1,399	560	350	700	1,430	572	358	715	11,488	2,872	5,744
2037	19	4,484	1,794	1,121	2,242	434	4,890	1,260	2,520	4,285	1,714	1,071	2,143	1,426	571	357	713	1,452	581	363	726	11,647	2,912	5,824
2038	**20**	4,579	1,832	1,145	2,290	448	4,999	1,288	2,576	4,302	1,721	1,076	2,151	1,454	582	363	727	1,473	589	368	737	11,809	2,952	5,904
2039	21	4,677	1,871	1,169	2,338	462	5,111	1,317	2,634	4,319	1,728	1,080	2,160	1,482	593	370	741	1,495	598	374	748	11,973	2,993	5,987
2040	22	4,776	1,911	1,194	2,388	475	5,224	1,346	2,692	4,336	1,734	1,084	2,168	1,511	604	378	755	1,518	607	379	759	12,141	3,035	6,070
2041	23	4,878	1,951	1,220	2,439	489	5,340	1,376	2,752	4,353	1,741	1,088	2,177	1,540	616	385	770	1,540	616	385	770	12,311	3,078	6,156
2042	24	4,982	1,993	1,245	2,491	503	5,457	1,406	2,813	4,371	1,748	1,093	2,185	1,569	628	392	785	1,563	625	391	782	12,485	3,121	6,243
2043	25	5,088	2,035	1,272	2,544	517	5,577	1,437	2,875	4,388	1,755	1,097	2,194	1,600	640	400	800	1,587	635	397	793	12,662	3,166	6,331
2044	26	5,196	2,078	1,299	2,598	531	5,699	1,469	2,938	4,405	1,762	1,101	2,203	1,631	652	408	815	1,611	644	403	805	12,842	3,211	6,421
2045	27	5,307	2,123	1,327	2,653	545	5,824	1,501	3,002	4,423	1,769	1,106	2,211	1,662	665	415	831	1,635	654	409	817	13,026	3,256	6,513
2046	28	5,420	2,168	1,355	2,710	559	5,951	1,534	3,067	4,440	1,776	1,110	2,220	1,694	678	424	847	1,659	664	415	830	13,213	3,303	6,606
2047	29	5,535	2,214	1,384	2,768	572	6,080	1,567	3,134	4,458	1,783	1,114	2,229	1,727	691	432	863	1,684	674	421	842	13,403	3,351	6,702
2048	30	5,653	2,261	1,413	2,826	586	6,211	1,601	3,202	4,475	1,790	1,119	2,238	1,760	704	440	880	1,709	684	427	854	13,597	3,399	6,799
2049	31	5,773	2,309	1,443	2,887	600	6,346	1,635	3,271	4,493	1,797	1,123	2,246	1,794	718	449	897	1,735	694	434	867	13,795	3,449	6,897
2050	32	5,896	2,358	1,474	2,948	614	6,482	1,671	3,341	4,511	1,804	1,128	2,255	1,829	731	457	914	1,760	704	440	880	13,996	3,499	6,998
2051	33	6,022	2,409	1,505	3,011	628	6,622	1,706	3,413	4,528	1,811	1,132	2,264	1,864	746	466	932	1,787	715	447	893	14,201	3,550	7,100
2052	34	6,150	2,460	1,537	3,075	642	6,764	1,743	3,486	4,546	1,819	1,137	2,273	1,900	760	475	950	1,814	725	453	907	14,410	3,602	7,205
2053	35	6,281	2,512	1,570	3,140	655	6,909	1,780	3,560	4,564	1,826	1,141	2,282	1,937	775	484	968	1,841	736	460	920	14,622	3,656	7,311
2054	36	6,415	2,566	1,604	3,207	669	7,056	1,818	3,636	4,582	1,833	1,146	2,291	1,974	790	493	987	1,868	747	467	934	14,839	3,710	7,419
2055	37	6,551	2,620	1,638	3,276	683	7,207	1,856	3,713	4,600	1,840	1,150	2,300	2,012	805	503	1,006	1,896	758	474	948	15,060	3,765	7,530
2056	38	6,691	2,676	1,673	3,345	697	7,360	1,896	3,791	4,619	1,847	1,155	2,309	2,051	820	513	1,025	1,924	770	481	962	15,284	3,821	7,642
2057	39	6,833	2,733	1,708	3,416	711	7,516	1,936	3,871	4,637	1,855	1,159	2,318	2,090	836	523	1,045	1,953	781	488	977	15,513	3,878	7,757
Total Growth		3,828	1,531	957	1,914	540	4,368	1,130	2,260	661	264	165	330	1,098	439	275	549	858	343	215	429	6,445	1,611	3,223

Flow calculations assume the entire population is connected to WWTPs - with and without First Nations.

Scenario 4 **ADJUSTED UCB - BASED ON MALAHAT HOUSING NEEDS AND POTENTIAL HOUSING DEVELOPMENT - MALAHAT CDP**

ADWF	Lpcd			250	320
Dwelling Occupancy	pph			2.5	
Peak Flow Factor	f			2.0	
Annual Growth Rate	(%/yr)	2.13%	0.40%	1.93%	1.49%

						Population				
Year	#	Mill Bay UCB	Homes #	ADWF (m^3/day)	PWWF (m^3/day)	Malahat Members	Housing Developed by Malahat	Adjusted M. Bay UCB + Malahat	ADWF (M. Bay + Malahat) (m^3/day)	PWWF (M. Bay + Malahat) (m^3/day)
2018	0	3,005	1,202	751	1,503	171	0	3,148	806	1,612
2019	1	3,069	1,228	767	1,534	185	0	3,226	826	1,653
2020	2	3,134	1,254	784	1,567	198	53	3,358	864	1,728
2021	3	3,201	1,280	800	1,601	212	107	3,492	902	1,805
2022	4	3,269	1,308	817	1,635	226	160	3,628	941	1,882
2023	5	3,339	1,335	835	1,669	240	213	3,764	980	1,960
2024	6	3,410	1,364	852	1,705	254	267	3,903	1,019	2,038
2025	7	3,482	1,393	871	1,741	268	320	4,043	1,059	2,117
2026	8	3,557	1,423	889	1,778	282	374	4,184	1,099	2,198
2027	9	3,632	1,453	908	1,816	295	427	4,327	1,139	2,278
2028	10	3,710	1,484	927	1,855	309	480	4,471	1,180	2,360
2029	11	3,789	1,515	947	1,894	323	534	4,618	1,221	2,443
2030	12	3,869	1,548	967	1,935	337	587	4,765	1,263	2,526
2031	13	3,952	1,581	988	1,976	351	640	4,915	1,305	2,610
2032	14	4,036	1,614	1,009	2,018	365	694	5,066	1,348	2,695
2033	15	4,122	1,649	1,030	2,061	378	747	5,219	1,391	2,781
2034	16	4,209	1,684	1,052	2,105	392	801	5,374	1,434	2,868
2035	17	4,299	1,720	1,075	2,149	406	854	5,531	1,478	2,956
2036	18	4,390	1,756	1,098	2,195	420	907	5,690	1,522	3,045
2037	19	4,484	1,794	1,121	2,242	434	961	5,851	1,567	3,134
2038	20	4,579	1,832	1,145	2,290	448	1,014	6,013	1,613	3,225
2039	21	4,677	1,871	1,169	2,338	462	1,067	6,178	1,658	3,317
2040	22	4,776	1,911	1,194	2,388	475	1,121	6,345	1,705	3,410
2041	23	4,878	1,951	1,220	2,439	489	1,174	6,514	1,752	3,504
2042	24	4,982	1,993	1,245	2,491	503	1,227	6,685	1,799	3,598
2043	25	5,088	2,035	1,272	2,544	517	1,281	6,858	1,847	3,695
2044	26	5,196	2,078	1,299	2,598	531	1,334	7,034	1,896	3,792
2045	27	5,307	2,123	1,327	2,653	545	1,388	7,211	1,945	3,890
2046	28	5,420	2,168	1,355	2,710	559	1,441	7,392	1,995	3,990
2047	29	5,535	2,214	1,384	2,768	572	1,494	7,574	2,045	4,090
2048	30	5,653	2,261	1,413	2,826	586	1,548	7,759	2,096	4,192
2049	31	5,773	2,309	1,443	2,887	600	1,601	7,947	2,148	4,295
2050	32	5,896	2,358	1,474	2,948	614	1,654	8,137	2,200	4,400
2051	33	6,022	2,409	1,505	3,011	628	1,708	8,330	2,253	4,506
2052	34	6,150	2,460	1,537	3,075	642	1,761	8,525	2,306	4,613
2053	35	6,281	2,512	1,570	3,140	655	1,815	8,723	2,361	4,721
2054	36	6,415	2,566	1,604	3,207	669	1,868	8,924	2,416	4,831
2055	37	6,551	2,620	1,638	3,276	683	1,921	9,128	2,471	4,942
2056	38	6,691	2,676	1,673	3,345	697	1,975	9,334	2,528	5,055
2057	39	6,833	2,733	1,708	3,416	711	2,028	9,544	2,585	5,169
Total Growth		3,828	1,531	957	1,914	540	2,028	6,396	1,779	3,558

Flow calculations assume the entire population is connected to WWTPs - with and without First Nations.

Scenario 4 **ADJUSTED UCB - BASED ON MALAHAT HOUSING NEEDS AND POTENTIAL HOUSING DEVELOPMENT - MALAHAT CDP**

ADWF	Lpcd			250	320
Dwelling Occupancy	pph			2.5	
Peak Flow Factor	f			2.0	
Annual Growth Rate	(%/yr)	2.13%	0.40%	1.93%	1.49%

Year	#	Cobble Hill UCB Population	Homes #	ADWF (m^3/day)	PWWF (m^3/day)	Pauquachin FN Member Housing Population	Adjusted C. Hill UCB+Pauquachin Population	ADWF (C. Hill + Pauquachin) (m^3/day)	PWWF (C. Hill + Pauquachin) (m^3/day)
2018	0	992	397	248	496	0	992	248	496
2019	1	1,011	404	253	506	0	1,011	253	506
2020	2	1,031	412	258	515	0	1,031	258	515
2021	3	1,051	420	263	525	0	1,051	263	525
2022	4	1,071	428	268	535	0	1,071	268	535
2023	5	1,091	437	273	546	29	1,120	282	564
2024	6	1,113	445	278	556	57	1,170	296	593
2025	7	1,134	454	284	567	86	1,220	311	622
2026	8	1,156	462	289	578	114	1,270	326	651
2027	9	1,178	471	295	589	143	1,321	340	681
2028	10	1,201	480	300	600	171	1,372	355	710
2029	11	1,224	490	306	612	200	1,424	370	740
2030	12	1,248	499	312	624	229	1,476	385	770
2031	13	1,272	509	318	636	257	1,529	400	800
2032	14	1,296	519	324	648	286	1,582	416	831
2033	15	1,321	529	330	661	314	1,636	431	862
2034	16	1,347	539	337	673	343	1,690	446	893
2035	17	1,373	549	343	686	371	1,744	462	924
2036	18	1,399	560	350	700	400	1,799	478	956
2037	19	1,426	571	357	713	429	1,855	494	987
2038	20	1,454	582	363	727	457	1,911	510	1,019
2039	21	1,482	593	370	741	486	1,968	526	1,052
2040	22	1,511	604	378	755	514	2,025	542	1,084
2041	23	1,540	616	385	770	543	2,083	559	1,117
2042	24	1,569	628	392	785	571	2,141	575	1,150
2043	25	1,600	640	400	800	600	2,200	592	1,184
2044	26	1,631	652	408	815	629	2,259	609	1,218
2045	27	1,662	665	415	831	657	2,319	626	1,252
2046	28	1,694	678	424	847	686	2,380	643	1,286
2047	29	1,727	691	432	863	714	2,441	660	1,321
2048	30	1,760	704	440	880	743	2,503	678	1,355
2049	31	1,794	718	449	897	771	2,565	695	1,391
2050	32	1,829	731	457	914	800	2,629	713	1,426
2051	33	1,864	746	466	932	829	2,692	731	1,462
2052	34	1,900	760	475	950	857	2,757	749	1,499
2053	35	1,937	775	484	968	886	2,822	768	1,535
2054	36	1,974	790	493	987	914	2,888	786	1,572
2055	37	2,012	805	503	1,006	943	2,955	805	1,609
2056	38	2,051	820	513	1,025	971	3,022	824	1,647
2057	39	2,090	836	523	1,045	1,000	3,090	843	1,685
Total Growth		1,098	439	275	549	1,000	2,098	595	1,189

Flow calculations assume the entire population is connected to WWTPs - with and without First Nations.

Appendix C – Wastewater Infrastructure Inventory

ref. Current Year 2019 (do not delete row)

No.	System Name	Authorization Number	Location	Watershed	Owner	WDR Schedule	Year Built	Age (years)	Condition	Permitted MDF (m^3/day)	Est. Peak Flow Factor f	Estimated ADWF (m^3/day)	Wastewater Generation (L/capita/d)	Population (people)	Home Occupancy (persons / home)	Est. no. of Home Equivalents #	Average Capacity (Note 1) (m^3/day)	Permitted Effluent Quality	Effluent Compliance with MOE Permit	Facility Type - Description	Comments	Current ADWFs (observed) (m^3/day)	Expansion Potential
	Electoral Area A																						
2	Mill Springs	PE-06435	Mill Bay Village (Electoral Area A)	Shawnigan Creek / Malahat	CVRD	Schedule 1	1997	22	I/I issues in collection system. Plant very temperamental. High man-hours (15-20 hrs/wk) needed for compliance.	565	2.0	283	250	1,130	2.5	452	100 - 140	Class A - BOD_5 / TSS < 10/10 mg/L; FC < 2.2/100 mL (median), 14/100 mL (maximum); **TN < 10 mg/L**; Turbidity < 2 NTU (average), 5 NTU (maximum)	Effluent quality seldom met; plant very temperamental; high man-hours (15-20 hrs/wk) required for compliance; I/I issues in collection system	Inlet screen, flow equalization, Ecofluid EAAS treatment with USBF, polishing post-filtration, UV disinfection, conventional ground disposal field (6,780 m total length); 48 hours overflow EQ storage	400-unit residential subdivision and an elementary school; currently 230 homes; odour issues reported	100 - 140	**Potential for EAAS treatment retrofit to MBR treatment and conversion/expansion of conventional ground disposal field to RIBs for capacity increase; the WWTP has potential to serve Mill Bay UCB**
7	Brulette Place	RE-16692 RE-17108	Mill Bay Village (Electoral Area A)	Shawnigan Creek / Mill Bay	CVRD	Schedule 1	1995	24	Long-term treatment/disposal is a major concern. No emergency storage.	46	2.0	23	250	92	2.5	37	29	Class A registration (57 m^3/day)	Never achieved	Aerobic Model 960-1500, Norweco/Biokinetic Wastewater Treatment Plant	Brulette Place - Serving 37 homes and ambulance site; expanded to 41 homes; 2 registrations (one not built) and 3 health permits - 1 for 19 homes(23 m^3/day), 1 for single house, 1 for ambulance station	?	162 m^3/day disposal capacity (unconfirmed); optimal solution is to connect to Stonebridge PS, then to community WWTP; no expansion potential to treat larger flows
8	Sentinel Ridge	RE-18138	Mill Bay Village (Electoral Area A)	Malahat	CVRD	Schedule 1	2007	12	Membranes nearing end of life cycle. Phase 2 of build-out will require new membranes. Odour issues from nearby residents.	162	3.5	46	250	185	2.5	75	30 - 40	Class A - BOD_5 / TSS < 10/10 mg/L; FC < 2.2/100 mL (median), 14/100 mL (maximum); TN < 10 mg/L; Turbidity < 2 NTU (average), 5 NTU (maximum)	Compliant with the MOE permit most of the time; effective sampling program in place; working with Mill Bay marina regarding FOG from restaurant	Inlet fine screening, flow equalization, Sanitherm UF Membrane Bioreactor with UV disinfection, odour control, effluent discharge to RIBs; 24-hr emergency storage	Currently 75-home single-family residential subdivision; 150 homes at buildout; odour complaints from nearby residents - installation of biofilter helped with odour issue	30 - 40	**Potential for membrane UF treatment expansion and existing RIB capacity increase (uprating) subject to RIB capacity verification. Expanded WWTP may serve additional phase(s) of Sentinel Ridge.**
8a	Sentinel Ridge	RE-18138	Mill Bay Village (Electoral Area A)	Malahat	CVRD	Schedule 1	2007	12	Membranes nearing end of life cycle. Phase 2 of build-out will require new membranes. Odour issues from nearby residents.	324	3.2	101	250	405	2.7	150		Class A - BOD_5 / TSS < 10/10 mg/L; FC < 2.2/100 mL (median), 14/100 mL (maximum); TN < 10 mg/L; Turbidity < 2 NTU (average), 5 NTU (maximum)		Inlet fine screening, flow equalization, Sanitherm UF Membrane Bioreactor with UV disinfection, odour control, effluent discharge to RIBs	150-home single-family residential subdivision	n/a	**Potential for membrane UF treatment expansion and existing RIB capacity increase (uprating) subject to RIB capacity verification. Expanded WWTP may serve additional phase(s) of Sentinel Ridge.**
10	Ocean Terrace (proposed development)	RE-105649	Mill Bay Village (Electoral Area A)	Malahat	CVRD	Schedule 1	-	-	n/a; future system	555	2.0	278	250	1,110	2.5	438		Class A - BOD_5 / TSS < 10/10 mg/L; FC < 2.2/100 mL (median), 14/100 mL (maximum); Nitrate < 10 mg/L; TN < 20 mg/L; Turbidity < 2 NTU (average), 5 NTU (maximum)	No operating facility yet	Ocean Terrace advanced wastewater treatment facility and RIBs.	Proposed 438-home residential development		n/a; proposed development
11	Kerry Village	104206	Mill Bay Village (Electoral Area A)	Shawnigan Creek	CVRD	Schedule 1	2009	10	Inadequate EQ, sand filters, UV disinfection, and sludge storage capacity. Plant very temperamental. High man-hours (6-8 hrs/wk) needed for compliance.	138	2.0	69	250	276	2.5	110	30	Class A - BOD_5 / TSS < 10/10 mg/L; FC < 2.2/100 mL (median), 14/100 mL (maximum); TN < 10 mg/L; Turbidity < 2 NTU (average), 5 NTU (maximum)	Effluent quality seldom met; plant very temperamental; high man-hours (6-8 hrs/wk) required for compliance; no source control for FOG; 4 monitoring wells without issue	Class A, 95 m^3/day Ecofluid EAAS with USBF, UV disinfection, RIBs	Odour issues occasionally; AC filter installed	30	WWTP suitable for conversion to a lift station and sewage co-treatment at a community WWTP serving Mill Bay UCB.
12	Cove Strata	PE-00451	Mill Bay Village (Electoral Area A)	Shawnigan Creek / Malahat	Strata	Schedule 1			Satisfactory based on visual observation.	32	2.0	16	220	73	2.0	36	10	BOD_5 < 10 mg/L; TSS < 10 mg/L	The facility cannot not meet Class A effluent quality requirements; little I/I	Flow equalization, septic tank, RSF, conventional ground disposal field located on Stonebridge land (480 m total length)	36-unit apartment block		n/a; Existing discharge is subject to connection to a municipal sewerage system when such facilities become available.
13	Brentwood College	PE-1640	Mill Bay Village (Electoral Area A)	Malahat / Shawnigan Creek	Private	Schedule 1	1961	58	Satisfactory based on visual observation.	105	2.0	53	100	525	-	-	80 (during school term); 2 (outside of term)	Marine discharge - BOD_5 < 45 mg/L; TSS < 60 mg/L	Compliant with the MOE permit; however, the facility cannot not meet Class A effluent quality requirements; little I/I	Flow equalization, trash tank/outlet screen, EAAS treatment, ocean discharge through a marine outfall	Private residential school; up to 700 students and staff during school term		n/a on campus premises; OCP does not support the discharge of liquid waste that is not treated to a Class A standard into any watercourse, including freshwater and the ocean.
16	Pioneer Square	PE-6503	Mill Bay Village (Electoral Area A)	Mill Bay	Private	Schedule 1	1987	32	Old aging system	140	2.0	70	250	280	2.5	112	5	BOD_5 < 20 mg/L; TSS < 30 mg/L	Compliant with the MOE permit; however, the facility cannot not meet Class A effluent quality requirements	Holding tank, secondary RBC treatment, RSF, conventional ground disposal field (1,310 m total length); disposal field on Stonebridge site	Retail Shopping Centre, Motel and Apartment Complex		n/a; RBC in rundown condition
18	Mill Bay Centre	PE-8662	Mill Bay Village (Electoral Area A)	Malahat	Private	Schedule 1	1995	24	Has extra capacity but does not want more users - fear of contamination from tenants.	54	2.0	27	250	108	-	-	15	BOD_5 < 45 mg/L; TSS < 60 mg/L	Compliant with the MOE permit; however, the facility cannot not meet Class A effluent quality requirements	Holding tank, secondary RBC treatment, conventional ground disposal field (420 m total length); disposal field capacity 83 m^3/day (CVRD source)	Shopping Centre; water conservation measures in place		n/a
19	Shell Gas Station	PE-10549	Mill Bay Village (Electoral Area A)	Malahat	Private	Schedule 1				26	2.0	13	250	52	-	-		BOD_5 < 45 mg/L; TSS < 60 mg/L	Compliant with the MOE permit; however, the facility cannot not meet Class A effluent quality requirements	Series of septic tanks, grease trap (restaurant), secondary EAAS treatment, effluent filter, and mound ground disposal filed (955 m^2 total area)	Service station, convenience store, laundromat, and A&W restaurant		n/a; pre-treatment may be required for high strength liquid waste prior to connection to a municipal system
19	Shell Gas Station	PE-10549	Mill Bay Village (Electoral Area A)	Malahat	Private	Schedule 2				7	2.0	4	250	14	-	-		Typical car wash effluent after treatment in a septic tank with discharge to RIB	Compliant with the MOE permit; however, the facility cannot not meet Class A effluent quality requirements	Septic tank and infiltration basin (210 m^3 total capacity)	Car wash		n/a; effluent is not compatible with municipal wastewater
21	Frances Kelsey	PE-12302	Mill Bay Village (Electoral Area A)	Shawnigan Creek	SD 79	Schedule 1	1996	23		76	2.0	38	32	1,200	-	-	35 - 55	BOD_5 < 20 mg/L; TSS < 30 mg/L; FC < 2.2/100 mL (median), 14/100 mL (maximum);	Compliant with the MOE permit; however, the facility cannot not meet Class A effluent quality requirements	Septic tank, flow equalization, secondary EAAS treatment, constructed wetland with subsurface flow, chlorination, dechlorination, effluent storage tank, infiltration beds (240 m total length). Effluent used for seasonal play field irrigation.	1200-student secondary school; fewer students at school, operating below capacity		**Potential for EAAS treatment retrofit to MBR treatment and expansion of conventional ground disposal field capacity; potential for integration of a septage receiving station.**
22	Windsong	PE-12303	Mill Bay Village (Electoral Area A)	Malahat	Strata	Schedule 1	1997	22	Succession - would like CVRD to take over the system. Connection to Mill Springs possible.	38.2	2.0	19	250	76	2.7	28		BOD_5 < 45 mg/L (max.); TSS < 45 mg/L (max.) BOD_5 < 10 mg/L (median); TSS < 10 mg/L (median)	Compliant with the MOE permit; however, the facility cannot not meet Class A effluent quality requirements	STEP collection system; flow equalization, 7 secondary sewage treatment facilities, conventional ground disposal field (540 m total length)	28-lot residential subdivision		n/a; Strata would like CVRD to take over system and add to Mill Springs
24	Axys Group	RE-16685	Mill Bay Village (Electoral Area A)	Malahat / Shawnigan Creek	Private	Schedule 1				27.3	2.0	14	-	-	-	-	13	Class A - BOD_5 / TSS < 10/10 mg/L; FC < 2.2/100 mL (median), 14/100 mL (maximum); Nitrate < 10 mg/L; TN < 20 mg/L; Turbidity < 2 NTU (average), 5 NTU (maximum)		Septic tank c/w Biotube effluent filters, secondary treatment (Nibbler system) for high strength waste, recirculation textile filters (Advantex), UV disinfection, Infiltrator ground disposal field	Commercial development (Shopping Centre in Mill Bay) - Tim Hortons, McDonalds, Island Pharmacy, Telus, etc. at 19 and Deloume Road		n/a; pre-treatment may be required for high strength liquid waste prior to connection to a municipal system
25	Lilmac	RE-17396	Mill Bay Village (Electoral Area A)	Shawnigan Creek	Strata	Schedule 1			Succession - would like CVRD to take over the system.	51	4.0	13	250	51	2.8	18			The facility cannot not meet Class A effluent quality requirements; high I/I	STEP/STEG collection system; septic tanks, flow equalization, recirculating textile filters (Advantex), UV disinfection, conventional ground disposal field (274 m total length)	18-lot residential subdivision		n/a; would like CVRD to take over system
27	George Bonner Elementary	Island Health Certificate	Electoral Area A	Mill Bay	SD 79	n/a	2006	13	Satisfactory based on visual observation.	37.5	2.0	19	250	75	-	-	17		The facility cannot not meet Class A effluent quality requirements	Septic tanks, flow equalization, recirculating textile filters (Advantex), conventional ground disposal field. The system was declassified wrt the original permit.	School Sewage System		Disposal field may have additional capacity
28	Mill Bay Elementary (Nature School)	Island Health Certificate	Electoral Area A	Mill Bay	SD 79	n/a			Satisfactory based on visual observation.		2.0	0	250	0	-	-			The facility cannot not meet Class A effluent quality requirements	Septic tanks, flow equalization, secondary sewage treatment (Bionest), UV disinfection, conventional ground disposal field	School Sewage System		Disposal field may have additional capacity
29	Stonebridge (proposed development)	n/a	Mill Bay Village (Electoral Area A)	Shawnigan Creek	CVRD	Schedule 1	-	-	-									Class A - BOD_5 / TSS < 10/10 mg/L; FC < 2.2/100 mL (median), 14/100 mL (maximum); Nitrate < 10 mg/L; TN < 20 mg/L; Turbidity < 2 NTU (average), 5 NTU (maximum)	No operating facility yet	n/a; currently Pioneer Square and Cove Strata disposal fields on site	700 - 750 units upon buildout; opportunity for reclaimed water use		**Site has potential to host a new WWTP**
31	Green House (3210 Kilipi Rd)		Electoral Area A	Mill Bay	Private	Schedule 2			Bioswale is well established.	unknown; small flow								unknown	unknown	Bioswale treats overflow from the greenhouse with final discharge to downstream creek. Small composting operation is on site for unsold produce. Residential house is on septic.	Greenhouse operation		n/a
32	Malahat Auto Parts (Trans Canada Highway)		Electoral Area A	Malahat	Private	Schedule 2			No environmental discharge on site for waste liquids incompatible with residential sewage.	n/a								n/a	n/a	Oil, antifreeze, engine fluids, and propane stored in holding tanks on site for removal off site. Old batteries and tires are recycled. Office is on septic.			n/a
36	Moon Water Lodge, Malahat Mountain Inn, and Gas Station located across from Malahat Auto Parts on Trans Canada Highway	Island Health Certificate	Electoral Area A	Malahat	Private	n/a			Reportedly septic tank discharge.	< 22.7 m^3/d								Septic tank discharge	The facility cannot not meet Class A effluent quality requirements	Septic tanks			n/a
	Electoral Area B																						
1	Shawnigan Beach Estates	PE-05290	Shawnigan Lake Village (Electoral Area B)	Shawnigan Creek	CVRD	Schedule 1	2008	11	Major I/I issues. Odour issues (lagoon). No emergency storage. 50% in compliance. Aerated lagoon desludged in Dec 2015.	485	2.0	243	250	970	2.5	388	300 - 1000	Lagoon discharge - BOD_5 < 45 mg/L; TSS < 60 mg/L; nitrogen removal in beds; < 1 mg/L phosphorus after beds		Aerated and facultative lagoons, micro screen, UV disinfection, conventional ground disposal field to provide nitrogen removal (3,584 m + 2,250 m totaling 5,834 m); disposal capacity 573 m^3/day (CVRD source)	303-unit residential subdivision and a school, plus 29-lot Shawnigan Hills subdivision; currently 380 homes and 1 school	300 - 1,000	**Potential for lagoon retrofit to MBR treatment and conversion of conventional ground disposal field to RIBs for capacity increase; potential for integration of a septage receiving station. The retrofitted WWTP can serve Shawnigan Lake UCB.**
14	Shawnigan Lake School	PE-04320	Shawnigan Lake Village (Electoral Area B)	Shawnigan Creek	Private	Schedule 1	1996	23	Good condition.	182	2.0	91	200	455	-	-		BOD_5 < 45 mg/L; TSS < 60 mg/L	Compliant with the MOE permit; however, the facility cannot not meet Class A effluent quality requirements	Grease trap for the kitchen effluent, flow equalization, secondary RBC treatment, polishing post-filtration (drum micro filter), conventional ground disposal field (3,034 m total length)	Private residential school; up to 700 students and staff during school term		n/a
15	Wendeb (Northgate Mobile Home Park)	PE-04995	Electoral Area B	Shawnigan Creek	Private	Schedule 1				158	2.0	79	250	316	2.3	139		BOD_5 < 45 mg/L; TSS < 60 mg/L	Compliant with the MOE permit; however, the facility cannot not meet Class A effluent quality requirements	Secondary sewage treatment, effluent roughing filter, conventional ground disposal field (2,850 total length)	139-unit mobile home park (Manufactured Home Park) located at 1751 Northgate Rd.		n/a
17	Dwight International School	PE-07938	Electoral Area B	Shawnigan Creek	Private	Schedule 1				38.5	2.0	19	200	96	-	-		BOD_5 < 45 mg/L; TSS < 60 mg/L	Compliant with the MOE permit; however, the facility cannot not meet Class A effluent quality requirements	Holding tank, secondary RBC treatment, conventional ground disposal field (1,110 m total length)	Shawnigan Lake residential school		n/a; ground disposal field located on the hill
6	Arbutus Mountain Estates	PE-14798	Electoral Area B	Shawnigan Creek	CVRD	Schedule 1	2007	12	I/I issues in collection system. No emergency storage. Constant wasting required for plant operation. Heavy man-hours presence. Motor issues occasionally.	147	1.7	89	229	389	2.0	195	50 - 60	Class A - BOD_5 / TSS < 10/10 mg/L; FC < 2.2/100 mL (median), 14/100 mL (maximum); **TN < 10 mg/L**; Turbidity < 2 NTU (average), 5 NTU (maximum); TP < 0.5 mg/L (seasonal discharge from Nov 1 to Mar 31)	Standards met occasionally	Inlet fine screen, flow equalization, Corix GR-25-F EAAS treatment, polishing post-filtration, UV disinfection, odour control, conventional ground disposal field (4,174 m total length); **The condition of the wastewater treatment tankage (made of aluminum) deteriorated significantly.**	120-unit modular home park (original permit) plus additional 75 units totaling 195 units	50 - 60	**The WWTP may require a substantial retrofit due to the condition of the process tankage; low density area. The WWTP may accept flows from future residential developments located nearby.**
30	Elkington Forest		Electoral Area B		Private	Schedule 1																	
34	Merridale Cidery and Distillery		Electoral Area B		Private	Schedule 2																	

No.	System Name	Authorization Number	Location	Watershed	Owner	WDR Schedule	Year	Age	Condition	Permitted MDF	Est. Peak Flow Factor	Estimated ADWF	Wastewater Generation	Population	Home Occupancy	Est. no. of Home Equivalents	Average Capacity (Note 1)	Permitted Effluent Quality	Effluent Compliance with MOE Permit	Facility Type - Description	Comments	Current ADWFs (observed)	Expansion Potential
							Built	(years)		(m^3/day)	f	(m^3/day)	(L/capita/d)	(people)	(persons / home)	#	(m^3/day)					(m^3/day)	
35	Unsworth Vineyards		Electoral Area B		Private	Schedule 2																	n/a
	Electoral Area C																						
3	Arbutus Ridge	PE-7735	Electoral Area C	Mill Bay	CVRD	Schedule 1	1990	29	Old RBC treatment was retrofitted with MBR treatment in 2019. New seepage bed was constructed.	499	1.4	350	250	1,400	2.2	646	250 - 300	Class A - BOD_5 / TSS < 10/10 mg/L; FC < 2.2/100 mL (median), 14/100 mL (maximum); Nitrate < 10 mg/L; TN < 20 mg/L; Turbidity < 2 NTU (average), 5 NTU (maximum)	Facility upgraded in 2019 to MBR plant	Inlet fine screen, flow equalization, UF membrane treatment, UV disinfection, seepage bed (1,500 m^2 total infiltration area)	646-unit residential subdivision and golf course		The old RBC treatment was retrofitted with the MBR (UF) membrane treatment in 2019. MWR registration pending. Catchment area is defined and is not anticipated to increase.
4	Cobble Hill Village (Galliers Rd)	PE-11310	Cobble Hill Village (Electoral Area C)	Shawnigan Creek / Koksilah River	CVRD	Schedule 1	1995	24	Field has issues with break-out and settling. Plant nearing end of life cycle. Disposal fields require constant (daily) work for levelling.	95	2.0	48	230	207	2.5	84	40	n/a; original permit BOD_5 < 45 mg/L; TSS < 60 mg/L	n/a; RBC system rarely met BOD standard	STEP collection system (Cobble Hill sewer); the old RBC WWTP will be converted to a transfer pump station (incl. flow distribution box, trash tank, flow equalization) in 2019 for wastewater co-treatment at the Twin Cedars WWTP.	70-unit residential subdivision (permit); currently 84 homes (CVRD source); odour issues prior to installation of AC filter		The old RBC WWTP will be converted to a transfer pump station in 2019 for wastewater co-treatment at the Twin Cedars WWTP. The existing ground disposal field will be converted to RIBs to increase disposal capacity.
5	Maple Hills	PE-11630	Electoral Area C	Mill Bay	CVRD	Schedule 1	1995	24	I/I issues in collection system. Plant nearing end of life cycle. Odour issues alleviated with installation of AC filter. Plant nearing end of life cycle.	82	2.0	41	250	164	2.7	60	30	BOD_5 < 45 mg/L; TSS < 60 mg/L	Compliant with the MOE permit; however, the facility cannot not meet Class A effluent quality requirements	Flow equalization, RBC treatment, polishing post-filtration, odour control, conventional ground disposal field (1,646 m total length)	60-unit residential subdivision		The existing RBC WWTP is slated for conversion to a transfer pump station for wastewater co-treatment at the Twin Cedars WWTP. The existing ground disposal field will be abandoned.
9	Twin Cedars	RE-18284	Cobble Hill Village (Electoral Area C)	Shawnigan Creek	CVRD	Schedule 1	2007	12	Membranes replaced in 2019.	187	4.0	47	250	187	2.4	80	40	Class A - BOD_5 / TSS < 10/10 mg/L; FC < 2.2/100 mL (median), 14/100 mL (maximum); Nitrate < 10 mg/L; TN < 20 mg/L; Turbidity < 2 NTU (average), 5 NTU (maximum)	Effluent standards usually achieved; RIB disposal/irrigation re-use at Quarry Nature Park with planned expansion to Cobble Hill Commons Park	Inlet fine screening, flow equalization, Sanitherm UF Membrane Bioreactor with UV disinfection; effluent discharge to RIBs with seasonal reclaimed water use.	80-home single-family residential subdivision; currently 75 homes (CVRD source); occasional odour issues		In 2019, the facility will be expanded with the addition of the Cobble Hill catchment area initially and the Maple Hills catchment in the future. In addition to seasonal reclaimed water use, treated effluent will be discharged to both Twin Cedars and Galliers Rd RIBs. The retrofitted WWTP can serve Cobble Hill UCB.
20	C.A. homes - no development	PE-11581	Cobble Hill Village (Electoral Area C)	Shawnigan Creek	Private	Schedule 1			Land developed ?	98	2.0	49	250	196	2.5	78		BOD_5 < 45 mg/L; TSS < 60 mg/L	Compliant with the MOE permit; however, the facility cannot not meet Class A effluent quality requirements	Secondary sewage treatment plant and conventional ground disposal field (1,022 m total length)	Residential subdivision (Hutchinson Rd , Cobble Hill)		n/a
23	Cobblestone Inn	RE-16580	Cobble Hill Village (Electoral Area C)	Shawnigan Creek	Private	n/a			n/a; Connected to Twin Cedars WWTP		2.0	0	-	-	-	-		n/a; Connected to Twin Cedars WWTP	n/a; Connected to Twin Cedars WWTP	n/a; Connected to Twin Cedars WWTP	Restaurant, pub, and retail development		n/a; Connected to Twin Cedars WWTP
26	Ecole Cobble Hill Elementary	Island Health Certificate	Cobble Hill Village (Electoral Area C)	Koksilah River / Mill Bay (mostly outside plan area)	SD 79	n/a	2000	19	Satisfactory based on visual observation.		2.0	0	250	0	-	-			The facility cannot not meet Class A effluent quality requirements	Septic tanks, flow equalization, recirculating textile filters (Advantex), conventional ground disposal field	School Sewage System		n/a
33	Chevron Hatch Point Terminal		Electoral Area C	Mill Bay	Private	Schedule 2																	n/a
37																							
38																							
	Total									4,356		2,139		10,032		3,127							

Notes:

BOD - Biochemical Oxygen Demand	FC - Fecal Coliforms	RIB - Rapid Infiltration Basin	USBF - Upflow Sludge Blanket Filtration	WWTP - Wastewater Treatment Plant	UV - Ultra Violet	Note 1 - CVRD, Urban Systems source and data compiled from various sources
TSS - Total Suspended Solids	CFU - Colony Forming Units	RBC - Rotating Biological Contactor	MBR - Membrane	MDF - Maximum Day Flow	UF - Ultra Filtration	UCB - Urban Containment Boundary
TN - Total Nitrogen	NTU - Nephelometric Turbidity Units	RSF - Recirculating Sand Filter	MOE - Ministry of Environment	ADWF - Average Dry Weather Flow	WWTP - Wastewater Treatment Plant	
TP - Total Phosphorus	WDR - Waste Discharge Regulation	EAAS - Extended Aeration Activated Sludge	OCP - Official Community Plan	f - MDF/ADWF Ratio		

Appendix D – Wastewater Servicing Options

				OPTION COMPONENTS				
Option Ref. #	**Electoral Area**	**Watershed**	**Catchment Area**	**Collection System**	**WWTP Site**	**Effluent Discharge**	**Owner**	**Comments**
	Electoral Area A							
A-OP1	Electoral Area "A"	Shawnigan Creek / Mill Bay	Mill Bay UCB (mix of residential, commercial, and institutional users)	Combination of gravity, pressurized, STEP and STEG systems	Mill Bay (Stonebridge property adjacent to Bayview Centre)	RIBs at Mill Springs site; reclaimed water use possible	CVRD	New WWTP construction; EIS will be required
A-OP2	Electoral Area "A"	Shawnigan Creek / Malahat	Mill Bay UCB (mix of residential, commercial, and institutional users)	Combination of gravity, pressurized, STEP and STEG systems	Mill Springs WWTP	RIBs at Mill Springs site; reclaimed water use possible	CVRD	Retrofit of the existing Mill Springs WWTP; EIS underway
A-OP3A	Electoral Area "A"	Shawnigan Creek / Mill Bay	Mill Bay UCB (mix of residential, commercial, and institutional users)	Combination of gravity, pressurized, STEP and STEG systems	Pioneer Square	RIBs at Mill Springs site; reclaimed water use possible	CVRD	New WWTP construction; Option assumes that effluent discharge onto the Stonebridge property will not be allowed.
A-OP3B	Electoral Area "A"	Shawnigan Creek / Mill Bay	Mill Bay UCB (mix of residential, commercial, and institutional users)	Combination of gravity, pressurized, STEP and STEG systems	Pioneer Square	Frances Kelsey School ground discharge; reclaimed water use possible	CVRD	New WWTP construction; Option assumes that effluent discharge onto the Stonebridge property will not be allowed.
A-OP4A	Electoral Area "A"	Shawnigan Creek	Mill Bay UCB (mix of residential, commercial, and institutional users)	Combination of gravity, pressurized, STEP and STEG systems	Frances Kelsey School WWTP	Frances Kelsey School ground discharge; reclaimed water use possible	Private or Private/Public Partnership	New WWTP construction; the WWTP location may be suitable for integration of a septage receiving facility into the WWTP process; EIS will be required
A-OP4B	Electoral Area "A"	Shawnigan Creek	Mill Bay UCB (mix of residential, commercial, and institutional users)	Combination of gravity, pressurized, STEP and STEG systems	Frances Kelsey School WWTP (extra capacity available)	Frances Kelsey School ground discharge; reclaimed water use possible	Private or Private/Public Partnership	New WWTP construction or retrofit/expansion of the existing school WWTP; this option is limited to Brulette Pl, Taggart, Hayden Pl, portion of Kerry Village, Garnett, and Pioneer Square; the WWTP location may be suitable for integration of a septage receiving facility into the WWTP process; EIS will be required
A-OP5	Electoral Area "A"	Shawnigan Creek / Malahat Benchland	Sentinel Ridge Development	Combination of gravity and pressurized collectors	Sentinel Ridge WWTP	Sentinel Ridge RIBs (existing and future)	CVRD	Stand-alone WWTP; Potential for UF membrane treatment expansion and existing RIB capacity increase (uprating) subject to RIB capacity verification.
A-OP6	Electoral Area "A"	Shawnigan Creek / Malahat Benchland	Mill Bay UCB (mix of residential, commercial, and institutional users) and Malahat Nation reserve and Malahat Nation developed lands	Combination of gravity, pressurized, STEP and STEG systems	Mill Springs WWTP	RIBs at Mill Springs site; reclaimed water use possible	CVRD	Retrofit of the existing Mill Springs WWTP; EIS underway
A-OP7A	Electoral Areas" A" and "B"	Shawnigan Creek	Mill Bay UCB + Shawnigan Creek UCB merged to form a continuous corridor	Combination of gravity and pressurized collectors for inter electoral area wastewater transfer, including STEP and STEG systems within UCBs	Pioneer Square	RIBs at Mill Springs site; reclaimed water use possible	CVRD	Stand-alone WWTP - new WWTP construction; EIS will be required
A-OP7B	Electoral Areas" A" and "B"	Shawnigan Creek	Mill Bay UCB + Shawnigan Creek UCB merged to form a continuous corridor	Combination of gravity and pressurized collectors for inter electoral area wastewater transfer, including STEP and STEG systems within UCBs	Mill Bay (Stonebridge property adjacent to Bayview Centre)	RIBs at Mill Springs site; reclaimed water use possible	CVRD	Stand-alone WWTP - new WWTP construction; EIS will be required
A-OP7C	Electoral Areas" A" and "B"	Shawnigan Creek	Mill Bay UCB + Shawnigan Creek UCB merged to form a continuous corridor	Combination of gravity and pressurized collectors for inter electoral area wastewater transfer, including STEP and STEG systems within UCBs	Mill Springs WWTP	RIBs at Mill Springs site; reclaimed water use possible	CVRD	Retrofit of the existing Mill Springs WWTP; EIS underway
A-OP8A	Electoral Areas" A" and "B"	Shawnigan Creek	Mill Bay UCB + Shawnigan Creek UCB + corridor in between UCBs + around the lake	Combination of gravity and pressurized collectors for inter electoral area wastewater transfer, including STEP and STEG systems within UCBs	Pioneer Square	RIBs at Mill Springs site; reclaimed water use possible	CVRD	Stand-alone WWTP - new WWTP construction; EIS will be required
A-OP8B	Electoral Areas" A" and "B"	Shawnigan Creek	Mill Bay UCB + Shawnigan Creek UCB + corridor in between UCBs + around the lake	Combination of gravity and pressurized collectors for inter electoral area wastewater transfer, including STEP and STEG systems within UCBs	Mill Bay (Stonebridge property adjacent to Bayview Centre)	RIBs at Mill Springs site; reclaimed water use possible	CVRD	Stand-alone WWTP - new WWTP construction; EIS will be required
A-OP8C	Electoral Areas" A" and "B"	Shawnigan Creek	Mill Bay UCB + Shawnigan Creek UCB + corridor in between UCBs + around the lake	Combination of gravity and pressurized collectors for inter electoral area wastewater transfer, including STEP and STEG systems within UCBs	Mill Springs WWTP	RIBs at Mill Springs site; reclaimed water use possible	CVRD	Retrofit of the existing Mill Springs WWTP; EIS underway

				OPTION COMPONENTS				
Option Ref. #	**Electoral Area**	**Watershed**	**Catchment Area**	**Collection System**	**WWTP Site**	**Effluent Discharge**	**Owner**	**Comments**
	Electoral Area B							
B-OP1A	Electoral Area "B"	Shawnigan Creek	Shawnigan Beach Estates Sewer (SBES) and Shawnigan Lake Village	Combination of gravity, pressurized, STEP and STEG systems, as applicable	SBES Lagoon Site	RIBs at SBES discharge site (potentially combined with Shawnigan Lake school); the site is currently outside the UCB but can be annexed; reclaimed water use possible	CVRD	Retrofit of the existing SBES WWTP; the WWTP location may be suitable for integration of a septage receiving facility into the WWTP process; EIS will be required
B-OP1B	Electoral Area "B"	Shawnigan Creek	Shawnigan Beach Estates Sewer (SBES) and Shawnigan Lake Village; potentially, septic collector running along the eastern/northern boundary (i.e., higher population density areas) of Shawnigan Lake	Combination of gravity, pressurized, STEP and STEG systems, as applicable	SBES Lagoon Site	RIBs at SBES discharge site (potentially combined with Shawnigan Lake school); the site is currently outside the UCB but can be annexed; reclaimed water use possible	CVRD	Retrofit of the existing SBES WWTP; the WWTP location may be suitable for integration of a septage receiving facility into the WWTP process; EIS will be required
B-OP1C	Electoral Area "B"	Shawnigan Creek	Shawnigan Beach Estates Sewer (SBES) and Shawnigan Lake Village; potentially, septic collector running around Shawnigan Lake	Combination of gravity, pressurized, STEP and STEG systems, as applicable	SBES Lagoon Site	RIBs at SBES discharge site (potentially combined with Shawnigan Lake school); the site is currently outside the UCB but can be annexed; reclaimed water use possible	CVRD	Retrofit of the existing SBES WWTP; the WWTP location may be suitable for integration of a septage receiving facility into the WWTP process; EIS will be required
B-OP2A	Electoral Area "B"	Shawnigan Creek	Shawnigan Lake Village UCB - Shawnigan Lake Village	Combination of gravity, pressurized, STEP and STEG systems, as applicable	New site close to Shawnigan Lake Village (OCP reference); the site is currently outside the UCB but can be annexed	RIBs at SBES discharge site (potentially combined with Shawnigan Lake school); the site is currently outside the UCB but can be annexed; reclaimed water use possible. The new site close to Shawnigan Lake Village (OCP reference) may not be sufficient to accommodate the entire flow, i.e., no effluent discharge potential for regional solution.	CVRD	New Shawnigan Lake Village WWTP construction; the WWTP location may be suitable for integration of a septage receiving facility into the WWTP process; EIS will be required
B-OP2B	Electoral Area "B"	Shawnigan Creek	Shawnigan Lake Village UCB - Shawnigan Lake Village; potentially, septic collector running along the eastern/northern boundary (i.e., higher population density areas) of Shawnigan Lake	Combination of gravity, pressurized, STEP and STEG systems, as applicable	New site close to Shawnigan Lake Village (OCP reference); the site is currently outside the UCB but can be annexed	RIBs at SBES discharge site (potentially combined with Shawnigan Lake school); the site is currently outside the UCB but can be annexed; reclaimed water use possible. The new site close to Shawnigan Lake Village (OCP reference) may not be sufficient to accommodate the entire flow, i.e., no effluent discharge potential for regional solution.	CVRD	New Shawnigan Lake Village WWTP construction; the WWTP location may be suitable for integration of a septage receiving facility into the WWTP process; EIS will be required
B-OP2C	Electoral Area "B"	Shawnigan Creek	Shawnigan Lake Village UCB - Shawnigan Lake Village; potentially, septic collector running around of Shawnigan Lake	Combination of gravity, pressurized, STEP and STEG systems, as applicable	New site close to Shawnigan Lake Village (OCP reference); the site is currently outside the UCB but can be annexed	RIBs at SBES discharge site (potentially combined with Shawnigan Lake school); the site is currently outside the UCB but can be annexed; reclaimed water use possible. The new site close to Shawnigan Lake Village (OCP reference) may not be sufficient to accommodate the entire flow, i.e., no effluent discharge potential for regional solution.	CVRD	New Shawnigan Lake Village WWTP construction; the WWTP location may be suitable for integration of a septage receiving facility into the WWTP process; EIS will be required
B-OP3	Electoral Area "B"	Shawnigan Creek	Arbutus Mountain	Combination of gravity and pressurized collectors; the WWTP may accept flows from future residential developments located nearby.	Arbutus Mountain WWTP	Arbutus Mountain ground discharge	CVRD	Status quo proposed; stand-alone WWTP
B-OP4	Electoral Area "B"	Shawnigan Creek	Elkington Forest (as an example of a private system)	Combination of gravity and pressurized collectors	Elkington Forest	Elkington Forest ground discharge	Private	Status quo proposed; stand-alone WWTP(s); the same status being proposed for other similar private systems outside UCBs, specifically located on the fringes of the electoral areas and away from UCBs
B-OP5A	Electoral Areas "B" and "C"	Shawnigan Creek	Shawnigan Lake Village UCB + Cobble Hill UCB + corridor in between UCBs	Combination of gravity and pressurized collectors for inter electoral area wastewater transfer, including STEP and STEG systems within UCBs	SBES Lagoon Site	RIBs at SBES discharge site (potentially combined with Shawnigan Lake school); the site is currently outside the UCB but can be annexed; reclaimed water use possible	CVRD	Retrofit of the existing SBES WWTP; the WWTP location may be suitable for integration of a septage receiving facility into the WWTP process; EIS will be required

Option Ref. #	Electoral Area	Watershed	Catchment Area	OPTION COMPONENTS: Collection System	OPTION COMPONENTS: WWTP Site	OPTION COMPONENTS: Effluent Discharge	Owner	Comments
B-OP5B	Electoral Areas "B" and "C"	Shawnigan Creek	Shawnigan Lake Village UCB + Cobble Hill UCB + corridor in between UCBs	Combination of gravity and pressurized collectors for inter electoral area wastewater transfer, including STEP and STEG systems within UCBs	New site close to Shawnigan Lake Village (OCP reference); the site is currently outside the UCB but can be annexed	RIBs at SBES discharge site (potentially combined with Shawnigan Lake school); the site is currently outside the UCB but can be annexed; reclaimed water use possible. The new site close to Shawnigan Lake Village (OCP reference) may not be sufficient to accommodate the entire flow, i.e., no effluent discharge potential for regional solution.	CVRD	New Shawnigan Lake Village WWTP construction; the WWTP location may be suitable for integration of a septage receiving facility into the WWTP process; EIS will be required
B-OP6A	Electoral Areas "B" and "C"	Shawnigan Creek	Shawnigan Lake Village UCB + Cobble Hill UCB + corridor in between UCBs + around the entire Lake	Combination of gravity and pressurized collectors for inter electoral area wastewater transfer, including STEP and STEG systems within UCBs	SBES Lagoon Site	RIBs at SBES discharge site (potentially combined with Shawnigan Lake school); the site is currently outside the UCB but can be annexed; reclaimed water use possible	CVRD	Retrofit of the existing SBES WWTP; the WWTP location may be suitable for integration of a septage receiving facility into the WWTP process; EIS will be required
B-OP6B	Electoral Areas "B" and "C"	Shawnigan Creek	Shawnigan Lake Village UCB + Cobble Hill UCB + corridor in between UCBs + around the entire Lake	Combination of gravity and pressurized collectors for inter electoral area wastewater transfer, including STEP and STEG systems within UCBs	New site close to Shawnigan Lake Village (OCP reference); the site is currently outside the UCB but can be annexed	RIBs at SBES discharge site (potentially combined with Shawnigan Lake school); the site is currently outside the UCB but can be annexed; reclaimed water use possible. The new site close to Shawnigan Lake Village (OCP reference) may not be sufficient to accommodate the entire flow, i.e., no effluent discharge potential for regional solution.	CVRD	New Shawnigan Lake Village WWTP construction; the WWTP location may be suitable for integration of a septage receiving facility into the WWTP process; EIS will be required
	Electoral Area C							
C-OP1	Electoral Area "C"	Shawnigan Creek	Cobble Hill UCB - Twin Cedars, Cobble Hill (Galliers Rd), Maple Hills, and potential users located between the Maple Hills, Galliers Rd, and Twin Cedars residential developments	Combination of gravity, pressurized, and STEP systems	Twin Cedars WWTP	Twin Cedars and Galliers Rd RIBs; reclaimed water use possible	CVRD	Retrofit of the existing Twin Cedars WWTP; EIS underway
C-OP2	Electoral Area "C"	Mill Bay	Arbutus Ridge gated community (catchment area will not further expand)	Combination of gravity and pressurized collectors	Arbutus Ridge WWTP	Seepage Bed at Arbutus Ridge; reclaimed water use possible	CVRD	Retrofit of the existing Arbutus Ridge WWTP; Status quo; EIS not required, facility derated
C-OP3A	Electoral Area "C"	Satellite Channel	Arbutus Ridge gated community and Pauquachin Hatch Point Reserve	Combination of gravity and pressurized collectors	Arbutus Ridge WWTP	Seepage Bed at Arbutus Ridge; reclaimed water use possible	CVRD	Retrofit of the existing Arbutus Ridge WWTP; facility derated; connection to a retrofitted Arbutus Ridge WWTP - the WWTP may be able to receive limited additional flows (e.g., initial phase of Pauquachin development); new MWR registration may be required
C-OP3B	Electoral Area "C"	Satellite Channel	Arbutus Ridge gated community and Pauquachin Hatch Point Reserve	Combination of gravity and pressurized collectors	Arbutus Ridge WWTP (new facility)	New disposal site (TBD)	CVRD	Stand-alone WWTP - new WWTP construction and disposal site will be required; EIS will be required

Notes:

WWTP - Wastewater Treatment Plant	SBES - Shawnigan Beach Estates Sewer	CVRD - Cowichan Valley Regional District	UF - Ultrafiltration
STEP - Septic Tank Effluent Pump	UCB - Urban Containment Boundary	A-OP3 - Electoral area A, Option 3	TBD - to be determined
STEG - Septic Tank Effluent Gravity	RIBs - Rapid Infiltration Basins	EIS - Environmental Impact Study	

N

East Patrolas Indian Reserve No. 4

Cobble Hill Options - Phase I (2020 - 2040)

Catchment Areas (Colour Coding)						Option (Ref #)	Collection System
Urban Containment Boundary (UCB)	Existing Sewer & Water services, Outside UCB	Corridor	Shawnigan Lake - East	Shawnigan Lake - West	First Nations Reserve		
						C-1	Cobble Hill UCB + Maple Hills
						C-2	Arbutus Ridge
						C-3A	Arbutus Ridge + Pauquachin FN
						C-3B	Arbutus Ridge + Pauquachin FN

COBBLE HILL U.C.B.

COBBLE HILL

WWTP

D

PS

ARBUTUS RIDGE

SEWER CONNECTION OPTIONS BEING EVALUATED

Hatch Point Indian Reserve No. 12

SHAWNIGAN BEACH ESTATES SYSTEM

SHAWNIGAN LAKE U.C.B.

SHAWNIGAN VILLAGE

FRANCES KELSEY

PIONEER SQUARE

MILL BAY

MILL SPRINGS

SENTINEL RIDGE

MILL BAY U.C.B.

MILL BAY

Shawnigan Lake

SEWER CONNECTION OPTIONS BEING EVALUATED

Malahat Indian Reserve No. 11

Shawnigan Lake Options - Phase I (2020 - 2040)

Catchment Areas (Colour Coding)						Option (Ref #)	Collection System
Urban Containment Boundary (UCB)	Existing Sewer & Water services, Outside UCB	Corridor	Shawnigan Lake - East	Shawnigan Lake - West	First Nations Reserve		
						B-1A	Shawnigan Village UCB
						B-1B	Shawnigan Village UCB + Eastern Lake Boundary
						B-1C	Shawnigan Village UCB + Lake Perimeter
						B-2A	Shawnigan Village UCB
						B-2B	Shawnigan Village UCB + Eastern Lake Boundary
						B-2C	Shawnigan Village UCB + Lake Perimeter
						B-3	Arbutus Mountain
						B-4	Elkington Forest

Shawnigan Lake & Cobble Hill Partnership Options - Phase II (2040 - 2050)

						B-5A	Shawnigan Village UCB + Cobble Hill UCB + Corridor
						B-5B	Shawnigan Village UCB + Cobble Hill UCB + Corridor
						B-6A	Shawnigan Village UCB + Cobble Hill UCB + Corridor + Lake Perimeter
						B-6B	Shawnigan Village UCB + Cobble Hill UCB + Corridor + Lake Perimeter

Mill Bay Options - Phases I and II (2020 - 2050)

Catchment Areas (Colour Coding)						Option (Ref #)	Collection System
Urban Containment Boundary (UCB)	Existing Sewer & Water services, Outside UCB	Corridor	Shawnigan Lake - East	Shawnigan Lake - West	First Nations Reserve		
						A-1	Mill Bay UCB
						A-2	Mill Bay UCB
						A-3A	Mill Bay UCB
						A-3B	Mill Bay UCB
						A-4A	Mill Bay UCB
						A-4B	Mill Bay UCB (Limited Coverage)
						A-5	Sentinel Ridge
						A-6	Mill Bay UCB + Malahat FN

Mill Bay & Shawnigan Lake Partnership Options - Phase II (2040 - 2050)

						A-7A	Mill Bay UCB + Shawnigan Village UCB + Corridor
						A-7B	Mill Bay UCB + Shawnigan Village UCB + Corridor
						A-7C	Mill Bay UCB + Shawnigan Village UCB + Corridor
						A-8A	Mill Bay UCB + Shawnigan Village UCB + Corridor + Lake Perimeter
						A-8B	Mill Bay UCB + Shawnigan Village UCB + Corridor + Lake Perimeter
						A-8C	Mill Bay UCB + Shawnigan Village UCB + Corridor + Lake Perimeter

ARBUTUS MOUNTAIN

ELKINGTON FOREST

Sooke Lake

LEGEND

Proposed Sanitary Facility Type
- Discharge Site
- Location of Interest for Discharge Expansion
- Lift Station
- Waste Water Treatment Plant
- Sanitary Main

Transportation
- Ferry
- Highway
- Arterial
- Collector
- Lane
- Local
- Resource
- Restricted
- Service
- Strata
- Unclassified
- Railways

Water Body
- Watershed Boundary
- Lakes
- Streams and Rivers

Areas
- Urban Containment Boundary
- Existing Sewer & Water Services, Outside UCB
- First Nation Reserve
- Corridor
- Shawnigan Lake - East
- Shawnigan Lake - West
- CVRD Urban Containment Boundary

CVRD

SOUTH COWICHAN LIQUID WASTE MANAGEMENT PLAN
COMMUNITY SEWER OPTIONS FOR FULL BUILDOUT TO 2050

McElhanney

Appendix E – Results of Option Assessment

			PHASE I										COMPLEMENTARY OPTION						PHASE II															
		Collection	Mill Bay UCB		Mill Bay UCB		Mill Bay UCB		Mill Bay UCB		Mill Bay UCB		Mill Bay UCB (Limited Coverage)		Sentinel Ridge		Mill Bay UCB + Malahat FN		**Mill Bay UCB + Shawnigan Village UCB + Corridor**		Mill Bay UCB + Shawnigan Village UCB + Corridor		Mill Bay UCB + Shawnigan Village UCB + Corridor		Mill Bay UCB + Shawnigan Village UCB + Corridor + Lake Perimeter		Mill Bay UCB + Shawnigan Village UCB + Corridor + Lake Perimeter		Mill Bay UCB + Shawnigan Village UCB + Corridor + Lake Perimeter			
		Treatment	Mill Bay WWTP		Mill Springs		Pioneer Square		Pioneer Square		Frances Kelsey School (Septage)		Frances Kelsey School (Septage)		Sentinel Ridge		Mill Springs		Pioneer Square		Mill Bay		Mill Springs		Pioneer Square		Mill Bay		Mill Springs			"Septage" means the WWTP site is suitable for co-treatment of septage with sewage.
		Effluent Discharge	Mill Springs		Mill Springs		Mill Springs		Frances Kelsey School		Frances Kelsey School		Frances Kelsey School		Sentinel Ridge		Mill Springs		Mill Springs		Mill Springs		Mill Springs		Mill Springs		Mill Springs		Mill Springs			
Score																																		
Ref. #	**Weighting Factor (x10%)**	**Evaluation Criteria**	**A-OP1 Score**	**A-OP1 Weighted Score**	**A-OP2 Score**	**A-OP2 Weighted Score**	**A-OP3A Score**	**A-OP3A Weighted Score**	**A-OP3B Score**	**A-OP3B Weighted Score**	**A-OP4A Score**	**A-OP4A Weighted Score**	**A-OP4B Score**	**A-OP4B Weighted Score**	**A-OP5 Score**	**A-OP5 Weighted Score**	**A-OP6 Score**	**A-OP6 Weighted Score**	**A-OP7A Score**	**A-OP7A Weighted Score**	**A-OP7B Score**	**A-OP7B Weighted Score**	**A-OP7C Score**	**A-OP7C Weighted Score**	**A-OP8A Score**	**A-OP8A Weighted Score**	**A-OP8B Score**	**A-OP8B Weighted Score**	**A-OP8C Score**	**A-OP8C Weighted Score**	**Comments (factors to consider in the evaluation process)**	**Additional Clarifications**
Financial Category		Max. 100 points (27% of total)		**95**		**100**		**95**		**90**		**90**		**25**		**25**		**85**		**75**		**75**		**80**		**60**		**60**		**60**		
F1	5	Capital cost	9	45	10	50	9	45	8	40	8	40	2	10	2	10	7	35	6	30	6	30	7	35	4	20	4	20	4	20	Construction cost to consider new infrastructure vs. upgrade of the existing infrastructure (e.g., new WWTP vs. existing WWTP upgrade); may require and will consider phased approach to match population projections	of importance to capital funding/investments related to federal and provincial funding, grants, or other funding sources for alignment with service areas and public/private financial participation/contributions - important for infrastructure planning purposes
		Collection System (Excl. Lift Stations)	GM, FM, STEP	$2,600,000	GM, FM, STEP	$2,600,000	GM, FM, STEP	$2,600,000	GM, FM, STEP	$3,100,000	GM, FM, STEP	$3,100,000	Limited Coverage	$500,000	Limited Coverage	$0	GM, FM, STEP	$7,300,000	GM, FM, STEP	$7,100,000	GM, FM, STEP	$7,100,000	GM, FM, STEP	$7,100,000	GM, FM, STEP	$21,300,000	GM, FM, STEP	$21,300,000	GM, FM, STEP	$21,300,000	Differentiators: collector lengths and diameters, and difficulties of construction	
		Lift Stations	6 Lift Stations	$3,000,000	5 Lift Stations	$2,500,000	6 Lift Stations	$3,000,000	6 Lift Stations	$3,000,000	6 Lift Stations	$3,000,000	1 Lift Station	$500,000	-	$0	6 Lift Stations	$3,000,000	7 Lift Stations	$3,500,000	7 Lift Stations	$3,500,000	6 Lift Stations	$3,000,000	7 Lift Stations	$3,500,000	7 Lift Stations	$3,500,000	6 Lift Stations	$3,000,000	Brulette, Stonebridge, Handy Rd, Lilmac, Kerry Village, (Mill Springs), Malahat, Shawnigan Village	STEP system assumed around Shawnigan Lake
		WWTP	New, in flood plain	$8,100,000	Retrofit	$6,100,000	New	$7,600,000	New	$7,600,000	New	$7,600,000	Limited Coverage (Use Extra Capacity)	$0	Existing + Expansion	$2,000,000	Retrofit	$6,100,000	New	$10,100,000	New	$9,600,000	Retrofit	$8,100,000	New	$12,100,000	New	$11,600,000	Retrofit	$10,100,000		"Septage" means the WWTP site is suitable for co-treatment of septage with sewage. The costs are exclusive of cost adders to accommodate septage treatment, otherwise the comparison would be meaningless. Differentiators: WWTP location, difficulties of construction, and retrofit vs. new construction
		Effluent Discharge	Existing + Expansion	$600,000	Existing + Expansion	$600,000	Existing + Expansion	$600,000	Existing + Expansion	$1,200,000	Existing + Expansion	$1,200,000	Existing	$0	Existing + Expansion	$350,000	Existing + Expansion	$600,000	Further Incremental Expansion	$1,200,000	Further Incremental Expansion	$1,200,000	Further Incremental Expansion	$1,200,000	Further Incremental Expansion	$1,500,000	Further Incremental Expansion	$1,500,000	Further Incremental Expansion	$1,500,000	Mill Bay and Sentinel Ridge - RIBs; Frances Kelsey - conventional (trench type) DF	
		Total	-	$14,300,000	-	$11,800,000	-	$13,800,000	-	$14,900,000	-	$14,900,000	-	$1,000,000	-	$2,350,000	-	$17,000,000	-	$21,900,000	-	$21,400,000	-	$19,400,000	-	$38,400,000	-	$37,900,000	-	$35,900,000		
F2	5	O&M Cost	10	50	10	50	10	50	10	50	10	50	3	15	3	15	10	50	9	45	9	45	9	45	8	40	8	40	8	40	Has an impact on annual O&M budgets and ongoing operations, e.g., impact of integration/amalgamation of existing WWTPs on O&M efforts/costs vs. new facilities	of importance for setting realistic annual O&M budgets for infrastructure maintenance, servicing, repairs, ongoing operations, etc. - important for planning ongoing infrastructure O&M operations
		Collection System	GM, FM, STEP	Reference	GM, FM, STEP	Reference	GM, FM, STEP	Reference	GM, FM, STEP	Reference	GM, FM, STEP	Reference	Limited Coverage	Lower	Limited Coverage	Lower	GM, FM, STEP	Reference	GM, FM, STEP	Higher	GM, FM, STEP	Higher	GM, FM, STEP	Higher	GM, FM, STEP	Higher	GM, FM, STEP	Higher	GM, FM, STEP	Higher		GM, FM, STEP along corridors and around Shawnigan Lake; Mill Bay UCB is used for reference
		WWTP	Estimated	$200,000	CVRD Budget	$200,000	Estimated	$200,000	Estimated	$200,000	Estimated	$200,000	Limited Coverage	Lower	Limited Coverage CVRD Budget	$170,000	Estimated	$200,000	Estimated	$250,000	Estimated	$250,000	Estimated	$250,000	Estimated	$300,000	Estimated	$300,000	Estimated	$300,000		2020 CVRD budgets for Mill Springs and Sentinel Ridge WWTPs includes salaries, benefits, O&M, allocations
		Effluent Discharge		Reference		Reference		Reference		Reference		Reference	Limited Coverage	Lower	Limited Coverage	Lower		Reference		Higher		Higher		Higher		Higher		Higher		Higher			Discharge at Mill Springs is used for reference
Technical Category		Max. 100 points (27% of total)		**90**		**95**		**92**		**92**		**92**		**75**		**75**		**92**		**82**		**83**		**83**		**75**		**76**		**76**		
T1	2	Technical advantages and disadvantages	8.2	16.4	8.4	16.9	8.1	16.1	7.9	15.8	8.1	16.2	5.6	11.1	5.3	10.6	8.5	17.1	8.2	16.5	8.4	16.8	8.5	17.0	8.6	17.3	8.8	17.6	8.8	17.5	Options to consider (a) capacity requirements and level of service required to meet service demand, (b) collection system alignments to maximize service areas and improve the overall quality/reliability of service, (c) level (extent) of utilization/reuse of the existing wastewater systems/infrastructure that affects the infrastructure feasibility/suitability for incremental expansion and long-term future use, (d) IRM opportunities, e.g., energy/water conservation, heat recovery, an opportunity for a district heating system, sludge processing and conversion to biosolids/compost, reclaimed effluent sales (e.g., agricultural operations, park/ball field irrigation), etc., (e) ability of system to mitigate environmental impacts, and (f) management complexity of system	e.g., configuration requirements (e.g., size, footprint, volume, layout - depending on the system component), reuse potential or continued use of the existing infrastructure vs. building new infrastructure, potential to increase service areas and/or population densities due to infrastructure improvements and/or layouts, etc. Assumes sub-components have the same weighting.
		Capacity Requirements	10		10		10		10		10		2		2		10		10	Assumes DF can handle total flow, if not No Go	10	Assumes DF can handle total flow, if not No Go	10	Assumes DF can handle total flow, if not No Go	10	Assumes DF can handle total flow, if not No Go	10	Assumes DF can handle total flow, if not No Go	10	Assumes DF can handle total flow, if not No Go	Capacity requirements and level of service required to meet service demand	Permitted Mill Springs DF discharge capacity = 565 m^3/day; Preliminary estimates indicate the max. DF discharge capacity is 4,800 m^3/day; potentially more capacity is available, but additional land acquisition is required; Mill Springs WWTP can be incrementally expanded to serve over 10,000 people (requires DF capacity of 5,000 m^3/d) - requires additional land acquisition from Island Timberlands Optimistic population projections predict max. 5,213 people (Mill Bay UCB) and 9,628 people (Mill Bay + Shawnigan Lake UCBs, excl. area around the lake) in Yr 2038;
		Collection System Alignments	7		7		7		7		7		2		2		7.5		8		8		8		10		10		10		Collection system alignments to maximize service areas and improve the overall quality/reliability of service	
		Utilization of Existing Infrastructure	4.3		7.7		4.3		3.5		3.5		9.3		7.7		7.7		3.4		3.4		5.9		2.8		2.8		4.5		Extent of utilization/reuse of the existing wastewater infrastructure in the overall solution that affects the infrastructure feasibility/suitability for incremental expansion and long-term future use	Assumes sub-components have the same weighting
		Collection (x 10%)	8		8		8		8		8		8		8		8		7		7		7		6		6		6		Extent of utilization/reuse of the existing collection infrastructure in the overall solution that affects the infrastructure feasibility/suitability for incremental expansion and long-term future use	Score x10% indicates percentage of usage in the overall solution.
		Treatment (x 10%)	0		10	Technology conversion	0		0		0		10		10		10	Technology conversion	0		0		7.5	Assumes incremental capacity increase to handle SL UCB	0		0		5	Assumes incremental capacity increase to handle SL UCB	Extent of utilization/reuse of the existing WWT infrastructure in the overall solution that affects the infrastructure feasibility/suitability for incremental expansion and long-term future use	Incremental capacity increase (when needed); Score x10% indicates percentage of usage in the overall solution. A-OP7C assumes additional 25% capacity increase; A-OP8C assumes additional 50% capacity increase
		Effluent Discharge (x 10%)	5		5		5		2.5		2.5		10		5		5		3.3	Assumes DF can handle total flow, if not No Go	3.3	Assumes DF can handle total flow, if not No Go	3.3	Assumes DF can handle total flow, if not No Go	2.5	Assumes DF can handle total flow, if not No Go	2.5	Assumes DF can handle total flow, if not No Go	2.5	Assumes DF can handle total flow, if not No Go	Extent of utilization/reuse of the existing effluent disposal infrastructure in the overall solution that affects the infrastructure feasibility/suitability for incremental expansion and long-term future use	Score x10% indicates percentage of usage in the overall solution. Permitted Mill Springs DF discharge capacity = 565 m3/day; Preliminary estimates indicate the max. DF discharge capacity is 4,800 m3/day; potentially more capacity is available, but additional land acquisition is required; Mill Springs WWTP can be incrementally expanded to serve over 10,000 people (requires DF capacity of 5,000 m3/d) - requires additional land acquisition from Island Timberlands Optimistic population projections predict max. 5,213 people (Mill Bay UCB) and 9,628 people (Mill Bay + Shawnigan Lake UCBs, excl. area around the lake) in Yr 2038;
		IRM Opportunities	8		6		7		7		8		0	Low Flow	0	Low Flow	6		8	Assumes DF can handle total flow, if not No Go	9	Assumes DF can handle total flow, if not No Go	7	Assumes DF can handle total flow, if not No Go	9	Assumes DF can handle total flow, if not No Go	10	Assumes DF can handle total flow, if not No Go	8	Assumes DF can handle total flow, if not No Go	IRM opportunities, e.g., energy/water conservation, heat recovery, an opportunity for a district heating system, sludge processing and conversion to biosolids/compost, reclaimed effluent system/sales (e.g., agricultural operations, park/ball field irrigation), etc.	Differentiators are highlighted in red
		Mitigation of Environmental Impacts	10		10		10		10		10		10		10		10		10		10		10		10		10		10		Ability of system to mitigate environmental impacts	Class A effluent; not a criterion differentiator
		System Complexity	10		10		10		10		10		10		10		10		10		10		10		10		10		10		Management complexity of system	Ultrafiltration membrane technology; not the technology differentiator except for the system size
T2	2	Technology	10	20	10	20	10	20	10	20	10	20	10	20	10	20	10	20	10	20	10	20	10	20	10	20	10	20	10	20	Options to consider: a) Conventional systems - drawing on a combination of physical, chemical, and biological processes and operations to remove solids, organic matter, nutrients b) Nanofiltration systems - to provide filtration at the molecular level which allows filtering out hardness, iron, tannins and other contaminants that conventional filtration cannot remove c) Other technology options	Not a criterion differentiator
		Conventional Systems	More Complex		More Complex		More Complex		More Complex		More Complex		More Complex		More Complex		More Complex		More Complex		More Complex		More Complex		More Complex		More Complex		More Complex			
		Ultrafiltration	Reference		Reference		Reference		Reference		Reference		Reference		Reference		Reference		Reference		Reference		Reference		Reference		Reference		Reference			Ultrafiltration treatment producing Class A effluent is used for reference; not a differentiator
		Nanofiltration	Retrofit		Retrofit		Retrofit		Retrofit		Retrofit		Retrofit		Retrofit		Retrofit		Retrofit		Retrofit		Retrofit		Retrofit		Retrofit		Retrofit			Requires UF MBR process retrofit; may not be necessary
		Advanced Oxidation	Complementary		Complementary		Complementary		Complementary		Complementary		Complementary		Complementary		Complementary		Complementary		Complementary		Complementary		Complementary		Complementary		Complementary			AO provides complementary (polishing) treatment; Removes pharmaceuticals, EDS, and emerging contaminants
T3	2	Risk consideration	8	16	9	18	8	16	8	16	8	16	10	20	10	20	8	16	6	12	6	12	7	14	5	10	5	10	6	12	Options to consider (a) safeguarding of wastewater collection, treatment, and discharge systems to security and climate risks including stormwater infiltration, flood, sea level rise, and slope failure (b) impacts and reliability of gravity (i.e., deep collection or STEG) systems vs. pumping stations and STEP systems.	Wastewater system security and reliability. Assumes sub-components have the same weighting
		Security	8	WWTP in Flood Plain	9	Reference	8		8		8		10		10		8		6		6	WWTP in Flood Plain	7		5		5	WWTP in Flood Plain	6		Safeguarding of wastewater collection, treatment, and discharge systems to security and climate risks including stormwater infiltration, flood, sea level rise, and slope failure	Differentiators: flood plain, # of LS, collector lengths and diameters
		Reliability	8		9	Reference	8		8		8		10		10		8		6		6		7		5		5		6		Impacts and reliability of gravity (i.e., deep collection or STEG) systems vs. pumping stations and STEP systems.	Differentiators: # of LS, collector lengths and diameters
T4	2	Difficulties of construction	9	18	10	20	10	20	10	20	10	20	10	20	10	20	9.5	19	8	16	8	16	7	14	6	12	6	12	5	10	Options to consider stream and road/highway crossings, impacts on the riparian areas and existing utilities/infrastructure, impacts on private properties and commercial operations	This criterion may have impact on schedule/implementation, permitting process with various agencies/stakeholders, construction techniques, constructability, or other complexities. Assumes sub-components have the same weighting.
		Stream (Riparian Areas), Road/Highway Crossings and Pipeline alignments along roads	8	WWTP in Flood Plain	10		10		10		10		10		10		9		8		8	WWTP in Flood Plain	6		6		6	WWTP in Flood Plain	4			This criterion is specific to the CVRD South Sector due to several creeks in the study area: Shawnigan Creek, Hollings Creek, Handysen Creek, and other smaller creeks and tributaries. Assumed stream crossings across existing bridges with no effect on riparian areas. Expected a higher level of disturbance with the collector length increase.
		Impacts on Existing Utilities and Infrastructure, Private Properties, and Commercial Operations	10		10		10		10		10		10		10		10		8		8		8		6		6		6			
T5	2	Phasing suitability and expandability	10	20	10	20	10	20	10	20	10	20	2	4	2	4	10	20	9	18	9	18	9	18	8	16	8	16	8	16	Options to consider (a) staged growth and maximizing the use of the existing and planned infrastructure and (b) incremental expansions as they relate to growth or late comers from outside the electoral areas.	This criteria was slightly modified based on the feedback received from Cowichan Tribes, Malahat FN, and Pauquachin FN.

			PHASE I										COMPLEMENTARY OPTION						PHASE II															
		Collection	Mill Bay UCB		Mill Bay UCB		Mill Bay UCB		Mill Bay UCB		Mill Bay UCB (Limited Coverage)		Sentinel Ridge		Mill Bay UCB + Malahat FN		**Mill Bay UCB + Shawnigan Village UCB + Corridor**		Mill Bay UCB + Shawnigan Village UCB + Corridor		Mill Bay UCB + Shawnigan Village UCB + Corridor		Mill Bay UCB + Shawnigan Village UCB + Corridor + Lake Perimeter		Mill Bay UCB + Shawnigan Village UCB + Corridor + Lake Perimeter		Mill Bay UCB + Shawnigan Village UCB + Corridor + Lake Perimeter				
		Treatment	Mill Bay WWTP		Mill Springs		Pioneer Square		Pioneer Square		Frances Kelsey School (Septage)		Frances Kelsey School (Septage)		Sentinel Ridge		Mill Springs		Pioneer Square		Mill Bay		Mill Springs		Pioneer Square		Mill Bay		Mill Springs				"Septage" means the WWTP site is suitable for co-treatment of septage with sewage.	
		Effluent Discharge	Mill Springs		Mill Springs		Mill Springs		Frances Kelsey School		Frances Kelsey School		Frances Kelsey School		Sentinel Ridge		Mill Springs		Mill Springs		Mill Springs		Mill Springs		Mill Springs		Mill Springs		Mill Springs					
Score																																		
Ref. #	**Weighting Factor (x10%)**	**Evaluation Criteria**	**A-OP1** Score	**A-OP1** Weighted Score	**A-OP2** Score	**A-OP2** Weighted Score	**A-OP3A** Score	**A-OP3A** Weighted Score	**A-OP3B** Score	**A-OP3B** Weighted Score	**A-OP4A** Score	**A-OP4A** Weighted Score	**A-OP4B** Score	**A-OP4B** Weighted Score	**A-OP5** Score	**A-OP5** Weighted Score	**A-OP6** Score	**A-OP6** Weighted Score	**A-OP7A** Score	**A-OP7A** Weighted Score	**A-OP7B** Score	**A-OP7B** Weighted Score	**A-OP7C** Score	**A-OP7C** Weighted Score	**A-OP8A** Score	**A-OP8A** Weighted Score	**A-OP8B** Score	**A-OP8B** Weighted Score	**A-OP8C** Score	**A-OP8C** Weighted Score	**Comments (factors to consider in the evaluation process)**	**Additional Clarifications**
Social Category		Max. 70 points (19% of total)		**65**		**64**		**65**		**55**		**55**		**48**		**57**		**64**		**63**		**63**		**62**		**58**		**58**		**57**		
S1	1.5	Impacts related to the opportunity and/or requirements for land development	7	10.5	7	10.5	7	10.5	7	10.5	7	10.5	2	3	2	3	7.5	11.3	8	12	8	12	8	12	10	15	10	15	10	15	Encourage growth within UCBs to support sustainable infrastructure and maximize the opportunity for population density specifically in UCBs to enable the financial support for infrastructure	
S2	1	Impact on local residents/businesses and disruptions wrt status quo	9.3	9.3	8.75	8.75	9.5	9.5	9.5	9.5	9.3	9.3	9.8	9.8	9.25	9.25	8	8	8.0	8.0	8.3	8.3	6.8	6.8	7.3	7.3	7.3	7.3	5.8	5.8	Options to consider impacts, such as: noise, dust/air pollution, traffic disruptions during and after construction, workers parking, odour, ROWs/easements, visual aesthetics, etc.	Assumes sub-components have the same weighting
		Noise, Dust/Air Pollution, Odour	9		8		10		10		8		10		10	n/a	8		9		8		7		9		7		6			Noise, Dust/Air Pollution - considered temporary impacts during construction. Operational Noise may be permanent impact but is expected to be contained within WW works (WWTP and LS). Odour treatment will be provided. May be periodic impact during operation.
		Traffic Disruptions, Workers Parking	8		10		10		10		10		10		10	n/a	9		9		9		7		8		8		6			Traffic Disruptions, Workers Parking - considered temporary impacts during construction. Differentiators: WWTP location, collector lengths
		ROW/Easements	10		10		10		10		10		10		10	Existing	8		6		6		6		4		4		4			ROW - expected along major roads. Easements - minimum impacts expected.
		Visual Aesthetics	10		7		8		8		9		9		7		7		8		10		7		8		10		7			Differentiator: WWTP location and buffer areas
S3	1	Community support	10	10	10	10	10	10	0	0	0	0	0	0	10	10	10	10	8	8	8	8	8	8	1	1	1	1	1	1	Consider likely community support/perception, long-term community benefits, sharing of services, and financial participation/contribution	
S4	2	Impacts on archaeological and heritage resources	10	20	10	20	10	20	10	20	10	20	10	20	10	20	10	20	10	20	10	20	10	20	10	20	10	20	10	20	Requires a map of known archaeological sites	not a criterion differentiator
S5	1.5	Impacts on First Nations (FN) cultural and traditional use sites	10	15	10	15	10	15	10	15	10	15	10	15	10	15	10	15	10	15	10	15	10	15	10	15	10	15	10	15	Consider and evaluate impacts to FN cultural/traditional use sites (e.g., spiritual/sacred or subsistence/harvesting areas), or FN access to those sites/areas.	This criterion was added based on the feedback received from Cowichan Tribes; not a criterion differentiator
Environmental Category		Max. 100 points (27% of total)		**86**		**97**		**94**		**96**		**96**		**100**		**100**		**95**		**94**		**86**		**97**		**93**		**85**		**96**		
E1	5	Impact of the existing/proposed infrastructure to the environment	7.2	36	9.4	47	8.8	44	9.2	46	9.2	46	10	50	10	50	9.0	45	8.8	44	7.2	36	9.4	47	8.6	43	7.0	35	9.2	46	Impacts include the effects of effluent collection and treatment to vegetation, aquatic resources, fisheries, wildlife habitat, soil contamination	Qualitative impact from the environmental perspective; Assumes sub-components have the same weighting
		Vegetation Impact	6	Riparian, DF	8	DF	8	DF	10	Low	10	Low	10	Low	10	Low	7	DF, Trunk alignment	8	DF	6	Riparian, DF	8	DF	8	DF	6	Riparian, DF	8	DF		Differentiators: riparian areas, effluent disposal field, WWTP location, collection system alignments
		Aquatic Resources/Fisheries Impact	8	WWTP in flood plain	10	Low	10	Low	10	Low	10	Low	10	Low	10	Low	10	Low	10	Low	8	WWTP in flood plain	10	Low	10	Low	8	WWTP in flood plain	10	Low		Differentiators: riparian areas, effluent disposal field, WWTP location, collection system alignments
		Wildlife Habitat Impact	6	Riparian, DF	9	DF	9	DF	10	Low	10	Low	10	Low	10	Low	8	DF	9	DF	6	Riparian, DF	9	DF	9	DF	6	Riparian, DF	9	DF		Differentiators: riparian areas, effluent disposal field, WWTP location, collection system alignments
		Soil Contamination, Environmental Spills	8	WWTP in flood plain	10	Exist. WWTP	8	New WWTP	8	New WWTP	8	New WWTP	10	Exist. WWTP	10	Exist. WWTP	10	Exist. WWTP	8	New WWTP	8	WWTP in flood plain	10	Exist. WWTP	8	New WWTP	8	WWTP in flood plain	10	Exist. WWTP		Differentiators: riparian areas, effluent disposal field, WWTP location, collection system alignments
		Erosion	8	WWTP in flood plain	10	DF	9	DF, WWTP	8	DF, WWTP	8	DF, WWTP	10		10		10	DF	9	DF, WWTP	8	WWTP in flood plain	10	DF	8	CS, DF, WWTP	7	CS, WWTP in flood plain	9	CS, DF		Differentiators: riparian areas, effluent disposal field, WWTP location, collection system alignments
E2	5	Impact of effluent discharge to the receiving environment	10	50	10	50	10	50	10	50	10	50	10	50	10	50	10	50	10	50	10	50	10	50	10	50	10	50	10	50	Impacts include the effects of Class A effluent discharge to ground and surface water resources.	Class A effluent; not a criterion differentiator
		Total Score		**336**		**356**		**346**		**333**		**333**		**248**		**257**		**336**		**314**		**307**		**322**		**287**		**279**		**288**		
		Relative Score		**0.94**		**1.00**		**0.97**		**0.93**		**0.93**		**0.70**		**0.72**		**0.94**		**0.88**		**0.86**		**0.90**		**0.80**		**0.78**		**0.81**		
		Option Summary and Go / No-Go		**3rd Best**		**Best**		**2nd Best**	No interest by FKS	**No-Go Exclude**	No interest by FKS	**No-Go Exclude**	No interest by FKS	**No-Go Exclude**		**Complementary Option**		**Requires further detailed evaluation**		**Inferior to A-OP7C**		**Inferior to A-OP7C**		**Best of A-OP7 options**	Low community support	**No-Go Exclude**	Low community support	**No-Go Exclude**	Low community support	**No-Go Exclude**		

Notes:

O&M - Operations and maintenance	CVRD - Cowichan Valley Regional District	TBD - to be discussed
WWTP - Wastewater treatment plant	UCB - Urban Containment Boundary	
IRM - Integrated resources management	ROW - Right of way	
STEP - Septic Tank Effluent Pump	GHG - Green house gas	
STEG - Septic Tank Effluent Gravity	CT - Cowichan Tribes	

			PHASE I												COMPLEMENTARY OPTIONS				PHASE II									
		Collection	Shawnigan Village UCB		Shawnigan Village UCB + SL-E		Shawnigan Village UCB + Lake Perimeter		Shawnigan Village UCB		Shawnigan Village UCB + SL-E		Shawnigan Village UCB + Lake Perimeter		Arbutus Mountain		Elkington Forrest		Shawnigan Village UCB + Cobble Hill UCB + Corridor		Shawnigan Village UCB + Cobble Hill UCB + Corridor		Shawnigan Village UCB + Cobble Hill UCB + Corridor + Lake Perimeter		Shawnigan Village UCB + Cobble Hill UCB + Corridor + Lake Perimeter				
		Treatment	SBES Lagoons (Septage)		SBES Lagoons (Septage)		SBES Lagoons (Septage)		Shawnigan Village (Septage)		Shawnigan Village (Septage)		Shawnigan Village (Septage)		Arbutus Mountain		Elkington Forrest		SBES Lagoons (Septage)		Shawnigan Village (Septage)		SBES Lagoons (Septage)		Shawnigan Village (Septage)			"Septage" means the WWTP site is suitable for co-treatment of septage with sewage.
		Effluent Discharge	SBES		SBES		SBES		SBES		SBES		SBES		Arbutus Mountain		Elkington Forrest		SBES		SBES		SBES		SBES				
Score																												
Ref. #	Weighting Factor (x10%)	Evaluation Criteria	B-OP1A Score	B-OP1A Weighted Score	B-OP1B Score	B-OP1B Weighted Score	B-OP1C Score	B-OP1C Weighted Score	B-OP2A Score	B-OP2A Weighted Score	B-OP2B Score	B-OP2B Weighted Score	B-OP2C Score	B-OP2C Weighted Score	B-OP3 Score	B-OP3 Weighted Score	B-OP4 Score	B-OP4 Weighted Score	B-OP5A Score	B-OP5A Weighted Score	B-OP5B Score	B-OP5B Weighted Score	B-OP6A Score	B-OP6A Weighted Score	B-OP6B Score	B-OP6B Weighted Score		Comments (factors to consider in the evaluation process)	Additional Clarifications
Financial Category		Max. 100 points (27% of total)		**100**		**85**		**75**		**90**		**80**		**70**		**25**		**25**		**85**		**75**		**60**		**60**			
F1	5	Capital cost	10	50	7	35	5	25	8	40	6	30	4	20	2	10	2	10	8	40	6	30	4	20	4	20		Construction cost to consider new infrastructure vs. upgrade of the existing infrastructure (e.g., new WWTP vs. existing WWTP upgrade); may require and will consider phased approach to match population projections	of importance to capital funding/investments related to federal and provincial funding, grants, or other funding sources for alignment with service areas and public/private financial participation/contributions - important for infrastructure planning purposes
		Collection System (Excl. Lift Stations)	GM, FM, STEP	$2,000,000	GM, FM, STEP	$7,400,000	GM, FM, STEP	$16,200,000	GM, FM, STEP	$1,000,000	GM, FM, STEP	$6,400,000	GM, FM, STEP	$15,200,000	Limited Coverage	$0	Limited Coverage	$0	GM, FM, STEP	$6,300,000	GM, FM, STEP	$5,300,000	GM, FM, STEP	$20,600,000	GM, FM, STEP	$19,600,000			Differentiators: collector lengths and diameters, and difficulties of construction
		Lift Stations	2 Lift Stations	$750,000	2 Lift Stations	$750,000	2 Lift Stations	$750,000	2 Lift Stations	$750,000	2 Lift Stations	$750,000	2 Lift Stations	$750,000		$0	-	$0	3 Lift Stations	$1,250,000	3 Lift Stations	$1,250,000	3 Lift Stations	$1,250,000	3 Lift Stations	$1,250,000			STEP system assumed around Shawnigan Lake
		WWTP	Retrofit	$6,000,000	Retrofit	$6,000,000	Retrofit	$6,000,000	New	$10,000,000	New	$10,000,000	New	$10,000,000	Limited Coverage (Existing)	$0	Limited Coverage (Existing)	$0	Retrofit	$6,000,000	New	$10,000,000	Retrofit	$6,000,000	New	$10,000,000			"Septage" means the WWTP site is suitable for co-treatment of septage with sewage. The costs are exclusive of cost adders to accommodate septage treatment, otherwise the comparison would be meaningless. Differentiators: WWTP location, difficulties of construction, and retrofit vs. new construction New Shawnigan Village WWTP cost also includes estimated land acquisition cost. Options B-OP5 and B-OP6 - an assumption was made that extra capacity may be available or capacity reallocation to Cobble Hill may be feasible.
		Effluent Discharge	Existing + Expansion	$2,500,000	Existing + Expansion	$2,500,000	Existing + Expansion	$2,500,000	Existing + Expansion	$3,500,000	Existing + Expansion	$3,500,000	Existing + Expansion	$3,500,000	Existing	$0	Existing + Expansion	$0	Existing + Expansion	$2,500,000	Existing + Expansion	$3,500,000	Existing + Expansion	$2,500,000	Existing + Expansion	$3,500,000			Effluent discharge for new Shawnigan Village WWTP also includes cost of effluent discharge pipeline to SBES discharge site. Options B-OP5 and B-OP6 - an assumption was made that extra capacity may be available or capacity reallocation to Cobble Hill may be feasible.
		Total	-	$11,250,000	-	$16,650,000	-	$25,450,000	-	$15,250,000	-	$20,650,000	-	$29,450,000	-	$0	-	$0	-	$16,050,000	-	$20,050,000	-	$30,350,000	-	$34,350,000			
F2	5	O&M Cost	10	50	10	50	10	50	10	50	10	50	10	50	3	15	3	15	9	45	9	45	8	40	8	40		Has an impact on annual O&M budgets and ongoing operations, e.g., impact of integration/amalgamation of existing WWTPs on O&M efforts/costs vs. new facilities	of importance for setting realistic annual O&M budgets for infrastructure maintenance, servicing, repairs, ongoing operations, etc. - important for planning ongoing infrastructure O&M operations
		Collection System	GM, FM, STEP	Reference	GM, FM, STEP	Reference	GM, FM, STEP	Reference	GM, FM, STEP	Reference	GM, FM, STEP	Reference	GM, FM, STEP	Reference	Limited Coverage	Lower	Limited Coverage	Lower	GM, FM, STEP	Higher	GM, FM, STEP	Higher	GM, FM, STEP	Higher	GM, FM, STEP	Higher			GM, FM, STEP along corridors and around Shawnigan Lake; Shawnigan Lake UCB is used for reference
		WWTP	CVRD Budget	$200,000	CVRD Budget	$200,000	CVRD Budget	$200,000	Estimated	$200,000	Estimated	$200,000	Estimated	$200,000	Limited Coverage	Lower	Limited Coverage	Lower	Estimated	$200,000	Estimated	$200,000	Estimated	$200,000	Estimated	$200,000			2020 CVRD budgets for CBES WWTP includes salaries, benefits, O&M, allocations
		Effluent Discharge		Reference		Reference		Reference		Reference		Reference		Reference	Limited Coverage	Lower	Limited Coverage	Lower		Reference		Higher		Reference		Higher			Discharge at SBES site is used for reference
Technical Category		Max. 100 points (27% of total)		**98**		**95**		**91**		**97**		**93**		**89**		**75**		**75**		**63**		**62**		**58**		**57**			
T1	2	Technical advantages and disadvantages	9.2	18.4	9.4	18.8	9.6	19.1	8.3	16.7	8.5	17.0	8.7	17.3	5.6	11.1	5.6	11.1	5.7	11.4	5.2	10.4	5.8	11.6	5.3	10.7		Options to consider (a) capacity requirements and level of service required to meet service demand, (b) collection system alignments to maximize service areas and improve the overall quality/reliability of service, (c) level (extent) of utilization/reuse of the existing wastewater systems/infrastructure that affects the infrastructure feasibility/suitability for incremental expansion and long-term future use, (d) IRM opportunities, e.g., energy/water conservation, heat recovery, an opportunity for a district heating system, sludge processing and conversion to biosolids/compost, reclaimed effluent sales (e.g., agricultural operations, park/ball field irrigation), etc., (e) ability of system to mitigate environmental impacts, and (f) management complexity of system	e.g., configuration requirements (e.g., size, footprint, volume, layout - depending on the system component), reuse potential or continued use of the existing infrastructure vs. building new infrastructure, potential to increase service areas and/or population densities due to infrastructure improvements and/or layouts, etc. Assumes sub-components have the same weighting.
		Capacity Requirements	10		10		10		10		10		10		2		2		0	Assumes DF cannot handle more flow No Go	0	Assumes DF cannot handle more flow No Go	0	Assumes DF cannot handle more flow No Go	0	Assumes DF cannot handle more flow No Go		Capacity requirements and level of service required to meet service demand	Permitted SBES DF discharge capacity = 591 m^3/day; Estimated max. DF capacity = 1,400 - 1,600 m^3/day (4 DFs). This capacity is insufficient to serve 2018 population of Shawnigan Lake UCB assuming 100% connection. SBES lagoon technology conversion is not a capacity limiting factor.
		Collection System Alignments	6		7		8		6		7		8		2		2		9		9		10		10			Collection system alignments to maximize service areas and improve the overall quality/reliability of service	
		Utilization of Existing Infrastructure	9.3		9.3		9.3		6.0		6.0		6.0		9.3		9.3		5.3		2.3		4.7		2.0			Extent of utilization/reuse of the existing wastewater infrastructure in the overall solution that affects the infrastructure feasibility/suitability for incremental expansion and long-term future use	Assumes sub-components have the same weighting
		Collection (x 10%)	8		8		8		8		8		8		8		8		7		7		6		6			Extent of utilization/reuse of the existing collection infrastructure in the overall solution that affects the infrastructure feasibility/suitability for incremental expansion and long-term future use	Score x10% indicates percentage of usage in the overall solution.
		Treatment (x 10%)	10	Technology Conversion	10	Technology Conversion	10	Technology Conversion	0	New	0	New	0	New	10		10		9	Assumes incremental capacity increase	0	New	8	Assumes incremental capacity increase	0	New		Extent of utilization/reuse of the existing WWT infrastructure in the overall solution that affects the infrastructure feasibility/suitability for incremental expansion and long-term future use	Incremental capacity increase (when needed); Score x10% indicates percentage of usage in the overall solution. B-OP5A assumes additional 10% capacity increase; B-OP6A assumes additional 20% capacity increase
		Effluent Discharge (x 10%)	10		10		10		10		10		10		10		10		0	Assumes DF cannot handle more flow No Go	0	Assumes DF cannot handle more flow No Go	0	Assumes DF cannot handle more flow No Go	0	Assumes DF cannot handle more flow No Go		Extent of utilization/reuse of the existing effluent disposal infrastructure in the overall solution that affects the infrastructure feasibility/suitability for incremental expansion and long-term future use	Score x10% indicates percentage of usage in the overall solution. Permitted SBES DF discharge capacity = 591 m^3/day; Estimated max. DF capacity = 1,400 - 1,600 m^3/day (4 DFs). This capacity is insufficient to serve 2018 population of Shawnigan Lake UCB assuming 100% connection. SBES lagoon technology conversion is not a capacity limiting factor.
		IRM Opportunities	10		10		10		8		8		8		0	Low Flow	0	Low Flow	0	Assumes DF cannot handle more flow No Go	0	Assumes DF cannot handle more flow No Go	0	Assumes DF cannot handle more flow No Go	0	Assumes DF cannot handle more flow No Go		IRM opportunities, e.g., energy/water conservation, heat recovery, an opportunity for a district heating system, sludge processing and conversion to biosolids/compost, reclaimed effluent system/sales (e.g., agricultural operations, park/ball field irrigation), etc.	Differentiators are highlighted in red
		Mitigation of Environmental Impacts	10		10		10		10		10		10		10		10		10		10		10		10			Ability of system to mitigate environmental impacts	Class A effluent; not a criterion differentiator
		System Complexity	10		10		10		10		10		10		10		10		10		10		10		10			Management complexity of system	Ultrafiltration membrane technology; not the technology differentiator except for the system size
T2	2	Technology	10	20	10	20	10	20	10	20	10	20	10	20	10	20	10	20	10	20	10	20	10	20	10	20		Options to consider: a) Conventional systems - drawing on a combination of physical, chemical, and biological processes and operations to remove solids, organic matter, nutrients b) Nanofiltration systems - to provide filtration at the molecular level which allows filtering out hardness, iron, tannins and other contaminants that conventional filtration cannot remove c) Other technology options	Not a criterion differentiator
		Conventional Systems	More Complex		More Complex		More Complex		More Complex		More Complex		More Complex		More Complex				More Complex		More Complex		More Complex		More Complex				
		Ultrafiltration	Reference		Reference		Reference		Reference		Reference		Reference		Reference		Unknown Technology		Reference		Reference		Reference		Reference				Ultrafiltration treatment producing Class A effluent is used for reference; not a differentiator
		Nanofiltration	Retrofit		Retrofit		Retrofit		Retrofit		Retrofit		Retrofit		Retrofit				Retrofit		Retrofit		Retrofit		Retrofit				Requires UF MBR process retrofit; may not be necessary
		Advanced Oxidation	Complementary		Complementary		Complementary		Complementary		Complementary		Complementary		Complementary				Complementary		Complementary		Complementary		Complementary				AO provides complementary (polishing) treatment; Removes pharmaceuticals, EDS, and emerging contaminants
T3	2	Risk consideration	10	20	9	18	8	16	10	20	9	18	8	16	10	20	10	20	7	14	7	14	6	12	6	12		Options to consider (a) safeguarding of wastewater collection, treatment, and discharge systems to security and climate risks including stormwater infiltration, flood, sea level rise, and slope failure (b) impacts and reliability of gravity (i.e., deep collection or STEG) systems vs. pumping stations and STEP systems.	Wastewater system security and reliability. Assumes sub-components have the same weighting
		Security	10		9		8		10		9		8		10		10		7		7		6		6			Safeguarding of wastewater collection, treatment, and discharge systems to security and climate risks including stormwater infiltration, flood, sea level rise, and slope failure	Differentiators: flood plain, # of LS, collector lengths and diameters
		Reliability	10		9		8		10		9		8		10		10		7		7		6		6			Impacts and reliability of gravity (i.e., deep collection or STEG) systems vs. pumping stations and STEP systems.	Differentiators: # of LS, collector lengths and diameters
T4	2	Difficulties of construction	10	20	9	18	8	16	10	20	9	18	8	16	10	20	10	20	9	18	9	18	7	14	7	14		Options to consider stream and road/highway crossings, impacts on the riparian areas and existing utilities/infrastructure, impacts on private properties and commercial operations	This criterion may have impact on schedule/implementation, permitting process with various agencies/stakeholders, construction techniques, constructability, or other complexities. Assumes sub-components have the same weighting.
		Stream (Riparian Areas), Road/Highway Crossings and Pipeline alignments along roads	10		9		8		10		9		8		10		10		9		9		7		7				This criterion is specific to the CVRD South Sector due to several creeks in the study area: Shawnigan Creek, Hollings Creek, Handysen Creek, and other smaller creeks and tributaries. Assumed stream crossings across existing bridges with no effect on riparian areas. Expected a higher level of disturbance with the collector length increase.
		Impacts on Existing Utilities and Infrastructure, Private Properties, and Commercial Operations	10		9		8		10		9		8		10		10		9		9		7		7				
T5	2	Phasing suitability and expandability	10	20	10	20	10	20	10	20	10	20	10	20	2	4	2	4	0	0	0	0	0	0	0	0		Options to consider (a) staged growth and maximizing the use of the existing and planned infrastructure and (b) incremental expansions as they relate to growth or late comers from outside the electoral areas.	This criteria was slightly modified based on the feedback received from Cowichan Tribes, Malahat FN, and Pauquachin FN. Options B-OP5 and B-OP6 assume SBES DF cannot handle more flow due to capacity limitations of the SBES effluent discharge site.

			PHASE I												COMPLEMENTARY OPTIONS				PHASE II									
		Collection	Shawnigan Village UCB		Shawnigan Village UCB + SL-E		Shawnigan Village UCB + Lake Perimeter		Shawnigan Village UCB		Shawnigan Village UCB + SL-E		Shawnigan Village UCB + Lake Perimeter		Arbutus Mountain		Elkington Forrest		Shawnigan Village UCB + Cobble Hill UCB + Corridor		Shawnigan Village UCB + Cobble Hill UCB + Corridor		Shawnigan Village UCB + Cobble Hill UCB + Corridor + Lake Perimeter		Shawnigan Village UCB + Cobble Hill UCB + Corridor + Lake Perimeter				
		Treatment	SBES Lagoons (Septage)		SBES Lagoons (Septage)		SBES Lagoons (Septage)		Shawnigan Village (Septage)		Shawnigan Village (Septage)		Shawnigan Village (Septage)		Arbutus Mountain		Elkington Forrest		SBES Lagoons (Septage)		Shawnigan Village (Septage)		SBES Lagoons (Septage)		Shawnigan Village (Septage)			"Septage" means the WWTP site is suitable for co-treatment of septage with sewage.
		Effluent Discharge	SBES		SBES		SBES		SBES		SBES		SBES		Arbutus Mountain		Elkington Forrest		SBES		SBES		SBES		SBES			
Score																												
Ref. #	**Weighting** Factor (x10%)	**Evaluation Criteria**	**B-OP1A** Score	**B-OP1A** Weighted Score	**B-OP1B** Score	**B-OP1B** Weighted Score	**B-OP1C** Score	**B-OP1C** Weighted Score	**B-OP2A** Score	**B-OP2A** Weighted Score	**B-OP2B** Score	**B-OP2B** Weighted Score	**B-OP2C** Score	**B-OP2C** Weighted Score	**B-OP3** Score	**B-OP3** Weighted Score	**B-OP4** Score	**B-OP4** Weighted Score	**B-OP5A** Score	**B-OP5A** Weighted Score	**B-OP5B** Score	**B-OP5B** Weighted Score	**B-OP6A** Score	**B-OP6A** Weighted Score	**B-OP6B** Score	**B-OP6B** Weighted Score		**Comments (factors to consider in the evaluation process)**	**Additional Clarifications**
Social Category		Max. 70 points (19% of total)		**70**		**67**		**64**		**70**		**67**		**63**		**58**		**58**		**35**		**35**		**35**		**35**			
S1	1.5	Impacts related to the opportunity and/or requirements for land development	10	15	9	13.5	8	12	10	15	9	13.5	8	12	2	3	2	3	0	0.0	0	0	0	0	0	0		Encourage growth within UCBs to support sustainable infrastructure and maximize the opportunity for population density specifically in UCBs to enable the financial support for infrastructure	
S2	1	Impact on local residents/businesses and disruptions wrt status quo	10.0	10.0	9.25	9.25	8.5	8.5	9.75	9.75	9.0	9.0	8.3	8.3	10.0	10.0	10	10	0	0	0.0	0.0	0.0	0.0	0.0	0.0		Options to consider impacts, such as: noise, dust/air pollution, traffic disruptions during and after construction, workers parking, odour, ROWs/easements, visual aesthetics, etc.	Assumes sub-components have the same weighting
		Noise, Dust/Air Pollution, Odour	10		9		8		10		9		8		10		10	n/a	0		0		0		0				Noise, Dust/Air Pollution - considered temporary impacts during construction. Operational Noise may be permanent impact but is expected to be contained within WW works (WWTP and LS). Odour treatment will be provided. May be periodic impact during operation.
		Traffic Disruptions, Workers Parking	10		9		8		10		9		8		10		10	n/a	0		0		0		0				Traffic Disruptions, Workers Parking - considered temporary impacts during construction. Differentiators: WWTP location, collector lengths
		ROW/Easements	10		9		8		10		9		8		10		10	Existing	0		0		0		0				ROW - expected along major roads. Easements - minimum impacts expected.
		Visual Aesthetics	10		10		10		9		9		9		10				0		0		0		0				Differentiator: WWTP location and buffer areas
S3	1	Community support	10	10	9	9	8	8	10	10	9	9	8	8	10	10	10	10	0	0	0	0	0	0	0	0		Consider likely community support/perception, long-term community benefits, sharing of services, and financial participation/contribution	
S4	2	Impacts on archaeological and heritage resources	10	20	10	20	10	20	10	20	10	20	10	20	10	20	10	20	10	20	10	20	10	20	10	20		Requires a map of known archaeological sites	not a criterion differentiator
S5	1.5	Impacts on First Nations (FN) cultural and traditional use sites	10	15	10	15	10	15	10	15	10	15	10	15	10	15	10	15	10	15	10	15	10	15	10	15		Consider and evaluate impacts to FN cultural/traditional use sites (e.g., spiritual/sacred or subsistence/harvesting areas), or FN access to those sites/areas.	This criterion was added based on the feedback received from Cowichan Tribes; not a criterion differentiator
Environmental Category		Max. 100 points (27% of total)		**100**		**98**		**96**		**96**		**94**		**92**		**100**		**100**		**50**		**50**		**50**		**50**			
E1	5	Impact of the existing/proposed infrastructure to the environment	10	50	9.6	48	9.2	46	9.2	46	8.8	44	8.4	42	10	50	10	50	0.0	0	0.0	0	0.0	0	0.0	0		Impacts include the effects of effluent collection and treatment to vegetation, aquatic resources, fisheries, wildlife habitat, soil contamination	Qualitative impact from the environmental perspective; Assumes sub-components have the same weighting
		Vegetation Impact	10	Low	10	Low	10	Low	9	New WWTP	9	New WWTP	9	New WWTP	10	Low	10	Low	0		0		0		0				Differentiators: riparian areas, effluent disposal field, WWTP location, collection system alignments
		Aquatic Resources/Fisheries Impact	10	n/a	10	n/a	10	n/a	10	n/a	10	n/a	10	Low	10	Low	10	Low	0		0		0		0				Differentiators: riparian areas, effluent disposal field, WWTP location, collection system alignments
		Wildlife Habitat Impact	10	Low	10	Low	10	Low	9	New WWTP	9	New WWTP	9	New WWTP	10	Low	10	Low	0		0		0		0				Differentiators: riparian areas, effluent disposal field, WWTP location, collection system alignments
		Soil Contamination, Environmental Spills	10		9		8		9	New WWTP	8	New WWTP	7	New WWTP	10	Exist. WWTP	10	Exist. WWTP	0		0		0		0				Differentiators: riparian areas, effluent disposal field, WWTP location, collection system alignments
		Erosion	10		9		8		9	New WWTP	8	New WWTP	7	New WWTP	10		10		0		0		0		0				Differentiators: riparian areas, effluent disposal field, WWTP location, collection system alignments
E2	5	Impact of effluent discharge to the receiving environment	10	50	10	50	10	50	10	50	10	50	10	50	10	50	10	50	10	50	10	50	10	50	10	50		Impacts include the effects of Class A effluent discharge to ground and surface water resources.	Class A effluent; not a criterion differentiator
		Total Score		**368**		**345**		**326**		**352**		**334**		**315**		**258**		**258**		**233**		**222**		**203**		**202**				
		Relative Score		**1.00**		**0.94**		**0.88**		**0.96**		**0.91**		**0.85**		**0.70**		**0.70**		**0.63**		**0.60**		**0.55**		**0.55**				
		Option Summary and Go / No-Go		**Best**		**No-Go Exclude**		**No-Go Exclude**		**2nd Best**		**No-Go Exclude**		**No-Go Exclude**		**Complementary Option**		**Complementary Option**		**Best of B-05 options**		**Inferior to B-OP5A**		**No-Go Exclude**		**No-Go Exclude**				

Notes:

O&M - Operations and maintenance	CVRD - Cowichan Valley Regional District	TBD - to be discussed
WWTP - Wastewater treatment plant	UCB - Urban Containment Boundary	
IRM - Integrated resources management	ROW - Right of way	
STEP - Septic Tank Effluent Pump	GHG - Green house gas	
STEG - Septic Tank Effluent Gravity	CT - Cowichan Tribes	