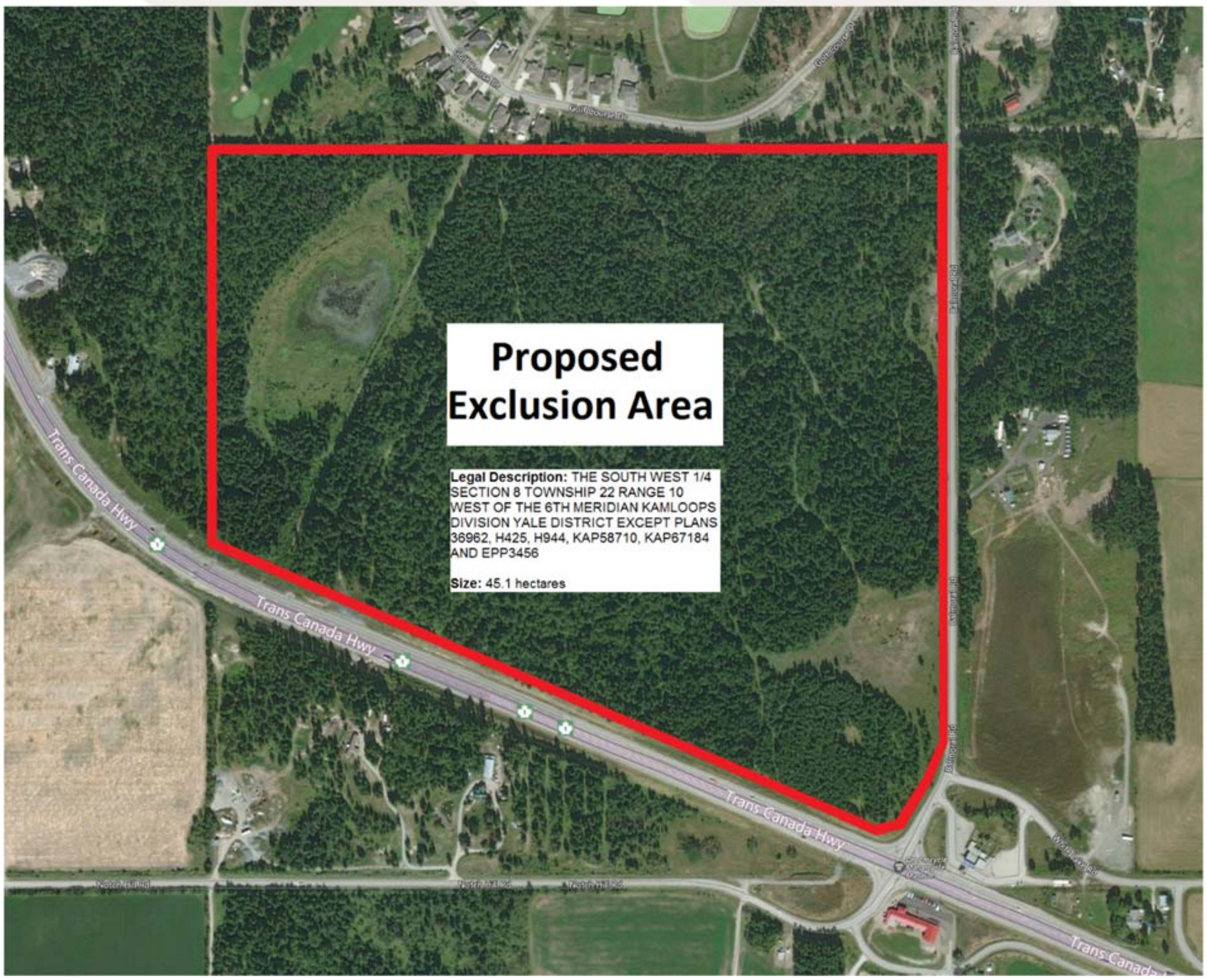
REAL ESTATE APPRAISAL, CONSULTATION & ARBITRATION

ALR EXCLUSION APPLICATION

45.1 ± hectares
NW Corner of Trans-Canada Highway and Balmoral Road
Columbia Shuswap Regional District

PREPARED FOR:

Agricultural Land Commission



Kent•Macpherson

J. Hettinga, B.Sc., RI

January 19, 2018

Kent•Macpherson

January 19, 2018

Agricultural Land Commission
133-4940 Canada Way
Burnaby, BC
V5G 4K6

Attention: Tony Pellett, Regional Planner

Re: Agricultural Land Commission - ALR Exclusion Application
Proposed ALR Exclusion: The South West 1/4 Section 8 Township 22 Range 10 West of the 6th Meridian Kamloops Division Yale District Except Plans 36962, H425, H944, KAP58710, KAP67184 and EPP3456

This document is to summarize the work completed by the Columbia Shuswap Regional District (CSRD) and Shuswap Lake Estates (SLE) pertaining to the ALR Exclusion Application for 45.1 hectares of land located at the NW Corner of the Trans-Canada Highway and Balmoral Road located in Balmoral, BC.

If you have any questions pertaining to this Application, please do not hesitate to contact us.

Sincerely,

KENT-MACPHERSON

Per: ______________________
J. Hettinga, B.Sc., RI

/jh

Table of Contents

	Page
Title Page	1
Letter of Transmittal	2
Executive Summary	5
Section 1 History and Current Application	**7**
1.1 Town Center and Original ALR Application	7
1.2 CSRD Liquid Waste Management Plan	8
1.3 Current Application	9
Section 2 Exhibits	**11**
2.1 Letter from Erik Karlsen (ALC) to Ted Bacigalupo (Area Director for CSRD)	11
2.2 Letter from Erik Karlsen (ALC) to Jay Simons (CSRD)	12
2.3 Agrologist's Report – Wayne Blashill	12
2.4 Balmoral Waste Management Opportunities and Benefits to Area Agriculture – AG Consulting	13
2.5 Sorrento/Blind Bay Community Sewer System Plan – Opus International	15
2.6 Field Investigation and Preliminary Assessment of Sewage Disposal – Piteau Associates	16
2.7 Sorrento Community Sanitary Sewer Opportunities – Gentech Engineering	16
2.8 Concept Plan for Balmoral Property	16
2.9 Letter of Support – Paul Demenok, Electoral Area C Director (CSRD)	16
2.10 Letter of Interest in Spray Irrigation for ~500 acres of land	17
2.11 Letter of Support from the South Shuswap Chamber of Commerce	17
2.12 Letter of Support from Mel Arnold, MP	17
2.13 Letter of Support from Greg Kyllo, MLA	18
2.14 Letter of Support from Shuswap Watershed Council	18
2.15 CSRD – Electoral Area C - Official Community Plan	18
2.16 Western Water Association Ltd – 2016 Groundwater Monitoring Report	18
2.17 Liquid Waste Management Plan – Stage 3 – EarthTech/AECOM	19
Section 3 Section 6 of ALC Act	**20**
Section 4 Benefits	**22**
4.1 Nutrient Rich Spray Irrigation	22
4.2 Densification	22
4.3 Reduction in GHG emissions	23
4.4 Removes Effluent from Shuswap Lake	23
4.5 Builds a Community Centre	23

ADDENDA –

Letter from ALC to CSRD Re Balmoral Corner – October 25, 2005
Letter from ALC to CSRD Re Balmoral Corner – January 21, 2008
Agrologist's Report – Wayne Blashill
Balmoral Waste Management Opportunities & Benefits to Area
Sorrento/Blind Bay Community Sewer System Plan
Field Investigation & Preliminary Assessment of Sewage Disposal
Sorrento Community Sanitary Sewer Opportunities
Concept Plan for Balmoral Property

Letter of Support – Paul Demenok, Electoral Area C Director (CSRD)
Letter of Interest – Village Ranch LTD
Letter of Support – South Shuswap Chamber of Commerce
Letter of Support – Mel Arnold, MP
Letter of Support – Greg Kyllo, MLA
Letter of Support – Shuswap Watershed Council
Official Community Plan - CSRD – Electoral Area C
2016 Groundwater Monitoring Report – Blind Bay & Sorrento
Liquid Waste Management Plan – Stage 3 Report

Executive Summary

Sorrento and Blind Bay have evolved over the last 100 years from a small meeting place known as Trapper's Landing, to a community of approximately 7,800 (with surrounding area). The South Shuswap has historically been a vacation spot which has now progressed into a vibrant lifestyle community with infrastructure and amenity demands from residents and businesses that have made this area their full-time home.

Over the past number of years, the growth of the Blind Bay/Sorrento community has created demands for various community provisions such as a Town Centre and related amenities that could provide various health and community related services. The Electoral Area C Official Community Plan (OCP) has identified the desire for a Town Centre as well as for increased density in the area. The OCP has also recognized that the increased density would necessitate the need for a community sewer system.

As the community developed over time, residential density concentrated along Shuswap Lake, and a proliferation of on-site sewer systems emerged. In 2002, the Columbia Shuswap Regional District developed its first formal Liquid Waste Management Plan (LWMP) which recognised the need for a community sewer system in the Blind Bay/Sorento area. As the mass of development was located north of productive farm land and adjacent to the lake, the foreshore became increasingly at risk of contamination from aging on-site septic systems, and the groundwater being polluted. The 2002 LWMP identified that the propensity of on-site sewer systems in the area was an environmental problem in the making.

In 2008 a comprehensive review of the 2002 LWMP occurred which identified viable options to develop a community sewer system for the area. The LWMP as well as subsequent studies involved numerous investigations related to the identification of an appropriate treatment and deposition site. After a thorough and exhaustive process, the CSRD has recently identified that the only available option to advance a community sewer system for the communities of Reedman Point/Blind Bay/Sorrento would be the acquisition of the existing Shuswap Lake Estates private community sewer system and the acquisition of suitable land (in proximity to this treatment plant as well as local farmers) to develop an effluent storage pond for the purpose of supplying spray irrigation effluent to neighbouring farmland. The CSRD focused its attention on the Balmoral Corner as a solution that could meet these community objectives.

The subject property is located directly south of the existing Shuswap Lake Estate (SLE) sewer system. With the exclusion of the subject property, ~30% of the land would be owned by CSRD as an irrigation storage area, and the existing SLE sewer system would be transferred to the CSRD and expanded to accept effluent from the surrounding community. This effluent would be treated and directed to the irrigation ponds to be utilized by adjacent farm land for crop irrigation and enhancement.

With the CSRD owning and operating the community sewer system and administering the spray irrigation program, long term agricultural benefit would be maintained for the surrounding farmland. The irrigation ponds are located close to existing farms that have expressed considerable interest in spray irrigation with expectations of significant increases in crop yields.

The exclusion of these lands from the Agricultural Land Reserve provides an opportunity for the CSRD and the communities of Blind Bay/Sorrento to advance its long awaited and publicly desired local government owned and operated community sewer system. In addition, the balance of the site would provide for a Town Centre as desired in the OCP, with community amenities. This Town Centre will support the surrounding agricultural community, and in combination with the development of the CSRD effluent storage and spray irrigation program, the agricultural community will thrive with the substantial increase in crop productivity and increased liveability in the community.

Section 1 History and Current Application

1.1 Town Center and Original ALR Application

Over the past 20 years, Shuswap Lake Estates (SLE) has been in conversation with the Agricultural Land Commission (ALC) and Columbia Shuswap Regional District (CSRD) regarding the property at the NW corner of the Trans-Canada Hwy and Balmoral Road.

In 1999, SLE applied to exclude the subject property for the purposes of private recreation, multi-family, single family, and commercial development. At the time of this application, the CSRD decided against forwarding the application to the ALC until an Official Community Plan (OCP) Review and Town Center Location Study was completed. There were a number of questionnaires and surveys completed within the community that showed over 90% of the respondents supported the development of a Balmoral Village on the subject property.

In August 2001, CSRD staff sent a letter and Board Resolution to the ALC that recommended the approval of the Balmoral Exclusion application. Although support was given by the CSRD, the exclusion application was refused in late 2002. The ALC indicated that the application did not preserve and protect farmland and encourage farming. However, the ALC did confirm its willingness to review future proposals that provide a net benefit for agriculture.

In 2005, the ALC indicated to the CSRD that, "The Commission believes that the proposed irrigation system could have long term benefits to agriculture in the Balmoral area, and as such is willing to continue discussions with the Regional District and the application as to how a spray irrigation infrastructure can be developed and administered that is supported by the Regional District, so that irrigation benefits will remain available to local farmers in the long term."

In 2006, an adjacent property of 450 acres within the ALR was purchased by the Born family (within 500 feet from the subject property). Mr. Born expressed interest in using treated effluent from SLE for spray irrigation. This information was provided to the ALC and the Commission stated its interest in seeing a program developed.

In 2005 and in 2008, the ALC sent letters to the CSRD (Exhibits 1&2) summarizing the previous exclusion applications. The letters requested additional information related to the proposed exclusion including development and administration aspects of how the spray irrigation program would benefit local farmers. Although the letters confirmed that the ALC saw the agricultural benefits of the spray irrigation program, there was concern expressed related to the long-term viability of this program if left under private ownership. The commitment from the ALC was that with further information and security, the ALC would reconsider the exclusion application from 2004.

1.2 CSRD Liquid Waste Management Plan

As the population increased along the South Shuswap shores, so did community concern of the impact of on-site septic systems to the groundwater and ongoing deterioration of water quality around Blind Bay and Sorrento. To track these concerns, the CSRD had 8 groundwater monitoring wells installed in 1995 which have been monitored over the past 20 years (Exhibit 16) for signs of influence from on-site septic systems.

In 2002, the CSRD developed a Liquid Waste Management Plan (LWMP) that identified the potential options for management of municipal liquid waste generated in the area, and recognised the need for a community sewer system in the Blind Bay/Sorento area. The LWMP underwent a comprehensive review and rewrite in 2009. The 2009 LWMP identified that a community sewer system with effluent irrigation on farm land would be a preferred solution, specifically using SLE wastewater treatment plant as a "Regional Facility" for Sorrento, Blind Bay and Reedman Point (Exhibit 17).

In the 2009 LWMP, the CSRD identified technical information pertaining to a potential community sewer system including cost and flows. In 2017 (Exhibit 5), the CSRD through its consultant (Opus), determined that the estimated wastewater flow at buildout of a community sewer system would be 10,304 m^3/day (assuming a population of 23,158).

After a number of years without an associated senior government grant intake, a general downturn in the economy, a change in Electoral Area Director at the CSRD, and recognition of the high capital costs of a spray irrigation system identified in the 2009 LWMP, the CSRD commissioned geological consultants to determine if any lower cost solutions such as rapid infiltration of effluent into the ground was a viable alternative. After completing significant research and investigation (including test pits) into possible sites (all within the ALR) that could potentially accommodate infiltration of effluent through rapid infiltration in the area, it was determined that there were no sites suitable for a stand-alone rapid infiltration system. One of the major issues identified in the Sorrento area was the shallow depth of bedrock on a number of sites and the reduced ability to incorporate rapid infiltration of effluent. In the Blind Bay area, the limiting factor was the lack of sandy granular soils that would be conducive to rapid infiltration.

Gentech Engineering was retained by the CSRD to summarize the findings of these studies (Exhibit 7). Based on numerous land and sewer system alternatives that were explored, the option to use the existing SLE system with an irrigation pond, and upgrade the system as additional properties connect to the community system has been identified as the lowest cost and best remaining option.

1.3 Current Application

During the summer of 2017, CSRD staff approached SLE to discuss the potential for acquisition of the existing community sewer system (owned and operated by SLE) as well as the acquisition of a portion of the Balmoral corner property for use to develop an effluent storage pond for use in a spray irrigation program. Based on the previous letters with the ALC, it was recognised that the agricultural capability to utilize the effluent would need to be studied, along with the potential benefits and feasibility of spray irrigation.

Two reports were commissioned to determine the potential impacts to agriculture should the exclusion application be approved. The first report was an updated agrologist report completed by Wayne Blashill (Exhibit 3), and the second report was a Waste Management Opportunities and Benefits to Area Agriculture by AG Consulting (Exhibit 4).

Wayne Blashill inspected the subject property in July 2017 and dug 6 test pits to determine soil structure and capability on various sections of the site. It was determined that the site was predominantly clayey glacial lacustrine blanket. The westerly portion of the property has significant limitations due to slope and the location of a low-lying pond. This depression and wetland is all Class 5 - Class 7 in agricultural capability, but lends itself to the use as an irrigation pond. The area to the east was substantially different from findings of previous reports as the soil structure was significantly worse that originally estimated.

AG Consulting researched the benefits of a proposed spray irrigation system by interviewing surrounding land owners, exploring typical nutrient amounts that spray irrigation would have, and determining the impact to the farming community. The final report is extremely detailed and provides significant information pertaining to the benefits of spray irrigation. Some of the relevant finding are:

- Surrounding properties have a lack of water to irrigate their lands
- Spray irrigation would allow for reduced reliance on area creeks and groundwater
- Spray irrigation would provide greater control over irrigation timing and an ability for farmers to diversify their crops

- An estimated 60% - 80% increase in yield with irrigation
- Increase in crop yield due to the nutrients in the effluent water
- 9 of 11 area farmers were very interested in spray irrigation
- 1,830 acres available for irrigation within the Balmoral area (6 km radius)
- At full buildout, a total of 3,050-acre feet of irrigation (annually)

The various historical reports completed in addition to reports prepared specific to this application, in addition to the history of dialogue with the ALC and previous exclusion applications for this subject property indicate that the exclusion of subject lands from the ALR has not been taken lightly by the applicant. The studies conducted leading to this application indicate that the ALC exclusion, if granted, will provide for many community needs as well as enhance and provide opportunities to improve agricultural activities in the area. In combination, the enhancement and improvement of agricultural activities and the improvements to environmental and social health and well-being provides the clear rationale for the overall support of this application to exclude the subject property from the Agricultural Land Reserve.

Section 2 *Exhibits*

Included in this document are the following attachments:

- Letter from Erik Karlsen (ALC) to Ted Bacigalupo (Director for CSRD) – Oct 20, 2005
- Letter from Erik Karlsen (ALC) to Jay Simons (CSRD) – Jan 21, 2008
- Agrologist's Report – Wayne Blashill
- Balmoral Waste Management Opportunities and Benefits to Area Agriculture – AG Consulting
- Sorrento/Blind Bay Community Sewer System Flow Data Plan – Opus International
- Field Investigation and Preliminary Assessment of Sewage Disposal; 874 Dilworth Road – Piteau Associates
- Sorrento Community Sanitary Sewer Opportunities – Gentech Engineering
- Concept Plan for Balmoral Property
- Letter of Support from Paul Demenok, CSRD Electoral Area C Director
- Letter of Interest in Spray Irrigation for ~500 acres of land
- Letter of Support from the South Shuswap Chamber of Commerce
- Letter of Support from Mel Arnold, MP
- Letter of Support from Greg Kyllo, MLA
- Letter of Support from Shuswap Watershed Council
- CSRD – Electoral Area C Official Community Plan
- Western Water Associates – 2016 Groundwater Monitoring Report
- Earth Tech / AECOM – Liquid Waste Management Plan – Stage 3 Report

2.1 Letter from Erik Karlsen (ALC) to Ted Bacigalupo (Area Director for CSRD)

This letter dated October 20, 2005 from Erik Karlsen, Chair of the ALC to Ted Bacigalupo, Area Director of Area C – CSRD, following up on their meeting from the previous week. The ALC recognised the agricultural benefit that a spray irrigation could have and was encouraged to know that the CSRD may be involved in the administering of the system.

The ALC expressed concern of the 'effectiveness and durability of such a program' if it were not to be wholly owned and operated by the local government.

This letter is found in the Addenda as Exhibit 1.

2.2 Letter from Erik Karlsen (ALC) to Jay Simons (CSRD)

This letter dated January 21, 2008 from Erik Karlsen, Chair of the ALC to Jay Simons, Development Services Manager of the CSRD regarding the exclusion application (at that time) for Balmoral Corner. The ALC requested additional information regarding the proposed exclusion, as well additional information pertaining to the development and administration of a spray irrigation program and how the program would benefit farmers in the Balmoral area. The commitment from the ALC was that with this information, the ALC would reconsider the application from 2004. The ALC expressed interest in the treated effluent spray irrigation as a benefit to agriculture.

This letter is found in the Addenda as Exhibit 2.

2.3 Agrologist's Report – Wayne Blashill

This report is a thorough agricultural capability study of the subject property and includes the complete analysis of 6 test pits. The table below summarizes the findings in the report.

Polygon #	Agricultural Capability	Landform	Acres
1	4D	Level glacial lacustrine with heavy clay in Bt.	55
2	$4^{T}_{D}{}^{7}:3^{T}_{D}{}^{3}$	Sloping glacial lacustrine with silty clay in Bt.	34
3	6T	Steep & gullied glacial lacustrine blanket.	14
4	5W	Wetland adjacent to south side of pond.	2
5	7W	Pond in depression on west side of parcel.	4
6	5T	Moderately steep glacial lacustrine NW of pond.	11
		Total	**120**

The agrologist found that "The 4D rating in polygon 1 is substantially different from that stated in the previous report by R&H Services Ltd (1980). They rated polygon 1 as $2D^7:3D^3$. They did not recognize the heavy clay and did not correctly evaluate the effect of that texture on the D limitation. The D limitation is worse than originally estimated."

As further evidence of the 4D rating (heavy clay), the agrologist completed a lab test of a soil sample (last 2 pages of the agrologist report) and the results confirmed the presence of heavy clay. Mr. Blashill also states, "The project is considered a benefit to agriculture" and "The wastewater will become cost effective crop fertilizer. Hay and forage yields are expected to increase with the irrigation of nutrient-rich wastewater (Rusan et al, 2006)" and "The existing pond will act as a natural reservoir for the wastewater".

This report is found in the Addenda as Exhibit 3.

2.4 Balmoral Waste Management Opportunities and Benefits to Area Agriculture – AG Consulting

This report prepared by Andrea Gunner, P.Ag. identifies the opportunities of using the subject site as a retention irrigation storage pond, as well as provides the agricultural benefits of using the treated effluent as spray irrigation for the farmland within the area. The report contains information gathered from direct interviews with surrounding farmers, and quantifies the agricultural benefits of using spray effluent in the area.

The three main benefits of spray irrigation determined by the report are:

- A reduced reliance on area creeks and groundwater
- A greater control over irrigation timing
- Increased yields for farming

AG Consulting recognises that a major limitation to agricultural productivity generally is a lack of water. The additional water (especially water rich in nutrients) from the proposed treatment plant is a highly valuable resource to the farming community.

AG Consulting states, "The nearby communities of Vernon, Kamloops and Armstrong have been providing treated effluent from their municipal wastewater treatment plants as irrigation water for various landowners since 1977, 1984 and 1995 respectively."

The report contains the following information in Table 1 that shows the Amount of Nutrients from Effluent from the City of Armstrong:

City of Armstrong 2012 Nutrients from the Effluent (in pounds per acre)	Amount of effluent irrigated onto land		
	6 inches	9 inches	12 inches
Nitrogen (as N)	28	40	56
Phosphorus (as P2O5)	16	23	32
Potassium (as K2O)	32	50	66
Sulphur	20	30	40

Source: Ruth McDougall, P.Ag., *2015 City of Armstrong Soil Monitoring Report*

The report also states that "Balmoral forage producers with both irrigated and dryland forage production estimate a 60-80% increase in yield with irrigation deriving from their observations over a range of years. This includes higher yields per forage cut as well as potential for additional forage cuts in a season."

Interviews with Balmoral area farmers within a six-kilometre radius of the subject site identified that over 80% of those interviewed were very interested in the potential acquisition of the proposed spray irrigation water and currently have non-irrigated land planted as forage crop. The report indicates that "Two of the nine farmers also grow grain (wheat and barley) for which access to irrigation would open up more lucrative markets (malting barley, food grade wheat)." In Table 3 of the report, a summary the available acreage for irrigation is presented for many farms within the surrounding area. In total, there is 1,830 acres currently not irrigated that could recognise agricultural benefit with the spray irrigation program.

Based on the estimated flows of waste water available for irrigation from a community sewer service area of Blind Bay, Reedman Point and Sorrento, it is estimated that enough effluent to irrigate over 3,000-acre feet annually will be available at full buildout of the community sewer system (summarized in Table 4).

Community Sewer System Projected Wastewater Volume Flows (m^3/day)[26]

YEAR	COMMERCIAL	RESIDENTIAL	ESTIMATED FLOW (m^3/day)	ESTIMATED DAILY FLOW (IMPERIAL GALLONS)	DAILY ACRE FEET AVAILABLE IRRIGATION	ANNUAL ACRE FEET AVAILABLE IRRIGATION
2009	N/A	27%	2,400	528,000	1.95	710
2014	16%	30%	2,323	510,000	1.88	685
2019	38%	36%	3,739	820,000	3.03	1,100
2024	66%	44%	5,083	1,120,000	4.12	1,500
2029	88%	51%	6,267	1,375,000	5.08	1.850
Buildout	100%	100%	10,304	2,265,000	8.35	3,050

Conclusion of Part 1: The value of a spray irrigation program to nine current forage operations within a six-km radius, with over 1,800 non-irrigated acres would be significant, adding 60-80% productivity to these holdings.

Conclusion of Part 2: The existing site has limited feasibility as an agricultural operation. The poor quality of the grazing due to slope and poisonous bracken fern, the costs of fencing, limited area suitable for crop production and the challenges of remediation all combine to render this site economically unfeasible for an agricultural operation.

This report is found in the Addenda as Exhibit 4.

2.5 Sorrento/Blind Bay Community Sewer System Plan – Opus International

This report was originally commissioned by the CSRD in 2013 and identifies options to provide a community sewer system for the communities of Sorrento, Blind Bay and Reedman Point. The report calculates predicted flows, collection systems, as well as treatment and disposal options. The report also provides details regarding site location, overall cost breakdown, and effluent discharge volumes.

The CSRD has reviewed and researched many of these options, with Option 1 (Expansion of the Existing Sewage Treatment Facility at Shuswap Lake Estates) being the preferred option. This allows the CSRD to utilize existing infrastructure and provided the earliest timeframe for completion of a sewer system and spray irrigation program for the area.

The outcome of the buildout design flow estimate for the communities of Sorrento, Blind Bay and Reedman Point (based on current OCP) are summarized in Table 2.2:

BLIND BAY, SORRENTO AND REEDMAN POINT	APPROXIMATE AREA (ha)	NUMBER OF RESIDENTIAL DWELLINGS	WASTEWATER GENERATION RATE	ESTIMATED WASTEWATER FLOW (m^3/day)
Residential	1,210	8,709	1000 L/pop/day 625 L/pop/day	6,270
Commercial	90	-	12 m^3/ha/day	1,070
Total	1,300	8,709	-	7,340

In addition, Opus revised the assumed growth in the subject area and provided a Community Sewer System Plan Growth Assumptions and Design Flows in Table 2.5:

YEAR	PERCENTAGE OF BUILDOUT		ESTIMATED FLOW (m^3/day)
	COMMERCIAL	RESIDENTIAL	
2009	Unknown	27%	2,400
2014	16%	30%	2,323
2019	38%	36%	3,739
2024	66%	44%	5,083
2029	88%	51%	6,267
Buildout	100%	100%	10,304

This report is found in the Addenda as Exhibit 5.

2.6 Field Investigation and Preliminary Assessment of Sewage Disposal – Piteau Associates

This report was commissioned by the CSRD in 2014 to assess the feasibility of in-ground disposal of sewage effluent at 874 Dilworth Road (a potential site for rapid infiltration of effluent from Sorrento). Based on the site work and investigation, the disposal capacity was substantially less than estimated or required for a community sewage system. Although the site looked promising for rapid ground water infiltration, the results were limited to only 300-400 m^3/day and therefore not worth pursuing.

This report is found in the Addenda as Exhibit 6.

2.7 Sorrento Community Sanitary Sewer Opportunities – Gentech Engineering

This report was commissioned by the CSRD and is a technical memo summarizing the findings of the evaluation onto the feasibility of a stand-alone Sorrento Community Sanitary Sewer system. This report summarizes the numerous reports that have been completed between 2009 and 2015.

This report is found in the Addenda as Exhibit 7.

2.8 Concept Plan for Balmoral Property

Concept Plan for the Balmoral Property outlining 13.5 ha for a CSRD retention irrigation storage pond and the balance of the property for commercial, recreational and higher density residential. This property will act as the Balmoral Village as referred to in the CSRD's Official Community Plan.

This plan is found in the Addenda as Exhibit 8.

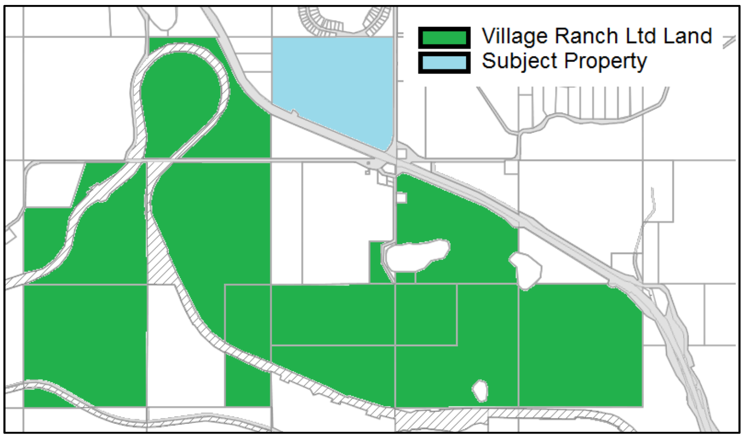
2.9 Letter of Support – Paul Demenok, Electoral Area C Director (CSRD)

This letter was written by Paul Demenok, CSRD Director for Electoral Area C (South Shuswap) and provides support for the community sewer system and village center development initiative. In addition to the major environmental concerns, Director Demenok identifies the benefits that the exclusion of land will have socially and economically.

This letter is found in the Addenda as Exhibit 9.

2.10 Letter of Interest in Spray Irrigation for ~500 acres of land

Letter from John Born, President of Village Ranch Ltd confirming his interest in spray irrigation for his properties. Mr. Born confirms that he has 500 acres of land close to the subject property and would be interested in irrigating with the treated effluent from the CSRD system. Mr. Born has expressed interest in spray irrigation for his properties since 2006 when he purchased land a few hundred feet from the proposed irrigation pond (south side of Trans-Canada Hwy). Below is a small map showing the subject parcel in blue, and lands owned by Village Ranch Ltd in green.



This letter is found in the Addenda as Exhibit 10.

2.11 Letter of Support from the South Shuswap Chamber of Commerce

Letter from Mark Lane, President of the South Shuswap Chamber of Commerce expressing support for the exclusion of the subject property and the existing shortage of land for potential development and commercial use.

This letter is found in the Addenda as Exhibit 11.

2.12 Letter of Support from Mel Arnold, MP

Letter from Mel Arnold, Member of Parliament for North Okanagan – Shuswap, expressing his support for the exclusion as it has a number of ecological, agricultural, economic and social benefits. In addition, Mr. Arnold identifies the agricultural benefit of using treated effluent in agricultural operations, making them more sustainable. With the treatment facility, it will also provide for future development (assisted living, nursing home, housing, amenities) as these require an adequate sewage system.

This letter is found in the Addenda as Exhibit 12.

2.13 Letter of Support from Greg Kyllo, MLA

Letter from Greg Kyllo, Member of Legislative Assembly for the Shuswap. Mr. Kyllo supports the application to excluded land from the ALR as it will allow for the construction of a Waste Water Treatment Facility.

This letter is found in the Addenda as Exhibit 13.

2.14 Letter of Support from Shuswap Watershed Council

Letter from Paul Demenok, Chair of the Shuswap Watershed Council (SWC). The SWC support the application as they recognize both the agricultural and environmental benefits. The agricultural benefit of using treaded effluent for spray irrigation to support and improve local agricultural operations, and the environmental benefits of reducing the environmental pressures on the critically important Shuswap watershed.

This letter is found in the Addenda as Exhibit 14.

2.15 CSRD – Electoral Area C - Official Community Plan

The Official Community Plan for Electoral Area C referenced both the need for a community sewer system, and the desire to have a Balmoral Village Centre. The OCP was written with guidance from the ALC although it is clear in the OCP that the ALC has not approved any exclusion.

The relevant sections of the OCP can be found in the Addenda as Exhibit 15.

2.16 Western Water Association Ltd – 2016 Groundwater Monitoring Report

The report is a summary of the background, method and results for groundwater monitoring in Blind Bay and Sorrento.

The report indicates that levels of fecal coliform and/or E. Coli exist in a number of sites in the study area.

The report is found in the Addenda as Exhibit 16.

2.17 Liquid Waste Management Plan – Stage 3 – EarthTech/AECOM

This Stage 3 report of the CSRD's Liquid Waste Management Plan was completed in January 2009 and identified the preferred solution for the Sorrento and Blind Bay area was to use the existing SLE treatment plan as a "Regional Facility".

The report goes on to recognise the agricultural benefit by identifying: "Given the strong interest shown by members of the agricultural community in the vicinity of the SLE treatment plant and the limited water supply, there appears to be significant demand for effluent for irrigation. Excess demand ensures that the effluent demand, even under a wet year, is greater than the available supply."

The report is found in the Addenda as Exhibit 17.

Benefits to Agriculture

To assist the ALC to deliver on its mandate, we have reviewed this proposal against the purpose of the Commission as outlined in Section 6 of the Agricultural Land Commission Act (the ‘Act’). Section 6 states:

“**The following are the purposes of the commission**”:

6a – to preserve agricultural land;

The subject land has not been farmed and the agricultural capabilities are predominantly Class 4 and higher due to the heavy clayey glacial lacustrine blanket. With this application, existing farm land will be able to receive adequate water and increased nutrients through a spray irrigation program increasing the agricultural capability of the lands. The anticipated increase in crop yield with irrigation is anticipated to be between 60% - 80%. (Exhibits 3 & 4)

6b – to encourage farming on agricultural land in collaboration with other communities of interest;

Upon approval of this application, ALR lands within the region that currently have limited or no access to irrigation would be enhanced through the acceptance of treated effluent. The proposed wastewater treatment site would result in a spray irrigation program operated by the CSRD that could ultimately provide over 3,000-acre feet of spray irrigation per year. Concurrently with the spray irrigation system, the sewer system would allow for densification of existing lands in the community by allowing subdivision of existing lots and densification to occur of non-ALR lands (currently parcels need to be a minimum of 1.0 hectare in size as they require septic fields). Finally, a community sewer system would allow existing properties to connect to the system and reduce the effluent that is currently entering the groundwater through individual sceptic systems and causing elevated constituents of onsite septic systems such as nitrates, phosphorus and fecal coliform and/or E. Coli levels in Shuswap Lake near Blind Bay and Sorrento. (Exhibits 4 & 16)

6c – to encourage local governments, first nations, the government and its agents to enable and accommodate farm use of agricultural land and uses compatible with agriculture in their plans, bylaws and policies.

The exclusion of the subject lands from the ALR would provide opportunities to develop the Balmoral Village that has been identified as a community goal and noted in the current CSRD OCP (Exhibit 15). A village centre would provide a community hub for various activities. These activities should reduce the vehicular trips to larger centers, resulting in reduced traffic and GHS emissions from vehicle exhaust. The Balmoral lands are large enough to provide for years of growth.

Overall, although the application is requesting the exclusion of 45.1 hectares of land from the ALR, the exclusion will increase agriculture productively in the community by improving yields for crop-based agriculture, while also improving the water quality of Shuswap Lake and deliver on many social needs in the community.

4.1 Nutrient Rich Spray Irrigation

Should the ALC approve this ALR Exclusion Application, approximately 1/3 of the site will be used as a wastewater storage effluent lagoon and receive effluent from the existing Shuswap Lake Estates Sewage system. The existing system will be transferred to CSRD as a community sewer system, and will be expanded over time to provide servicing to areas of Blind Bay, Reedman Point and Sorrento. As more effluent is captured it will be directed to be utilized in the spray irrigation program.

There has been strong interest for spray irrigation from the surrounding farmers who see the possibility of nutrient rich spray irrigation being a benefit to their fields and agricultural capability. This will result in a 60% - 80% increase in crop yields. (Exhibit 3)

Spray irrigation is a method for disposing of secondary treated municipal wastewater by spraying it on the land surface. Land application of wastewater has advantages over conventional means of disposal. These advantages or benefits are derived from the "natural" treatment of the wastewater that takes place in the soil when plants and other biota remove nutrients (nitrogen and phosphorus) from the wastewater.

Another benefit of effluent reuse is the decrease in wastewater discharges to natural waterways. When pollutant discharges to waterways are removed or reduced, the pollutant loadings to these waters are decreased. Substances that can be pollutants when discharged to waterways can be beneficially reused for irrigation. For example, plant nutrients such as nitrogen and phosphorus can stimulate harmful algal blooms in waterways and are a valuable fertilizer for crops.

4.2 Densification

The development of the storage effluent reservoir and the acquisition of the existing sewer system by the CSRD will enable the expansion of the service area into Sorrento, Reedman Point and Blind Bay, and will reduce the overall number of individual septic fields within these communities.

As Health Authorities do not recommend that properties containing on-site septic systems subdivide unless they are over 2 hectares in size (thus creating a propensity of 1 Ha lots), there is a lack of opportunity for densification in these existing communities. By connecting to community sewer, existing lots will be able to decommission their septic systems, subdivide their properties, and densify the land.

4.3 Reduction in GHG emissions

With the location of Balmoral Village Centre located in the northwest corner of the Trans-Canada Highway and Balmoral Road, the number of vehicular trips into Salmon Arm should be reduced, and result in fewer overall GHG emissions from fewer operating vehicles.

4.4 Removes Effluent from Shuswap Lake

The CSRD has conducted groundwater monitoring in the Blind bay Sorrento area since 1995. Since that time, water tests have found that the area has deteriorating water quality, with indicators most likely related to septic impacts. Over the past five years sampling has shown "slightly higher" levels of fecal coliform in Shuswap Lake. In 2012 the Columbia-Shuswap Regional District advised that "swimmers should make efforts not to ingest lake water and children should always be closely supervised."

With the acquisition of the community sewer system and corresponding decrease in on-site systems, a decrease in the levels of constituents of on-site sewer systems (such as fecal coliform) is expected at the foreshore of Shuswap Lake. (Exhibit 12)

4.5 Builds a Community Centre

Residents of Blind Bay and Sorrento have for decades commuted to larger community centers such as Salmon Arm for shopping and activities. This commute adds increased traffic to the ~29 km section of the Trans-Canada Highway separating Salmon Arm and Blind Bay/Sorrento. By placing a community centre in Balmoral, the use of this highway by residents should decrease. This will build community and social character and identity within Balmoral by encouraging locally owned and operated businesses to open in the proposed community centre.

ADDENDA –

EXHIBIT 1

Letter from ALC to CSRD Re Balmoral Corner – October 20, 2005

ALC

Agricultural Land Commission
133–4940 Canada Way
Burnaby, British Columbia V5G 4K6
Tel: 604-660-7000
Fax: 604-660-7033
www.alc.gov.bc.ca

October 20, 2005

Reply to the attention of Martin Collins

RECEIVED
OCT 27 2005

Ted Bacigalupo, Director Electoral Area C
Columbia Shuswap Regional District
PO Box 978
Salmon Arm, B.C. V1E 4P1

Dear Sir:

Re: Application H-33986 (Balmoral Corner)

The Agricultural Land Commission would like to thank you very much for taking the time to meet on Friday, October 14th, 2005.

The Commission appreciated the opportunity to discuss growth pressures in the Blind Bay/Sorrento are, and to hear your vision as to how growth will be accommodated. The Commission was also pleased to hear that you believe that the Regional District may have a role to play in the administration of a spray irrigation system in the Balmoral area. The Commission believes that the proposed irrigation system could have long term benefits to agriculture in the Balmoral area, and as such is willing to continue discussions with the Regional District and the applicant as to how a spray irrigation infrastructure can be developed and administered that is supported by the Regional District, so that irrigation benefits will remain available to local farmers in the long term.

However, it should be emphasised that continuing discussions with the Regional District and the applicant should in no way be construed that the Commission will exclude ALR land if spray irrigation is developed. The Commission continues to have reservations about the effectiveness and durability of such a program, particularly if it continues to be wholly owned and operated by private, rather than public interests.

If you have any further questions about the next steps in the process, please contact Martin Collins at 604-6607021.

Yours truly,

PROVINCIAL AGRICULTURAL LAND COMMISSION

Per:

Erik Karlsen, Chair

Cc: Terry Barker, Shuswap lake Estates Ltd., PO Box 150, Blind Bay, BC V0H 1H0

MC/eg/l/33986m16

EXHIBIT 2

Letter from ALC to CSRD Re Balmoral Corner – January 21, 2008

Agricultural Land Commission
133–4940 Canada Way
Burnaby, British Columbia V5G 4K6
Tel: 604 660-7000
Fax: 604 660-7033
www.alc.gov.bc.ca

January 21, 2008

Reply to the attention of Martin Collins

Jay Simons
Chief Administrative Officer
Columbia Shuswap Regional District
PO Box 978
Salmon Arm, B.C.
V1E 4P1

RECEIVED
JAN 28 2008

Re: Application H-33986 (Balmoral Corner)

Your File: LC2247-C

The Agricultural Land Commission considered and refused an exclusion application for 47 ha of ALR at the northwest quadrant of the intersection of Balmoral Rd. and Highway #1 in late 2003. The excluded area was proposed for commercial, low and medium density residential housing, and a golf course (see attached map and sketches for details).

The applicant (Shuwap Lake Estates) requested (in 2004) that the application be reconsidered based on a revised proposal which proposed the following benefits for agriculture;

- to include 19 ha into the ALR,
- to irrigate farmlands lying to the west of Highway #1 with treated sewage water.

The Commission requested more detailed information about the irrigation project, expressing interest in the concept, but also expressing concern that any irrigation agreement between two private entities would not ensure that the irrigation benefits would be secured by agriculture for the long term. In that vein, concurrent discussions with Director Bacigalupo confirmed that the Regional District might have an interest in administering a spray irrigation program.

It is the Commission's understanding that the Regional District may soon be entering into negotiations to purchase Shuwap Lake Estates' sewage treatment facility as a result of recommendations arising from Electoral Area C Liquid Waste Management Plan. The Commission may consider the purchase and administration of the sewage treatment facility by the Regional District to potentially offer an agricultural benefit, if spray irrigation is developed.

Shuswap Lake Estates has requested a commitment from the Commission that the 47 ha area proposed for exclusion at Balmoral corner will be excluded if the Regional District purchases the sewage treatment facility and operates a spray irrigation program. The Commission is not prepared to consider the issue without understanding the Regional District's position on the matter. The Commission therefore requests the Board provide its position regarding:

- the proposed exclusion, and
- developing and administering a spray irrigation program that will benefit farmers in the Balmoral area

Upon receipt of the above, the Commission will reconsider the application, taking into account both the agricultural benefits proposed by the applicant, the views of the Regional District, and its mandate as described in the *Agricultural Land Commission Act.*

If you have any questions about this matter, please contact Martin Collins at 604-660-7021.

Yours truly,

PROVINCIAL AGRICULTURAL LAND COMMISSION

Per

Erik Karlsen, Chair

Enclosure

MC/33986m19

EXHIBIT 3

Wayne Blashill, PAg

Agrologist’ s Report

S.W. ¼, SECTION 8, TWP. 22, RANGE 10, KDYD
BALMORAL. BC.
AGROLOGIST'S REPORT

Prepared by: Wayne A. Blashill, PAg
11519 Quinpool Road.
Summerland. BC. V0H 1Z5.
(250) 494 5323
e-mail: <wayne_blashill@telus.net>
August 28, 2017

Signature Wayne Blashill, PAg

WB

INTRODUCTION

This Agrologist's Report has been compiled to provide an agricultural capability and arability assessment for a property NW of the corner of Balmoral Road and the TransCanada Highway 1, Blind Bay, BC. This report will be used to form part of a future ALC Application for Exclusion. The land is currently in the ALR.

The legal address of the property is:

S.W. ¼, Section 8, TWP. 22, Range 10, KDYD.

METHODS

The site was inspected on July 12, 2017. There were 6 soil test pit locations numbered TP1 to TP6. The soil pits were excavated by machine. The soil pits were placed to sample the variation in the soils and landforms across the property. The BC Ministry of Forests FS882 field form was used to record the data. Site and soil data was recorded at each test pit to enable calculation of the agricultural capability. Slope only was recorded at a couple of locations to confirm the topography limitation T.

The soil horizons were described to determine depth of topsoil and surface gravel content. Soil color, depth, % coarse fragments, soil texture, roots, structure and clay skins are among the factors used to differentiate soil horizons, topsoil depth and extent. Site factors such as slope, aspect, drainage, landform and surface shape are also recorded.

The soil pits were dug to about 1.5 m depth and a photograph taken. A topsoil sample was taken from soil test pits TP1 and TP6. The soil chemistry samples will characterize the nutritional status of the soil. The data was collected over a period of 7.5 hours.

RESULTS

It was determined from field inspection that the 120-acre parcel is mainly composed of a clayey glacial lacustrine blanket ($cL^{G}b$) described by Howes and Kenk (1988). The glacial lacustrine deposit topography varies from level to sloping and contains a pond in the NW portion. The soil polygon labels and boundaries are shown in Figure 1. The soil test pit locations are depicted in Figure 2. The original high resolution ortho-image for Figures 1 and 2 can be inspected on Google Earth.

Soils

The following soils descriptions (Tables 1 & 2) show two of the typical profiles found at the property. The complete descriptions can be found in their entirety in Appendix B which contains photographs of the original FS882 field cards from all test pits. TP1 is in the flat east part of polygon 1. TP6 is in the sloping north central part of polygon 2.

The soil pit pictures are in Appendix A. The soil horizon and texture definitions can be found in NRC (1998). Soil colors were determined using a Munsell Color Chart (Amazon.ca, 2017).

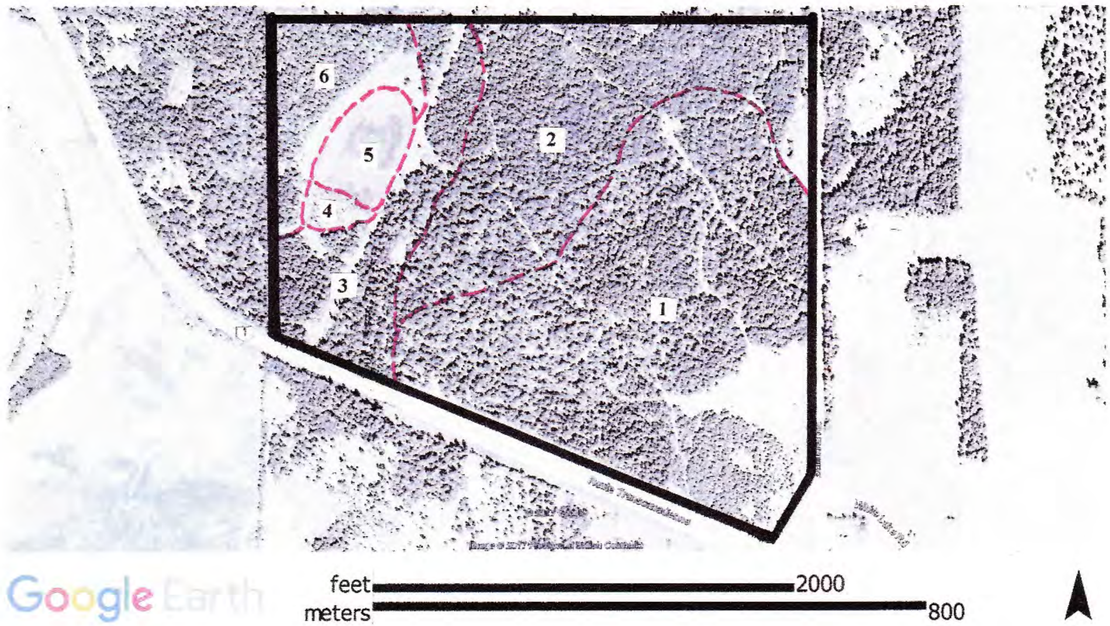


Figure 1. Soil polygon numbers and boundaries at the Balmoral Road property.

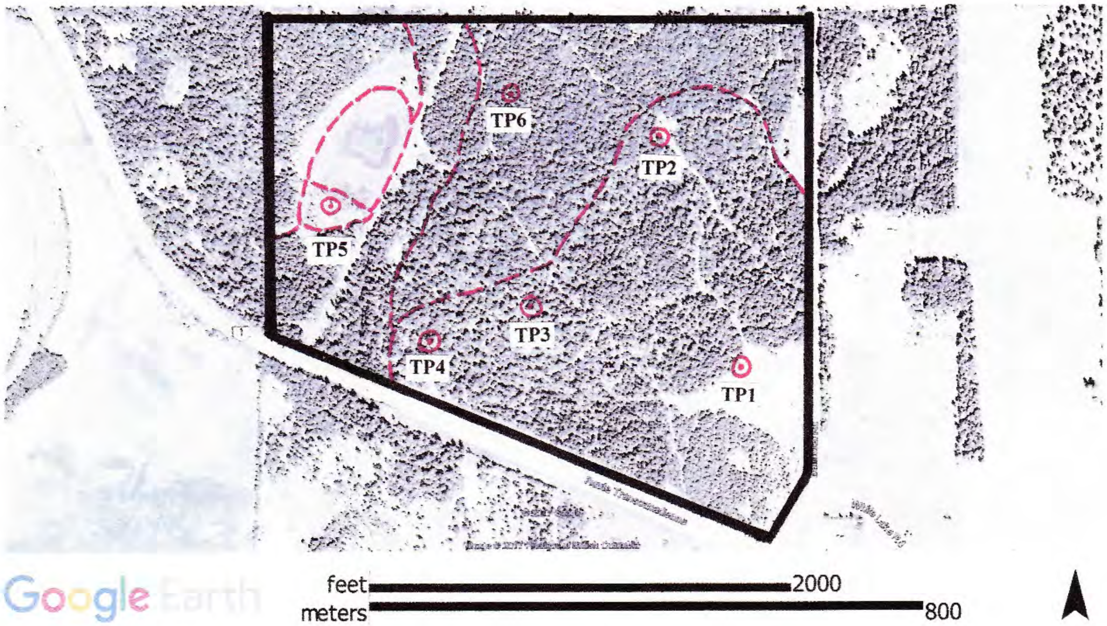


Figure 2. Soil test pit locations at the Balmoral Road property.

Table 1. Soil description for TP1 an Orthic Gray Luvisol (NRC, 1998) on flat glacial lacustrine.

HORIZON	DEPTH	COLOUR	TEXTURE	TOTAL	COARSE	FRAGMENT	CONTENT
	(cm)			**Gravel**	**Cobbles**	**Stones**	**Total**
LFH	2-0			(%)	(%)	(%)	(%)
Ae	0-18	10YR5/2	silty clay loam	0	0	0	0
Bt1	18-43	10YR4/2	heavy clay	0	0	0	0
Bt2	43-77	10YR4/2	heavy clay	0	0	0	0
C	77-127	10YR4/2	silty clay	0	0	0	0

Table 2. Soil description for TP6 an Orthic Gray Luvisol on sloping glacial lacustrine.

HORIZON	DEPTH	COLOUR	TEXTURE	TOTAL	COARSE	FRAGMENT	CONTENT
	(cm)			**Gravel**	**Cobbles**	**Stones**	**Total**
LFH	5-0			(%)	(%)	(%)	(%)
Ae	0-12	10YR3.5/2	silt loam	0	0	0	0
Bt1	12-33	10YR4/2	silty clay	0	0	0	0
Bt2	33-72	10YR4/2	silty clay	0	0	0	0
C	72-115	10YR4/2	silty clay loam	0	0	0	0

Soil Chemistry

The soil chemistry samples are used to determine the fertility of the topsoil (Tables 3 & 4). The complete chemistry data sheets for horizons Bt1 (18-43) and Bt1 (12-33) are found in Appendix B. The data is used to characterize the nutritional status of the soils. The soil analytical data was provided by Exova (2017).

Table 3. Soil chemistry analysis for the TP1 sample.

SAMPLE	pH	%OM	NO_3^- (ppm)	CEC (meq/100g.)	P (ppm)	K (ppm)	Ca (ppm)	Mg (ppm)	EC (dS/m)
Bt1 (18-43)	7.2	3.1	<2	37.4	29	555	4500	1610	0.26

The soil chemistry analysis for TP1 has potassium, calcium and magnesium in excess (Appendix B). Phosphorus, iron, copper and manganese are optimal. Sulphate-S and zinc are marginal while Nitrate-N, boron and chlorine are deficient. The pH is ideal, the EC is good and the %OM is normal. Sodium is low (good). The overall nutritional status of the topsoil is considered moderate. Fertilizer is still recommended for balanced crop nutrition.

Particle size analysis was also done on this sample to verify the heavy clay soil texture. The % sand, silt and clay are 14, 20 and 66 respectively. The data is below the bar graphs.

Table 4. Soil chemistry analysis for the TP6 sample.

SAMPLE	pH	%OM	NO_3^- (ppm)	CEC (meq/100g.)	P (ppm)	K (ppm)	Ca (ppm)	Mg (ppm)	EC (dS/m)
Bt1 (12-33)	6.8	1.8	3	11	>60	380	1130	267	0.1

The soil chemistry data for TP6 shows that phosphorus is in excess. Potassium, calcium, magnesium, iron and manganese are all optimal. Sulphate-S, copper, zinc and chlorine are marginal. Nitrate-N and boron are deficient. The pH is ideal, the EC is good and the %OM is low. Sodium is low. The overall nutritional status of the topsoil is considered moderate.

Climatic Capability

The nearest climate station to the property is Salmon Arm at 506 m in elevation (RAB, 1972). The property is lower in elevation than the climate station. This would make the site slightly warmer than Salmon Arm. The climatic capability for agriculture is estimated to be virtually the same as Salmon Arm:

5A
(1aF)

Aridity subclass 5A is improved through irrigation to Class 1A. Subclass (F) indicates minimum temperatures near freezing will adversely affect plant growth during the growing season. Subclass (1a) climate can theoretically produce: hardy apples, berries, beans, asparagus, tomatoes, lettuce, potatoes, corn, carrots, beets, radishes, peas, onions, leeks, spinach, cauliflower, cabbage, broccoli, turnips, Brussel sprouts, Swiss chard, cereal grains and forage. However, the main local commercial agricultural operations are hay and forage production.

Agricultural Capability

The property was mapped into 6 polygons of similar site and soil characteristics. Table 5 has the agricultural capability rating for each soil polygon in Figure 1. The rating was derived from each soil pit data and notes about each polygon. Table 6 has the definitions for the various capability subclasses present (Kenk, 1983).

Table 5. Agricultural capability ratings for the polygons in Figure 1.

Polygon #	**Agricultural Capability**	**Landform**	**Acres**
1	4D	Level glacial lacustrine with heavy clay in Bt.	55
2	$4^{T}_{D}{}^{7}:3^{T}_{D}{}^{3}$	Sloping glacial lacustrine with silty clay in Bt.	34
3	6T	Steep & gullied glacial lacustrine blanket.	14
4	5W	Wetland adjacent to south side of pond.	2
5	7W	Pond in depression on west side of parcel.	4
6	5T	Moderately steep glacial lacustrine NW of pond.	11
		Total	**120**

Soil limitations due to topography T are not considered improvable. The pond and wetland are in a closed bowl with no outlet. Thus, the 5W and 7W cannot be improved by drainage. The soil structure limitation D has no improved rating. It is unknown if deep ploughing, ripping or blading will significantly improve this soil. It would probably just create a field of heavy clay cement-hard clods.

The heavy clay soil texture in the Bt horizons may explain why this land shows no visual evidence of historical farming. Flat, clay soil this close to the highway would surely have been cultivated in the past. However, the heavy clay would have been difficult to break with the lightweight plows, cultivators and seed drills they had back in the 1900's. The soil has 66% clay which can make cultivation problematic even with modern farm implements.

The forest land south across the highway and NW from the subject property is flat and about the same elevation. The presence of heavy clay in this area, may be a contributing factor as to why those forested lands are currently not cultivated.

Table 6. The agricultural capability class, subclass & definitions for Table 5.

Class	Subclass	Limitation	Definition
3	D	Soil Structure	Root restricting layer occurs within 25 to 50 cm of the mineral soil surface, or the upper 25 cm usually has a texture of silty clay or clay.
4	D	Soil Structure	Root restricting layer occurs within 25 cm of the mineral soil surface, or the upper 25 cm usually has a texture of heavy clay.
3	T	Topography	Simple slopes varying from 11 to 15% or complex slopes varying from 6 to 10%.
4	T	Topography	Simple slopes varying from 16 to 20% or complex slopes varying from 11 to 15%.
5	T	Topography	Simple slopes varying from 21 to 30% or complex slopes varying from 16 to 30%.
6	T	Topography	Slopes, either simple or complex, varying from 31 to 60%. The land provides only natural grazing for livestock.
5	W	Excess Water	Frequent or continuous occurrence of excess water during the growing period. Water level is near the soil surface until early summer, or the maximum period the water level is less than 20 cm below the soil surface is 6 weeks during the growing period.
7	W	Excess Water	Underwater most of the growing season, not useable for agriculture.

DISCUSSION

Polygon Summary

Polygons 1 and 2 are the arable portions of the property. They comprise an area of approx. 89 acres. This is about 74% of the entire property. The remaining 31 acres are non-arable, because of being too steep T or too wet W.

The 4D rating in polygon 1 is substantially different from that stated in the previous report by R&H Services Ltd (1980). They rated polygon 1 as $2D^7$:$3D^3$. They did not recognize the heavy clay and did not correctly evaluate the effect of that texture on the D limitation. The D limitation is worse than originally estimated.

Benefit to Agriculture

The owners intend to construct a commercial, recreational and housing subdivision on the property. The Regional District and the owners propose to move treated wastewater from this development and the adjacent Shuswap Lake Estates (SLE) into the existing pond on the property. SLE already has operating primary, secondary sewage treatment and a chlorination plant.

The owners want to deliver treated wastewater as liquid fertilizer for spray application on adjacent and nearby farms. The pond and wetland will become the new reservoir for the secondary treated and chlorinated wastewater. The Regional District plans to buy the SLE sewer treatment plant and the pond area on the subject property. They will commit to using spray irrigation as the means of disposing of the treated effluent.

The project is considered a benefit to agriculture. The wastewater will become cost effective crop fertilizer. Hay & forage yields are expected to increase with the irrigation of nutrient-rich wastewater (Rusan *et al*, 2006). Much like it would through the equivalent applications of dry fertilizer. Photo#7 shows the existing reservoir with a noticeable "algae bloom". General knowledge is that algae and aquatic plants in ponds and lakes indicate eutrophic (nutrient-rich) water conditions. In the case of wastewater ponds, the water is usually high in nitrates, phosphate and potassium. These are important plant macro-nutrients.

Additionally, periodic inspections will be required to ensure that salts do not accumulate in the soil. Fall irrigation with freshwater would alleviate possible high salt levels. Crop irrigation rates should not exceed the available water storage capacity (AWSC) of the root zone. Excess wastewater would drain below the root uptake zone and nitrates could leach into the groundwater. Also, irrigating with freshwater prior to harvest would wash any nitrate residue from crop leaves. Thus, reducing the ingestion of excess nitrates by livestock.

Spray irrigation of treated wastewater directly onto edible food crops is not recommended, especially those that are eaten raw. The treated effluent irrigation would be strictly for hay and forage crops.

CONCLUSION

It is the Agrologist's opinion that the subject property has 89 arable acres composed of polygons 1 and 2. The remaining 31 acres are non-arable due to topography and wetness. The proposed irrigation of adjacent farmland using nutrient-rich wastewater, will provide a benefit to agriculture of a cost-effective source of fertilizer and the subsequent increase in crop yield.

The existing pond will act as a natural reservoir for the wastewater. It is suggested that wastewater irrigation be conducted in consultation with Agriculture Canada using their Best Agricultural Practices guidelines.

REFERENCES

Amazon.ca. 2017. Webpage: Munsell Color Book or Munsell Color Book 2-page packet.

Exova. 2017. #104 19575-55A Ave. Surrey. BC. V3S 8P8. Canada.

Howes, D.E. and E. Kenk. 1988. Terrain Classification System for British Columbia. MOE Manual 10. Ministry of Environment. Victoria.

Kenk, E. 1883. Land Capability Classification for Agriculture in BC. MOE Manual 1. Ministry of Environment. Victoria.

NRC. 1998. *The Canadian System of Soil Classification.* Agriculture Canada. Research Branch. Ottawa.

RAB. 1972. Climatic Capability for Agriculture in BC. Resource Analysis Branch. Technical Paper 1. Province of BC. Victoria.

R&H Services Ltd. 1980. Agricultural Land Assessment for Nortco Construction Ltd. Balmoral Property.

Rusan, M.J.M, S. Hinnawi and L. Rousan. 2006. Long term effect of wastewater irrigation of forage crops on soil and plant quality parameters. Presented to the International Conference on Sustainable Water Management, Rational Water Use, Wastewater Treatment and Reuse. Marrakech. Morocco.

APPENDIX A

Photo Diary

Executive Summary

Photo #1. Soil test pit TP1 an Orthic Gray Luvisol with heavy clay in the Bt.

Photo #2. Soil test pit TP2 an Orthic Gray Luvisol with heavy clay in the Bt.


Photo #3. Soil test pit TP3 an Orthic Gray Luvisol with heavy clay over silty clay.


Photo #4. Soil test pit TP4 an Orthic Gray Luvisol with heavy clay over deep sand.


Photo #5. Soil test pit TP5 an Orthic Humic Gleysol with silt loam and prominent mottles.


Photo #6. Soil test pit TP6 an Orthic Gray Luvisol with silty clay in the Bt.


Photo #7. Nutrient-rich wastewater reservoir at Shuswap Lake Estates with algae bloom.

Executive Summary

Mr. Blashill, *Professional Agrologist*, has 40 years experience in soils and ecology field work throughout BC and in AB, SK and the USA. He has completed Agrologist's Reports for numerous ALC Applications. He has a background in soil science. Climate and soils experience is required to: calculate and rate the climatic and agricultural capability; assess the extent and depth of topsoil. The soil texture, colour, % coarse fragments, structure, carbonates, roots and chemistry are all used to determine topsoil amount and quality.

The Agrologist's opinion is based on the site and soil factors observed and recorded at the property, along with the operational constraints and plans from the landowner. The Agrologist also has knowledge in field crops, soil chemistry, evaporation theory and soil water balance modelling.

APPENDIX B

FS882 Field Cards

Soil Chemistry Analysis

PROVINCE OF BRITISH COLUMBIA
Ministry of Forests

ECOLOGICAL CLASSIFICATION RECONNAISSANCE FORM

SITE DESCRIPTION

SITE TYPE: Balmoral Rd and Highway 1, Shuswap.

DATE: July 12, 2017

SURVEYOR: Blashill

SITE NO.:

PLOT NO.: TP1

BIOGEOCLIMATIC UNIT:

MAP UNIT:

ECOSYSTEM ASSOC.:

LOCATION

TRANSECT: landing near opening.

LOCATION:

AIR PHOTO NO.: X CO-ORD.: Y CO-ORD.:

MAP SHEET (NTS): LONG.: LAT.:

ELEVATION: 441 m SLOPE: 0 % ASPECT: — °

MESO SLOPE POS.: LEVEL SURFACE SHAPE: STRAIGHT

MOISTURE REGIME: NUTRIENT REGIME:

SUCCESSIONAL STATUS: EXPOSURE:

SITE HISTORY: Logging

SITE DIAGRAM

GEOLOGY

BEDROCK GEOLOGY: COARSE FRAG. LITH.:

NOTES: Photo # 703

— poor forage.

SURFACE SUBSTRATE	
HUMUS	
DEAD WOOD	
BEDROCK	
ROCKS	
MINERAL SOIL	
WATER	

FS 882 RES 88/08

SOIL DESCRIPTION

SOIL CLASSIF.: Orthic Gray Luvisol

TERRAIN CLASSIF.: $^{\phi}$c L^{Gb}

HUMUS FORM:

DRAINAGE CLASS: mw

ROOTING DEPTH: 40 cm

ROOT RESTRICTING LAYER: TYPE: — DEPTH: — cm

SEEPAGE WATER DEPTH: — cm

(TP1)

PROFILE DIAGRAM

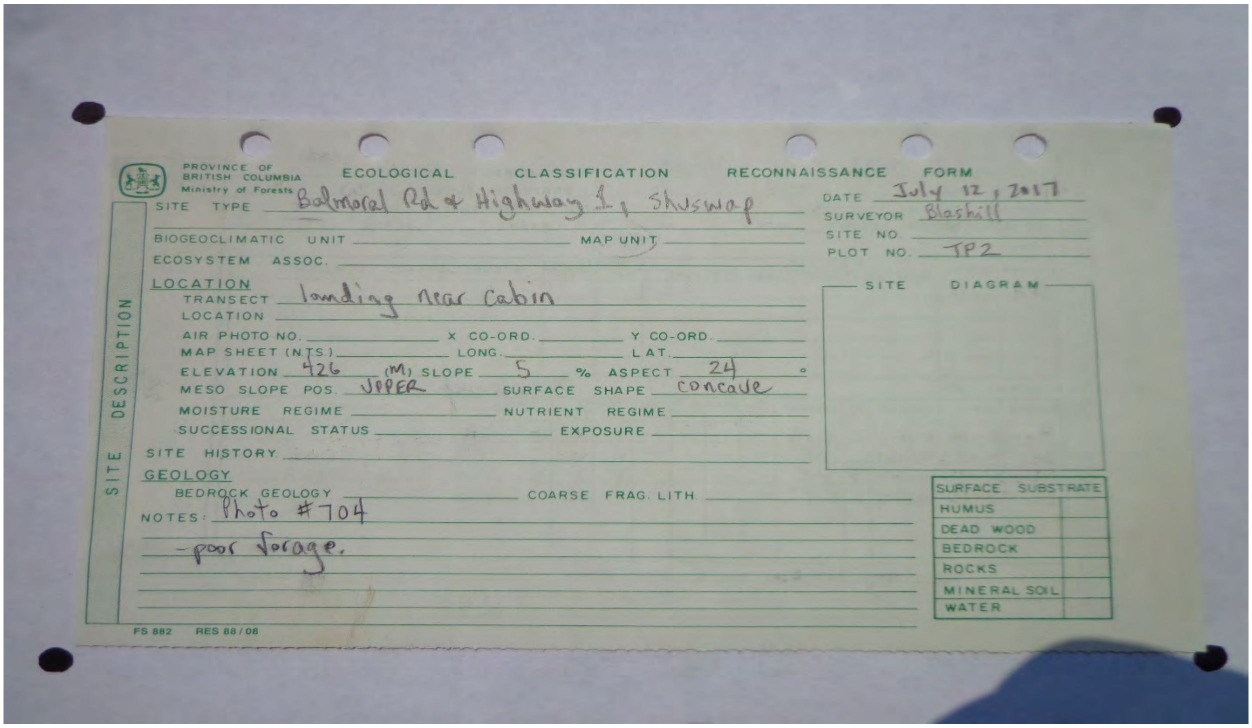
HUMUS

HORIZON	DEPTH	FABRIC STRUCTURE / CONSIST / CHAR. / TEXTURE	ROOTS AB.	ROOTS SIZE	MISCELLANEOUS COMMENTS
LFH	2–0				

MINERAL SOIL

HORIZON	DEPTH	COLOUR	A/Sp	TEXTURE	% COARSE FRAGS. G	C	S	TOT.	ROOTS AB.	ROOTS SIZE	MISC.	STRUCTURE	COMMENTS
Ae	0–18	10YR5/	2	SiCl	—	—	—	—	A	M	F	GR	
Bt1	18–43	10YR4/	2	HC	—	—	—	—	P	M	VC	ABK	– clay skins
Bt2	43–77	10YR4/	2	HC	—	—	—	—	F	F	VC	ABK	– clay skins
C	77–127	10YR4/	2	SiC	—	—	—	—	—	—		MA	

NOTES: – no carbonates
– very strong structure + lots of clay skins



PROVINCE OF BRITISH COLUMBIA Ministry of Forests

ECOLOGICAL CLASSIFICATION RECONNAISSANCE FORM

SITE DESCRIPTION

SITE TYPE Balmoral Rd & Highway 1, Shuswap

DATE July 12, 2017

SURVEYOR Blashill

BIOGEOCLIMATIC UNIT

MAP UNIT

SITE NO.

ECOSYSTEM ASSOC.

PLOT NO. TP2

LOCATION

TRANSECT LOCATION landing near cabin

AIR PHOTO NO.

X CO-ORD.

Y CO-ORD.

MAP SHEET (N.T.S.)

LONG.

LAT.

ELEVATION 426 (M)

SLOPE 5 %

ASPECT 24 °

MESO SLOPE POS. UPPER

SURFACE SHAPE concave

MOISTURE REGIME

NUTRIENT REGIME

SUCCESSIONAL STATUS

EXPOSURE

SITE HISTORY

SITE DIAGRAM

GEOLOGY

BEDROCK GEOLOGY

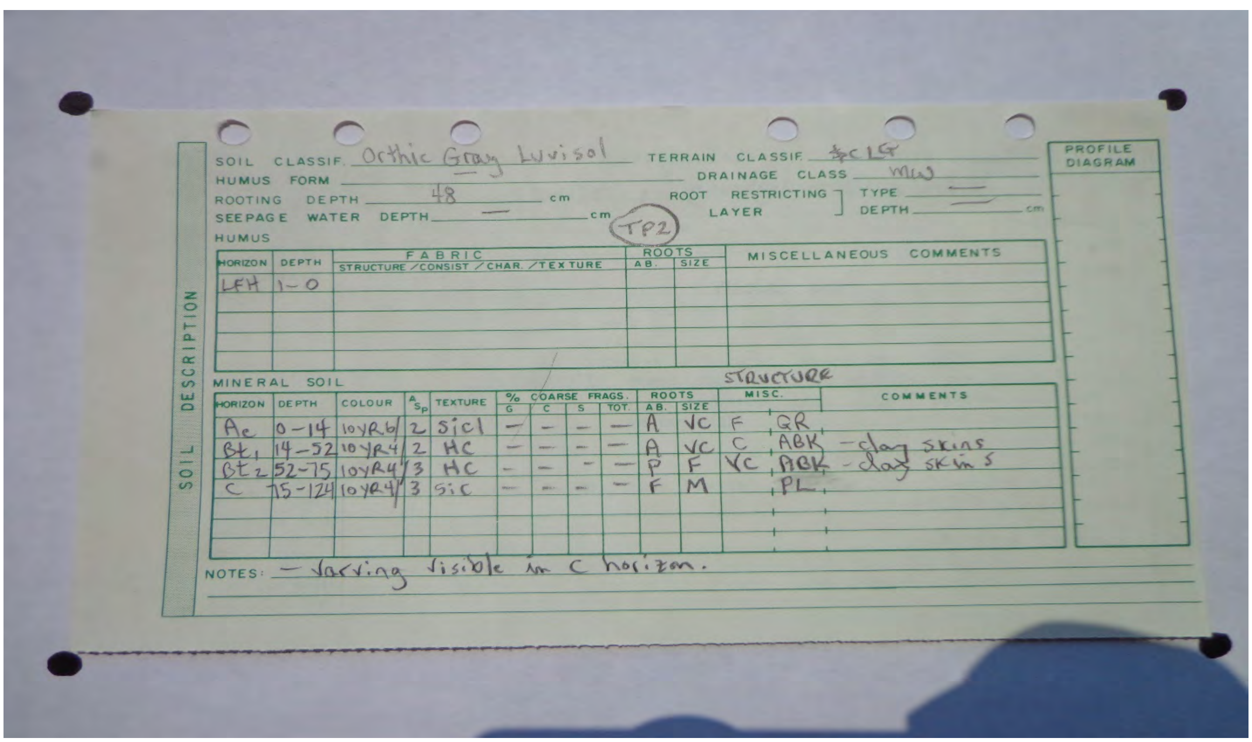
COARSE FRAG. LITH.

NOTES: Photo #704

- poor forage.

SURFACE SUBSTRATE	
HUMUS	
DEAD WOOD	
BEDROCK	
ROCKS	
MINERAL SOIL	
WATER	

FS 882 RES 88/08



SOIL DESCRIPTION

SOIL CLASSIF. Orthic Gray Luvisol

TERRAIN CLASSIF. [illegible]c LG

HUMUS FORM

DRAINAGE CLASS MW

ROOTING DEPTH 48 cm

ROOT RESTRICTING LAYER TYPE —

DEPTH — cm

SEEPAGE WATER DEPTH — cm

TP2

PROFILE DIAGRAM

HUMUS

HORIZON	DEPTH	FABRIC STRUCTURE / CONSIST / CHAR. / TEXTURE	ROOTS AB.	ROOTS SIZE	MISCELLANEOUS COMMENTS
LFH	1–0				

MINERAL SOIL

HORIZON	DEPTH	COLOUR	ASp	TEXTURE	% COARSE FRAGS. G	C	S	TOT.	ROOTS AB.	ROOTS SIZE	MISC. (STRUCTURE)		COMMENTS
Ae	0–14	10YR6/	2	SiCl	—	—	—	—	A	VC	F	GR	
Bt1	14–52	10YR4/	2	HC	—	—	—	—	A	VC	C	ABK	- clay skins
Bt2	52–75	10YR4/	3	HC	—	—	—	—	P	F	VC	ABK	- clay skins
C	75–124	10YR4/	3	SiC	—	—	—	—	F	M		PL	

NOTES: - varving visible in C horizon.

PROVINCE OF BRITISH COLUMBIA
Ministry of Forests

ECOLOGICAL CLASSIFICATION RECONNAISSANCE FORM

SITE DESCRIPTION

SITE TYPE: Balmoral Rd + HIGHWAY 1, Shuswap

DATE: July 12, 2017
SURVEYOR: Blashill
SITE NO.:
PLOT NO.: TP3

BIOGEOCLIMATIC UNIT: MAP UNIT:
ECOSYSTEM ASSOC.:

LOCATION
TRANSECT: logged area.
LOCATION:
AIR PHOTO NO.: X CO-ORD.: Y CO-ORD.:
MAP SHEET (NTS.): LONG.: LAT.:
ELEVATION: 438 (M) SLOPE: 2 % ASPECT: 46° °
MESO SLOPE POS.: LOWER SURFACE SHAPE: Concave
MOISTURE REGIME: NUTRIENT REGIME:
SUCCESSIONAL STATUS: EXPOSURE:
SITE HISTORY:

GEOLOGY
BEDROCK GEOLOGY: COARSE FRAG. LITH.:
NOTES: Photo #706

– up to 7% slope 30 m south.

SITE DIAGRAM

SURFACE SUBSTRATE	
HUMUS	
DEAD WOOD	
BEDROCK	
ROCKS	
MINERAL SOIL	
WATER	

FS 882 RES 88/08

SOIL DESCRIPTION

SOIL CLASSIF.: Orthic Gray Luvisol
TERRAIN CLASSIF.: sCL_b^G
HUMUS FORM:
DRAINAGE CLASS: mw
ROOTING DEPTH: 46 cm
ROOT RESTRICTING LAYER: TYPE: — DEPTH: — cm
SEEPAGE WATER DEPTH: — cm

TP3

HUMUS

HORIZON	DEPTH	FABRIC STRUCTURE / CONSIST / CHAR. / TEXTURE	ROOTS AB.	ROOTS SIZE	MISCELLANEOUS COMMENTS
LFH	6–0				

MINERAL SOIL

HORIZON	DEPTH	COLOUR	A_{sp}	TEXTURE	% COARSE FRAGS. G	C	S	TOT.	ROOTS AB.	ROOTS SIZE	MISC. (STRUCTURE)		COMMENTS
Ae	0–16	10YR4/	3	SiL	—	—	—	—	P	F	F	GR	
Bt1	16–29	10YR4/	3	Hc	—	—	—	—	P	M	VC	ABK	clay skins
Bt2	29–51	10YR4/	2	SiC	—	—	—	—	F	C	M	ABK	clay skins
C	51–117	10YR4/	2	SiC	—	—	—	—	F	F		PL	

NOTES:

PROFILE DIAGRAM

PROVINCE OF BRITISH COLUMBIA
Ministry of Forests

ECOLOGICAL CLASSIFICATION RECONNAISSANCE FORM

SITE DESCRIPTION

DATE: July 12, 2017
SURVEYOR: Gaskill
SITE NO.:
PLOT NO.: TP4

SITE TYPE: Balmoral Rd & Highway 1, Shuswap

BIOGEOCLIMATIC UNIT: MAP UNIT:

ECOSYSTEM ASSOC.:

LOCATION

TRANSECT LOCATION: flat area near highway 1.

AIR PHOTO NO.: X CO-ORD.: Y CO-ORD.:

MAP SHEET (NTS): LONG.: LAT.:

ELEVATION: 440 (m) SLOPE: 0 % ASPECT: — °

MESO SLOPE POS.: LEVEL SURFACE SHAPE: Concave

MOISTURE REGIME: NUTRIENT REGIME:

SUCCESSIONAL STATUS: EXPOSURE:

SITE HISTORY:

SITE DIAGRAM

GEOLOGY

BEDROCK GEOLOGY: COARSE FRAG. LITH.:

NOTES: Photo #705

-poor forage.

SURFACE SUBSTRATE	
HUMUS	
DEAD WOOD	
BEDROCK	
ROCKS	
MINERAL SOIL	
WATER	

FS 882 RES 88/08

SOIL DESCRIPTION

SOIL CLASSIF.: Orthic Gray Luvisol
TERRAIN CLASSIF.: sCLGv / sLGb
HUMUS FORM: —
DRAINAGE CLASS: Well
ROOTING DEPTH: 38 cm
ROOT RESTRICTING LAYER: TYPE: — DEPTH: — cm
SEEPAGE WATER DEPTH: — cm

TP4

PROFILE DIAGRAM

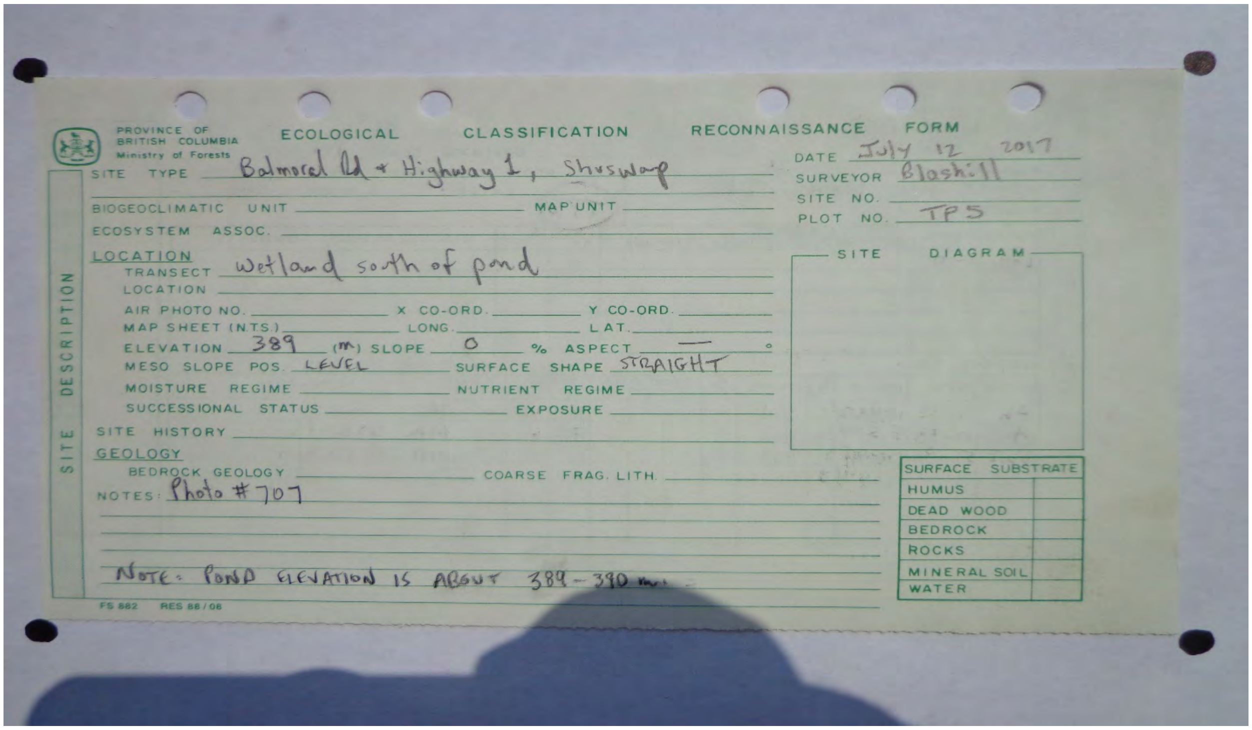
HUMUS

HORIZON	DEPTH	FABRIC STRUCTURE / CONSIST / CHAR. / TEXTURE	ROOTS AB.	ROOTS SIZE	MISCELLANEOUS COMMENTS
LFH	5-0				

MINERAL SOIL

HORIZON	DEPTH	COLOUR	A Sp	TEXTURE	% COARSE FRAGS. G	C	S	TOT.	ROOTS AB.	ROOTS SIZE	MISC.		COMMENTS
Ae	0-12	10YR5/2		Sil	—	—	—	—	P	F	F	GR	
Bt1	12-38	10YR4/	2	HC	—	—	—	—	P	M	VC	ABK	-clay skins
Bt2	38-59	2.5Y4/	3	SiC	—	—	-	—	F	C	C	ABK	-clay skins
C	59-112	2.5Y5/	3	S	—	—	—	—	—	—		PL	

NOTES: -varving evident in the fine sand of the C



PROVINCE OF BRITISH COLUMBIA
Ministry of Forests

ECOLOGICAL CLASSIFICATION RECONNAISSANCE FORM

DATE July 12 2017
SURVEYOR Blashill
SITE NO.
PLOT NO. TP5

SITE DESCRIPTION

SITE TYPE Balmoral Rd + Highway 1, Shuswap
BIOGEOCLIMATIC UNIT MAP UNIT
ECOSYSTEM ASSOC.

LOCATION
TRANSECT wetland south of pond
LOCATION
AIR PHOTO NO. X CO-ORD. Y CO-ORD.
MAP SHEET (NTS) LONG. LAT.
ELEVATION 389 (m) SLOPE 0 % ASPECT — °
MESO SLOPE POS. LEVEL SURFACE SHAPE STRAIGHT
MOISTURE REGIME NUTRIENT REGIME
SUCCESSIONAL STATUS EXPOSURE
SITE HISTORY

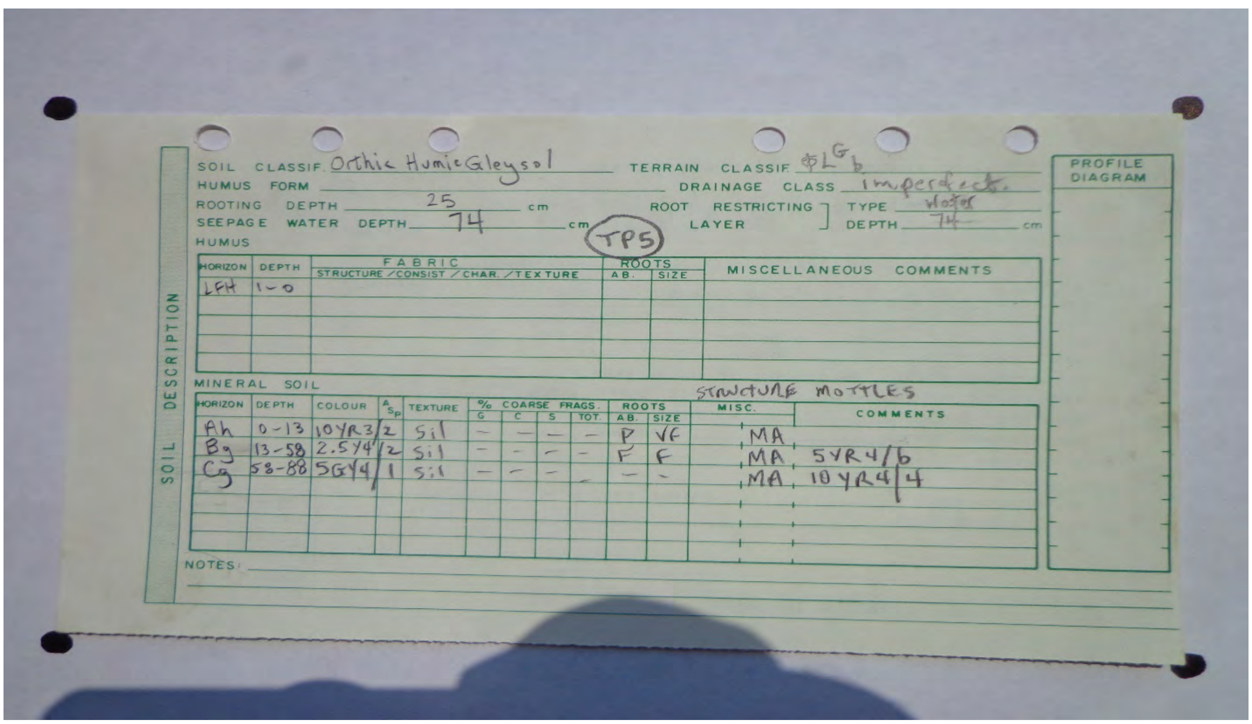
GEOLOGY
BEDROCK GEOLOGY COARSE FRAG. LITH.
NOTES: Photo #707

NOTE: POND ELEVATION IS ABOUT 389 – 390 m.

SITE DIAGRAM

SURFACE SUBSTRATE	
HUMUS	
DEAD WOOD	
BEDROCK	
ROCKS	
MINERAL SOIL	
WATER	

FS 882 RES 88/06



SOIL DESCRIPTION

SOIL CLASSIF. Orthic Humic Gleysol
TERRAIN CLASSIF. ΦL^{G}$_{b}$
HUMUS FORM
DRAINAGE CLASS imperfect.
ROOTING DEPTH 25 cm
ROOT RESTRICTING LAYER TYPE Water DEPTH 74 cm
SEEPAGE WATER DEPTH 74 cm

TP5

HUMUS

HORIZON	DEPTH	FABRIC STRUCTURE / CONSIST / CHAR. / TEXTURE	ROOTS AB.	ROOTS SIZE	MISCELLANEOUS COMMENTS
LFH	1–0				

MINERAL SOIL

HORIZON	DEPTH	COLOUR	A_{Sp}	TEXTURE	% COARSE FRAGS. G	C	S	TOT.	ROOTS AB.	ROOTS SIZE	MISC. (STRUCTURE)	COMMENTS (MOTTLES)
Ah	0–13	10YR3/2		Sil	—	—	—	—	P	VF	MA	
Bg	13–58	2.5Y4/2		Sil	—	—	—	—	F	F	MA	5YR4/6
Cg	58–88	5GY4/1		Sil	—	—	—	—	—	—	MA	10YR4/4

NOTES:

PROFILE DIAGRAM

PROVINCE OF BRITISH COLUMBIA
Ministry of Forests

ECOLOGICAL CLASSIFICATION RECONNAISSANCE FORM

SITE TYPE: Balmoral Rd + Highway 1, Shuswap

DATE: July 12 2017
SURVEYOR: Blashill
SITE NO.:
PLOT NO.: TP6

BIOGEOCLIMATIC UNIT:
MAP UNIT:
ECOSYSTEM ASSOC.:

SITE DESCRIPTION

LOCATION
TRANSECT: The slope in the 4T area near powerline.
LOCATION:
AIR PHOTO NO.: X CO-ORD.: Y CO-ORD.:
MAP SHEET (NTS): LONG.: LAT.:
ELEVATION: 410 (m) SLOPE: 16 % ASPECT: 240 °
MESO SLOPE POS.: UPPER SURFACE SHAPE: Concave.
MOISTURE REGIME: NUTRIENT REGIME:
SUCCESSIONAL STATUS: EXPOSURE:
SITE HISTORY:

SITE DIAGRAM

GEOLOGY
BEDROCK GEOLOGY: COARSE FRAG. LITH.:

NOTES: Photo # 708

SURFACE SUBSTRATE	
HUMUS	
DEAD WOOD	
BEDROCK	
ROCKS	
MINERAL SOIL	
WATER	

FS 882 RES 88/08

SOIL DESCRIPTION

SOIL CLASSIF.: Orthic Gray Luvisol
TERRAIN CLASSIF.: ᶠCL^{G}b
HUMUS FORM: —
DRAINAGE CLASS: mw
ROOTING DEPTH: 35 cm
ROOT RESTRICTING LAYER: TYPE: — DEPTH: — cm
SEEPAGE WATER DEPTH: — cm

TP6

HUMUS

HORIZON	DEPTH	FABRIC STRUCTURE / CONSIST / CHAR. / TEXTURE	ROOTS AB.	ROOTS SIZE	MISCELLANEOUS COMMENTS
LFH	5-0				

MINERAL SOIL

HORIZON	DEPTH	COLOUR	A Sp	TEXTURE	% COARSE FRAGS. G	C	S	TOT.	ROOTS AB.	ROOTS SIZE	MISC. (STRUCTURE)		COMMENTS
Ae	0-12	10YR3.5/2		SiL	—	—	—	—	A	C	F	GR	-
Bt1	12-33	10YR4/2		SiC	—	—	—	—	P	M	VC	ABK	- collected.
Bt2	33-72	10YR4/2		SiC	—	—	—	—	F	M	C	ABK	
C	72-115	10YR4/2		SiCL	—	—	—	—	F	F		MA	

PROFILE DIAGRAM

NOTES: - earthworm found in Ae.

Exova
#104, 19575-55 A Ave.
Surrey, British Columbia
V3S 8P8, Canada

T: +1 (604) 514-3322
F: +1 (604) 514-3323
E: Surrey@exova.com
W: www.exova.com

Exova

Farm Soil Analysis

Bill To:	Wayne Blashill	Grower Name:		Lot Number:	1221032
Report To:	Wayne Blashill	Client's Sample Id:		Report Number:	2215009
		Field Id:	TP1-Bt1(18-43)	Date Received:	Aug 17, 2017
	11519 Quinpool Road	Acres:		Disposal Date:	Sep 16, 2017
	Summerland, BC., Canada	Legal Location:		Report Date:	Aug 22, 2017
	V0H 1Z5	Last Crop:	Crop not provided	Arrival Condition:	
Agreement:	99398				

Nutrient analysis (ppm)													Soil Quality			
Depth	N*	P	K	S**	Ca	Mg	Fe	Cu	Zn	B	Mn	Cl	BiCarbP	pH	EC(dS/m)	OM(%)	Sample#
0" - 16"	<2	29	555	1	4500	1610	92.5	1.5	0.7	0.3	6.3	3		7.2	0.26	3.1	5809930

Excess
Optimum
Marginal
Deficient

pH	EC	OM
Alkaline	*Extreme*	*High*
Neutral	*Very High*	*Normal*
Acidic	*High*	*Low*
Very Acidic	*Good*	*Very Low*

	N	P	K	S
Total lbs/acre	11	152	2963	7
Estimated lbs/acre	12	103	1114	8

Texture *Heavy Clay* Hand Texture *n/a*
Sand 14.4 % Silt 20.0 % Clay 66.5 %
Ammonium n/a
Lime 0 T/ac Buffer pH Not Required Est. N Release n/a K/Mg Ratio n/a

BS 100 % CEC 37.4 meq/100 g
Ca 60.0 % Mg 35.5 % Na 0.7 % K 3.8 %
TEC 37.4 meq/100 g Na 59 ppm

**Nitrate-N **Sulfate-S n/a = not analysed*

RECOMMENDATIONS FOR BALANCED CROP NUTRITION

	Hay - Grass					Alfalfa - New				
Macro-nutrients	**Yield**	**N**	**P2O5**	**K2O**	**S**	**Yield**	**N**	**P2O5**	**K2O**	**S**
Growing Condition	T/ac	To be added (lbs/acre)				T/ac	To be added (lbs/acre)			
Excellent	4.3	94	19	0	19	1.5	10	11	0	19
Average	2.9	71	12	0	14	1.2	10	10	0	18
Your Goal	0.0					0.0				
Removal Rate (Seed/Total)	4.3	0 / 161	0 / 47	0 / 204	0 / 20	1.5	0 / 96	0 / 23	0 / 99	0 / 10
Micro-nutrients	Iron	Copper	Zinc	Boron	Manganese	Iron	Copper	Zinc	Boron	Manganese
To be added (lbs/ac)	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	2.0	0.0

Hay - Grass: Add Boron or try a test strip.

Alfalfa - New: Parts of the field may be Zinc deficient.
Add Boron or try a test strip.

Comments:

- Sample Information Sheet was not received.

Recommendations are based on general research consensus. They should not replace responsible judgement.

Exova
#104, 19575-55 A Ave
Surrey, British Columbia
V3S 8P8, Canada

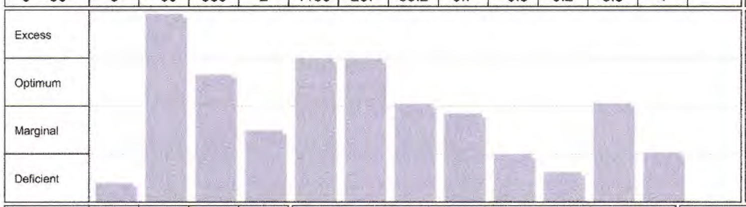
T: +1 (604) 514-3322
F: +1 (604) 514-3323
E: Surrey@exova.com
W: www.exova.com

Exova

Farm Soil Analysis

Bill To:	Wayne Blashill	Grower Name:	Balmoral Road	Lot Number:	1215167
Report To:	Wayne Blashill	Client's Sample Id:		Report Number:	2207309
		Field Id:	TP6 - Bt1 (12-33)	Date Received:	Jul 18, 2017
	11519 Quinpool Road	Acres:		Disposal Date:	Aug 17, 2017
	Summerland, BC., Canada	Legal Location:		Report Date:	Jul 20, 2017
	V0H 1Z5	Last Crop:	Crop not provided	Arrival Condition:	
Agreement:	99398				

Nutrient analysis (ppm)														Soil Quality			
Depth	N*	P	K	S**	Ca	Mg	Fe	Cu	Zn	B	Mn	Cl	BiCarbP	pH	EC(dS/m)	OM(%)	Sample#
0" - 36"	3	>60	380	2	1130	267	63.2	0.7	<0.5	0.2	5.3	4		6.8	0.1	1.8	5781824



pH	EC	OM
Alkaline	Extreme	High
Neutral	Very High	Normal
Acidic	High	Low
Very Acidic	Good	Very Low

	N*	P	K	S**
Total lbs/acre	33	720	4565	19
Estimated lbs/acre	32	480	770	19

Texture *n/a* Hand Texture *n/a*
Sand n/a Silt n/a Clay n/a
Ammonium n/a
Lime 0 T/ac Buffer pH 6.9 Est. N Release n/a

BS 89 % CEC 11 meq/100 g
Ca 57 % Mg 22 % Na <1.3 % K 9.9 %
TEC 9.9 meq/100 g Na <30 ppm
K/Mg Ratio n/a

**Nitrate-N **Sulfate-S n/a = not analysed*

RECOMMENDATIONS FOR BALANCED CROP NUTRITION

	Hay - Grass - New					Hay - Legume				
Macro-nutrients	**Yield**	**N**	**P2O5**	**K2O**	**S**	**Yield**	**N**	**P2O5**	**K2O**	**S**
Growing Condition	T/ac	To be added (lbs/acre)				T/ac	To be added (lbs/acre)			
Excellent	4.7	108	0	0	21	6.3	23	0	0	18
Average	3.1	44	0	0	13	5.8	21	0	0	17
Your Goal	0.0					0.0				
Removal Rate (Seed/Total)	4.7	0 / 177	0 / 52	0 / 224	0 / 22	6.3	0 / 373	0 / 96	0 / 350	0 / 19
Micro-nutrients	Iron	Copper	Zinc	Boron	Manganese	Iron	Copper	Zinc	Boron	Manganese
To be added (lbs/ac)	0.0	0.0	7.0	2.0	0.0	0.0	0.0	7.0	2.0	0.0

Hay - Grass - New: Incorporate the recommended rate of Zinc or seed place 1 lb/ac.
Add Boron or try a test strip.

Hay - Legume: Incorporate the recommended rate of Zinc or seed place 1 lb/ac.
Add Boron or try a test strip.

Comments:

Recommendations are based on general research consensus. They should not replace responsible judgement.

EXHIBIT 4

AG Consulting

Balmoral Waste Management Opportunities & Benefits to Area

Waste Management Opportunities and

Benefits to Area Agriculture

Report TO:

Terry Langlois
Utilities Team Leader, Operations Management
Columbia Shuswap Regional District
555 Harbourfront Drive NE
Salmon Arm, BC V1E 4P1
Email <tlanglois@csrd.bc.ca>
O 250-833-5941 TF 1-888-248-2773

BY

Andrea Gunner, P.Ag.
AG Consulting
4218 Wyatt Road.
Armstrong, BC V0E 1B4
gunnera@telus.net
O 250-546-2712 C 250-308-6146

November 24, 2017

Disclaimer

This report relies on a September 23, 2017 site visit and information contained in the *Technical Memorandum Review of Treatment Strategies in the Development of a Community Sewer System for Blind Bay and Sorrento* by Kathryn Jessamine, Opus Dayton Knight Consultants Ltd. as well as *S.W. ¼, Section 8, TWP. 22, Range 10, KDYD Balmoral, B.C. Agrologist's Report* by Wayne Blashill, P.Ag.

The author is an agricultural economist based in the North Okanagan. The author is neither a soils specialist (therefore not qualified to assess the technical structure or stability of the site) nor a waste management expert (therefore not qualified to assess the environmental impacts from spray effluent). The author has relied on qualified professional soil scientist, waste management agrologist and a district agrologist for interpretation on the potential benefits or negative impacts of waste water irrigation on agricultural lands.

TABLE OF CONTENTS

PART ONE 3
Benefits of Wastewater Irrigation to Agricultural Production in the Shuswap........ 3
Agricultural Land Base, Soils and Climate Information 3
Wastewater Irrigation in Nearby Communities........ 4
Nutrient Contribution of Wastewater Treatment Plant Effluent 6
Potential Benefits of Spray Effluent to Balmoral Agricultural Producers (within a 6 km radius)........ 7
Reduced Reliance on Area Creeks and Groundwater 7
Greater Control over Irrigation Timing........ 7
Effects on Yield 7
Results from Balmoral Farmer Interviews 8
List of Balmoral Farmers Interviewed........ 9
Projected Wastewater Volume Flows 10
Crop Water Requirements 11
Assumptions 11
Conclusion to Part One: Benefits of Wastewater Irrigation to Agricultural Production in the Shuswap........ 12

PART TWO........ 13
Agricultural Capacity and Feasibility of S.W. ¼, Section 8, TWP. 22, Range 10, KDYD 13
General Site Context 13
Agricultural Context 14
Agricultural Capacity & Feasibility Assessment 16
Conclusion to Part Two Agricultural Capacity and Feasibility of S.W. ¼, Section 8, TWP. 22, Range 10, KDYD 18

PART ONE

Benefits of Wastewater Irrigation to Agricultural Production in the Shuswap

Cities and towns generate a stream of water that has already been used, such as for domestic purposes. This stream of water represents a waste product that can be re-used downstream as a resource.[1] In the Shuswap, the value of treated wastewater to agricultural production is significant due to frequent growing season soil moisture deficits. Apart from its value as irrigation water, it also contains nutrients which are of benefit to agricultural production.[2]

Agricultural Land Base, Soils and Climate Information

The Shuswap has a complex geological history which has created a variable growing region by way of diverse bedrock, soils, terrain and climate. Soil types and agricultural capability vary across the region and by elevation.

With long frost-free periods and high temperatures during the growing season, the Shuswap has a highly favourable climate for agriculture. On average, precipitation is amongst the lowest in southern Canada and summers are generally very hot. Across much of the region, the dry, hot summers and evapo-transpiration lead to soil moisture deficits requiring irrigation for perennial and annual crops.

The land base of the agriculture industry in the Shuswap generally is dominated by many small production units but in the Balmoral area, forage crops predominate on larger acreages. The dairy industry is a major user of forage crops along with a smaller beef and equine industry across the region. Grain crops such as barley and wheat are also grown in this area.

For agricultural producers across the temperate interior of BC, including the Shuswap, there are three main potential benefits of spray effluent to area agricultural producers. The value of access to waste water for irrigation purposes on forage lands reduces the reliance on creeks and groundwater aquifers to supply crop needs during the growing season. This is of particular concern when growing seasons are impacted by increased temperatures and decreasing frequency of precipitation events. A second important

---

[1] Food and Agriculture Organisation of the United Nations, *Wastewater Treatment and Reuse in Agriculture,* retrieved at http://www.fao.org/land-water/water/water-management/wastewater/en/

[2] R. McDougall, P.Ag., personal communication, November 2017

benefit is greater control over timing of irrigation, critical for both crop renovation and re-planting where dryland systems are reliant on natural precipitation. Thirdly, implementing a spray effluent program on agricultural land contributes nutrients, not only improving yields but utilising a waste resource in an ecologically sound manner.

Wastewater Irrigation in Nearby Communities

The nearby municipalities of Vernon, Kamloops and Armstrong have been providing treated effluent from their municipal wastewater treatment plants as irrigation water for various landowners since 1977, 1984 and 1995 respectively.[3],[4]

In Vernon, the wastewater treatment plant currently serves a population of 40,000. Vernon's wastewater undergoes primary, secondary and tertiary treatment (fine screening, grit removal, primary clarification, biological nutrient removal, secondary clarification), as well as filtration and ultra-violet disinfection during the spray irrigation season (May – October). The reclaimed water is chlorinated and allocated to approximately 970 Ha or 2,400 acres including Predator Ridge Golf Resort, Vernon Golf and Country Club, The Rise Golf Course, Vernon Seed Orchard, Kalamalka Forestry Centre, Pacific Regeneration's Vernon Nursery as well as Marshal sports fields and grazing and forage lands on the Vernon Commonage.[5]

The Kamloops wastewater treatment plant currently serves a population of approximately 90,000. Kamloops implemented significant upgrades to the treatment plant systems in 2010-2013 as a result of concerns by the BC Ministry of Environment and federal authorities regarding the quality of effluent being discharged into the Thompson River. Kamloops discharges 80% of it's treated wastewater directly into the Thompson River and provides approximately 20% for land application to Cinnamon Ridge Farm, adjacent lands at the Kamloops Airport, Kamloops Golf and Country Club as well as nearby forage and pasture lands.[6]

The City of Armstrong has a successful, fully subscribed spray irrigation program derived from the waste water treatment plant serving 5,100 domestic residents[7] and

---

[3] J.E. Bryan, *The Effects of Wastewater Releases by City of Vernon on Vernon Creek and Vernon Arm of Okanagan Lake in 1984 and 1985*, Ministry of Environment and Parks, November 1987, retrieved at http://www.env.gov.bc.ca/wat/wq/studies/vernonwastewater.pdf

[4] R. McDougall, *2015 City of Armstrong Soil Monitoring Report,* November 2015

[5] City of Vernon, retrieved at https://www.vernon.ca/homes-building/utilities/water-sewer-0/wastewater

[6] City of Kamloops, *Sustainable Kamloops Plan Information Package on Wastewater*, retrieved at http://www.kamloops.ca/sustainable/pdfs/SKP-WasteWaterBackground.pdf

[7] Statistics Canada, 2016 Census Population, retrieved at http://www12.statcan.ca/census-recensement/2016/dp-pd/prof/details/page.cfm?Lang=E&Geo1=POPC&Code1=0020&Geo2=PR&Code2=59&Data=Count&SearchText=armstrong&SearchType=Begins&SearchPR=59&B1=All

industrial facilities (poultry processing, cheese processing) within city limits since 1995. The water goes through a multi-stage treatment program. The reclaimed water is chlorinated and allocated to approximately 900 acres in 2017, predominantly applied to forage crops with a small allocation to a poplar tree plantation.[8],[9],[10],[11],[12] The spray irrigation program is distributed over a network of about 10 km of various diameter PVC pipeline (250 mm to 600 mm diameter) to a total of 12 agricultural landowners, ranging in size from 10 acres to approximately 500 acres[13],[14].

In both Vernon and Armstrong, an initial monitoring program was developed and background data was collected from each site. Once the spray irrigation program was initiated, monitoring and testing was conducted on an annual basis to ensure no negative effects were observed from the program. With the approval of the Ministry of Environment, the monitoring is now conducted bi-annually.[15] The monitoring program tracks soil quality parameters (pH, conductivity, major nutrients, trace elements and micronutrients), erosion or soil loss, salinity and soil exchangeable sodium, the latter two of particular concern in spray effluent land application programs. There has been no observable trend in the soil concentration of any of the nutrients monitored since monitoring began. The soil concentration of nutrients fluctuates from year to year in most fields but this appears to be due to fertilization or application of manure, or to annual variations in climate. There was no evidence of erosion or soil loss due to effluent irrigation. There has been no trend in salinity observed since effluent irrigation began. All sites have had low salinity values, well below the salinity threshold.
The soil pH has remained very stable in the past several years, and all fields had pH values within or very close to the optimum range of 6.5 to 7.5 with no trend in pH in monitored fields since monitoring began. Likewise, the values of soil exchangeable sodium remain within the range of values observed since data collection began in fall 2000. Irrigation of City of Armstrong effluent does not appear to have negatively impacted any of the soil quality or fertility parameters monitored since 1995.[16]

---

[8] Kerry Fox, City of Armstrong Waste Water Technician, personal communication, October 2017

[9] Opus DaytonKnight Consultants Ltd., *City of Armstrong Master Sewer Plan Update*, February 2014

[10] Kerry Fox, City of Armstrong Waste Water Technician, personal communication, October 2017

[11] David Derbowka, Passive Remediation Systems, personal communication, October 2017

[12] Ruth McDougall, P.Ag, personal communication, October 2017

[13] Opus DaytonKnight Consultants Ltd., *City of Armstrong Master Sewer Plan Update*, February 2014

[14] Ruth McDougall, P.Ag.. personal communication, October 2017

[15] ibid

[16] R. McDougall, P.Ag., *2015 City of Armstrong Soil Monitoring Report,* November 2015

The benefits of the spray irrigation program to Armstrong farmers are mainly the access to irrigation water, control over irrigation timing as well as the value of nutrient content.[17],[18]

Nutrient Contribution of Wastewater Treatment Plant Effluent

Wastewater treatment plant effluents can vary in nutrient content so should be tested for total and available nutrients to accurately estimate nutrient contribution. Nutrient content also varies with the time of year; in spring nutrient content will be lower due to dilution from rain and snow in the storage facility. Concentrations will increase through the growing season and will be at their highest in fall due to little rain during the summer months.

As an example, effluent from Armstrong's wastewater treatment plant contains on average 21 mg/L of nitrogen, 5 mg/L of phosphorus and 20 mg/L of potassium. Per 6" (15 cm) of effluent irrigated, it would contribute the following:

- Total nitrogen (as N) (up to 20% may be available in the year of application): 31 kg/ha or 28 lbs/A
- Total phosphorus (as P) (approx. 20% will be crop-available): 8 kg/ha (7 lbs/A)
- Total potassium (as K) (most will be crop-available): 31 kg/ha or 28 lb/A

Effluent will also contribute small amounts of micronutrients including boron, and a moderate amount of sodium to the land base. It typically has a neutral pH and contains very little organic matter.[19]

Table 1 Amount of Nutrients from Effluent, City of Armstrong, 2012 Data

City of Armstrong 2012 Nutrients from the Effluent (in pounds per acre)	Amount of effluent irrigated onto land		
	6 inches	9 inches	12 inches
Nitrogen (as N)	28	40	56
Phosphorus (as P2O5)	16	23	32
Potassium (as K2O)	32	50	66
Sulphur	20	30	40

Source: Ruth McDougall, P.Ag., *2015 City of Armstrong Soil Monitoring Report*

---

[17] David Derbowka, Passive Remediation Systems, personal communication, November 2017

[18] David Kennedy, farmer, personal communication, November 2017

[19] Ruth McDougall, P.Ag., personal communication, November 2017

Potential Benefits of Spray Effluent to Balmoral Agricultural Producers (within a 6 km radius)

There are three main potential benefits of spray effluent to Balmoral area and its agricultural producers: reduced reliance on area creeks and groundwater, greater control over irrigation timing and positive effects on crop yield.

Reduced Reliance on Area Creeks and Groundwater

The value of access to waste water for irrigation purposes on forage lands reduces the reliance on creeks and groundwater aquifers to supply crop needs during the growing season. This is of particular concern when growing seasons are impacted by increased temperatures and decreasing frequency of precipitation events.

Greater Control over Irrigation Timing

A second important benefit is greater control over timing of irrigation, critical for both crop renovation and re-planting where dryland systems are reliant on natural precipitation events. This increase in control also facilitates diversifying into other field crops of higher per acre income (eg. corn, hops, malting barley, sunflower) which require greater soil moisture control.[20]

Effects on Yield

Balmoral forage producers with both irrigated and dryland forage production estimate a 60-80% increase in yield with irrigation. [21],[22],[23], deriving from their observations over a range of years. This includes higher yields per forage cut as well as the potential for additional forage cuts in a season.

The nutrient value of the effluent, based on 2012 data from the City of Armstrong, is estimated in the following Table[24] It is reasonable to expect additional yield increases from the nutrients in the effluent.

---

[20] Laura Code, P.Ag. Regional Agrologist, BC Minisry of Agriculture, personal communication, October 2017

[21] Trevor Schaaffsma, Balmoral farmer, personal communication, November 2017

[22] Robert Shuster, Balmoral farmer, personal communication, November 2017

[23] Rob Trenholme, Balmoral farmer, personal communication, November 2017

[24] Ken Clancy, P.Ag., Okanagan Fertilizer, personal communiation, November 2017

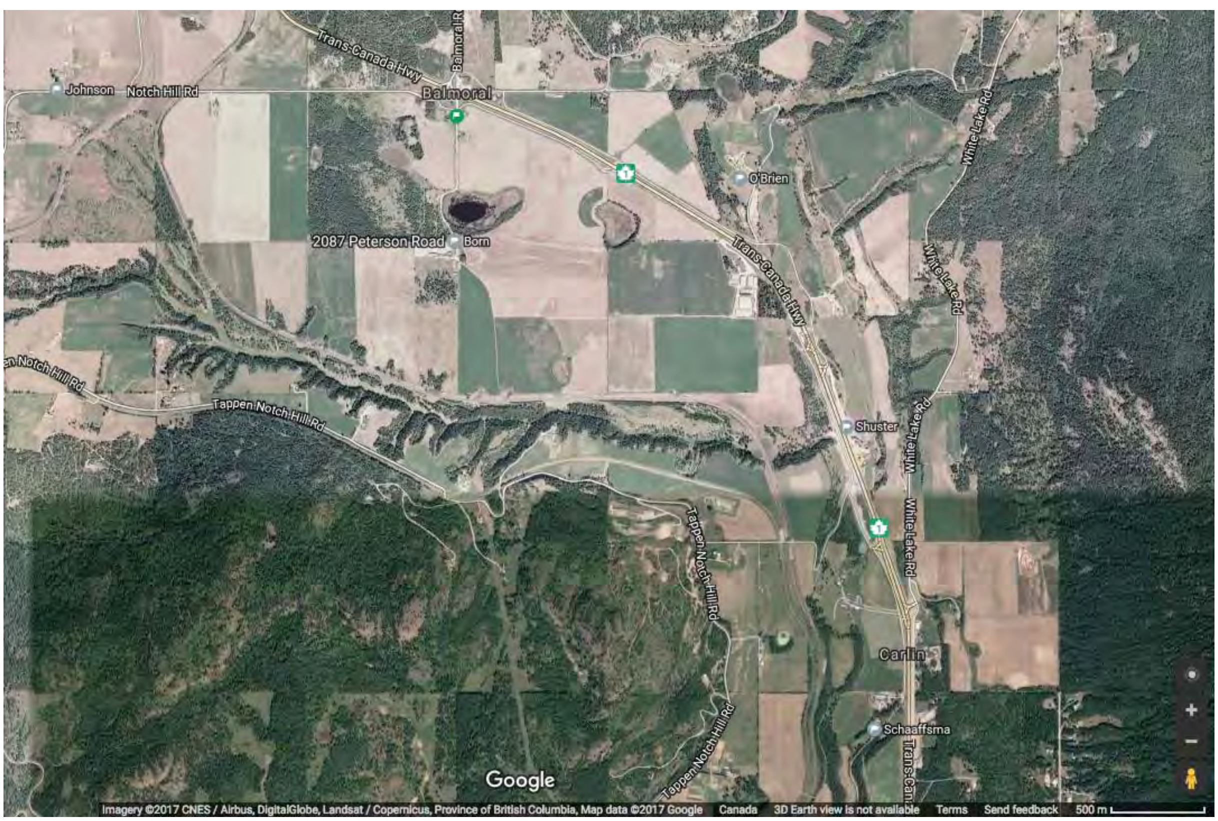
Table 2   Value of Effluent Nutrients, City of Armstrong, 2012 Data

City of Armstrong 2012 Value of Effluent Nutrients	Amount of effluent irrigated onto land		
(in dollars ($) per acre)	6 inches	9 inches	12 inches
Nitrogen (as N)	12.32	17.60	24.64
Phosphorus (as P2O5)	8.32	11.96	16.64
Potassium (as K2O)	9.60	15.00	19.80
Sulphur	2.00	3.00	4.00
TOTAL	**$32.24**	**$47.56**	**$65.08**

Results from Balmoral Farmer Interviews

Interviews were conducted with eleven Balmoral area farmers within a six kilometre radius to gauge their interest in and crop suitability to a spray irrigation program. Nine of the eleven farmers were very interested and have non-irrigated land planted to forage crops. Of the six farmers with irrigation, only two have drilled wells, the others have water rights on a nearby creek. Two of the nine farmers also grow grain (wheat and barley) for which access to irrigation would open up more lucrative markets (malting barley, food grade wheat).

Figure 1 Balmoral Agricultural Forage Lands



List of Balmoral Farmers Interviewed

1. John Born, 2087 Peterson, Tappen, personal communication, Oct-Nov 2017
2. Keith Boulter, 2519 Hendrickson Road, Tappen, personal communication, Nov 2017
3. Jim Gooch, 1078 Birch Road, Tappen, personal communication, Nov 2017
4. Roy Johnson, 2704 Notch Hill, Tappen personal communication, Nov 2017
5. Geoff O'Brien, 2149 Wuori, Tappen, personal communication, Nov 2017
6. Brad Romyn, 1844 Hammond, Tappen, personal communication, Nov 2017
7. Trevor Schaaffsma, 1585 Calhoun, Tappen, personal communication, Nov 2017
8. Robert Shuster, 3727 White Creek Frontage Road, Tappen, personal communication, November 2017
9. Grant Smith, 2804 White Lake Road, Tappen, personal communication, Nov 2017
10. Rob Trenholme, 3862 Trans-Canada Highway, Tappen, personal communication, November 2017
11. John Vanderveen, Tappen, personal communication, November 2017

Table 3 Area Agriculture Producers within a 10 km Radius with Crops & Acreage that would Benefit from a Spray Irrigation Program

Name & Address	Major Crops	Major Soil Types	Irrigated Acreage	Acreage Available for Irrigation	Total Acreage
John Born	Alfalfa grass silage & hay, corn silage	Clay, sandy loam	150	850	1,000
Jamie Gooch	Alfalfa grass hay	Clay	0	20	20
Roy Johnson	Alfalfa grass hay	Heavy clay	0	320	320
Geoff O'Brien	Alfalfa grass silage & hay, corn silage	Heavy clay	120	30	150
Brad Romyn	Alfalfa grass hay	Sandy loam peat	0	80	80
Trevor Schaaffsma	Alfalfa grass hay, corn silage, grain	Clay, sandy loam	580	70	650
Robert Shuster	Alfalfa grass silage & hay, corn silage	Clay, sandy loam	60	60	120
Rob Trenholme	Alfalfa grass hay	Heavy clay	50	350	400
John Vanderveen	Alfalfa grass hay	Clay loam	150	50	200
TOTAL			**1,110**	**1,830**	**2,940**

Projected Wastewater Volume Flows

The estimated flows of waste water available for irrigation (after treatment) vary over time as shown in Tables 4 and 5. A Community Sewer System built to serve the areas of Blind Bay, Reed Point and Sorrento is estimated to produce annual volumes enough to irrigate approximately 3,000 acre feet at full future capacity.[25]

Table 4 Projected Waste Water Flows

Community Sewer System Projected Wastewater Volume Flows (m^3/day)[26]							
YEAR	**COMMERCIAL**	**RESIDENTIAL**	**ESTIMATED FLOW (m^3/day)**	**ESTIMATED DAILY FLOW (IMPERIAL GALLONS)**		**DAILY ACRE FEET AVAILABLE IRRIGATION**	**ANNUAL ACRE FEET AVAILABLE IRRIGATION**
2009	N/A	27%	2,400	528,000		1.95	710
2014	16%	30%	2,323	510,000		1.88	685
2019	38%	36%	3,739	820,000		3.03	1,100
2024	66%	44%	5,083	1,120,000		4.12	1,500
2029	88%	51%	6,267	1,375,000		5.08	1.850
Buildout	100%	100%	10,304	2,265,000		8.35	3,050

Depending on allocation to individual landowners, the spray irrigation could be applied to as much as 3,000 acres at full build out, as shown in Table 5. However, based on the experience of the similar sized community system in the City of Armstrong, it is likely that approximately 1,000 -1,500 acres of forage crops will absorb the annual volumes of a Community Sewer System in the Balmoral area, providing sufficient storage capacity exists. The allocation of spray irrigation to individual land owners and attendant distribution strategy will need to be developed.

[25] Opus DaytonKnight Consultants Ltd., *Draft Review of Treatment Strategies for Blind Bay and Sorrento*, October 2017
[26] ibid

Table 5 Projected Irrigated Acres at Varying Application Levels

Projected Acres to be Irrigated from Community Sewer System Volume Flows (at varying levels of appiication)			
Irrigated	Total Acres @ 6" irrigation	Total Acres @ 9" irrigation	Total Acres @ 12" irrigation
2009	1,420	1,065	710
2014	1,370	1,027	685
2019	2,200	1,650	1,100
2024	3,000	2,250	1,500
2029	3,700	2,775	1,850
Buildout	6.100	4,575	3,050

Crop Water Requirements

Forage crops have varying water requirements depending on a number of factors including but not limited to soil type, amount and frequency of precipitation, cloud cover, wind, average daily temperature and Growing Degree Days (GDD)* or Corn Heat Units (CHU). As an example of this variability, heavy clay soils will retain soil moisture better than sandy, light soils but early season crops may be delayed or diminished since wet clay soils are also significantly cooler, delaying crop growth.

Assumptions

1. 180 day growing cycle
2. Average irrigated corn silage yield of 8 tons dry matter/acre
3. Average irrigated alfalfa grass mix yield of 1.75 tons/acre/cut, 3 cuts/season

Table 6 shows the estimated crop water requirements for the most common forage crops grown in the Balmoral area. Table 7 shows the variability in size of acreage necessary to utilise the projected waste water, depending on the forage crops grown. Non-irrigated forage lands within a 6 km radius show sufficient capacity for the total volume of spray irrigation at build-out.

Table 6 Estimated Crop Water Requirements

Crop Water Requirements (inches)[27],[28],[29],[30]				
CROP	**PEAK DAILY**	**PRODUCTION CYCLE TOTAL (metric)**	**PRODUCTION CYCLE TOTAL (Imperial)**	**ESTIMATED GALLONS/ACRE**
Alfalfa	9 mm	540-680 mm	5 inches/ton	595,000
Timothy Grass Hay	6 mm	500 mm	4.0 inches/ton	407,000
Alfalfa Grass mix	9 mm	540-680 mm	5 inches/ton	595,000
Silage Corn[31]	7 mm	500-550 mm	20-25 inches/acre	510,000

Table 7 Spray Irrigation Application Acreage Variability Depending on Cropping

	Alfalfa Grass Hay / Corn Silage				
Effluent volume	**100% / 0%**	**75% / 25%**	**50% / 50%**	**25% / 75%**	**0% / 100%**
1,100	503	521	542	563	587
1,500	686	711	738	768	800
1,850	846	877	911	947	987
3,050	1,394	1,446	1,502	1,562	1,627

Conclusion to Part One: Benefits of Wastewater Irrigation to Agricultural Production in the Shuswap

The value of a spray irrigation program to nine current forage operations within a six km radius, with over 1,800 non-irrigated acres would be significant, adding 60-80% productivity to these holdings.

---

[27] *Irrigation Scheduling for Alfalfa Hay in Southern Alberta*, Alberta Agriculture and Forestry, July 2017

[28] I *Irrigation Scheduling for Timothy Hay in Southern Alberta*, Alberta Agriculture and Forestry, August 2017

[29] *Irrigation Scheduling for Silage Corn in Southern Alberta*, Alberta Agriculture and Forestry, August 2017, retrieved at http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex14256

[30] *Irrigation Decisions with Limited Water*, BC Ministry of Agriculture, June 2015 Drought Management Factsheet , retrieved at https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/agricultural-land-and-environment/water/drought/665000-4_irrigation_decisions_with_limited_water-drought_factsheet_no4.pdf

[31] *Report of 2016 Field Trials*, Pacific Field Corn Association, October 2016, retrieved at http://www.farmwest.com/node/1588

PART TWO

Agricultural Capacity and Feasibility of S.W. ¼, Section 8, TWP. 22, Range 10, KDYD

Part Two outlines the economic value to agriculture of 48.4 ha, currently in the ALR, on the North West corner of Balmoral Road and the TransCanada Highway in Blind Bay, B.C. measured against the value of spray effluent irrigation outlined in Part One to active forage production on adjacent ALR lands.

General Site Context

A site visit on September 23, 2017 confirmed the topographic information contained within the August 28, 2017 *S.W. ¼, Section 8, TWP. 22, Range 10, KDYD Balmoral, B.C Agrologist's Report* by Wayne Blashill, P.Ag.[32]

The site encompasses fairly level to fairly steep sloped forest land which has been recently logged. Mr. Blashill's report maps six polygons with similar site and soil characteristics.

The plant communities are dominated by typical Shuswap species: poplar (*Populus spp*.), cedar (*Thuja plicata*), red osier dogwood (*Cornus sericea*), chokecherry (*Prunus virginiana*) and snowberry (*Symphoricarpus abus*), as well as two noxious weeds Canada thistle (*Cirsium ravense)*, and mullein (*Verbascum thapsis*), common to disturbed sites.

[32] Wayne Blashill, P.Ag., *S.W. ¼, Section 8, TWP. 22, Range 10, KDYD Balmoral, B.C*

Looking west, down slope towards small pond

Bracken fern (*Pteridium aquilinum*) exists throughout the site, including the level, class 2 soils. Bracken fern is poisonous to domestic livestock, including cattle, horses and sheep. Poisoning is essentially untreatable. However, poisoning is easily controlled by preventing exposure. Initial epidemiological studies suggest that consumption of milk from cattle exposed to bracken fern increases the risk of esophageal or gastric cancers in humans.[33] The site is not fenced.

Agricultural Context

In an agricultural context, this site appears to have some limited potential for livestock grazing. However, it has several limitations. There is no contiguous livestock operation that would benefit from the available grazing; there is poisonous bracken fern throughout the level areas and on the slopes, there is a lack of effective fencing; and access to the small pond for livestock watering would be the subject of pressure from cattle or any other livestock and be impacted by erosion. According to Range Agrologist, Anne Skinner, P.Ag., with the B.C. Ministry of Forests,[34] a fence right adjacent to the shallow pond or the wetland adjacent to it would get a lot of pressure

[33] Bryan L. Stegelmeier, *Bracken Fern Poisoning*, Veterinary Pathologist, Poisonous Plant Research Laboratory, USDA-ARS, Merck Veterinary Manual, retrieved at http://www.merckvetmanual.com/toxicology/bracken-fern-poisoning/overview-of-bracken-fern-poisoning

[34] Personal communication, October 4, 2017

from cattle and be impacted by erosion. The preferred fencing option would be well back from the pond, resulting in a loss of forage.

The population of bracken fern is problematic for use as a grazing site. Bracken is a strong competitor with an extensive underground rhizome system containing nutrient reserves, is allelopathic to other species and is not controllable by chemical controls and is toxic to livestock.[35] The slopes on this site make the bracken fern weed cultural control method of discing and reseeding to pasture grasses impractical.[36]

The Soil Management Handbook for the Okanagan and Similkameen Valley designates **Grassland**: sites which are suited to the grassland crop group may not have a high animal unit month (AUM) carrying capacity. They are best suited to "grass species". Grasslands are defined as lands where native vegetation, including grasses, forbs, sedges, shrubs and trees, and cultivated species, i.e., crested wheatgrass or reed canarygrass, grow well. They may have been revegetated to include tame forages, however, intensive forage production, irrigation, drainage or fertilization is not normal. If harvested, they are normally harvested by grazing due to steepness and/or stoniness. Areas are designated to this crop group when slopes are 15% and up, stoniness greater than S3 and depth of the soil less than 50 cm over compact till or bedrock. Some lowland, wetter sites or soils have also been given this crop group designation. This is a result of several soil limitations which do not allow for use of soil management inputs at an economic level. These lands may be Crown or privately owned. Grassland sites may or may not be used for grazing, outdoor recreation or may be held as ecological reserves.[37]

The soil classification indicates that this site may have potential for grain and/or forage production. The site visit on September 23 confirmed that there is a small area which could be suitable for forage production, if not populated by bracken fern, which retains its toxicological effects through the harvest and drying process.

---

[35] R.H. Marrs, M.G. Le Duc, R.J. Mitchell, D. Goddard, S. Paterson and R.J. Pakeman, *The Ecology of Bracken: It's Role in Succession and Implications for Control*, Annals of Botany, 85, 3-15, 2000

[36] ibid

[37] N. A. Gough, G. A. Hughes-Games, D.C. Nikkel, *Soil Management Handbook for the Okanagan and Similkameen Valleys*, B.C. Ministry of Agriculture, Fisheries and Food, 1994

Agricultural Capacity & Feasibility Assessment

View North across reasonably level, arable 89 acre S.W. ¼, Section 8 TWP 22, Range 10, KDYD, Balmoral

Potential Agricultural Activity – Livestock Grazing

Opportunities	**Constraints**	**Potential Area**	**Estimated Development & Capital Cost**	**Estimated Total Annual Return**
Grazing for an adjunct livestock operation	No adjunct livestock operation	89 acres	\$400,000 - 500,000	\$25,000
	Fencing cost of \$10,000/km[38]	4 km	\$40,000	
	Poisonous bracken fern			
	Dryland annual growth of 500 lbs./forage/acre[39]	60 acres		\$2,000
	Insufficient land productivity			

[38] Greg Tegart, P.Ag., Central Manager, retired, B.C. Ministry of Agriculture, Sustainable Agriculture Management Branch, personal communication, October 4, 2017
[39] ibid

Assumptions:

1. Estimated development and capital costs are the investment required to develop an agricultural enterprise.
2. Estimated development and capital costs do not include annual operating costs.
3. Estimated total annual returns are on a gross return basis.
4. No evidence of irrigation infrastructure on the property.
5. Fencing is required to keep livestock on the property and away from highway, neighbouring commercial and residential areas.
6. A cow/calf unit requires 4 acres of reasonable forage/month[40] and access to water.
7. Well drilling costs $7,000 – 10,000/test well.
8. Grazing quality poor to fair, maximum 70-100 days spring to early summer[41]
9. A small beef operation (100 cows) requires investments of $400,000 – 500,000 while generating less than $25,000 of gross farm income.[42]

Potential Agricultural Activity – Forage Production

Opportunities	Constraints	Potential Area	Estimated Development & Capital Cost	Estimated Total Annual Return
Forage production	Available small scale equipment	< 2 acres	$35,000 - $50,000 (used equipment)	$200-250
	Poisonous Bracken fern			
	Lack of irrigation system			

Assumptions:

1. Estimated development and capital costs are the investment required to develop an agricultural enterprise.
2. Estimated development and capital costs do not include annual operating costs
3. Estimated total annual returns are on a gross return basis.
4. Well drilling costs $7,000 – 10,000/test well.
5. Equipment complement includes a maximum 30 HP tractor, cultivator, seeder, swather, tedder and baler and for forage production.
6. A dryland forage operation in this location will likely only get one cut/season plus fall grazing. Estimated production = 20- 25 bales/acre @ $5/bale

---

[40] ibid

[41] B.M. Wikeem, A. McLean, A. Bawtree and D. Quinton, *An Overview of the Forage Resource and Beef Production on Crown Land in B.C.*, Can. Journal of Animal Science, December 1993, 73: 779-794

[42] Grant Henry, P.Ag. *Beef Production – An Economic Profile*, Economic Development Branch, BC Ministry of Sustainable Resource Management, March 2003

7. Gaining farm status for this land would require a minimum of $2,500 gross annual income plus 5% of the regulated value of the land over 10 acres[43], estimated at $4,800/year.

Potential Agricultural Activity – Horticultural Operation

Opportunities	**Constraints**	**Potential Area**	**Estimated Development & Capital Cost**	**Estimated Total Annual Return**
Nursery	Land remediation	< 2 acres	$??	
	High development costs		Minimum $250,000	
	Irrigation system		$15,000/acre	
	Aspect (east)			

Assumptions:

1. Removal of added debris would have associated excavation, trucking and disposal costs.
2. Land could be remediated with a program of excavation, removal and intensive soil rebuilding over time. No estimate for this cost was available.
3. Well drilling costs $7,000 – 10,000/test well.
4. Nursery production requires specialised technical production and/or marketing abilities.

Conclusion to Part Two Agricultural Capacity and Feasibility of S.W. ¼, Section 8, TWP. 22, Range 10, KDYD

The existing site has limited feasibility as an agricultural operation. The poor quality of the grazing due to slope and poisonous bracken fern, the costs of fencing, limited area suitable for crop production and the challenges of remediation all combine to render this site economically unfeasible for an agricultural operation.

[43] BC Assessment Factsheet "*Classifying Farm Land",* http://www.bcassessment.ca/public/Fact%20Sheets/Classifiying%20Farm%20Land.aspx

TEAM MEMBERS

Andrea Gunner and Ruth McDougall are both Professional Agrologist in good standing with the B.C. Institute of Agrologists.

Andrea Gunner, P.Ag.

Andrea's area of practise is agricultural economics and farm business management. She has a Bachelor's degree in Horticulture with a minor in Agricultural Economics and post-graduate studies in Economics and Marketing from UBC and Agricultural Leadership from the University of Saskatchewan.

In her role as a both a Professional Agrologist and as a Farm Business Advisor, she is familiar with production practises and market conditions across the agri-food industry as well as the range of provincial and federal regulations that affect the various sectors of the industry, both at primary production and secondary processing levels. In addition to site assessments and business planning with individual farms and agri-food processors, she also researches and assesses existing and new agricultural opportunities within a broad range of sectors on behalf of industry associations, municipalities and Regional Districts, First Nations, Community Futures and government. She is on the Ministry of Agriculture's list of Farm Business Management consultants for all five levels of business management services for both primary producers as well as agri-food processors. These include Tier 1 and Tier 2 of the BC Farm Business Advisory Services Program, the First Nations AGRI-business opportunity assessment, the development and delivery of farm business management workshops and education sessions, and the development of agri-business fact sheets and enterprise budgets.

Ruth McDougall, P.Ag

Ruth's area of practise is Waste Management. She is an acknowledged expert in BC in the characterization and recycling of organic residuals to agricultural land. She has been extensively involved with regulatory and policy development and the composting and use of various organic residuals and effluent since 1993. She has worked with various municipalities and residuals generators throughout British Columbia since 1996 to develop and implement land application programs. Her expertise in soil fertility and nutrient cycling in agricultural systems, has been utilised by municipal, regional and provincial governments to establish appropriate regulations. Ruth has been involved in writing provincial guidelines for residuals recycling, organic matter recycling, the BC Soil Amendment Code of Practise and has produced Land Application Plans for the application of many residuals to agricultural land.

Andrea and Ruth both maintain a close association with other agrologists in British Columbia through active involvement in the B.C. Institute of Agrologists, a professional body whose duty is to uphold and protect the public interest through ensuring the competent and ethical practise. Both spend an average of one hundred hours of Professional Development each year to ensure continuing competency.

EXHIBIT 5

Opus International

Sorrento/Blind Bay Community Sewer System Plan

Opus International Consultants (Canada) Limited
Kelowna Office
Suite 206, 2365 Gordon Drive
Kelowna BC V1W 3C2
Canada

t: +1 250 868 4925
f: +1 250 868 4923
w: www.opusinternational.ca

To	Terry Langlois, Team Leader, Utilities, CSRD
By	Greg Cockburn, EIT
Reviewed by	Stephen Horsman, P.Eng; Tim Phelan, P.Eng.
Date	November 17, 2017
File	Sorrento/Blind Bay Community Sewer System Plan
Subject	TM4 – Review of Treatment Strategies – Update (Revision H)

1 Introduction

Rev. H

This is an updated version of the TM4 – Review of Treatment Strategies originally completed December 2, 2013. Section 2 of this memorandum incorporates changes to the proposed development of Shuswap Lake Estates. The planning horizons used in the previous version are based on a 2009 design year and have not been updated.

This Technical Memorandum (TM) builds on the work completed in previous TMs to develop a range of community sewer system (CSS) options with the aim of providing a more affordable solution for the communities of Sorrento, Blind Bay and Reedman Point. The structure of this TM is as follows:

- *Section 2 – Design Criteria for CSS Plan* sets out the population and wastewater flow data to be used in the development of the CSS Plan
- *Section 3 – Regulations and Guidelines* sets out the provincial and federal regulatory frameworks within which a CSS must operate.
- *Section 4 – Preliminary Community Sewer System Options* discusses some of the issues and assumptions common to the three preliminary options developed
- *Sections 5, 6, 7, and 8* outline the preliminary options developed, for the purpose of selection of one or more preferred options for more detailed evaluation, including cost estimation.
- *Section 9* - provides a summary of the preliminary options including total capital costs, operations and maintenance costs and service connection costs. It also discusses potential cost allocation methods and summarises the estimated costs on a per household basis.

2 Design Flows for CSS Plan

As discussed in Technical Memorandum 1 - Service Area Characterisation (TM1), several previous reports, including the Liquid Waste Management Plan for Area C (LWMP), have made estimates of the design flows for the Sorrento, Blind Bay and Reedman Point areas. The various reports have used different assumptions with regards to growth and wastewater generation rates. The intent of this section of the TM is to confirm the design criteria that will be used going forward in the development of the CSS plan.

2.1 Ultimate Buildout Wastewater Flow

The ultimate future design flow is defined as the wastewater flow that would be produced at an unknown future date once complete infilling of the LWMP service area has occurred. Although the CSS Plan currently in development will address servicing of flows for development over the near term, the plan must also take into account that the ultimate buildout flow must be serviced at some point in the future.

Rev. H

The Electoral Area 'C' Official Community Plan (OCP) Bylaw No. 725, adopted July 20, 2017, has been used as the basis of what type of development will occur, and where. The GIS data provided by the CSRD was used to estimate the areas for each different type of land designation in the OCP. For residential land uses, the theoretical maximum number of properties was determined using the maximum property densities set out in the OCP. The different types of residential land designation, and the maximum densities set out by the OCP are outlined in Table 2.1.

Table 2.1 – Property Density Information from the OCP

LAND USE DESIGNATION	ASSUMED MAXIMUM DENSITY (units/ha)	COMMENTS
Village Centre	34	Range is 12 – 74 units/ha
Medium Density	20	Range is 12 – 30 units/ha
Neighbourhood Residential	5	
Rural Residential	1	
Rural Residential 2	0.5	
Rural Holdings	0.017	
Agricultural	0.017	Minimum parcel size is 60 ha
Rural Resource	0.017	Minimum parcel size is 60 ha

Once the number of residential properties was determined, a per unit wastewater generation rate was applied to determine the residential wastewater flow:

- 1000 L/unit/day for single family dwellings. Assuming a population density of 2.5 people per dwelling this corresponds to 400 L/person/day.
- 625 L/unit/day for medium density and village centre designations to reflect reduced water usage in higher density housing situations. Still using a population density of 2.5 people per dwellings, this corresponds to 250 L/person/day.

For commercial type properties[1], rather than determining the expected number of future units, a per hectare wastewater generation rate was applied. This rate was calculated from the work done by the Sorrento Business Improvement Association (SBIA). The SBIA system was sized to service 21 properties in the commercial area of Sorrento, incorporating a mixture of hotels, RV parks, offices, retail and residential premises. An assumption was made that this group of properties is a fair representation of the mixture of business that might be developed in the future. Knowing the sum area of these properties and the expected wastewater flows, a per hectare commercial wastewater generation rate of 12 m^3/ha/day was determined.

A number of other assumptions were made to complete the estimate of the ultimate buildout wastewater flows:

Rev. H

- Because the Village Centre in Sorrento is expected to contain both residential and commercial developments, it was assumed that 50% of the area would be developed as residential, and 50% as commercial.
- There are currently 244 properties in Reedman Point. This exceeds the maximum density set by the OCP. The current number of properties was used in the estimate.
- The OCP designates a group of 11 properties east of Shuswap Lakes Estates as medium density residential. These properties lie outside of the service area defined in the LWMP. The ultimate buildout design flow estimate assumes that the community sewer service area is extended to include these properties.
- For clarity it is noted that these calculations do not include the Balmoral Village Centre, which is currently part of the ALR but the future use is unclear.

Table 2.2 summarises the outcome of the ultimate buildout design flow estimate for the communities of Sorrento, Blind Bay and Reedman Point.

Table 2.2 – Summary of Ultimate Buildout Wastewater Flow Estimate

BLIND BAY, SORRENTO AND REEDMAN POINT	APPROXIMATE AREA (ha)	NUMBER OF RESIDENTIAL DWELLINGS	WASTEWATER GENERATION RATE	ESTIMATED WASTEWATER FLOW (m^3/day)
Residential	1,210	8,709	1000 L/pop/day 625 L/pop/day	6,270
Commercial	90	-	12 m^3/ha/day	1,070
Total	1,300	8,709	-	7,340

[1] Commercial type properties were assumed to include the following land use designations as defined by the OCP: Village Centre, Neighbourhood Commercial, Public and Institutional, Highway Commercial, Residential Resort, Tourist Commercial, and Waterfront Commercial.

2.2 Community Sewer System Plan Flows

The ultimate buildout flow is the required capacity of the CSS at some point in the future. The design horizon for this CSS Plan is 20 years, but with a view to accommodate the ultimate buildout scenario at some unknown point in the future. This section sets out the design flows that will be used going forward in the development of the CSS Plan.

The construction of a sewer system in the Blind Bay/Sorrento/Reedman Point area is going to have a positive impact on growth. Commercial growth and residential growth have been treated separately:

- Given that a sewer system is constructed in the near future, by 2019 it is assumed that commercial development throughout the service area, including the Sorrento Village Centre, will have reached 50% of the ultimate buildout.
- Regardless of in which areas the sewer system is constructed for all residential areas a per annum growth rate of 2% has been assumed.

It is important to ensure that the above assumptions are sound. Underestimating growth rates will lead to undersizing of the system which may cause problems later on, while overestimation will lead to redundancy and unnecessary costs. The only source of information available for current growth patterns in the area is the Canadian Census. For comparative purposes, the results of the 2011 census are summarised in Table 2.3. Also refer to the discussion in TM1.

Table 2.3 – Summary of 2011 Census Results

PARAMETER	SORRENTO	BLIND BAY POPULATION CENTRE	BLIND BAY AND REEDMAN POINT	TOTAL
Population 2011	1,255	1,738	1,234	4,227
Population 2006	1,360	1,684	1,091	4,135
Percentage Change in Population 2006 -2011	-7.7%	3.2%	13.1%	2.2%
Average Per Annum Growth Rate	-1.6%	0.6%	2.5%	0.4%

Rev. H

A proposed expansion of the Shuwswap Lake Estates was not included in the OCP and is considered as additional growth above the OCP and Census based population growth. The development currently has 194 residential units and 30 commercial units. By 2029, the Shuswap Lake Estates projects a total of 555 residential units and 100 commercial units. The wastewater flows from the proposed Shuswap Lake Estates will flow into the existing Shuswap Lake Estates Sewage Treatment Plant. The proposed development phasing is shown in Table 2-4.

Rev. H

Table 2-4 – Shuswap Lake Estates Additional Development

YEAR	RESIDENTIAL UNITS	COMMERCIAL UNITS
Current Condition		
2017	194	30
Planned/Proposed Additional Per Period		
2019	61	0
2024	155	40
2029	145	30
Total Buildout	555	100

Table 2-5 outlines the revised assumed growth in the Blind Bay/Sorrento/Reedman Point area and the resulting wastewater design flows (average annual daily flows). 2009 has been included as a base year as this is when the LWMP process was completed. The flow for 2009 is the design flow from the LWMP.

Table 2-5 – Community Sewer System Plan Growth Assumptions and Design Flows

YEAR	PERCENTAGE OF BUILDOUT		ESTIMATED FLOW (m^3/day)
	COMMERCIAL	RESIDENTIAL	
2009	Unknown	27%	2,400
2014	16%	30%	2,323
2019	38%	36%	3,739
2024	66%	44%	5,083
2029	88%	51%	6,267
Buildout	100%	100%	10,304

The information from Table 2-5 is presented graphically in Figure 2.1.

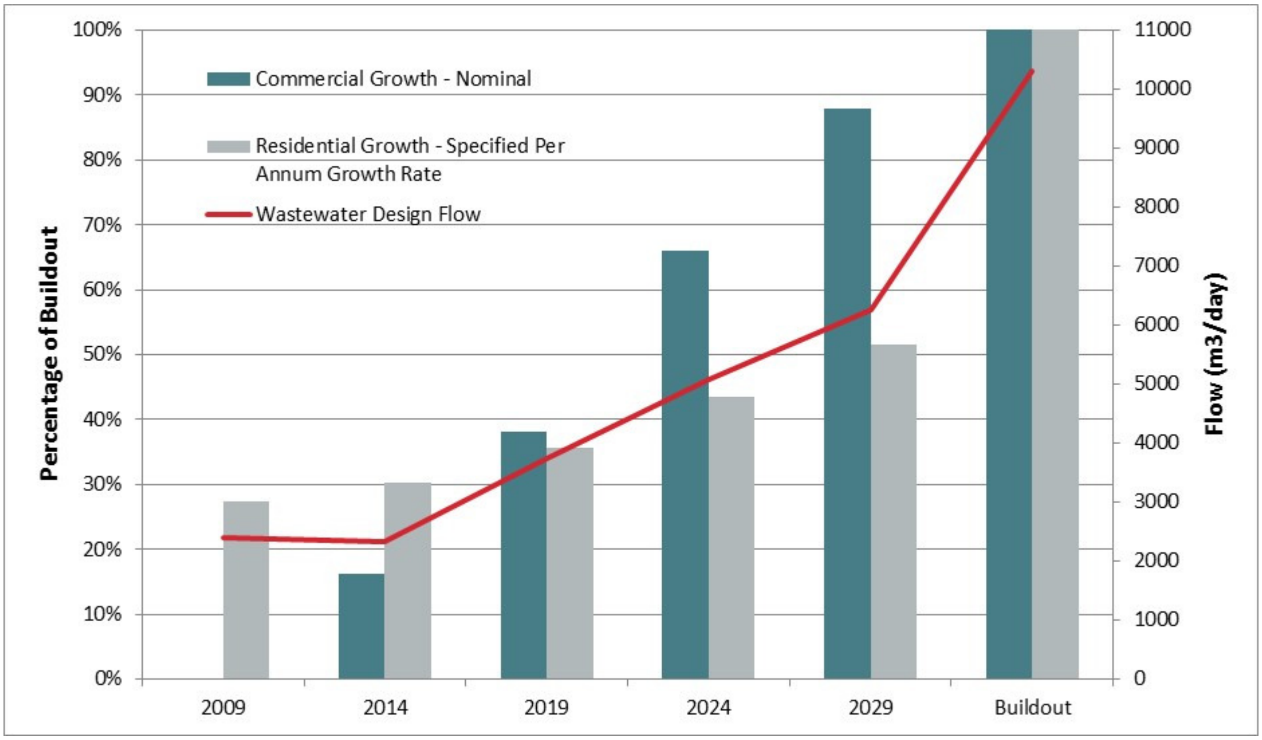


Figure 2.1 –Assumed Growth and Flows for Community Sewer System Plan

The various scenarios developed in previous reports, and summarised in TM1 are presented for, comparison only, side-by-side with the CSS Plan Flows in Table 2-6.

Table 2-6 – Comparison of Development Scenarios[2]

SCENARIO	SOURCE	POPULATION SERVICED	NUMBER PARCELS SERVICED	DESIGN FLOW (m^3/day)
Phase 1 Only	LWMP	1,398	559	560
Current (phases 1, 2, and 3)	LWMP	5,965	2,386	2,400
	BBSO[3]	5,965	2,386	3,240
20 Year Horizon	AECOM combined servicing option	7,610	*3,040*	3,000
	TM4	*11,178*	*4,575*	6,267
Ultimate Buildout	TM4	*23,158*	9,365	10,304

[2] Numbers in italics are calculated based on a population density of 2.5 people/dwelling and do not necessarily form part of the calculations for any particular scenario
[3] Blind Bay Servicing Options – Aecom for Columbia Shuswap Regional District, December 2011

Rev. H

Table 2-7, Table 2-8, and Table 2-9 outline the design criteria for satellite plants for Blind Bay and Reedman Point, Sorrento, and Shuswap Lake Estates respectively. These have been calculated using the same methods and assumptions described above that were used for the entire service area.

Table 2-7 – Design Flows for Sorrento Satellite Plant

SCENARIO	SOURCE	POPULATION SERVICED	NUMBER PARCELS SERVICED	DESIGN FLOW (m^3/day)
Phase 1 Only	LWMP	277	289	290
Current (phases 1, 2, and 3)	LWMP	1,240	494	490
5 year horizon	TM4	1,630	652	650
10 year horizon	TM4	1,909	764	770
15 year horizon	TM4	2,198	879	880
20 Year Horizon	TM4	2,497	999	1,000
Ultimate Buildout	TM4	5,288	2,115	2,120

Table 2-8 – Design Flows for Blind Bay and Reedman Point Satellite Plant

SCENARIO	SOURCE	POPULATION SERVICED	NUMBER PARCELS SERVICED	DESIGN FLOW (m^3/day)
Phase 1 Only	LWMP	675	270	270
Current (phases 1, 2, and 3)	LWMP	3,510	1,922	1,890
5 year horizon	TM4	5,383	2,153	1,700
10 year horizon	TM4	6,002	2,401	1,900
15 year horizon	TM4	6,674	2,670	2,110
20 Year Horizon	TM4	7,406	2,963	2,340
Ultimate Buildout	TM4	16,485	6,594	5,220

Rev. H

Table 2-9 – Design Flows for Shuswap Lake Estates Development

SCENARIO	SOURCE	POPULATION SERVICED	NUMBER PARCELS SERVICED	DESIGN FLOW (m^3/day)
2017	TM4	485	224	959
2019	TM4	638	285	1,112
2024	TM4	1,025	480	2,131
2029	TM4	1,388	655	2,968
Total Buildout	TM4	1,388	655	2,968

2.3 List of References

- Liquid Waste Management Plan Area 'C' Final Stage 2 Report – Earth Tech for Columbia Shuswap Regional District, June 2008
- Blind Bay Servicing Options – Aecom for Columbia Shuswap Regional District, December 2011
- Rev. H Official Community Plan for Area 'C' Bylaw No. 725– Columbia Shuswap Regional District, Adopted July 20, 2017
- Liquid Waste Management Plan Area 'F' Stage 3 Report (AECOM Combined Servicing Option)– Focus Corporation for Columbia Shuswap Regional District, July 2009
- Sorrento Community Sewer Proposal – Stokes, B. Sorrento Business Improvement Association (now Sorrento & Area Community Association), February 2008
- 2011 Census Data – Statistics Canada
- Technical Memorandum 1 Service Area Characterisation for Blind Bay/Sorrento – Opus DaytonKnight for Columbia Shuswap Regional District, June 2013
- Rev. H Proposed Shuswap Lake Estates development details – Terry Barker, Vice President, Shuswap Lake Estates, 2017

3 Regulations and Guidelines

The LWMP for the Sorrento/Blind bay area specifies that no new private discharges to Shuswap Lake will be allowed, and does not give discharge of municipal effluent to the lake as one of the options. Although municipal discharges of treated effluent to Shuswap Lake are not prohibited, it would require a change to the LWMP, including consultation with the community. It is anticipated that these will be strong opposition to a municipal effluent discharge to the lake from the community, therefore it is assumed that wastewater must be treated to a standard where it can either be reused or discharged to ground.

Discharges to ground are normally undertaken using ground disposal fields (also referred to as drain fields and tile fields), which consist of a network of shallow-buried perforated pipes that disperse the effluent to the surrounding soil. In the case of larger discharges, rapid infiltration (RI) basins may be used (these consist of constructed basins with porous bottoms that are periodically filled with treated effluent, which then percolates into the ground). For both ground disposal methods, soils and subsurface conditions must be such that the receiving environment (native soils and groundwater) is protected.

This section contains a summary of regulations that apply to ground discharges and to use of reclaimed effluent that apply to the Blind Bay/Sorrento study area.

3.1 Federal Regulations for Effluent Discharges

The Canadian Council of Ministers of the Environment (CCME) has developed a Canada-wide Strategy for the Management of Municipal Wastewater Effluent. The CCME strategy focuses on effluents released from wastewater treatment systems and overflows from sewer collection systems. National performance standards regulated under the Fisheries Act and in provincial and territorial regulatory instruments are contained in the Wastewater Systems Effluent Regulations, which are now in force.

The new federal regulations apply to effluent discharges greater than 100 m^3/day to waters that are frequented by fish, or where the deposit may enter water frequented by fish. This for the most part would apply to outfall discharges. However, since effluent discharged to ground can be assumed to migrate to Shuswap Lake, it is unclear whether or not the federal regulations may apply to this study. In any case, for a discharge to ground, additional renovation of the effluent would occur as the infiltrated effluent migrates down-gradient toward the lake. Table 3.1 summarises the discharge criteria defined in the Wastewater System Effluent Regulations.

Table 3.1 – Wastewater System Effluent Regulations Discharge Criteria

PARAMETER	CRITERIA
BOD_5	Effluent average not to exceed 25 mg/L
TSS	Effluent average not to exceed 25 mg/L[4]
Residual Chlorine	Maximum 0.02 mg/L
Acute Toxicity	Include specific requirement and timelines to identify and reduce toxicity in cases of acute toxicity test failure
Ammonia	Include specific requirement if acute toxicity test failure is due to ammonia that would authorize discharge of ammonia in effluent based on receiving environment considerations

Monitoring of the environment and timelines to achieve effluent discharge levels are based on risk while considering elements such as sensitivity of the receiving environment, size and composition of the effluent release.

The Wastewater Systems Effluent Regulations require that the minimum discharge standards be met by January 1, 2015, unless a Transitional Authorization has been applied for on or before June 30, 2014. A Transitional Authorization allows discharge of an effluent that does not meet the minimum standards set out in the Regulations for a specified period.

Schedule 2 of the Regulations contains a procedure for allocating points to a particular discharge, with the number of points determining the maximum duration of a Transitional Authorization. If the number of points allocated to the discharge is more than 70 points it would mean that the duration of a Transitional Authorization would not extend past December 31, 2020. If the number of points is less than 70 and equal to or greater than 50, the Transitional Authorization would extend until December 31, 2030; if less than 50 points, the Transitional Authorization would extend to 2040.

Based on the scoring system set out for the federal regulations, it appears that less than 40 points would be awarded to a single discharge from the entire Sorrento/Blind Bay study area at OCP build-out (i.e. worst-case scenario); a Transitional Authorization would therefore extend to 2040, well beyond the horizon for this study. In the long-term, the regulations require wastewater treatment systems equivalent in performance to secondary treatment with advanced treatment if required. A level of treatment that meets or exceeds the criteria set out in Table 3.1 is envisioned for the study area in any case (see Provincial Regulations below).

3.2 Provincial Regulations for Effluent Discharges to Ground

In July of 1999, the Province of B.C. introduced regulatory standards for wastewater discharges and for the use of reclaimed water under the Municipal Sewage Regulation (MSR). The MSR was updated in 2012, with the objectives of clarifying registration requirements, reorganizing the regulation to improve ease of use, simplifying the requirements for reclaimed water use, and providing flexible storage and alternate disposal options for reclaimed water. Because of the

[4] For a continuous wastewater system with a hydraulic retention time of five or more days (e.g. lagoon systems), during the months of July, August, September of October are excluded if the result is >25 mg/L

extensive reorganization that the Regulation underwent, it was renamed the Municipal Wastewater Regulation (MWR). Despite the extensive reorganization, the water quality standards for effluent discharges and for reclaimed water have not changed from the earlier version of the Regulation. The MWR requirements that apply to the study area are summarized below.

Since the study area has an approved LWMP, wastewater discharges will be regulated under Operational Certificates. It is important to note that effluent discharges and use of reclaimed water that are authorized under an Operational Certificate as part of an approved LWMP do not have to be registered under the MWR. However, the Ministry of Environment (MOE) generally uses the MWR standards in developing Operational Certificates.

Municipal effluent for ground disposal is separated into four classes which are summarised in Table 3.2.

Table 3.2 – Municipal Effluent Classes

CLASS	DEFINITION
A	High quality municipal effluent from advanced treatment that includes filtration with disinfection and nitrogen reduction
B	High quality municipal effluent from advanced treatment that includes filtration
C	Municipal effluent from secondary treatment (for lagoon systems the maximum allowable TSS is 60 mg/L)
D	Municipal effluent from a septic tank

The MWR standards for discharges to ground are summarized in Table 3.3.

Table 3.3 – Municipal Effluent Quality Requirements for Discharges to Ground

PARAMETER	CLASS A	CLASS B	CLASS C	CLASS D
BOD_5 (mg/L)	10	10	45	n/a
TSS (mg/L)	10	10	45	n/a
Faecal coliform (MPN / 100 mL)	Median: 2.2 any sample: 14	400, if maximum daily flow is ≥ 37 m^3/d	n/a	n/a
Turbidity (NTU)	Average: 2 Any sample :5	n/a	n/a	n/a
Nitrogen (mg/L)	Nitrate – N: 10 Total N:20	n/a	n/a	n/a

The MWR specifies that if the ground discharge is within 300 m of a drinking water source, then Class A effluent standards must be met. Sub-surface travel time must be at least six days for Class A and B effluent, and at least ten days for Class C and D effluent (sub-surface travel time is the time that the effluent takes to travel from the ground disposal site perimeter to the point where the effluent surfaces, reaches a property line, or is intercepted by a water well). Minimum setback distances are as shown in Table 3.4.

Table 3.4 – Minimum Setback Requirements

ROW	FEATURE	MAXIMUM DAILY FLOW	
		< 37 m^3/day	≥ 37 m^3/day
1	Property boundary	3 m	6 m
2	Building drain, buffer strip	5 m	10 m
3	Body of water	30 m	30 m
4	Water within the Okanagan Basin	30 m	150 m
5	Water well	60 m	90 m
6	Water well within unconfined aquifer	60 m	300 m

Additional restrictions for discharges to ground that are set out in the MWR include, depth to the ground water table, potential for mounding of the groundwater table, and effect on water quality parameters. Where subsurface disposal fields are used, the size of the field depends on the soil percolation rate, and the volume and quality of the discharge. Two disposal fields must be provided, each designed to accommodate the design flow of the system, with a third undeveloped field retained as a standby area. For rapid infiltration basins, at least two basins must be provided, each capable of accepting all of the effluent under annual average rainfall conditions. A minimum of Class C effluent must be achieved for rapid infiltration. Sand mounds and seepage beds may also be allowed if authorized by the MOE.

It should be noted that for situations that require Class A effluent (i.e. potable water well within 300mm of the ground disposal facility), the requirement for nitrogen removal and the low effluent turbidity limits will add significantly to the capital and operational costs of treatment compared to Class B effluent.

3.3 Provincial Standards for Reclaimed Wastewater

Standards for the use of reclaimed effluent in British Columbia are administered by the MOE under the standards set out in the MWR. Categories of reclaimed water are determined based on the point of distribution or use. Uses of reclaimed water are categorized as follows:

a) *indirect potable reuse, being any use of reclaimed water to replenish a potential potable water source;*
b) *greater exposure potential, being uses for which public contact is likely or that present a risk to the receiving environment;*
c) *moderate exposure potential, being uses*
   i. *for which public contact is likely minimal;*
   ii. *for which public access to the reclaimed water is restricted and users are educated as to the risks posed by the use of the reclaimed water, or*
   iii. *that present a moderate risk to the receiving environment;*
d) *lower exposure potential, being uses*
   i. *for which public access to the reclaimed water is restricted and users are not likely to have contact with the reclaimed water,*
   ii. *that are commercial or industrial in nature and users are educated as to the risks posed by the use of the reclaimed water, or*
   iii. *that presents a low risk to the receiving environment.*

The MWR standards for water reuse in British Columbia dictate that effluent used as reclaimed water must meet the requirements described in Table 3.5, depending on the use of the reclaimed water. Use of reclaimed water must be authorized in writing by the local health authority having jurisdiction, or a local service area bylaw must be in place that specifically authorizes the reclaimed water use and that specifies local government responsibility for ensuring compliance with the MWR and for ensuring proper operation and maintenance.

Table 3.5 – Municipal Effluent Quality Requirements for Reclaimed Water

PARAMETER	INDIRECT POTABLE USE	GREATER EXPOSURE POTENTIAL	MODERATE EXPOSURE POTENTIAL	LOWER EXPOSURE POTENTIAL
pH	Site specific	6.5 to 9	6.5 to 9	6.5 to 9
BOD_5, TSS	BOD_5 5 mg/L TSS <5 mg/L	10 mg/L	25 mg/L	45 mg/L
Turbidity	max 1 NTU	average 2 NTU, max 5 NTU	N/A	N/A
Fecal Coliform (/100 mL)	median <1 CFU or < 2.2 MPN	median < 1 CFU or < 2.2 MPN; max 14 CFU	median 100 CFU; max 400 CFU	median 200 CFU; max 1,000 CFU

The MWR sets out additional restrictions for uses of reclaimed water (e.g., setbacks from potable water sources, worker contact, restrictions for irrigation). For reclaimed water used in applications having greater exposure potential, treatment must include chemical addition followed by filtration. A chlorine residual must be maintained in the reclaimed water distribution system regardless of exposure potential.

An alternate means of disposing of the effluent is also required under the MWR. In the case of this study for the Sorrento/Blind Bay Community Sewer System Plan, the preferred alternate means of disposal would be ground disposal, since discharge to surface water (Shuswap Lake) is not considered in the LWMP. However, as discussed in TM3, there are few locations within the study area that are suitable for ground disposal, particularly in the Balmoral area. Our discussions with MoE Kamloops office indicate that some flexibility can be provided regarding alternative means of disposal, since the system will be operating under an approved LWMP (Operational Certificate) rather than registration under the MWR.

Acceptable alternatives for dealing with process upsets or mechanical problems that may temporarily result in the production of effluent that does not meet reclaimed water standards include dedicated temporary storage with subsequent re-treatment, or pump and haul to a treatment facility that can accept the wastewater. The latter alternative would require a binding agreement with the owners of the treatment facility ensuring that the waste would be accepted. Refer also to Section 4.5 for further discussion.

4 Preliminary Community Sewer System Options

Sections 5, 6, 7 and 8 discuss preliminary options for a Community Sewer System for the Blind Bay, Sorrento and Reedman Point area. The options are based on those previously investigated in the LWMP and Blind Bay Servicing Options Report (BBSO), but have been updated based on the new information available. It is intended that one or more of these options is selected to go on to more in-depth design and costing. The preliminary options presented are:

- Option 1 – Expansion of the Existing Shuswap Lake Estates Treatment Facility
- Option 2 – New regional treatment facility at Balmoral
- Option 3 – Satellite Treatment Facilities for Sorrento and Blind Bay
- Option 4 – Hybrid Regional Facility

This section discusses and defines some of the issues that are common to all options.

4.1 Service Area and Phasing

No change is to be made to the service area defined in the LWMP except to extend it to include the 11 properties east of Shuswap Lake Estates (SLE) that are included as part of the Secondary Settlement Area but were excluded at the time the LWMP was developed.

The LWMP identified areas of Blind Bay and Sorrento that are priorities for centralised sewage collection. These areas, described in this report as priority 1 areas, are along the lakefront and have the greatest potential to contaminate Shuswap Lake from inefficient or damaged septic tank systems. Priority 2 and 3 refers to the remaining properties within the LWMP service area. Refer to Appendix A which includes Figure 02 from the Stage 2 LWMP Report defining the priority areas for Sorrento, Blind Bay and Reedman Point.

In the following sections, the definition of priority 1 has been retained and priority 2 has been amended to refer to priority 2 and 3 from the LWMP. Once a preferred option is selected, and more detailed design/costing is undertaken, it may be favourable to extend or reduce these priority areas to best fit with the phasing plan and the design.

For the community sewer system options presented at this preliminary stage, two phases are proposed. In general, it is expected that the first phase will be implemented as soon as possible, and will address the needs of priority 1 areas only. It is expected that the second phase will be implemented 5-10 years following phase 1 and will provide servicing for the remaining areas within Blind Bay and Sorrento, allowing for 20 years of growth. This is different from the LWMP, which did not make allowances for the 20 years of growth. In addition, the system must be configured in light of long term (buildout) future development.

4.2 Collection System

The LWMP provides a concept design for the collection system for Blind Bay, Sorrento and Reedman Point. The design is a conventional gravity collection system with force mains for low-lying areas as required. No changes are proposed at this stage to that network, although the design will be reviewed in detail when a preferred option is selected.

An alternate type of collection system is Septic Tank Effluent Pump (STEP) or Septic Tank Effluent Gravity (STEG). In this type of system each household has a pumped connection into a low pressure sewer main. This type of system is suited to communities with terrain that makes it challenging to construct a conventional gravity sewer system. A review of the potential difference in cost between the two collection systems has been carried out and is summarised in Table 4.1.

Table 4.1 – Comparison of Collection Systems

COLLECTION SYSTEM	PHASE	ESTIMATED CAPITAL COST ($MILLION)		
		NETWORK	SERVICE CONNECTION	TOTAL
Conventional gravity	1	$4.8	$2.8	$7.6
	2	$20.0	$17.0	$37.0
	Total	$24.8	$19.8	$44.6
STEP	1	$2.8	$5.6	$8.4
	2	$10.3	$34.0	$44.3
	Total	$13.1	$39.6	$52.7

Table 4.1 shows that using a STEP system reduces the overall network costs, but increases the cost of the service connection to each household. The cost of a service connection (from the house to the property boundary) for a STEP system is approximately $10,000 per household, compared to $5,000 per household for a conventional gravity system. Overall, the STEP is likely to be more expensive than a conventional gravity system for the Sorrento, Blind Bay and Reedman Point communities and would be more challenging and costly to operate.

4.3 Wastewater Treatment

In general, the most economical approach for small community systems where secondary treatment is required is to use partial-mix aerated lagoons. These systems typically employ screening to remove coarse trash (plastics and other debris), followed by one or more partially mixed aerated ponds, and then a final unmixed, un-aerated pond to allow settling of solids prior to discharge. In some systems, settling is accomplished be leaving a portion of the last lagoon in the series unmixed and un-aerated. Additional treatment steps (e.g., disinfection) may be added depending on the effluent quality requirements. With the addition of a storage reservoir, this type of system can be used to produce reclaimed water for irrigation (as practiced at the City of Armstrong).

In partial-mix lagoon systems, solids gradually accumulate in the settling pond or section; these must be periodically removed and either disposed of or beneficially used (e.g., land applied under a permit). Solids removal typically occurs on a 20 to 30 year cycle, depending on the design and the loading of the system.

Lagoon systems are robust and simple to operate; their main disadvantage is the relatively large space requirement.

For larger communities or where space restrictions prevent the use of lagoons, mechanical treatment facilities are used; these may be based on fixed or suspended growth processes, depending on a number or site-specific factors. Mechanical treatment facilities have much smaller space requirements than lagoons and are in general capable of producing a better quality effluent. However, they are more costly to construct and to operate, and they require a greater level of operator training.

Mechanical treatment facilities produce waste solids that must be removed regularly from the process. Depending on the nature and size of the facility, waste solids may consist of primary sludge (mainly untreated fecal material that is separated from the wastewater by gravity settling or filtration), and waste biological sludge (mainly consisting of bacterial cells that grow in the treatment system). Both of these waste solids streams must be removed from the liquid treatment process (generally on a daily or weekly basis), and normally are subjected to additional treatment (e.g., digestion or composting) before being disposed of or beneficially used. For small systems, the untreated waste solids may be taken by tanker truck to a larger facility that receives this type of waste. Solids handling and treatment at mechanical facilities represents a significant capital and O&M cost, and is also source of nuisance odours.

The CSRD currently operates an Organic Matter Recycling Regulation (OMRR) compliant static pile composting facility in Salmon Arm. This is a potential destination for waste solids generated from a community sewer system, if a mechanical treatment process is selected.

4.4 Reclaimed Water Use for Irrigation

4.4.1 Effluent Storage Reservoir Sizing

The minimum effluent storage volume required must accommodate one year's worth of effluent at design flows. It is recommended that capacity in excess of this be provided in case of extended unfavorable (wet) conditions during the summer when effluent irrigation would not take place. For the purposes of cost estimation the effluent storage reservoirs have been sized to hold 1.25 years' worth of effluent at design flows. Because the design flow is a summertime flow, and wastewater flows for the remainder of the year are expected to be significantly less than this, the effective storage in the reservoir is estimated to be up two years of effluent at actual flows, and this is judged to provide an adequate safety factor.

It should be noted that the provincial Municipal Wastewater Regulation (MWR) requires that an alternative method of effluent disposal be available for reclaimed water systems (see Section 3 for further detail).

4.4.2 Irrigation System

The required irrigation areas have been calculated based on a duty irrigation of 380 mm/year or 3,800 m^3/hectare. During the LWMP process a number of properties in the vicinity of Shuswap Lake Estates and Balmoral expressed interest in receiving reclaimed water for irrigation, and from this it is estimated there may be 275 ha of land available for irrigation of reclaimed water.

There are no suitable irrigation areas in the vicinity of the Fredrickson Rd site, and a plant located there would need to dispose of effluent with rapid infiltration basins.

It is noted here that there are options regarding ownership of the irrigation equipment. For example, some municipalities have found that it was beneficial for them to own all the irrigation equipment initially, to encourage local farmers to take part in the scheme. Once the irrigation scheme was well developed, the municipality sold the irrigation equipment to the farmers, for a nominal amount. It is our understanding that the land in the Balmoral area is primarily used for dairy, and much of the irrigation equipment is already in place.

For the purpose of providing a preliminary capital cost estimation it has been assumed that only irrigation distribution infrastructure (lift stations and forcemain to property boundary) will be provided by the CSRD.

4.5 Rapid Infiltration and Other Alternative Disposal Means

As noted previously, the MWR requires an alternative means of effluent disposal for reclaimed water systems. This may be a ground or surface water discharge, or another system that MoE deems acceptable. In any case, it is recommended that a back-up method for disposing of effluent is allowed for, in case of prolonged unfavourable irrigation conditions or deterioration of treated effluent quality.

For Blind Bay/Sorrento, rapid infiltration basins are the preferred alternative disposal method. TM3 discusses potentially suitable locations for rapid infiltration basins in the Blind Bay and Sorrento areas. Figure 1 from TM3 which shows these locations is reproduced in Appendix B. Currently, no suitable locations in the immediate vicinity of the Shuswap Lake Estates or in the Balmoral area have been identified. A number of other potential sites for rapid infiltration are discussed in TM3, but require further investigation to confirm suitability. For the purposes of preparing cost estimates, the rapid infiltration site proposed in the LWMP, at Fredrickson Rd, has been used. There are number of issues with use of the Fredrickson Rd site for rapid infiltration:

- The site is approximately 9km away from the potential treatment sites at Shuswap Lake Estates and Balmoral, and at a difference in elevation of 35m.
- If the entire service area is to be serviced by rapid infiltration basins, the estimated capacity of the site (2,700 m^3/day) would only be sufficient until around the year 2019. However, if only Sorrento is to be serviced at this site, the capacity of the site is likely to be sufficient to ultimate buildout.
- Approximately ten houses downstream of the site will be required to stop using wells for drinking water supply. It is possible for CSRD to extend the current Sorrento drinking water supply system to these properties; however, this is an additional cost that must be considered.

Although the costs for providing back-up rapid infiltration systems may be high due to the distances and changes in elevation involved, as noted in Section 3.3, there is some flexibility in the requirement for a back-up disposal system. It is proposed that for any regional treatment facility in the Balmoral area where irrigation of reclaimed water is intended, a dedicated emergency storage reservoir, sized to hold 20 days of effluent at design flows, is provided (this is in addition to the much larger reclaimed water storage reservoirs).

4.6 Septage Handling

Septage is the waste solids from a septic tank system. It has a higher solids to liquid ratio than municipal wastewater, is much more concentrated in organic matter, heavy metals, grease and extraneous solids and is highly odorous. It has the potential to upset the treatment performance at a wastewater treatment facility if it is not designed to handle septage. There are a number of methods for dealing with septage:

- Direct application to land. Septage is mixed with chemicals to reduce pathogen count prior to land application (in trucks). A license is required to do this, which may be difficult to obtain. Requires a large land area. Odours would be a significant concern.
- Disposal at a regional wastewater treatment facility. The wastewater facility would need to be design to handle septage, which would increase the cost. Septage may be disposed directly into aerated lagoons, although this will increase the frequency with which desludging is required. Septage treatment can also be accommodated at a mechanical treatment plant, but the waste solids generation will increase.
- Composting. Dewatering of septage is required prior to being used as an additive to a composting system. The viability is dependent on the volumes of septage and other compostable material found and the ease of dewatering (which may require chemicals).
- Dewatering trenches. This involves digging long trenches in permeable soils, which allow the liquid portion of the septage to seep into the ground or evaporate. The dewatered solids can then be disposed of at an approved landfill or further stabilised and applied to land. This is a no discharge system (no permit required) but land application requires a large land area.

Whichever method is chosen, it is important that the owner/operator of the treatment system set appropriate user fees for receiving septage to cover the additional costs of treating and disposing of it.

The CSRD do not currently operate a septage handling facility in the Blind Bay/Sorrento area. There is a private septage handling facility operating in the area, however its continued future operation is uncertain.

The existing septage handling facility has a discharge permit for 910 m^3/year, although we understand that the facility operates as evaporation beds and there is no discharge occurring.

An estimate of the annual volume of septage generated within the study area is summarised in Table 4.2. It is assumed that all properties in Area C not serviced by the Blind Bay/Sorrento regional wastewater treatment facility are on septic tanks and will generate septage.

Table 4.2 – Estimate of Annual Volume of Septage in Area C

PARAMETER	VALUE
2011 Census number of dwellings in Area C	4,807
Number of properties to be serviced by Blind Bay/Sorrento regional wastewater treatment facility (2011, no growth)	2,385
Nominal allowance for growth	2% per annum for 20 years
Number of dwellings to be serviced by septage handling facility (20 year design horizon)	3,600
Assumed average capacity of septic tank	4,000 L
Recommended septic tank clearing frequency	5 years
Annual volume of septage to be treated	2,880 m^3/year

In this TM, the assumption has been made that septage will not be received at any wastewater treatment facility, largely due to the risk of undesirable material entering the wastewater treatment facility from septage trucks resulting in process disruptions. It is assumed that a dedicated septage receiving and treatment facility will be located on a separate site.

4.7 Design Criteria

The design flows for this project are discussed in detail in Section 2 of this TM. The minimum design flow values for a regional treatment facility (Options 1 and 2) are summarised in Table 4.3, and in Table 4.4 and Table 4.5 for satellite facilities (Option 3). Design values for the effluent storage reservoir and irrigation area are also given.

Table 4.3 - Design Criteria for Regional Treatment Facility

SCENARIO	NUMBER PARCELS SERVICED	WASTEWATER AVERAGE DAY FLOW	EFFLUENT STORAGE RESERVOIR VOLUME[5]	IRRIGATION AREA
Existing Priority 1 areas	559	0.6 ML/day	274,000 m^3	58 ha
Existing Priority 1 and 2 areas	2,386	2.4 ML/day	1,095,000 m^3	231 ha
Future Priority 1 and 2 plus 20 years growth	3,920	3.3 ML/day	1,506,000 m^3	317 ha
Ultimate Buildout	8,710	7.3 ML/day	3,331,000 m^3	705 ha

[5] Sized based on 1.25 years' worth of design flows.

Table 4.4 – Design Criteria for Sorrento Satellite Plant

SCENARIO	NUMBER PARCELS SERVICED	WASTEWATER AVERAGE DAY FLOW	EFFLUENT STORAGE RESERVOIR[5]	IRRIGATION AREA
Existing Priority 1 areas	289	0.3 ML/day	137,000 m^3	28 ha
Existing Priority 1 and 2 areas	494	0.5ML/day	228,000 m^3	47 ha
Future Priority 1 and 2 plus 20 years growth	999	1.0 ML/day	456,000 m^3	96 ha
Ultimate Buildout	2,115	2.1 ML/day	958,000 m^3	204 ha

Table 4.5 – Design Criteria for Blind Bay and Reedman Point Satellite Plant

SCENARIO	NUMBER PARCELS SERVICED	WASTEWATER AVERAGE DAY FLOW	EFFLUENT STORAGE RESERVOIR[5]	IRRIGATION AREA
Existing Priority 1 areas	270	0.3 ML/day	137,000 m^3	26 ha
Existing Priority 1 and 2 areas	1,892	1.9 ML/day	867,000 m^3	182 ha
Future Priority 1 and 2 plus 20 years growth	2,963	2.3 ML/day	1,049,000 m^3	225 ha
Ultimate Buildout	6,594	5.2 ML/day	2,373,000 m^3	501 ha

Table 4.6 is provided for information only at this stage. It summarises the service levels required at five year intervals up to the design horizon based on the work done in Section 2. Refer also to Table 2-6.

Table 4.6 – Design Criteria for Regional Treatment Facility by Year

SCENARIO	NUMBER PARCELS SERVICED	WASTEWATER AVERAGE DAY FLOW (ML/day)	EFFLUENT STORAGE RESERVOIR[5] (m^3)	IRRIGATION AREA (ha)
2009	1,920	2.4	1,095,000	222
2014	2,150	2.3	1,049,000	221
2019	2,400	2.6	1,186,000	250
2024	2,670	3.0	1,369,000	288
2029	2,960	3.3	1,506,000	317
Buildout	6,590	7.3	3,331,000	701

4.8 Preliminary Costing

Indicative costing for the options is presented in the following sections and in Appendix C. It is important to note that the costs provided are preliminary costs only and are intended to enable a relative comparison of cost between the various options.

For the sewer collection system, concept design for the pipe diameters and unit costs for the installation of sewer pipes, service connections and pump stations were developed in consultation with a local civil engineering firm, Gentech Engineering. Unit excavation costs for lagoon construction are also based on information from recent local projects.

The uncertainties present in the opinions of probable cost include:

- The location of the proposed treatment facility in the Balmoral area is to be confirmed. A conservative location has been assumed for the purposes of cost estimation. If a suitable location can be found closer to the service area, then costs may be reduced.
- The location and extent of potential reclaimed water irrigation sites is to be confirmed
- The purchase/lease arrangements need further discussion with land owners
- The layout of the collection system and sizing of lift stations may have changes in installation depth (affected by vertical realignment at crossings), or adjustments in the service area (affecting flow rate).
- Ground and soil conditions are to be confirmed. At this stage no allowance has been made for import of materials

We also note that costs for a separate septage treatment facility have not been included in the capital cost estimates. The cost of the septage facility is independent of the wastewater treatment option selected. A septage treatment facility is expected to consist of the following at a minimum:

- Land purchase
- Civil works includes public and private access roads, unloading area and fencing
- Receiving kiosk including card access module
- Screening
- Septage treatment lagoon with or without waste effluent disposal facility

A concept design has not been carried out for a septage treatment facility, but it is expected the capital cost may be in the order of $1,000,000[6].

4.8.1 Contingency

A contingency of 20% of construction cost has been applied to the estimates developed in this report to be consistent with the contingency level applied during the 2009 LWMP. Contingency is an allowance for unknown project costs that may become apparent during detailed design and/or construction, and should be proportional to the level of design development or design risks not yet identified.

Normally, a 20% contingency is applied for projects which are developed to approximately 30% design, whereas the present options are considered to be at more within a 10% to 15% design. However, as a measure of design risks not yet identified, this type of infrastructure generally has less risk than a more complex treatment facility with multiple process streams. On the other hand, there are unknowns at this level of design that can result in significantly higher

[6] Assuming $40,000 for land purchase, $100,000 for civil works, $50,000 for utilities, $350,000 for kiosk and screening and $450,000 for treatment.

costs than anticipated (e.g. difficult ground conditions, need for rock blasting, high groundwater, poor structural soils etc.). Therefore, while a more conservative contingency level of up to 40% would normally be used based strictly on the level of design development, using a 20% contingency level is still acceptable based on acceptance of that risk. It also makes the costs in this report directly comparable to the 2009 LWMP in 2013 dollars. However, it must be recognised that using the lower contingency of 20% increases the risk that the project may exceed budgeted amounts during detailed design and construction.

4.8.2 Engineering

An allowance of 15% of construction costs was applied for engineering, legal, and administration (ELA) which is the same as was used in the 2009 LWMP; a typical allowance for projects of this nature at this level of analysis.

4.9 Public Private Partnerships

Public Private Partnerships (P3s) are discussed in TM 2. They are a mechanism for project delivery, and can be applied to any of the options discussed in the following sections. If the CSRD decide to pursue a P3 delivery method, then the agreement between the parties will set out the parameters for the project including the performance specification, location, general process requirements etc.

It is important to provide sufficient detail to ensure that all of the CSRD's needs are met by the project.

5 OPTION 1 - Expansion of the Existing Sewage Treatment Facility at Shuswap Lake Estates

As discussed in TM1, expansion of the existing Shuswap Lake Estates Sewage Treatment Plant (STP) was one of two preferred options during the LWMP process. Since the LWMP, Shuswap Lake Estates (SLE) have added a third aerated lagoon and upgraded the aeration systems in the existing two lagoons. SLE estimates the current treatment capacity of the facility at 1 ML/day.

It appears the current facility operates as a no discharge system that relies on evaporation of treated effluent from a system of ponds on the golf course. It may be possible for SLE to utilise the effluent for seasonal irrigation of their golf course, but we have no information on the frequency of watering and the quantity of effluent that could be used in this manner.

5.1 Existing Capacity

The number of properties intended to be developed at Shuswap Lake Estates is currently unknown, but it assumed that it will not exceed the capacity of the lagoons (approximately 1,000 properties). As shown in Table 5.1, treatment of this number of properties will require expansion of the storage reservoir and irrigation area.

The following is a summary of the current capacity of the SLE STP:

- Lagoon capacity is 1 ML/day
- Effluent storage reservoir capacity is 270,800 m^3
- There is 44 ha of land available on the golf course for irrigation of reclaimed water.

Table 5.1 summarises further information on the Shuswap Lake Estates treatment facility.

Table 5.1 –Shuswap Lake Estates STP Flows

ITEM	PARCELS SERVICED	FLOW THROUGH AERATED LAGOONS	EFFLUENT STORAGE RESERVOIR VOLUME REQUIRED	REQUIRED IRRIGATION AREA
Current Flows	200	<0.1 ML/day	73,000 m^3	10 ha[7]
Capacity Required to Service 1,000 Properties	1,000	1 ML/day	456,000 m^3	96 ha

5.2 Required Upgrades to Existing Plant

Although the current STP operates at well under capacity, it is not large enough to accommodate the entire Sorrento and Blind Bay service area (refer to Table 5.1 and Section 4.6) and the

[7] Theoretically this is the irrigation area required, but currently reclaimed water is not used to irrigate the golf course

current effluent storage capacity is not adequate for a service population of this size. At some point in the future, expansion of the existing plant will be required.

It is expected that any expansion of the existing STP will take place on the current site. (Option 4 covers a situation where the SLE facility is initially used, but any expansion occurs offsite). From the LWMP, the proposed expansion of the treatment facility consists of:

- Addition of a primary fine screen filter (Salsnes filter)
- Addition of mechanical treatment process train - rotating biological contactor (RBC) units
- Upgrade/replacement of existing mechanical and electrical equipment as required
- Addition of septage handling facility
- Provision of additional effluent storage capacity
- Irrigation distribution system
- Provision of alternative means of effluent disposal (emergency storage reservoir)
- A Management Plan for primary and biological waste solids generated at the treatment plant will be required prior to commissioning.

There is little room for expansion of the existing storage reservoir on the existing site. When additional storage is required a new effluent storage reservoir would have to be constructed (assumed to be close by in the Balmoral area).

Local residents have previously raised concerns about the structural stability of the dam and aerated lagoons at the Shuswap Lake Estates facility. It is recommended that a geotechnical investigation be carried out to assess the stability to the storage reservoir and aerated lagoons. Ideally this would take place before any further costing/design was to take place, but must take place before a final decision on options takes place. A geotechnical investigation would cost in the order of $50,000.

Providing an alternative means of disposal at this site is also problematic. There are no suitable areas for ground disposal of effluent using rapid infiltration in the vicinity, nor is there sufficient space on site to accommodate an emergency storage reservoir. Additional effluent storage to the existing is required to service priority 1 areas, so it is recommended that the existing storage reservoir be converted into emergency storage, and a new effluent storage reservoir be constructed offsite. The existing storage reservoir will provide approximately 450 days of emergency storage at priority 1 flows and 80 days at priority 1 and 2 plus growth flows.

There is little room to house a separate septage handling facility on the existing site. There are two options for dealing with septage for this option;

- Construct a separate septage handling facility offsite, likely in the Balmoral area. This would allow dewatering trenches or another low technology method of dewatering and disposing of septage to be utilised
- The existing lagoon system is too small to handle septage. Therefore septage could only be accepted once the mechanical treatment plant is constructed. This will require the capacity of this equipment to increase, and would further increase the amount of waste solids produced in the mechanical treatment process. It is noted that odour risk for the plant neighbours will be increased if septage is received at the site.

5.3 Phased Expansion of Shuswap Lake Estates STP

There is sufficient capacity in the aerated and lagoons and effluent storage reservoir at the SLE STP to accommodate the priority 1 area from the LWMP, plus 300 additional SLE properties on top of the properties already serviced. However, the irrigation area available at the golf course is insufficient to reuse all of the effluent. Table 5.2 summarises the actions required at phase 1 and 2.

Table 5.2 – Phasing for Option 1

COMPONENT	PHASE 1	PHASE 2
Collection and Transmission	Construction of collection system for priority 1 areas and connection to existing Shuswap Lake Estates STP	Construction of a collection system for priority 2 areas and connection to existing collection system
Treatment	Purchase of Shuswap Lake Estates STP	Expansion of Shuswap Lake Estates treatment facility including addition of screening and RBC units
Storage	Construction of new effluent storage reservoir in Balmoral area (provides ¼ total storage) Convert existing effluent storage reservoir into emergency storage reservoir	Construction of additional of effluent storage reservoirs to meet total storage requirements
Disposal	Preparation of a minimum of 20 hectares of additional irrigation area (plus golf course)	Preparation of additional irrigation areas (approximately 250 ha)

It is noted that although the existing SLE facility has sufficient capacity to service priority 1 areas, there is insufficient effluent storage available.

Option 1 utilises existing infrastructure, avoids the operation of two parallel sewer systems in the area and provides for the earliest installation of a sewer system for the community. The location of the site is also favourable for effluent reuse. There are, however, a number of potential issues with this option, which are outlined below:

- There are concerns over the structural stability of the dam and lagoon structures. These need to be investigated and proved sound before CSRD can confirm they would be willing to take over this facility
- The limited space available for expansion of the existing treatment facility means that a mechanical treatment process must be used to provide additional capacity.
- The use of mechanical treatment facilities (primary screen filter and RBC units) will generate waste primary and secondary solids, which will require additional treatment (solids digestion or composting) as well as a beneficial biosolids reuse programme.

- There is no space available on the site for an additional effluent storage reservoir. This will most likely be located in the nearby Balmoral area.
- There are no locations in the vicinity that are suitable for rapid infiltration. The closest sites are several kilometres away and at significantly greater elevations. There is no space available on the site for a basin designed for short term storage of effluent that does not meet reclaimed water standards except for the existing storage basins which are currently used for treated effluent. Emergency storage reservoirs may satisfy the requirement for an alternative disposal system but there is a residual risk that an in the event of an extended period where reclaimed water standards are not being met by the treatment process there is no facility to deal with excess sewage.
- The existing facility is located within a residential area and has received complaints regarding odours in the past. Expansion of the facility and addition of mechanical treatment processes and waste solids handling will worsen the odour problem.
- CSRD would need to come to an agreement with Shuswap Lake Estates

5.4 Configuration of System and Cost Estimate

The configuration of the system under Option 1 is shown in Figure 5.1. The preliminary capital cost estimate for this option is summarised in Table 5.3. A breakdown of the cost estimate is provided in Appendix C.

Table 5.3 – Preliminary Capital Cost Estimate for Option 1 ($million)

COMPONENT	PHASE 1	PHASE 2	TOTAL
Collection system	$4.82	$20.01	$24.83
Transmission	$2.02	-	$2.02
Treatment	$3.00	$4.19	$7.19
Storage	$4.74	$5.93	$10.67
Disposal	$0.74	$0.45	$1.19
Subtotal	**$15.31**	**$30.58**	**$45.90**
Contingency & ELA	$5.36	$10.70	$16.06
Total	**$20.67**	**$41.29**	**$61.96**

Placeholder page for Figure 5.1

6 OPTION 2 – New Regional Facility at Balmoral

As discussed in TM1, construction of a new regional treatment facility in the Balmoral area was the preferred option at Stage 3 of the LWMP process. Much of the land in the Balmoral area is administered by the ALC, who have offered to negotiate with the CSRD over purchase/lease of land for the purpose of situating a regional treatment facility. Note that the location is not necessarily the same as presented in TM1 (in the rail loop). The ALC would like the wastewater facility to be constructed on the least desirable agricultural land in the area.

A community sewer system under this option is expected to consist of the following:

- Collection system and transfer to treatment facility
- Partial-mix aerated lagoons for wastewater treatment and chlorination for irrigation.
- Effluent storage reservoir
- Irrigation distribution system
- Septage receiving and handling
- Provision of an alternative means of effluent disposal (emergency storage reservoir)

Refer to Section 4 for additional discussion on the effluent storage reservoir sizing, and the irrigation and rapid infiltration systems.

The treatment plant and effluent storage reservoir are expected to be located in the Balmoral area. There are no suitable sites for rapid infiltration in the vicinity of the Balmoral area. It is proposed that an alternative means of disposal is provided by way of emergency storage reservoir located on the treatment plant site.

Table 6.1 summarises the anticipated phasing that would occur for this option.

Table 6.1 – Phasing for Option 2

COMPONENT	PHASE 1	PHASE 2
Collection and Transmission	Construction of collection system for priority 1 areas in Sorrento and Blind Bay	Construction of collection system for priority 2 areas
Treatment	Construction of new partial-mix aerated lagoon treatment facility at Balmoral	Expansion of aerated lagoon treatment facility
Storage	Construction of new effluent storage reservoir Construction of emergency storage reservoir	Construction of additional of effluent storage reservoirs to meet total storage requirements Construction of additional emergency storage reservoir
Disposal	Preparation of initial irrigation area	Preparation of additional irrigation area

Option 2 was a preferred option in the LWMP. It has the advantages of providing a purpose built facility on a dedicated site with plenty of room. The amount of space available means that low maintenance aerated lagoons can be used as a treatment process, and that all elements of the facility, including treatment processes, effluent storage, septage handling and irrigation distribution can be located on the same site. The location is also favourable for effluent reuse and is within an agricultural area, reducing the number of immediate neighbours and potential odour complaints. There are, however, a number of potential issues with this option, which are outlined below:

- There are no locations in the vicinity that are suitable for rapid infiltration. The closest sites are several kilometres away and at significantly greater elevations. Emergency storage reservoirs may satisfy the requirement for an alternative disposal system but there is a residual risk that an in the event of an extended period where reclaimed water standards are not being met by the treatment process there is no facility to deal with excess sewage.
- It will create two parallel treatment facilities in the area (the other being SLE) and does not utilise the available existing infrastructure.

6.1 Configuration of System and Cost Estimate

The configuration of the system under Option 2 is shown in Figure 6.1. The preliminary capital cost estimate for this option is summarised in Table 6.2. A breakdown of the cost estimate is provided in Appendix C.

Table 6.2 – Preliminary Capital Cost Estimate for Option 2 ($million)

COMPONENT	PHASE 1	PHASE 2	TOTAL
Collection system	$4.82	$20.01	$24.83
Transmission	$2.58	-	$2.58
Treatment	$5.20	$2.13	$7.33
Storage	$2.93	$6.26	$9.18
Disposal	$0.63	$0.45	$1.08
Subtotal	**$16.15**	**$28.85**	**$45.00**
Contingency & ELA	$5.65	$10.10	$15.75
Total	**$21.80**	**$38.95**	**$60.74**

Placeholder page for Figure 6.1

7 OPTION 3 – Satellite Plants for Sorrento and Blind Bay

Separate "satellite" plants were also discussed as part of the LWMP process and were described in TM1. Construction of satellite plants for Sorrento, Blind Bay and Reedman point were not considered preferred options at Stage 3 of the LWMP process. Creating two separate service areas offers greater flexibility in the phasing. Six similar options are presented here and are summarised in Table 7.1. The options involve two potential locations for the satellite treatment facility for Blind Bay/Reedman Point, and three phasing options.

Table 7.1 – Summary of Satellite Treatment Plant Options

OPTION	SORRENTO SATELLITE TREATMENT FACILITY	BLIND BAY SATELLITE TREATMENT FACILITY	PHASING
3a	Fredrickson Road	Shuswap Lake Estates	Priority 1 areas serviced at phase 1 and remaining areas at phase 2
3b	Fredrickson Road	Shuswap Lake Estates	Sorrento serviced at phase 1 and Blind Bay/Reedman Point serviced at phase 2.
3c	Fredrickson Road	Balmoral area	Priority 1 areas serviced at phase 1 and remaining areas at phase 2
3d	Fredrickson Road	Balmoral area	Sorrento serviced at phase 1 and Blind Bay/Reedman Point serviced at phase 2.
3e	Fredrickson Road	Fredrickson Road / Shuswap Lake Estates	Priority 1 areas serviced at Fredrickson Rd at Phase 1. At phase 2 Blind Bay effluent is diverted to a new treatment facility at Shuswap Lake Estates
3f	Fredrickson Road	Fredrickson Road / Balmoral area	Priority 1 areas serviced at Fredrickson Rd at Phase 1. At phase 2 Blind Bay effluent is diverted to a new treatment facility in the Balmoral area

The Sorrento Satellite facility will consist of screening and partial-mix aerated lagoons, and disposal will be via rapid infiltration basins. There is to be no effluent storage at this site. The Blind Bay Satellite facility will either be similar to Option 1 or Option 2, whichever is relevant. Tables 7.2 to 7.7 provide a more detailed summary of the six options.

Table 7.2 – Outline of Option 3a (Treatment Facilities at Fredrickson Rd and SLE, Phased by Priority Area)

AREA	BLIND BAY AND REEDMAN POINT	SORRENTO
Treatment Facility Location	Shuswap Lake Estates	Fredrickson Rd

Phase 1	• Collection system for priority 1 area in Blind Bay constructed and connected to SLE • Existing storage reservoir utilised • New emergency storage reservoir constructed in the Balmoral area • Preparation of irrigation area	• Collection system for priority 1 area in Sorrento constructed • New partial-mix aerated lagoon treatment facility constructed • Rapid infiltration basins constructed
Phase 2	• Collection system for priority 2 areas in Blind Bay and Reedman Point • Expansion of existing treatment facility by addition of screening and RBC units • New effluent storage reservoir constructed in the Balmoral area • Expansion of irrigation area	• Collection system for priority 2 area in Sorrento • Expansion of lagoon system • Expansion of rapid infiltration area

Table 7.3 – Outline of Option 3b (Treatment Facilities at Fredrickson Rd and SLE, Phased by Geographical Area)

AREA	BLIND BAY AND REEDMAN POINT	SORRENTO
Treatment Facility Location	Shuswap Lake Estates	Fredrickson Rd
Phase 1	• No action	• Collection system for entire Sorrento area constructed • New partial-mix aerated lagoon treatment facility constructed • New rapid infiltration basins constructed
Phase 2	• Collection system for entire Blind Bay/Reedman Point area constructed • Expansion of existing treatment facility by addition of screening and RBC units • New effluent storage reservoir constructed in the Balmoral area • New emergency storage reservoir constructed in the Balmoral area • Preparation of irrigation area	• No action

Table 7.4 – Outline of Option 3c (Treatment Facilities at Fredrickson Rd and in Balmoral Area, Phased by Priority Area)

AREA	BLIND BAY AND REEDMAN POINT	SORRENTO
Treatment Facility Location	In Balmoral area	Fredrickson Rd
Phase 1	• Collection system for priority 1 area in Blind Bay constructed • New partial-mix aerated lagoon treatment facility constructed • New effluent storage reservoir constructed • New emergency storage reservoir constructed • Preparation of irrigation area	• Collection system for priority 1 area in Sorrento constructed • New partial-mix aerated lagoon treatment facility constructed • New rapid infiltration basins constructed
Phase 2	• Collection system for priority 2 areas in Blind Bay and Reedman Point constructed • Expansion of lagoon system • Additional effluent storage reservoirs constructed • Additional emergency storage reservoirs constructed • Preparation of additional irrigation area	• Collection system for priority 2 area in Sorrento constructed • Expansion of lagoon system • Expansion of rapid infiltration area

Table 7.5 – Outline of Option 3d (Treatment Facilities at Fredrickson Rd and in Balmoral Area, Phased by Geographical Area)

AREA	BLIND BAY AND REEDMAN POINT	SORRENTO
Treatment Facility Location	In Balmoral area	Fredrickson Rd
Phase 1	• No Action	• Collection system for entire Sorrento area constructed • New partial-mix aerated lagoon treatment facility constructed • New rapid infiltration basins constructed
Phase 2	• Collection system for entire Blind Bay/Reedman Point area constructed • New partial-mix aerated lagoon treatment facility constructed	• No action

	• New effluent storage reservoir constructed • New emergency storage reservoir constructed • Preparation of irrigation area	

Table 7.6 – Outline of Option 3e (Treatment Facilities at Fredrickson Rd and at Shuswap Lake Estates, Priority 1 areas initially serviced at Fredrickson Rd)

AREA	BLIND BAY AND REEDMAN POINT	SORRENTO
Treatment Facility Location	Phase 1 – Fredrickson Road Phase 2 - Shuswap Lake Estates	Fredrickson Rd
Phase 1	• Collection system for priority 1 area in Blind Bay constructed and connected to Fredrickson Rd treatment facility	• Collection system for priority 1 area in Sorrento constructed • New partial-mix aerated lagoon treatment facility constructed • New rapid infiltration basins constructed
Phase 2	• Collection system for priority 2 areas in Blind Bay and Reedman Point constructed • Sewage from existing priority 1 area diverted to SLE treatment facility • Expansion of existing treatment facility by addition of screening and RBC units • New effluent storage reservoir constructed in the Balmoral area • Preparation of irrigation area	• Collection system for priority 2 area in Sorrento constructed • Expansion of lagoon system • Expansion of rapid infiltration area

Table 7.7 – Outline of Option 3f (Treatment Facilities at Fredrickson Rd and in Balmoral Area, Priority 1 areas initially serviced at Fredrickson Rd)

AREA	BLIND BAY AND REEDMAN POINT	SORRENTO
Treatment Facility Location	Phase 1 – Fredrickson Road Phase 2 - In Balmoral area	Fredrickson Rd
Phase 1	• Collection system for priority 1 area in Blind Bay constructed and connected to Fredrickson Rd treatment facility	• Collection system for priority 1 area in Sorrento constructed • New partial-mix aerated lagoon treatment facility constructed • New rapid infiltration basins constructed

Phase 2	• Collection system for priority 2 areas in Blind Bay and Reedman Point constructed • Sewage from existing priority 1 area diverted to new Balmoral area treatment facility • New partial-mix aerated lagoon treatment facility constructed • New effluent storage reservoir constructed • New emergency storage reservoir constructed • Preparation of irrigation area	• Collection system for priority 2 area in Sorrento constructed • Expansion of lagoon system • Expansion of rapid infiltration area

Refer to Section 4 for additional discussion on the effluent storage reservoir sizing, and the irrigation and rapid infiltration systems. The design criteria for these satellite plants is set out in Section 4.6.

The lack of a suitable location for rapid infiltration basins in the Balmoral area remains an issue for the Blind Bay community in this option. Instead an emergency storage reservoir will be constructed for the Blind Bay Satellite facility.

The Fredrickson Road site has been considered since the 2002 LWMP by Urban Systems. If one of these options is chosen for further consideration, it is recommended that the extent of the site is checked. Discussions with the owners indicate that use of the site is still possible. Disposal of effluent using rapid infiltration at this site may require neighbouring properties that have groundwater wells to be connected to the Sorrento water supply system. There are approximately 10 properties that may be affected and an allowance of $15,000 per property has been included in the cost estimates for this purpose.

The use of satellite treatment facilities was not a preferred option in the LWMP. We have considered it in this TM because of the increased flexibility it provides in phased construction of a community sewer system, and the opportunity it provides to utilise existing infrastructure (at SLE), irrigations areas (in Balmoral) and disposal sites (at Fredrickson Rd). There are, however, a number of potential issues with this option, which are outlined below:

- Many of the issues associated with Options 1 and/or 2 remain. Blind Bay is still faced with the problem of an alternative method of effluent disposal, and issues around ownership, space and safety of the SLE facility also remain.
- It will create two or three parallel treatment facilities in the area.
- There will be increased operating and maintenance costs associated with running two separate plants.
- From a funding perspective, it is not clear whether this can be packaged in a way that grant money for both satellite plants can be obtained.

7.1 Configuration of System and Cost Estimate

The configuration of the system under Option 3 is shown in Figures 7.1 and 7.2. The preliminary capital cost estimates for this option are summarised in Tables 7.8 – 7.13. A breakdown of the cost estimates is provided in Appendix C.

Table 7.8 – Preliminary Capital Cost Estimate for Option 3a (Treatment Facilities at Fredrickson Rd and SLE, Phased by Priority Area) ($million)

COMPONENT	PHASE 1	PHASE 2	TOTAL
Collection system	$4.82	$20.96	$25.78
Transmission	$2.66	-	$2.66
Treatment	$5.43	$4.12	$9.55
Storage	$2.46	$5.47	$7.92
Disposal	$1.40	$0.97	$2.38
Subtotal	**$16.77**	**$31.52**	**$48.29**
Contingency & ELA	$5.87	$11.03	$16.90
Allowance for connections to Sorrento water supply	$0.15	-	$0.15
Total	**$22.78**	**$42.56**	**$65.34**

Table 7.9 – Preliminary Capital Cost Estimate for Option 3b (Treatment Facilities at Fredrickson Rd and SLE, Phased by Geographical Area) ($million)

COMPONENT	PHASE 1	PHASE 2	TOTAL
Collection system	$7.03	$18.75	$25.78
Transmission	$1.59	$1.07	$2.66
Treatment	$3.16	$6.39	$9.55
Storage	-	$7.82	$7.82
Disposal	$1.19	$1.19	$2.38
Subtotal	**$12.97**	**$35.22**	**$48.18**
Contingency & ELA	$4.54	$12.33	$16.87
Allowance for connections to Sorrento water supply	$0.15	-	$0.15
Total	$17.65	$47.55	$65.20

Table 7.10 – Preliminary Capital Cost Estimate for Option 3c (Treatment Facilities at Fredrickson Rd and in Balmoral Area, Phased by Priority Area) ($million)

COMPONENT	PHASE 1	PHASE 2	TOTAL
Collection system	$4.82	$20.96	$25.78
Transmission	$3.22	-	$3.22
Treatment	$6.78	$2.29	$9.08
Storage	$2.01	$4.74	$6.74
Disposal	$0.66	$1.60	$2.26
Subtotal	**$17.49**	**$29.59**	**$47.09**
Contingency & ELA	$6.12	$10.36	$16.48
Allowance for connections to Sorrento water supply	$0.15	-	$0.15
Total	**$23.77**	**$39.95**	**$63.72**

Table 7.11 – Preliminary Capital Cost Estimate for Option 3d (Treatment Facilities at Fredrickson Rd and in Balmoral Area, Phased by Geographical Area) ($million)

COMPONENT	PHASE 1	PHASE 2	TOTAL
Collection system	$7.03	$18.75	$25.78
Transmission	$1.59	$1.63	$3.22
Treatment	$3.16	$5.34	$8.50
Storage	-	$6.55	$6.55
Disposal	$1.19	$1.08	$2.26
Subtotal	**$12.97**	**$33.35**	**$46.31**
Contingency & ELA	$4.54	$11.67	$16.21
Allowance for connections to Sorrento water supply	$0.15	-	$0.15
Total	**$17.65**	**$45.02**	**$62.67**

Table 7.12 – Preliminary Capital Cost Estimate for Option 3e (Treatment Facilities at Fredrickson Rd and at Shuswap Lake Estates, Priority 1 areas initially serviced at Fredrickson Rd) ($million)

COMPONENT	PHASE 1	PHASE 2	TOTAL
Collection system	$4.82	$20.96	$25.78
Transmission	$2.56	$1.07	$3.62
Treatment	$2.79	$6.76	$9.55
Storage	-	$7.82	$7.82
Disposal	$1.19	$1.18	$2.38
Subtotal	**$11.35**	**$37.79**	**$49.15**
Contingency & ELA	$3.97	$13.23	$17.20
Allowance for connections to Sorrento water supply	$0.15	-	$0.15
Total	**$15.48**	**$51.02**	**$66.50**

Table 7.13 – Preliminary Capital Cost Estimate for Option 3f (Treatment Facilities at Fredrickson Rd and in Balmoral Area, Priority 1 areas initially serviced at Fredrickson Rd) ($million)

COMPONENT	PHASE 1	PHASE 2	TOTAL
Collection system	$4.82	$20.96	$25.78
Transmission	$2.56	$1.63	$4.19
Treatment	$2.79	$5.70	$8.50
Storage	-	$6.55	$6.55
Disposal	$1.19	$1.08	$2.26
Subtotal	**$11.35**	**$35.92**	**$47.28**
Contingency & ELA	$3.97	$12.57	$16.55
Allowance for connections to Sorrento water supply	$0.15	-	$0.15
Total	**$15.48**	**$48.50**	**$63.97**

Placeholder page for figure 7.1

Placeholder page for Figure 7.2

8 OPTION 4 – Hybrid Regional Option

Option 4 is a combination of Options 1 and 2. The concept is to utilise SLE as an interim solution so that a community sewer system is operational as soon as possible. Once capacity is reached at SLE, rather than spend money expanding that system which has limited space available, CSRD will invest in a new, purpose built regional facility in the Balmoral area, which is designed to service the entire area. At that point, the SLE treatment facility can be:

- Returned to Shuswap Lake Estates for their own private use
- Kept running as a parallel system, either for exclusive SLE use, or for the wider community
- Decommissioned

Table 8.1 summarises the anticipated phasing that would occur for this option.

Table 8.1 – Phasing for OPTION 4

COMPONENT	PHASE 1	PHASE 2
Collection and Transmission	Construction of collection system for priority 1 areas in Blind Bay and Sorrento and connection to existing Shuswap Lake Estates STP	Construction of collection system for priority 2 areas
Treatment	No action	Construction of new partial-mix aerated lagoon treatment facility in Balmoral area Disconnection (permanent or temporary) of SLE
Storage	Construction of new effluent storage reservoir in Balmoral area Construction of new emergency storage reservoir in Balmoral area	No action
Disposal	Preparation of a minimum of 20 hectares of additional irrigation area (plus golf course)	Preparation of irrigation area

Option 4 has the benefit from Option 1 that a community sewer system can be up and running as soon as possible using existing infrastructure, and for a lower initial capital cost. It then avoids the complications of trying to expand SLE to fit the needs of the entire community, instead a purpose built, low maintenance facility will be built on land with plenty of space and excellent effluent reuse potential. There will still be some issues with this Option including:

- The structural issues associated with the SLE reservoir and lagoons still need to be addressed

- Agreement needs to be reached with SLE
- There are no locations in the vicinity that are suitable for rapid infiltration. The closest sites are several kilometres away and at significantly greater elevations. Emergency storage reservoirs may satisfy the requirement for an alternative disposal system but there is a residual risk that an in the event of an extended period where reclaimed water standards are not being met by the treatment process there is no facility to deal with excess sewage.
- It may (depending on how SLE is utilised) create two parallel treatment facilities in the area in the long term

8.1 Configuration of System and Cost Estimate

The configuration of the system under Option 4 is shown in Figure 8.1. The preliminary capital cost estimate for this option is summarised in Table 8.2. A breakdown of the cost estimate is provided in Appendix C.

Table 8.2 – Preliminary Capital Cost Estimate for Option 4 ($million)

COMPONENT	PHASE 1	PHASE 2	TOTAL
Collection system	$4.82	$20.01	$24.83
Transmission	$2.02	$0.96	$2.98
Treatment	$3.19	$7.53	$10.72
Storage	$2.77	$6.21	$8.97
Disposal	$0.63	$0.45	$1.08
Subtotal	**$13.42**	**$35.16**	**$48.58**
Contingency	4.70	$12.31	$17.00
Total	**$18.12**	**$47.47**	**$65.58**

Placeholder page for figure 8.1

9 Summary of Preliminary Options

Based on the preliminary evaluation of options presented in Sections 5-8 it was decided not to carry out any further evaluation of Options 3b, 3d or 4. Options 3b and 3d involve servicing Sorrento prior to Blind Bay and it is considered that this does not meet the objectives of the project to provide a community sewer system. Option 4, like Options 3b and 3d, is significantly more expensive than the other proposed options.

9.1 Summary of Total Capital Costs

The preliminary capital cost estimate for the options is summarised in Table 9.1. A breakdown of costs is provided in Appendix C. There are a number of differences between the LWMP options and the options in this TM to be aware of when comparing the capital cost estimates including, but not limited to, the following:

- The design flows used to size the components in this TM are nearly 40% higher than those used in the LWMP. The design flows used in this TM account for the final OCP.
- The LWMP assumed that there would be rapid infiltration basins used for all options. For the options in this TM, treatment facilitates in the Blind Bay area do not dispose to rapid infiltration, instead additional effluent and emergency storage is to be provided
- No allowance was made for irrigation pipework in the LWMP

For all options, the construction of a collection system makes up the largest proportion of costs in the order of 40% of the total capital cost. The next most expensive components are treatment and storage.

Table 9.1 – Summary of Preliminary Capital Cost Estimates ($million)

OPTION	DESCRIPTION	PHASE 1	PHASE 2	TOTAL
1	Expansion of existing Shuswap Lake Estates treatment facility	$20.67	$41.29	$61.96
2	New regional treatment facility in Balmoral area	$21.80	$38.95	$60.74
3	Satellite treatment facility for Sorrento at Fredrickson Rd and for Blind Bay at either Shuswap Lake Estates or Balmoral			
3a	Blind Bay STP at Shuswap Lake Estates, priority 1 areas serviced at phase 1, priority 2 areas at phase 2	$22.78	$42.56	$65.34
3c	Blind Bay STP in Balmoral area, priority 1 areas serviced at phase 1, priority 2 areas at phase 2	$23.77	$39.95	$63.72
3e	Blind Bay STP at Shuswap Lake Estates, priority 1 areas in Sorrento and Blind Bay initially serviced at Fredrickson Rd	$15.48	$51.02	$66.50
3f	Blind Bay STP in Balmoral area, priority 1 areas in Sorrento and Blind Bay initially serviced at Fredrickson Rd	$15.48	$48.50	$63.97

Cost estimates for two options similar to Option 1 and Option 2 were completed during the LWMP process. The cost estimates for these options, updated to 2013 using the Engineering News Record (ENR) Construction Cost Index, are summarised in Table 9.2.

Table 9.2 – Summary of Cost Estimates from LWMP (Updated to 2013)

LWMP OPTION	DESCRIPTION	PHASE 1	PHASE 2	TOTAL
D	Shuswap Lake Estates Regional Facility	$17.0	$48.8	$65.8
F	Balmoral Regional Facility	$32.2	$38.5	$70.6

Table 9.1 shows that several options provide phase 1 capital costs in the same range as those in the LWMP. In particular options 3e, and 3f have phase 1 capital costs less than $20 million. This is largely because in these cases the construction of a treatment facility (and the associated reservoirs) for Blind Bay are delayed until phase 2.

9.2 Cost Allocation

When there is phased implementation of a system, consideration must be given to the application of the parcel tax to unserviced residents within a defined service area. Uniform application of the parcel tax across the entire service area is problematic as not all households will receive service at the same time.

One approach is to assign user fees only to those residents within the service area who are connected. Another approach is to collect user fees from everyone in the service area whether they are serviced or not to improve affordability. Finally, there can be a split of the costs so there is a balance between affordability (more users are taxed) and fairness (fewer users are taxed). For the purposes of comparing options, two cost breakdowns have been considered:

- Method A - Costs are divided only amongst those users receiving service at that phase.
- Method B - Costs are apportioned amongst the entire service area. Households that receive service (at phase 1) pay a larger proportion than those that do not. The remaining users pay additional fees when they receive service (at phase 2).

Details of both methods are summarised in Table 9.3. Other models are possible and can be studied when a preferred option is selected.

Table 9.3 – Proposed Cost Breakdown Methods

COST ELEMENT	METHOD A		METHOD B	
	HOUSEHOLDS SERVICED IN PHASE 1	HOUSEHOLDS SERVICED IN PHASE 2	HOUSEHOLDS SERVICED IN PHASE 1	HOUSEHOLDS SERVICED IN PHASE 2
Phase 1 Capital	100%	0%	60%	40%[8]
Phase 1 O&M	100%	0%	100%	0%
Phase 2 Capital	0%	100%	0%	100%
Phase 2 O&M	Split equally per parcel		Split equally per parcel	

9.3 Household Costs

This section shows costs per parcel for capital costs, service connections and operation and maintenance costs.

9.3.1 Infrastructure Capital Cost

Total capital cost is amortised as an annual cost assuming the following criteria:

- 2/3 Government funding received
- Interest rate 4% per annum
- Amortisation period 20 years

The community sewer system is sized to service more properties than currently exist within the service area (to allow for growth). The current (existing) number of parcels is used to determine the amortised annual cost per parcel. This will give a realistic, if conservative, idea of the cost to the community of establishing a sewer system. At a later date the CSRD will need to establish a protocol for dealing with latecomers to the system[9]. The relevant parcel numbers are summarised in Table 9.4.

Table 9.4 – Parcel Numbers for Annual Household Cost Calculations

DESCRIPTION	NUMBER OF PARCELS
Priority 1 - households serviced at phase 1	559
Priority 2 - households serviced at phase 2	1827

The amortised annual costs per parcel (proposed parcel tax) for each cost breakdown method (refer Section 9.2) of is summarised in Table 9.5 and Table 9.6.

[8] Covers sizing and construction of collection system.
[9] There are an estimated 1,576 additional future parcels that will be created within the service area in the next 20 years

Table 9.5 – Amortised Annual Costs per Parcel – Cost Breakdown Method A

OPTION	TOTAL CAPITAL COST ($million)		AMORTISED ANNUAL COST PER PARCEL (assuming 2/3 funding)			
	PHASE 1	PHASE 2	PHASE 1		PHASE 2	
			PRIORITY 1	PRIORITY 2	PRIORITY 1	PRIORITY 2
1	$20.67	$41.29	$907	$0	$0	$554
2	$21.80	$38.95	$957	$0	$0	$523
3a	$22.78	$42.56	$1,000	$0	$0	$571
3c	$23.77	$39.95	$1,043	$0	$0	$536
3e	$15.48	$51.02	$679	$0	$0	$685
3f	$15.48	$48.50	$679	$0	$0	$651

Table 9.6 – Amortised Annual Costs per Parcel – Cost Breakdown Method B

OPTION	TOTAL CAPITAL COST ($million)		AMORTISED ANNUAL COST PER PARCEL (assuming 2/3 funding)			
	PHASE 1	PHASE 2	PHASE 1		PHASE 2	
			PRIORITY 1	PRIORITY 2	PRIORITY 1	PRIORITY 2
1	$20.67	$41.29	$635	$83	$0	$554
2	$21.80	$38.95	$670	$88	$0	$523
3a	$22.78	$42.56	$700	$92	$0	$571
3c	$23.77	$39.95	$730	$96	$0	$536
3e	$15.48	$51.02	$475	$62	$0	$685
3f	$15.48	$48.50	$475	$62	$0	$651

9.3.2 Service Connections

In addition to the annual cost, residents receiving service will also be required to pay a one time service connection cost for the portion of infrastructure located on their own property. The estimated service connection cost is $5,000 including decommissioning of existing septic tanks. The estimated additional cost for a pumped service connection if required is $500.

9.3.3 Operations and Maintenance

Operation and maintenance costs cover the costs of the system operator, chemical, energy and other consumables costs, repairs and replacements and other costs related to the operation of the system. The estimated O&M costs for a community sewer system for Blind Bay and Sorrento are summarised in Table 9.7 and Table 9.8. The main assumptions are:

- For Options 1, 2 and 4 operator costs are based on the assumption that a halftime commitment is required at phase 1 and a fulltime commitment at phase 2. For Option 3 it is assumed that a three quarter time commitment is required at phase 1 and a one and a half time commitment at phase 2.
- Electricity costs are based on a rate of 6 cents/kWh.
- Annual maintenance costs are assumed to be 3% of the total mechanical equipment costs.

Table 9.7 – Phase 1 Annual Operation and Maintenance Cost Estimate

OPTION	ANNUAL OPERATOR COST	ANNUAL POWER COST	ANNUAL MAINTENANCE COST	TOTAL ANNUAL O&M COST	ANNUAL O&M COST PER PARCEL
1	$30,000	$6,000	$78,000	$114,000	$204
2	$30,000	$3,000	$122,000	$155,000	$277
3a	$45,000	$8,000	$111,000	$164,000	$293
3c	$45,000	$4,000	$143,000	$192,000	$343
3e	$45,000	$4,000	$89,000	$138,000	$247
3f	$45,000	$4,000	$89,000	$138,000	$247

Table 9.8 – Phase 2 Annual Operation and Maintenance Cost Estimate

OPTION	ANNUAL OPERATOR COST	ANNUAL POWER COST	ANNUAL MAINTENANCE COST	TOTAL ANNUAL O&M COST	ANNUAL O&M COST PER PARCEL
1	$60,000	$6,000	$263,000	$299,000	$125
2	$60,000	$12,000	$207,000	$249,000	$104
3a	$90,000	$12,000	$313,000	$370,000	$155
3c	$90,000	$21,000	$256,000	$322,000	$135
3e	$90,000	$18,000	$325,000	$388,000	$163
3f	$90,000	$18,000	$262,000	$325,000	$136

9.3.4 Combined Costs

The combined costs payable by each household is summarised in Tables 9.8 – 9.11, assuming a two thirds Government grant is received for the infrastructure capital costs. For an explanation of the cost breakdown methods refer to Section 9.2. Note that the parcel tax is an annual fee repaid to the CSRD over a fixed term, the service connection fee is once off and the operations and maintenance cost is an annual fee.

Table 9.9 –Costs per Household for a Community Sewer System at Phase 1 – Cost Breakdown Method A

HOUSEHOLD	COST	OPTION					
		1	2	3a	3c	3e	3f
Priority 1 Households	Amortised Annual Cost	$907	$957	$1,000	$1,043	$679	$679
	O&M	$204	$277	$293	$353	$247	$247
	Subtotal	$1,111	$1,234	$1,293	$1,386	$926	$926
	Service Connection	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000
Priority 2 Households	Amortised Annual Cost	$-	$-	$-	$-	$-	$-
	O&M	$-	$-	$-	$-	$-	$-
	Subtotal	$-	$-	$-	$-	$-	$-
	Service Connection	$-	$-	$-	$-	$-	$-

Table 9.10 –Costs per Household for a Community Sewer System at Phase 2 – Cost Breakdown Method A

HOUSEHOLD	COST	OPTION					
		1	2	3a	3c	3e	3f
Priority 1 Households	O&M and Remaining Amortized Capital	Priority 1 households continue to pay O&M costs, plus any remaining amortised capital costs from Phase 1					
Priority 2 Households	Amortised Annual Cost	$554	$523	$571	$536	$685	$651
	O&M	$125	$104	$155	$135	$163	$136
	Subtotal	$680	$627	$726	$671	$848	$787
	Service Connection	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000

Table 9.11 –Costs per Household for a Community Sewer System at Phase 1 – Cost Breakdown Method B

HOUSEHOLD	COST	OPTION					
		1	2	3a	3c	3e	3f
Priority 1 Households	Amortised Annual Cost	$635	$670	$700	$730	$475	$475
	O&M	$204	$277	$293	$343	$247	$247
	Subtotal	$839	$947	$993	$1,073	$722	$722
	Service Connection	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000
Priority 2 Households	Amortised Annual Cost	$83	$88	$92	$93	$62	$62
	O&M	$-	$-	$-	$-	$-	$-
	Subtotal	$83	$88	$92	$93	$62	$62
	Service Connection	$-	$-	$-	$-	$-	$-

Table 9.12 –Costs per Household for a Community Sewer System at Phase 2 – Cost Breakdown Method B

HOUSEHOLD	COST	OPTION					
		1	2	3a	3c	3e	3f
Priority 1 Households	O&M and Remaining Amortized Capital	Priority 1 households continue to pay O&M costs, plus any remaining amortised capital costs from Phase 1					
Priority 2 Households	Amortised Annual Cost[10]	$554	$523	$571	$536	$685	$651
	O&M	$125	$104	$155	$135	$163	$136
	Subtotal	$679	$627	$726	$671	$848	$786
	Service Connection	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000

9.4 Summary of Non-Cost Factors

Table 9.13 provides a complete summary of the various options for a community sewer system for the Sorrento, Blind Bay and Reedman Point area.

[10] Households may continue to pay the amortised annual costs from phase 1 if phase 2 occurs within 20 years of phase 1

Table 9.13 – Summary of Community Sewer System Options

OPTION	PROS AND CONS
OPTION 1 Expansion of SLE	**Pros** • Utilises existing infrastructure • Avoids two parallel sewage treatment systems operating in Blind Bay • Will provide the earliest installation of a sewer system • Excellent effluent reuse potential in the surrounding area
	Cons • Concerns over the structural stability of the dam and lagoon structures (to be investigated) • Requires reaching an agreement with Shuswap Lake Estates • Small site requires use of mechanical treatment processes for additional capacity and hence solids treatment/reuse programme required • Additional effluent storage reservoir located on a separate site • No suitable sites for rapid infiltration in the area • The existing facility is located within a residential area and already receives complaints regarding odours. Expansion of the facility and addition of mechanical treatment processes and waste solids handling will worsen the odour problem.
OPTION 2 New Regional Facility at Balmoral	**Pros** • New, purpose built facility • Large site will be available • Excellent effluent reuse potential in the surrounding area
	Cons • Duplicate treatment plant running at SLE • No suitable sites for rapid infiltration in the area
OPTIONS 3a – 3e Satellite Treatment Plants	**Pros** • Greater flexibility in phasing and timing of construction • Opportunity to utilise existing infrastructure (if Shuswap Lake Estates option selected) • Opportunity to utilise reclaimed water through irrigation
	Cons • Will be two or three treatment plants operating in parallel in the area • Alternative method of effluent disposal (lack of rapid infiltration sites) will continue to be an issue for Blind Bay • Increased operation and maintenance costs • Use of rapid infiltration basins in Sorrento area may require some residents to be taken off domestic well water supply and added to the Sorrento water supply network.

Appendix A – Plan of LWMP Priority Areas

Figure 2 from LWMP Stage 2 Report - Earthtech

Appendix B – Plan of Potential Sites for Rapid Infiltration

Figure 1 from TM3 – Piteau for Opus DaytonKnight

Appendix C – Estimated Capital Costs for Preliminary CSS Options

A more detailed summary of the indicative capital costs for the preliminary options presented in this TM are presented in Appendix C.0. A more detailed breakdown is provided in Appendices C.1 to C.4. As noted in Section 4.8, the cost estimates are intended to be used for comparison and option selection only.

Notes:

a) **Condition of Existing Shuswap Lake Estates Treatment Facility** - No allowance has been made for upgrades or refurbishment to the existing Shuswap Lake Estates STP, power or water supplies. A pre-purchase geotechnical investigation is required, but as it is recommended this takes place before this options is confirmed as a preferred option, it has not been allowed for in the capital cost estimate. The estimated cost for a geotechnical investigation is $50,000.

b) **Not Used**

c) **Land Purchase** - The total land area required to be purchased to situate infrastructure is assumed to be 200% of the size of the summed component sizes. This is to allow additional space for access, expansion and other items. Where the treatment facility and reservoirs are co-located a single allowance is made for land purchase.

d) **Location of Facilities in Balmoral Area** - The exact location of the proposed treatment facility in the Balmoral area is unknown. An allowance has been made for any treatment facilities (including reservoirs) that are to be located in the Balmoral area of an additional 2.5km distance from the existing SLE treatment facility.

e) **Civil Works** - A nominal allowance has been made for provision of general civil works including roads, fencing and drainage.

f) **Conversion of Existing Storage Reservoir** - A nominal allowance has been made for conversion of the existing storage reservoir at Shuswap Lake Estates to an emergency storage reservoir.

g) **Irrigation Forcemain** - The lengths of forcemain assumed for irrigation are:

STP Location	Phase 1	Phase 2
Shuswap Lake Estates	1500m	2000m
Balmoral Area	1000m	2000m

h) **Building** - Building to house blower equipment, headworks, electrical/controls, chlorine storage and operations.

Notes (continued):

i) **Power Supply to Treatment Facility in Balmoral Area** - A review of the existing three-phase power supply in the area shows there is power along Notch Hill Road, Tappen Notch Hill Road and Hendrickson Road. An allowance of $50,000 has been made for connection to the three-phase power supply to a treatment facility in the Balmoral area

j) **Water Supply** - A nominal allowance has been made for provision of a well water supply

k) **Power Supply to Sorrento Treatment Facility** - A nominal allowance of $30,000 has been made for provision of a power supply to the Fredrickson Rd treatment facility site

EXHIBIT 6

Piteau Associates

Field Investigation & Preliminary Assessment of Sewage Disposal – 874 Dilworth Road

PITEAU ASSOCIATES
GEOTECHNICAL AND
HYDROGEOLOGICAL CONSULTANTS

SUITE 300 - 788 COPPING STREET
NORTH VANCOUVER, B.C.
CANADA - V7M 3G6
TEL: (604) 986-8551 / FAX: (604) 985-7286
www.piteau.com

DRAFT TECHNICAL MEMORANDUM

TO: Mr. Terry Langlois
CSRD

Our file: 3319 (3319-M02)

March 4, 2015

FROM: Remi Allard, M. Eng., P. Eng.
Email: rallard@piteau.com

Re: Field Investigation and Preliminary Assessment of Sewage Disposal Potential at 874 Dilworth Road, Sorrento, Columbia Shuswap Regional District

---

Piteau Associates Engineering Ltd. (Piteau) was retained by Columbia Shuswap Regional District (CSRD) to assess the feasibility of in-ground disposal of sewage effluent on a site located at 874 Dilworth Road. The site includes legal properties defined by Parcel Identifier Number (PID) 013-815-351 and 013-815-831, which are owned by Mr. Ray Swan. The investigations were completed at the southern limits of the property where the Canadian National Railway (CNR) main rail line bisects the property.

Previous work was completed for CSRD to identify a site for effluent disposal at a location approximately 1 km to the east of the Swan Property, near the southern terminus of Frederickson Road (PID 013-813-838). Boreholes and test pits completed by Golder Associates Engineering Ltd. at the site (Golder, 1999) identified an alluvial fan deposit with sand and gravel materials suitable for effluent disposal. Further investigation was recommended for the site to identify the depth to groundwater and direction of subsurface flow in order to determine the volume that could be disposed. In 2014, Piteau completed a desktop assessment of the same site and determined that effluent disposal could potentially cause negative water quality impacts to residential water wells and surface water located down-gradient (Piteau, 2014). It was recommended to investigate alternate areas to the west of the Frederickson Road site, where similar alluvial fan deposits are present and where no residential development (water wells) are present.

An alluvial fan deposit was identified at the southern limits of the Swan Property, to the south of the CNR rail line. This letter report provides a summary of field investigations completed and the results of a preliminary level assessment of the potential for sewage disposal on the property.

Authorization for this work was provided by Mr. Terry Langlois of CSRD via email on September 9, 2014.

FIELD INVESTIGATIONS

Piteau staff supervised exploratory drilling of 6 test borings on the site in October 2014. The drilling was completed using a track-mounted hollow stem auger rig operated by Blue Max Drilling of Kelowna, BC. Logs for the test borings are provided in Appendix I. Selected soil samples from the borings were subjected to sieve analysis. Grain size distribution curves for the tested samples are presented in Appendix II. Three of the test bores encountered groundwater (MW-1, MW-2 and MW-4) and were completed as monitoring wells. Water levels were measured and hydraulic response testing completed in the monitoring wells. The results of hydraulic response testing are presented in Appendix III. Double ring infiltrometer testing was completed at two locations and the results of this testing are also presented in Appendix III.

The locations of the test bores, monitoring wells and infiltrometer tests are shown in Fig. 1. A summary of the field investigation results is as follows:

SUMMARY OF FIELD INVESTIGATIONS IN 2014

Location Name	UTM east	UTM north	Ground Elev. (masl)	Well Depth (mbgs)	Static Water Level (mbtoc)	Water Level (masl)	Depth to Limiting Condition (mbtoc)	Unsat. Zone Thickness (m)	Hydraulic Conductivity (m/day)
MW-1	324300	5638341	493.5	14.81	14.02	479.48	14.02	12.85	2.0
MW-2	324130	5638363	518	13.32	13.11	504.89	13.11	11.14	0.6
MW-3	324393	5638558	461	5.18	-	-	5.18	5.18	1.4
MW-4	324482	5638489	459	15.24	6.1	452.9	3.7	6.45	0.6
MW-5	324366	5638886	432	5.79	-	-	5.79	5.79	-
MW-6	324351	5638424	485	5.8	-	-	5.8	5.80	0.8
INF-A	324427	5638498	467.5	-	-	-	-	-	300
INF-B	324267	5638343	497.5	-	-	-	-	-	33

Notes: UTM location and ground elevation data based on DEM data from ARCGIS online World Imagery. mbtoc is meters below top of casing; depth to limiting condition is depth to first occurrence of water, clay, till or bedrock; hydraulic conductivity determined using field methods

The UTM coordinates and surface elevation for each location were initially established in the field using a hand-help GPS device and adjusted using digital elevation model (DEM) data and aerial imagery accessed from the ARCGIS World Imagery web mapping service at the following URL:

http://www.arcgis.com/home/item.html?id=10df2279f9684e4a9f6a7f08febac2a9)

A clinometer and hip-chain were used to verify the relative difference in elevation between each borehole location. Stratigraphy and water level information were determined using the assigned surface elevation at each location.

The stratigraphy encountered was predominantly gravel, sand and silt to 15.2m depth, which is the maximum depth achievable with the auger drilling method used. A clay or clay till layer was intersected in MW-4 from 3.7 to 4.9m depth. MW-3, MW-5 and MW-6 were terminated at shallower depths as the auger rig hit “refusal”, interpreted as encountering a hard till, or bedrock. The bedrock encountered in MW-3 and MW-4 supports the theory that buried bedrock ridges exist in the area, oriented roughly perpendicular to the base of the hills, in a northeast direction. The refusal in MW-6 at 6.1m depth is more likely associated with a buried boulder or clay till.

A summary of the stratigraphy encountered in each test bore is as follows:

SUMMARY OF HYDROGEOLOGICAL UNITS ENCOUNTERED

Hydrogeological Unit and Description	Depth Interval for Unit (meters below ground surface)					
	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6
1. GRAVEL	-	0.0 - 1.5	-	0.0 - 3.7	-	-
2. SAND (fine to medium)	0.0 - 6.5	1.5 - 2.1	0.0 - 5.2	-	0.0 - 5.8	0.0 - 6.1
3. CLAY / TILL	-	-	-	3.7 - 4.9	-	
4. SILT / SAND	6.5 - 7.1	2.1 – 9.1	-	-	-	
5. SAND (medium)	7.1 - 15.2	9.1 - 15.2	-	4.9 - 15.2	-	
6. Bedrock			5.2 -		5.8 -	6.1 -

A geological cross section through the area was prepared based on the assigned hydrogeological units and measured water levels (Fig 2.) Fig. 1 shows the orientation of the cross section, along with a rough estimate of the extent and orientation of the buried bedrock ridges.

HYDROGEOLOGICAL ANALYSIS

The thickness of unsaturated materials in the area of MW-1 and MW-2 exceeds 10m. The direction of groundwater flow is to the northeast, which generally follows the topography in the area and the orientation of the buried bedrock ridges. The hydraulic gradient is roughly 0.12. The width of the fan deposit between the bedrock ridges is conservatively estimated to be 100m.

Hydraulic conductivity was determined by analyzing hydraulic response data with Aqtesolv, a commercially available software package (HydroSOLVE, 2014). Specific solutions in the software that were utilized include analytical methods by Bouwer-Rice (1976), Dagan (1978) and KGS (Hyder et al, 1994). Hydraulic conductivity was also estimated using Hazen's equation, which utilizes the 10% passing grain size from the sieve analyses completed on the selected soil samples (Fetter, 2001). Less weight was assigned to the values generated using the Hazen equation, as all soil samples were fine-grained and at the lower grain size limit applicable to use of this method. Based on the geometric mean of all results, hydraulic conductivity is highest to the southwest in the area of MW-1 and MW-2, which is consistent with conditions typically encountered at the highest elevation portion (apex) of a fan deposit. Hydraulic conductivity decreases to the northeast in MW-3, MW-4 and MW-6, within the distal portion of the fan. A summary of the methods used for analysis and hydraulic conductivity results is as follows:

SUMMARY OF HYDRAULIC CONDUCTIVITY ANALYSIS

Method of Analysis	Hydraulic Conductivity (m/day)						
	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	Geometric Mean
Bouwer-Rice	1.64	0.17	-	0.26	-	-	0.42
Dagan	2.33	0.69	-	0.69	-	-	1.04
KGS	-	-	-	0.95	-	-	0.95
Hazen	2.16	1.38	1.38	n.a.	-	0.78	1.34
Geometric Mean	2.02	0.55	1.38	0.55	-	0.78	0.92

Estimate of Disposal Capacity

A preliminary estimate of the disposal capacity for the area investigated was derived based on the concept of natural discharge capacity (NDC). NDC is dependent on the width and thickness of the unsaturated zone, the hydraulic conductivity (K) of the soils beneath the disposal area and the hydraulic gradient (i). The following equation was used to calculate the NDC:

$$NDC = KiLT$$

where:

K (hydraulic conductivity) = 0.9 m/day
i (hydraulic gradient) = 0.12
L (length of disposal field perpendicular to groundwater flow) = 100 m
T (thickness of unsaturated zone available for flow) = 8m

Unsaturated zone thickness was reduced from 10m to 8m to account for 2m of water level rise expected during spring runoff. Using the NDC methodology, the disposal capacity of this area is therefore in the order of 85 m^3/day. For comparison, the maximum disposal rate for an 8m rise in the water table under a low hydraulic gradient condition (worst case scenario) was estimated. This was done using the Hantush solution (1967) in Aqtesolv, where the disposal area was maximized as represented by 3 basins of dimensions 90m by 15m. The maximum disposal rate using this method of calculation is roughly 80 m^3/day. The high hydraulic gradient in the area is expected to have a greater influence on the effluent discharge capacity and therefore, 85 m^3/day is considered more representative.

Estimate of Travel Times

For Class C (untreated) effluent, the minimum subsurface travel time between an infiltration field (including RI basins) and the nearest property line, location where effluent could come to surface, enter a surface watercourse, or is intercepted by a well, is 10 days (BCMoE, 2012).

Travel times can be estimated using the Darcy Equation as follows:

$$v^* = K * i / n$$

where:

K (hydraulic conductivity) = 0.9 m/day
i (hydraulic gradient) = 0.12
n (porosity) = 0.25

It is conservatively assumed that the vertical effluent flow velocity (infiltration rate) and time of travel to the limiting condition (water table) is immediate. The horizontal effluent flow velocity and time of travel to the were estimated using the slope of the water table (0.12) and a hydraulic conductivity of 0.9 m/day. The porosity was assumed to be 25%.

Solving for v*, the horizontal velocity of groundwater flow down-gradient of the area is 0.5 m/day. The corresponding times of travel for the nearest selected points are as follows:

- Point A - property boundary (*eastern limit of Swan Property (340m) = 680 days*

- Point B - *seasonally flooded wetland* area (*330m)* = 660 days
- Point C - seasonal water course (200m) = 400 days
- Point D - water well (WTN 36206) located on Dilworth Road (794m) = 1588 days
- Point E - surface license (PD50478) on Dilworth Road (975m) = 1950 days

These locations are shown in Fig.1

DISCUSSION

Investigations completed to date have identified a 100m by 200m area suitable for effluent disposal to ground. The disposal capacity of this area is 85 m^3/day, which is substantially less than the volume initially estimated. The difference is primarily due to the width of the disposal zone (perpendicular to groundwater flow) being limited by the 100m distance between buried bedrock ridges, which have yet to be appropriately characterized. The disposal capacity is also limited by the relatively low hydraulic conductivity of the medium and fine-grained sands that predominate in the fan deposit.

There is potential to increase the capacity for disposal by adding to the currently defined area. The best potential for additional disposal area exists to the west where similar fan deposits are expected to be present. Further field investigations are required to identify the thickness and hydraulic properties of unsaturated soils in this area. The locations, plus influence of buried bedrock ridges on disposal zone width also need to be determined. Less potential exists to add capacity to the south of the currently defined area, as the fan is expected to narrow to the south, which will also narrow disposal zone width.

There remains approximately 550m width within the contiguous Swan Property that lies along the base of the hill and to the west of the currently defined area that could potentially be investigated. If an additional 200m to 300m of disposal zone width can be identified, the total volume of effluent which can be handled could potentially be increased by 200 m^3/day to 300 m^3/day. Prior to any further drilling, a geophysical survey is proposed to determine the depths to bedrock through the area. A hammer seismic profile along the north side of the rail line is proposed.

A realistic estimate of the maximum effluent disposal capacity that can be developed at the south end of the Swan property is 300 m^3/day to 400 m^3/day.

LIMITATIONS

This investigation has been conducted using a standard of care consistent with that expected of scientific and engineering professionals undertaking similar work under similar conditions in B.C. No warranty is expressed or implied.

This report was prepared for the sole use of the Columbia Shuswap Regional District . Any use, interpretation, or reliance on this information by any third party is at the sole risk of that party. Piteau accepts no liability for such unauthorized use.

CLOSURE

We trust the information provided in this technical memorandum is sufficient for your present needs. Please contact Piteau if you have any questions or comments.

References

ASTM., 2009. Standard Test Method for Infiltration Rate of Soils in Field Using Double-Ring Infiltrometer. Subcommittee D18.04 on Hydrologic Properties and Hydraulic Barriers. ASTM international Standards Volume 04.08 Soil and Rock (1), ASTM International, West Conshohocken, PA, 2007, www.astm.org

Bouwer,H.and R.C.Rice., 1976. A slug test method for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells, Water Resources Research, vol. 12, no. 3, pp. 423-428.

Dagan, G., 1978. A note on packer, slug, and recovery tests in unconfined aquifers, Water Resources Research, vol. 14, no. 5. pp. 929-934.

Fetter, C.W., 2001. Applied Hydrogeology, 4 Edition. Prentice Hall, New Jersey

Golder Associates Ltd., 1999. Screening Hydrogeological Assessment for Effluent Disposal Fredrickson Road west (previously referred to as the Dilworth Road South Site), Sorrento, BC. Unpublished report for the Columbia Shuswap Regional District.

Hantush, 1967. Xxxxxxxxxxxxxxxxxxx

Hyder et al., 1994. Slug tests in partially penetrating wells, Water Resources Research, vol. 30, no. 11, pp. 2945-2957.

Hydrosolve Inc., 2014. Aqtesolv. Advanced Aquifer test Analysis Software.

Piteau Associates Engineering Ltd. 2014. Hydrogeological Feasibility of Wastewater Disposal to Ground at the Frederickson Road Site, Sorrento, BC. Unpublished report for the Columbia Shuswap Regional District

Province of British Columbia., 2012. Environmental Management Act – Municipal Wastewater Regulation, BC Reg 87/2012. (Accessed online September 2013 at http://www.bclaws.ca /EPLibraries/bclaws_new/document/ID/freeside/87_2012).

Appendix I

Appendix II

Appendix III

EXHIBIT 7

Gentech Engineering

Sorrento Community Sanitary Sewer Opportunities

Sorrento Community Sanitary Sewer

Gentech Technical Memorandum #1: Project Summary

April 7, 2016

GENTECH ENGINEERING INC.
CIVIL ENGINEERING

TABLE OF CONTENTS

1.0 INTRODUCTION 2
1.1 BACKGROUND 2
1.2 REFERENCES 3
2.0 SUMMARY OF METHODOLOGY 4
2.1 BASELINE STUDY CRITERIA 4
2.2 PROPOSAL 4
2.3 TREATMENT PLANT FACILITY AND TREATED EFFLUENT RESERVOIR CONCEPTUAL DESIGN . 5
2.4 TREATMENT PLANT FACILITY SITE SELECTION CRITERIA 5
2.5 ORTHOGRAPHIC PLAN 5
2.6 TREATED EFFLUENT IRRIGATION 6
2.7 POTENTIAL WASTE WATER TREATMENT PLANT SITES 6
2.8 SITE ASSESSMENT 6
2.9 ENGINEERING AND COST EVALUATION OF SEWAGE COLLECTION AREAS 6
3.0 RESULTS OF ASSESSMENT 7
3.1 PREFERRED SITES 7
3.2 PARCEL 4 7
3.3 PARCEL 1 7
3.4 PARCELS 2 & 3 8
3.5 WWAL AREA 3 – NOTCH HILL: PARCELS 6, 7, 8 AND 10 8
4.0 CONCLUSION 9

APPENDICES

Appendix 1 Hydrogeological Assessment in Support of Site Selection for Sorrento WWTP facilities, Columbia Shuswap Regional District Electoral Area “C”. September 10, 2015. By: Western Water Associates Ltd.

Appendix 2 Dwg. No. S-1. Potential Sewer System Treatment Sites.

Appendix 3 Hubland Road Test Pit Logs 18Feb2016. Fletcher Paine Associates Ltd., Consulting Geotechnical and Material Engineers.

1.0 INTRODUCTION

1.1 Background

The CSRD Area 'C' has a Liquid Waste Management Plan (LWMP) approved by the Minister of Environment. This plan is titled, *Liquid Waste Management Plan, Area 'C', Stage 3 Report. January 2009",* completed by Earthtech|AECOM Consultants. The LWMP outlined a detailed plan to provide sanitary sewer infrastructure for Sorrento, Blind Bay and Reedman Point.

Subsequent to the approval of the 2009 LWMP, studies have been conducted to evaluate the feasibility of defining a project(s) within the scope of the LWMP that would possibly be more successful in obtaining provincial and federal grant funding. In this regard, a report was completed to evaluate options for a community sanitary sewer system for Sorrento and Blind Bay. This report is titled, *'Community Sewer System Plan for Sorrento/Blind Bay, Area 'C': Summary Report. December 6, 2014",* completed by OPUS DaytonKnight engineering consultants. This report outlined options for a liquid waste management system that would be feasible for the Sorrento and Blind Bay communities.

The overall costs projected to initiate and complete the LWMP have proven to be significant and have created an obstacle in applying for grant funding that would see the start of the required projects. As a result, in mid-2014 discussions were undertaken to determine whether a smaller area within the approved Area 'C' LWMP could be considered to get reasonably sized projects up and running at a cost that may prove to be more successful in receiving grant funding. In May 2015, Gentech Engineering Inc. was commissioned to evaluate whether a stand-alone Sorrento Community Sanitary Sewer system would be feasible, and have a high likelihood of receiving both provincial and federal grant funding.

This technical memo is a summary of the findings of the evaluation into the feasibility of a stand-alone Sorrento Community Sanitary Sewer system.

1.2 References

Since the 2000's, there has been a desire to investigate the potential to proceed with sewage treatment in CSRD Area 'C'. Studies have been done in order get to the stage where an approved Liquid Waste Management Plan, Stage 3 Report was completed. Subsequent studies, reports and technical memos have supplemented concepts for a viable liquid waste management plan.

i. ***'Liquid Waste Management Plan, Area 'C', Stage 3 Report. January 2009.'*** By: Earthtech|AECOM Consultants.

ii. ***'Blind Bay Servicing Options. December 2011.'*** By AECOM Consultants.

iii. ***'Sorrento/Blind Bay Community Sewer System Plan. TM1 – Service Area Characterisation. June 27, 2013.'*** By Opus DaytonKnight Consultants Ltd.

iv. ***'Sorrento/Blind Bay Community Sewer System Plan. TM2 – Financing Methodology.'*** By Opus DaytonKnight Consultants Ltd.

v. ***'Technical Memorandum No. 3 – Hydrogeological Assessment for Sorrento/Blind Bay. August 6, 2013.'*** By Piteau Associates, Geotechnical and Hydrogeological Consultants.

vi. ***'Sorrento/Blind Bay Community Sewer System Plan. TM4 – Review of Treatment Strategies.'*** By Opus DaytonKnight Consultants Ltd.

vii. ***'Community Sewer System Plan for Sorrento/Blind Bay, Area 'C'. Summary Report. December 2013.'*** By Opus DaytonKnight Consultants Ltd.

viii. ***'2013 Groundwater Monitoring Report – Blind Bay/Sorrento, BC. January 2014.'*** By Summit Environmental Consultants Ltd.

ix. ***'Shuswap Lake Estates Sewer System. September 19, 2014.'*** Correspondence from Terry Barker, Shuswap Lakes Estates.

x. ***'2014 Groundwater Monitoring Report, Columbia Shuswap Regional District, Blind Bay and Sorrento, B.C. December 2014.'*** By Western Water Associates Ltd., Consultants in Hydrogeology and Environmental Science.

xi. ***'Hydrogeological Feasibility of Wastewater Disposal to Ground at the Frederickson Road Site, Near Sorrento, BC. June 10, 2014.'*** By Piteau Associates, Geotechnical and Hydrogeological Consultants.

xii. ***'Field Investigation and Preliminary Assessment of Sewage Disposal Potential at 874 Dilworth Road, Sorrento, Columbia Shuswap Regional District. March 4, 2015.'*** By Piteau Associates, Geotechnical and Hydrogeological Consultants.

2.0 SUMMARY OF METHODOLOGY

2.1 Baseline Study Criteria

To develop the baseline criteria for a stand-alone Sorrento Community Sanitary Sewer (SCSS) system, several meetings were held with CSRD to discuss the optimal direction in which to proceed. At the meetings, the following were discussed:

a) Feasibility of a stand-alone sewage collection and treatment facility would be of priority.

b) The existing, private Shuswap Lake Estates sewage treatment facilities would not be considered as an option for the SCSS system.

c) The feasibility of locating rapid infiltration ponds at the Frederikson Road site was eliminated as per a report, *'Hydrogeological Feasibility of Wasterwater disposal to Ground at the Frederickson Road Site, Near Sorrento. June 10, 2014',* completed by Piteau Associates, Geotechnical and Hydrological Consultants.

d) The feasibility of locating rapid infiltration ponds near 874 Dilworth Road in Sorrento was eliminated as per a report, *'Field Investigation and Preliminary Assessment of Sewage Disposal Potential at 874 Dilworth Road, Sorrento, Columbia Shuswap Regional District. March 4, 2015',* completed by Piteau Associates, Geotechnical and Hydrological Consultants.

e) Spray irrigation of treated effluent would be investigated as the preferred method of disposal.

f) Rapid infiltration will be required for both: i) the initial phases of the project until spray irrigation infrastructure is built; and, ii) emergency disposal for a completed treatment facility.

g) The Sorrento Official Community Plan (OCP) as approved in late 2014 would be used as the basis to determine the most feasible area for phasing in the gravity sewage collection system. Importance should remain high for high density areas and properties on the shoreline of Shuswap Lake.

h) Any proposed conceptual design of a treatment facility must be able to be expanded as additional collection areas are added to the system.

i) Design criteria as outlined and used in the approved LWMP and in the OPUS DaytonKnight report would be confirmed and used to calculate estimated flows, etc., required for this study.

2.2 Proposal

With information received at various meetings and discussions with CSRD staff, Gentech Engineering Inc. prepared a proposal, *'Sorrento Sanitary Sewer System, Proposal for Engineering Services. May 1, 2015'.* Western Water Associates Ltd. (WWAL) would provide hydrogeological data as a sub-consultant. On approval to proceed, further information on task timelines and milestone dates was submitted to CSRD.

2.3 Treatment Plant Facility and Treated Effluent Reservoir Conceptual Design

Using data contained in both the approved LWMP and the OPUS DaytonKnight report – TM4, a conceptual design was undertaken for all facilities that would be required for a treatment facility. Based on future projections for **full build out** from the approved Liquid Waste Management Plan (LWMP), the OCP and calculations relevant to Sorrento only, the area required for a Sorrento waste water treatment plant (WWTP) and treated effluent storage reservoir (TESR) would be approximately 18ha to 20ha. Therefore, although it may take significant years to achieve Sorrento's ultimate full build out of ±2,172 m³/day effluent flow for ±5,288 persons, an area of approximately **20ha** was used to determine potential sites for the treatment facility and treated effluent storage reservoir.

2.4 Treatment Plant Facility Site Selection Criteria

To initiate investigating whether there were feasible sites within the Sorrento area for a sewage treatment plant facility, a list of preliminary site criteria was developed by WWAL. These preliminary criteria included:

a) Opportunities for buffer zone of 100m around the site and visible buffers (trees, topography) and other buffers such as roads and power lines.

b) Sufficient area for expansion provided within the site.

c) Shape of site (i.e. rectangular or square preferred.)

d) Slope: some elevation change acceptable, but no steep slopes.

e) Hydrology and drainage: no watercourses or wetlands on the site, nearest creeks are >30m from site.

f) Soils: granular and/or well-compacted soils that are suitable for construction without the need for import.

g) Groundwater: depth to groundwater (seasonal high) greater than 5m to minimize/eliminate need for dewatering during construction.

h) Proximity to service area.

i) Proximity to potential spray irrigation acreages and potential ground infiltration sites.

j) General compatibility with surrounding land uses.

(These criteria were refined for the final report, *'Hydrogeological Assessment in Support of Site Selection for Sorrento WWTP facilities, Columbia Shuswap Regional District Electoral Area "C". September 10, 2015'*, completed by WWAL. Refer to Appendix 1.)

2.5 Orthographic Plan

As previous studies and reports had not considered the Sorrento area for a WWTP, a method needed to be devised for an aerial mapping study of the area surrounding Sorrento. Using internet resources and digital software, an orthographic plan was developed. The plan encompassed the general area of Sorrento and surrounding upland areas that could be researched for the potential location of a WWTP and TESR.

2.6 Treated Effluent Irrigation

Using the City of Armstrong treated effluent irrigation reservoir as an example, calculations of the area required for a TESR for Sorrento were undertaken. Using conservative values required by regulations, it was estimated that a TESR site would require approximately 17ha for the ultimate build-out flows.

The CSRD provided a list of potential irrigation users for the treated effluent. These properties were outlined and highlighted in green on, *'Dwg. No. S-1. Potential Sewer System Treatment Sites'.* Refer to Appendix 2.

2.7 Potential Waste Water Treatment Plant Sites

Using the area of approximately 20ha required for both a WWTP and a TESR, and the criteria for site selection, potential parcels of land were plotted on the orthographic plan. Ten (10) parcels were identified for further investigation as potential sites and were highlighted on, *'Dwg. No. S-1. Potential Sewer System Treatment Sites'.* Refer to Appendix 2.

2.8 Site Assessment

With the identification of potential sites/parcels on *'Dwg. No. S-1. Potential Sewer System Treatment Sites'*, the assessment proceeded to determine suitability for locating a WWTP and TESR. A field visit was undertaken to identify any obvious physical features related to the selected parcels.

The assessment of the parcels was completed by Western Water Associates Ltd. (WWAL), with the objectives as follows:

- Evaluate the potential WWTP sites identified by Gentech in terms of site suitability, from hydrological, geological and environmental impact perspectives.
- Inventory existing groundwater and surface water users near the potential WWTP sites.
- Complete a review of previous hydrogeological reports and provide comment on whether rapid infiltration is feasible and, if so, to what extent.

2.9 Engineering and Cost Evaluation of Sewage Collection Areas

One of the main objectives of the study was determine whether projects could be developed for phased construction that would be of reasonable cost. Using the phased construction approach, the treatment facility would obviously be required before any collection system was built. Preliminary costs were developed for a treatment facility that could potentially handle sewage flows of ±300 m^3/day for a 6-10 year horizon servicing ±400 dwellings or ±1,000 persons, noting that expansion of this facility would be required as build out of the collection system occurred.

Potential collection areas for a Phase 1 project were outlined based on several different lift station locations. The collection areas generally followed the existing LWMP concept for the Village Center area. After a meeting with CSRD, it was determined that a CSRD owned property (old water treatment site) at 1207 Dieppe Road was a good location for the lift station. Two options for a collection area boundary with the lift station at 1207 Dieppe Road were developed.

For a conceptual Phase 1 of construction that included treatment facility infrastructure and a potential initial collection area with lift stations, preliminary cost estimates were in the range of $7Million to $10Million.

3.0 RESULTS OF ASSESSMENT

3.1 Preferred Sites

WWAL grouped the ten potential parcels for evaluation into three (3) areas for evaluation. Based on the hydrological, geological and environmental evaluation, WWAL concluded the following (refer to Appendix 1):

C1 The site with the fewest anticipated constraints, from a hydrogeological, geological and environmental impact perspective, appears to be **Parcel 4 in Areas 2**. Orthophoto coverage indicates that there is a topographical break on the property as well, which may facilitate construction of wastewater treatment lagoons and storage reservoir. Surficial deposits have not been investigated, but there appears to be some potential for rapid infiltration of effluent at this site as well.

C2 The second most favourable site is **Parcel 1 in Area 1**. There is more development and existing surface water and groundwater use in this area than at Parcel 4 that could be impacted by WWTP construction. Further, there may be a relatively shallow groundwater table in this area. Recent hydrogeologic investigations indicate that there is some potential rapid infiltration of treated effluent nearby, which may be useful in the early stages of the sewer project before spray irrigation infrastructure is in place.

C3 The shallow expected depth to bedrock at the Notch Hill sites is the largest anticipated constraint to constructing the WWTP facility in that area. Little is known about the surficial deposits in the area, but the potential for successfully incorporating rapid infiltration in the Notch Hill area is believed to be low.

3.2 Parcel 4

The CSRD contacted the owner of property that contains Parcel 4. The owner is an organic dairy farmer and has no interest in having a WWTP on or around any of his properties, which include Parcel 5 and Parcel 6. This eliminated the preferred and best sites for a WWTP near Sorrento.

3.3 Parcel 1

From an engineering perspective, Parcel 1 is not ideal, as it is at the far west end of the entire Sorrento area and a significant distance from the potential irrigation sites. Known difficult construction constraints such as excessive groundwater and extremely wet excavations would also be encountered for some of the transmission piping. Also, potential for rapid infiltration near this parcel was assessed as poor in the Piteau Associate reports.

3.4 Parcels 2 & 3

In order to explore options for a WWTP beyond the preferred sites identified in the WWAL report, consideration was given to assessing the feasibility of Parcels 2 & 3. Some initial constraints were noted, including proximity to housing and a potential watercourse in the southern portion of Parcel 3. On further investigation and discussions with CSRD, it was also confirmed that significant issues related to '*shallow groundwater or surface water on the sites"* (WWAL). WWAL also noted the *'proximity to and potential to adversely affect nearby surface water users'.* When all these constraints were evaluated, Parcel 2 & 3 would not be suitable for a WWTP and were not considered further.

3.5 WWAL Area 3 – Notch Hill: Parcels 6, 7, 8 and 10

As noted in WWAL conclusion C3 (refer to Section 3.1 above), there were a lot of geological unknowns associated with Area 3 – Notch Hill. The area is mainly '*forested and mostly undeveloped lands'.* CSRD contacted the owners of property encompassed in Area 3 and found little or no interest in selling or having a WWTP located on their lands. On further consideration, the property owner for Parcel 10 was willing to entertain consideration of the use of his land for a WWTP. As one of the main objectives for a stand-alone Sorrento WWTP was to include rapid infiltration, it was decided that two test holes in Parcel 10 would provide information as to whether it would be feasible to continue evaluating Parcel 10.

Permission for two test holes in Parcel 10 was given by the owner. On February 18, 2016, two tests were dug. In the presence of a geotechnical engineer from Fletcher Paine Associates Ltd., one test hole was dug to approximately 4m (13ft) and the other to 3.2m (10.5ft). The general description of the material was compact to dense sand and gravel (refer to Appendix 3). This type of material would be suitable for treatment plant facility and treated effluent storage, but would not be suitable for rapid infiltration. Based on the unsuitability of the area for rapid infiltration, Parcel 10 could not be considered for a WWTP and TESR.

4.0 CONCLUSION

The investigation into the potential for a stand-alone waste water treatment plant (WWTP) and a treated effluent storage reservoir (TESR) for the community of Sorrento was thorough and encompassing. With the objective of having rapid infiltration as part of the solution for treated effluent and ultimately employing spray irrigation as the preferred method of treated effluent disposal, no suitable parcel of land was identified. The most probable and suitable sites were eliminated as a result of dis-interest by the property owners. Other sites were eliminated due to hydrological and geological unsuitability.

Pricing out of conceptual designs for both the proposed treatment facility infrastructure, treated effluent storage reservoir and sewage collection systems (phased) indicate that initial project size to initiate a stand-alone Sorrento Community Sanitary Sewer System would most likely be greater than $10Million from an engineering perspective only.

If a Sorrento Community Sanitary Sewer System remains as an objective, other treatment and disposal methods would have to be considered.

Ernie C. Carson, P.Eng.

Jerry L. Andrew, CTech

Appendix 1

Hydrogeological Assessment in Support of Site Selection for Sorrento WWTP facilities, Columbia Shuswap Regional District Electoral Area "C".

September 10, 2015

By:

Western Water Associates Ltd.

western water ASSOCIATES LTD
Consultants in Hydrogeology and Environmental Science

September 10, 2015 **WWAL Project 15-043-01**

Mr. Ernie Carson, P.Eng.
Gentech Engineering Inc.
Box 328, #3 – 551 Trans-Canada Highway NE
Salmon Arm, BC
V1E 4N5

Re: Hydrogeological Assessment in Support of Site Selection for Sorrento WWTP facilities, Columbia Shuswap Regional District Electoral Area "C"

Western Water Associates Ltd. (WWAL) is pleased to provide this report to support the selection of a site for a future Wastewater Treatment Plant (WWTP) near Sorrento, B.C. The scope of work for this study is outlined in our proposal dated June 15, 2015.

PROJECT UNDERSTANDING AND BACKGROUND

The Columbia Shuswap Regional District (CSRD) conducted a Liquid Waste Management Plan for the communities in and around Shuswap Lake in the 2000s, and since approximately 2012 has been assessing the feasibility of providing municipal sewer service in the Blind Bay and Sorrento areas. CSRD retained Opus DaytonKnight (OPUS) to examine options for sewage collection, treatment and disposal and this study produced several technical memos and a report in late 2013. After reviewing several options, the CSRD chose to proceed with a phased approach to sewering the Sorrento and Blind Bay areas, beginning with Sorrento.

Going into the OPUS Sewer System Plan project, it was assumed that treated wastewater from Sorrento could be disposed of to-ground through Rapid Infiltration Basins (RIBs). Previous assessment by Golder Associates in 1999 suggested that a site near Fredrickson Road was suitable for rapid infiltration. In support of OPUS Sewer System Plan project, three hydrogeological reports were prepared by Piteau Associates (2013, 2014, 2015). WWAL reviewed these reports, which in brief, essentially determined that the Fredrickson Road site and a second site near Dilworth Road (Swann property) were not suitable for the large scale disposal of wastewater to ground due to concerns with breakout and changes to the hydrology and hydrogeology downslope.

Without the ability to dispose of effluent to ground near a WWTP site, an alternate strategy for handling wastewater had to be developed. We understand that the approach to managing treated effluent flows will now be to construct an appropriate volume of storage supplying seasonal spray irrigation for agricultural fields in the area.

For a Sorrento stand-alone system, a concurrent engineering study by Gentech Engineering will confirm the potential service area and design flow. For the purposes of this proposal, we assume that the flow will be in the range of 2,000 to 3,000 m^3/day when the entire Sorrento area is sewered, but sewering of the area will occur progressively in phases. We understand the total area needed for the WWTP facility including a large treated effluent storage reservoir is on the order of 20 ha (50 acres). This size requirement assumes a relatively deep storage reservoir with a depth of approximately 12 m.

PROJECT OBJECTIVES

WWAL's objectives for this assessment included the following:

- Evaluate the potential WWTP sites identified by Gentech in terms of site suitability, from hydrological, geological and environmental impact perspectives.
- Inventory existing groundwater and surface water users near the potential WWTP sites.
- Complete a review of previous hydrogeological reports and provide comment on whether rapid infiltration is feasible, and if so, to what extent.

Figure 1, attached, shows the general extent of the Sorrento project area. Subsequent maps show areas of interest in greater detail.

Concurrent with our evaluation, Gentech is completing a separate evaluation of the potential WWTP sites from an engineering and cost to construct point of view. When both are complete, the findings of the study are to be compared, ideally resulting in the clear identification of a preferred WWTP site.

SITE DESCRIPTION

Bedrock Geology

Bedrock geology in the project area is comprised of the Eagle Bay Formation – Mt. Ida Assemblage (BCGS 2005). In the northern and lower elevation parts of the study area, these rocks are mapped as fine grained sedimentary rocks (mudstone, siltstone and shale. In the southwestern and higher elevation part of the project area, bedrock is mapped as metamorphic (greenstone, greenschist). A north-south trending fault is mapped along the Davidson Road alignment in the center of the project area.

Surficial Geology

Surficial geology in the project area is shown on Figure 2, attached, as mapped by Fulton (1975). Surficial deposits in the study area are variable and relatively complex. On the hillsides, south of the study area, bedrock outcrop is common or blanketed by a thin veneer of colluvium or till. Fluvial and alluvial fan deposits are present on the northerly sloping areas near the railway corridor. Both the Fredrickson and Dilworth Road sites previously investigated are located on these fluvial or alluvial deposits, which are likely to be characterized by some of the coarsest-grained deposits in the area.

At the Sorrento town core and upslope agricultural lands, surficial deposits consist of a complex assemblage of lacustrine, morainal till and deltaic terrace deposits. On Notch Hill, some areas of bedrock outcrop are mapped, and reportedly overlain by morainal till in most places. A review of well logs on Notch Hill indicate that the morainal deposits are relatively thin, typically between 3 m and 6 m.

Hydrogeology

There are two Provincially-mapped aquifers in the study Area (Figure 3). The first, bedrock aquifer 227IIIC, is located in the eastern part of the study area and centered around Notch Hill. Aquifer 227IIIC is classified as having a low productivity, low demand and low vulnerability to contamination.

The second, sand and gravel aquifer 222IIIC, is located west and south of Notch Hill. Aquifer 222IIIC is a confined aquifer, classified as having a moderate productivity, low demand and low vulnerability to contamination. While not mapped as present, a shallower aquifer system above Aquifer 222 is also present in places, indicated by the presence of dug wells and documented with monitoring wells installed for previous projects. This shallow aquifer system is likely unconfined, and limited to areas around perennial or seasonal drainages, and in areas where the aquitard overlying aquifer 222 pinches out.

CRITERIA FOR EVALUATING SITES

At the start of this project, Gentech identified 10 parcels as possible WWTP sites. These Parcels (and subsequently identified parcels) can be grouped into three Areas, as shown on Figures 4 through 6. Each of these Areas is discussed and evaluated below.

Part of WWAL's mandate for this project was to develop criteria for evaluating the suitability of the possible WWTP sites, from hydrogeological, geological and environmental impact perspectives. The following criteria were applied in our assessment of each Parcel:

Criteria	Rationale
Expected depth to bedrock	Bedrock outcrop or near surface bedrock would pose significant challenges to construction of a treated effluent storage reservoir, which is expected to be 12 m deep. Areas with greater depth to bedrock are preferable.
Depth to Water Table / Presence of Shallow Groundwater	Areas with a shallow water table would complicate construction of treatment lagoons and storage reservoir, and may require significant dewatering during construction.
Presence of Surface Water	The presence of surface water courses and wetlands, which would require special consideration during construction, is considered a detriment.
Proximity to Wells	Construction of the WWTP, lagoons, and the possibility of incorporating rapid infiltration of effluent has the potential to impact nearby groundwater users. The absence of or a low density of wells near the WWTP site is preferable.
Proximity to Points of Diversion	Construction of the WWTP, lagoons, and the possibility of incorporating rapid infiltration of effluent has the potential to impact nearby surface water users. The absence of or a low density of surface water users near the WWTP site is preferable.
Potential to Incorporate Rapid Infiltration On the Site or Nearby	While not necessarily critical to the success of the project, rapid infiltration of effluent during early phases of the project (before flows become large and before spray irrigation infrastructure is constructed) could be considered, and if possible, would be an asset.

AREA 1 – Dilworth Road / Swann Property Area

Figure 4 shows the extent of Area 1 with orthophoto coverage that illustrates land use in the area. Area 1 is in the general vicinity of the Swann Property site that was evaluated in 2014 as a possible RIB site. Area 1 consists primarily of large parcels that have been previously cleared for agriculture, as well as some forested parcels in the east.

Parcel 1 identified by Gentech is located in Area 1, and is part of a larger parcel of land owned by the Swann family. As shown on Figure 4, Parcel 1 is located just north of the site investigated by Piteau in 2014 for RIB feasibility.

The Piteau assessment indicates that there is at least 6 m and in most cases greater thickness of surficial deposits above bedrock, and that bedrock features at the site investigated may include northeast trending ridges. There are few reported water wells in the area, but those present to the east and west near the rail line indicate 30 m or more of surficial deposits overlying bedrock.

Groundwater was encountered in three of six monitoring wells completed at and downslope of the RIB investigation site, at depths between 5 and 14 m below grade. Area 1 is located above mapped sand and gravel aquifer 222IIIC, and it is likely that parts of Area 1 overlie a shallower unconfined aquifer as well.

In terms of surface water features, Gulch Creek is mapped as present east of Parcel 1. No other surface water courses are mapped in the area, but orthophoto coverage suggests that shallow groundwater or seasonal wetland conditions may exist on Parcel 1 and to the northwest.

Tables 1 and 2 summarize selected information for reported water wells and surface water points of diversion in the area. There are few water wells reported in Area 1, and those present are completed in both the deep confined aquifer system (222IIIC) and underlying bedrock aquifers. There are 7 surface water points of diversion in Area 1, six of which are associated with Gulch Creek to the east or north of Parcel 1. These POD's are for both domestic and irrigation uses.

Table 1: Reported Wells in and Near Area 1

Well Tag Number	Well Depth (ft)	Water Depth (ft)	Well Yield	Depth to Bedrock (ft)	Aquifer Type	Owner
61344	160	125	20 GPM	90	Bedrock	Bill Hook
59422	122	n/a	4 GPM	107	Bedrock	Dave Inkster
36206	120	n/a	6 GPM	n/a	Sand and Gravel	Dennis Wells
83854	239.5	n/a	25 UGPM	n/a	Sand and Gravel	Wamsteeker
58239	125	72	6 GPM	n/a	Sand and Gravel	Bill Hook

Table 2: Reported Surface Water Points of Diversion in and Near Area 1

POD Tag Number	Stream Name	Use	Quantity	Licensee
PD50520	Gulch Creek	Domestic	2.273 MD	David John Kurylowich
PD50519	Gulch Creek	Domestic	2.273 MD	P & Victoria L Tessier Henry
PD50510	Gulch Creek	Domestic	2.273 MD	Edwynne A Swann
PD50509	Gulch Creek	Domestic	2.273 MD	Glenn Frederick & Coleen Aria Jackson
PD185287	Gulch Creek	Irrigation	24792.985 MY	Raymond Edward Swann
PD76069	Best Creek	Land Improve	TF	Kelly Kevin Craig & Clarke Carma Dee
PD50388	McCall Spring	Domestic	4.546 MD	Lavington Florence Metal
PD50528	Dilworth Creek	Irrigation	2466.96 MY	Archie & Edwynne Swann
PD50528	Dilworth Creek	Domestic	4.546 MD	Archie & Edwynne Swann
PD50532	Louise Spring	Domestic	2.273 MD	Philip L & Doris Marilyn Clark
PD70750	Wolf Spring	Domestic	2.273 MD	Clark G & Joan E Quintin

Notes:

1) MD = m^3/day; 2) MY = m^3/year; 3) TF = Total Flow

Area 1 Summary

Parcel 1 and the property immediately south (see area indicated on Figure 4) are potentially good locations for a WWTP site for several reasons. It is likely bedrock will be found at depths of at least 6 m in most of the area, and shallow groundwater, while potentially present, is likely at depths greater than 5 m. Being sparsely developed, there are few groundwater wells and only a handful of Points of Diversions in the area which could potentially be effected by the construction of the lagoons and storage reservoir. There is the potential that deep excavation for a storage reservoir in this area could affect the local shallow groundwater regime, and as a result affect water availability at PODs to the north and down-gradient.

In addition, the Piteau investigation in this area found that rapid infiltration was feasible, but at rates much lower than the full build-out wastewater flows. It is possible that some rapid infiltration could be employed in this area in the early stages of the Sorrento Sewer Project, to accommodate early phase wastewater flows before spray irrigation infrastructure is in place.

AREA 2 – Fredrickson Road Area

Figure 5 shows the extent of Area 2 with orthophoto coverage that illustrates land use in the area. The Fredrickson Road RIB site investigated by Golder in 1999 and by Piteau in 2014 is located on the southwestern edge of Area 2. Area 2 consists mainly of large agricultural parcels, but is bordered to the north by medium density residential development. The majority of Area 2 is underlain by mapped sand and gravel aquifer 222IIIC, and in the northeast adjoins bedrock aquifer 227IIIC.

Four Parcels (2 through 5) were identified by Gentech and fall within Area 2.

Parcels 2 and 3 are located adjacent to Dilworth Road and Davidson Road. Based on well logs in the area, Parcels 2 and 3 likely overlie relatively thick (>30m) surficial deposits, and shallow bedrock is not expected to be an issue at these locations. Shallow groundwater and surface water are likely to be constraints to development, particularly on Parcel 2. Orthophoto coverage indicates a seasonal wetland complex is present on Parcel 2, and previous work by Piteau suggests these wetlands are groundwater fed. There are also several active surface water POD's on Parcel 2 which would be impacted by lagoon and storage reservoir construction.

Parcel 3 is only partially cleared, however field reconnaissance identified a wetland area or seasonal watercourse along the eastern tree line. It is likely that there is a sufficient thickness of surficial deposits for lagoon and storage reservoir construction, however the wetland/water course area could be considered environmentally sensitive, and shallow groundwater is expected to be an issue on Parcel 3.

Parcels 4 and 5 are located at higher elevations, adjacent to the rail right of way. Both parcels are cleared, and no surface Points of Diversion are reported on the properties or in the immediate vicinity. No surface water courses are mapped on either Parcel, however orthophoto coverage suggests a drainage ditch may be present on Parcel 5 extending to the north; this may result in a shallow water table and near surface saturation on portions of Parcel 5. There are few well logs in the area of Parcel 4 and 5, and those closest are located to the south and likely up-gradient. In terms of expected depth to bedrock, well logs in the vicinity (e.g. WTN83983) indicate at least 60 m of surficial deposits are present.

Table 3. Reported Wells in and Near Area 2

Well Tag Number	Well Depth (ft)	Depth to Water (ft)	Well Yeild	Depth to Bedrock (ft)	Aquifer Type	Owner
97187	200	79	30 USGM	n/a	Unknown	Pennerosa Farms
97335	280	n/a	0.33 USGM	55	Sand and Gravel	Pennerosa Farms
97336	119	n/a	n/a	135	Sand and Gravel	Pennerosa Farms
59857	275	78	10 GPM	n/a	Sand and Gravel	Gus Betke
56021	137	n/a	0	n/a	Sand and Gravel	Dave Culver
58148	50	30	3 GPM	31	Bedrock	Shalon Terra Holding
25632	95	75	8 GPM	n/a	Sand and Gravel	Ken Mcleod
32620	155	84	4 GPM	n/a	Sand and Gravel	J K Ranches
38862	155	84	4 GPM	n/a	Sand and Gravel	J K Ranches
27341	105	n/a	30 GPM	n/a	Sand and Gravel	John Lindsay
51718	55	30	12 GPM	n/a	Sand and Gravel	Wish
83863	210	n/a	30 USGM	n/a	Sand and Gravel	Pennerosa Farms
58006	225	40	2.5 GPM	45	Bedrock	Shalon Terra Holding
58239	125	72	6 GPM	n/a	Sand and Gravel	Bill Hook
83983	209	n/a	18 USGM	n/a	Sand and Gravel	Dowding
99203	48	11	10 USGM	n/a	Sand and Gravel	Lawrence

Table 4. Reported Surface Water Points of Diversion In and Near Area 2

POD Tag Number	Stream Name	Use	QUANTITY	LICENSEE
PD75109	Brock Brook	Land Improve	TF	Edward & Charlotte Jackson
PD50478	Brock Creek	Domestic	2.273 MD	Maxine C Janzen
PD50478	Brock Creek	Irrigation	1850.22 MY	Walter E & Maxine C Janzen
PD50478	Brock Creek	Domestic	2.273 MD	Marcel & Donna Lessard
PD50475	Brock Creek	Storage (non-power)	1233.48 MY	Edward & Charlotte Jackson
PD50475	Brock Creek	Irrigation	1233.48 MY	Edward & Charlotte Jackson
PD50475	Brock Creek	Land Improve	TF	Edward & Charlotte Jackson
PD50495	Abear Brook	Domestic	2.273 MD	Edward S & Rena M Szybunka
PD50490	Esther Spring	Domestic	2.273 MD	Rondald V & Lauralee T Depatie
PD50489	Vernon Spring	Domestic	2.273 MD	Rodney & Leisya Woods
PD50480	Brock Creek	Land Improve	TF	John & Sharon A Deboer
PD50488	Harcourt Spring	Domestic	2.273 MD	Brian E & Shelley Y Larsen
PD50482	Lindsay Slough	Irrigation	24669.6 MY	John & Sharon A Deboer
PD50482	Lindsay Slough	Land Improve	TF	John & Sharon A Deboer

Notes:

1) MD = m^3/day; 2) MY = m^3/year; 3) TF = Total Flow

Area 2 Summary

Several potential issues have been identified on Parcels 2 and 3 which make them less attractive as WWTP sites. The main issues relate to shallow groundwater or surface water on the sites, and proximity to and the potential to adversely affect nearby surface water users.

Parcels 4 and 5 are more prospective sites due to their locations at high elevations and away from surface water. In our opinion, Parcel 4 is the best candidate for a WWTP site in Area 2. It is harder to comment on the potential for rapid infiltration in this area, but the apparent absence of surface water and the thickness of surficial deposits (which are mapped as alluvial deposits) on Parcel 4 indicate it may be feasible. A more detailed site investigation would be required to confirm the feasibility of rapid infiltration on Parcel 4.

AREA 3 – Notch Hill Area

Figure 6 shows the extent of Area 3 with orthophoto coverage that illustrates land use in the area. Area 3 is located on Notch Hill, and we understand this area is attractive from an engineering perspective in that a WWTP site in this area could take advantage of the higher elevations to distribute treated wastewater using gravity pressure.

All of the parcels identified in Area 3 (6 through 10) occupy forested and mostly undeveloped lands. Area 3 is mapped as overlying bedrock aquifer 227IIIC. There is only one well reported on Parcels 6 through 10 and relatively few reported wells in the area. A cluster of wells are present northwest of Parcels 6 and 7 associated with a residential subdivision in that area. The majority of reported wells are completed in bedrock aquifer 227IIIC.

Bedrock is mapped as outcropping to the east and south of Parcels 6 through 10, and may outcrop in some areas on Parcels 6 through 10. Based on well logs in the area, the depth to bedrock on Parcels 6 through 10 can be expected to be in the 3 m to 6 m range. Owning to the elevation and location of Parcels 6 through 10 on a small ridge, the potential for widespread shallow groundwater is low, and alluvial (sand and gravel) aquifers are likely not present in most areas.

There are no mapped water courses on Parcels 6 through 10, and no reported Points of Diversion except for three located near the northeast corner of Parcel 10.

Table 5. Wells in and Near Area 3

Well Tag Number	Well Depth (ft)	Depth to Water (ft)	Well Yield	Depth to Bedrock (ft)	Aquifer Lithology	Owner
46366	240	70	6 GPM	32	Bedrock	Hawes
46399	360	210	5 GPM	40	Bedrock	Halsey
22347	112	12	0.3 GPM	24	Bedrock	C E Gleave
35060	305	n/a	0	43	Bedrock	Hans Kirchner
37404	350	n/a	10 GPM	n/a	Bedrock	George Ewert
34769	200	n/a	15 GPM	43	Bedrock	Ervert George
84884	500	n/a	0	75	Bedrock	Sagesser
58925	326	225	4 GPM	n/a	Silt and Sand	Bernard Guilbault
22858	90	19	0	n/a	Bedrock	E Agar
8309	120	n/a	340 GPH	n/a	Broken Rock and Clay	George Ewert

Table 6. Reported Surface Water Points of Diversion In and Near Area 3

POD Tag Number	Stream Name	Use	Quantity	Licensee
PD52125	Crispi Spring	Domestic	2.273 MD	Dondald N & Margaret Patricia Underhill
PD69991	Sophie Pond	Stockwatering	2.273 MD	Una Mary St Clair-Moniz
PD69991	Sophie Pond	Domestic	2.273 MD	Una Mary St Clair-Moniz
PD62363	Sophie Pond	Conserv. Construct. Works	22202.64 MY	Una Mary St Clair-Moniz
PD52130	Sophie Pond	Irrigation	37004.4 MY	Una Mary St Clair-Moniz
PD52130	Sophie Pond	Irrigation	24669.6 MY	Una Mary St Clair-Moniz
PD52133	Sophie Pond	Irrigation	24669.6 MY	Una Mary St Clair-Moniz
PD52133	Sophie Pond	Irrigation	37004.4 MY	Una Mary St Clair-Moniz
PD52135	Sophie Pond	Stockwatering	2.273 MD	Lyons Vernon Lyle & Shore Sharon Patric
PD52126	Croce Spring	Domestic	2.273 MD	Dondald N & Margaret Patricia Underhill
PD52128	Cripps Spring	Domestic	2.273 MD	Jerrold Alexander Code
PD52128	Cripps Spring	Domestic	2.273 MD	Donald C & Christina D Paterson

Notes:

1) MD = m^3/day; 2) MY = m^3/year; 3) TF = Total Flow

Area 3 Summary

There are both positive and negative factors associated with Parcels 6 through 10 and the Notch Hill area in general. Positive factors include limited development, and therefore a low potential to affect existing groundwater and surface water users. There is also little surface water in the area and shallow groundwater is not expected to be an issue. The largest issue with a WWTP site in the Notch Hill area is an expected shallow depth to bedrock in most places (3 – 6 m) which may complicate or increase the cost associated with the construction of a deep treated effluent storage reservoir and other WTP infrastructure.

It is worth noting that there are several small, natural depressions with standing water on Notch Hill, located to the east of Parcel 9. It is possible that these depressions could serve as lagoon sites, similar to a natural lake that is used by the City of Vernon for treated wastewater storage prior to use for spray irrigation. There are several Points of Diversion associated with these depressions, as shown on Figure 6 and summarized in Table 6.

There is little information available in the Notch Hill area on which to base an opinion as to the potential for rapid infiltration of effluent. Surficial geology in the area is mapped as morainal till, which based on area well logs is expected to be relatively thin. Overall, we believe the potential for rapid infiltration in the Notch Hill Area is likely low, due to expected low permeability of sediments, and the possibility of breakout downslope.

CONCLUSIONS

Based on our assessment we offer the following conclusions:

C1 The site with the fewest anticipated constraints, from a hydrogeological, geological and environmental impact perspective appears to be **Parcel 4 in Areas 2**. Orthophoto coverage indicates that there is a topographical break on the property as well, which may facilitate construction of wastewater treatment lagoons and storage reservoir. Surficial deposits have not been investigated, but there appears to be some potential for rapid infiltration of effluent at this site as well.

C2 The second most favourable site is **Parcel 1 in Area 1**. There is more development and existing surface water and groundwater use in this area than at Parcel 4 that could be impacted by WWTP construction. Further, there may be a relatively shallow groundwater table in this area. Recent hydrogeologic investigations indicate that there is some potential rapid infiltration of treated effluent nearby, which may be useful in the early stages of the sewering project before spray irrigation infrastructure is in place.

C3 The shallow expected depth to bedrock at the Notch Hill sites is the largest anticipated constraint to constructing the WWTP facility in that area. Little is known about the surficial deposits in the area, but the potential for successfully incorporating rapid infiltration in the Notch Hill area is believed to be low.

We note that there are several natural depressions/ponds on Notch Hill, to the east of Parcel 9, which may have potential to serve as storage lagoons.

RECOMMENDATIONS

R1 Compare the results of our evaluation of Parcels with the engineering assessment being completed and determine if there is a clear, preferred choice for a WWTP facility.

R2 Depending on the results of that comparison, a detailed site assessment will likely be necessary to confirm the feasibility of constructing a WWTP facility at the preferred location. The assessment would better quantify depths to bedrock and shallow groundwater which may be factors in lagoon and storage reservoir design and construction.

R3 Once a preferred WWTP site is identified, confirm whether rapid infiltration of effluent will be needed or would be an asset in the early stages of the sewering project before spray irrigation of effluent can be implemented. If so, a site specific evaluation of the feasibility of rapid infiltration may be required, and can be combined with R2, above.

CLOSURE

We trust the information provided in this report addresses your needs at this time. Please note that there are limitations that apply to our assessment, as outlined on the attached standard limitations page. If you have any questions or wish to discuss any of our findings, do not hesitate to contact the undersigned.

Western Water Associates Ltd.

Ryan Rhodes, P.Geo., P.Geol
Hydrogeologist

Reviewed By:

Doug Geller, M.Sc., P.Geo
Senior Hydrogeologist

Attachments: Figures 1 through 6

References:

Fulton, R.J. 1975. Surficial Geology of Shuswap Lake. GSC Map 1391A.

British Columbia Geological Survey (BCGS). 2005. Digital Geology Map of British Columbia: Whole Province, B.C. Ministry of Energy and Mines, GeoFile 2005-1, by N.W.D. Massey, D.G. MacIntyre, P.J. Desjardins and R.T. Cooney. http://www.mapplace.ca/

BC Ministry of Forests, Lands and Natural Resource Operation. 2015. Online water well, observation well and aquifer mapping. http://webmaps.gov.bc.ca/imf5/imf.jsp?site=wrbc

Opus DaytonKnight. 2013. Columbis Shuswap Regional District Community Sewer System Plan for Sorrento / Blind Bay, Area “C”. Summary Report, December 2013.

Piteau Associates. 2013. Technical Memorandum No. 3 – Hydrogeological Assessment for Sorrento/Blind Bay. Prepared for Opus DaytonKnight, August 6, 2013.

Piteau Associates. 2014. Hydrogeological Feasibility of Wastewater Disposal to Ground at the Fredrickson Road Site, near Sorrento, B.C. Prepared for the Columbia Shuswap Regional District, June 10, 2014.

Piteau Associates. 2015. Field Investigation and Preliminary Assessment of Sewage Disposal Potential at 874 Dilworth Road, Sorrento, Columbia Shuswap Regional District. March 4, 2015.

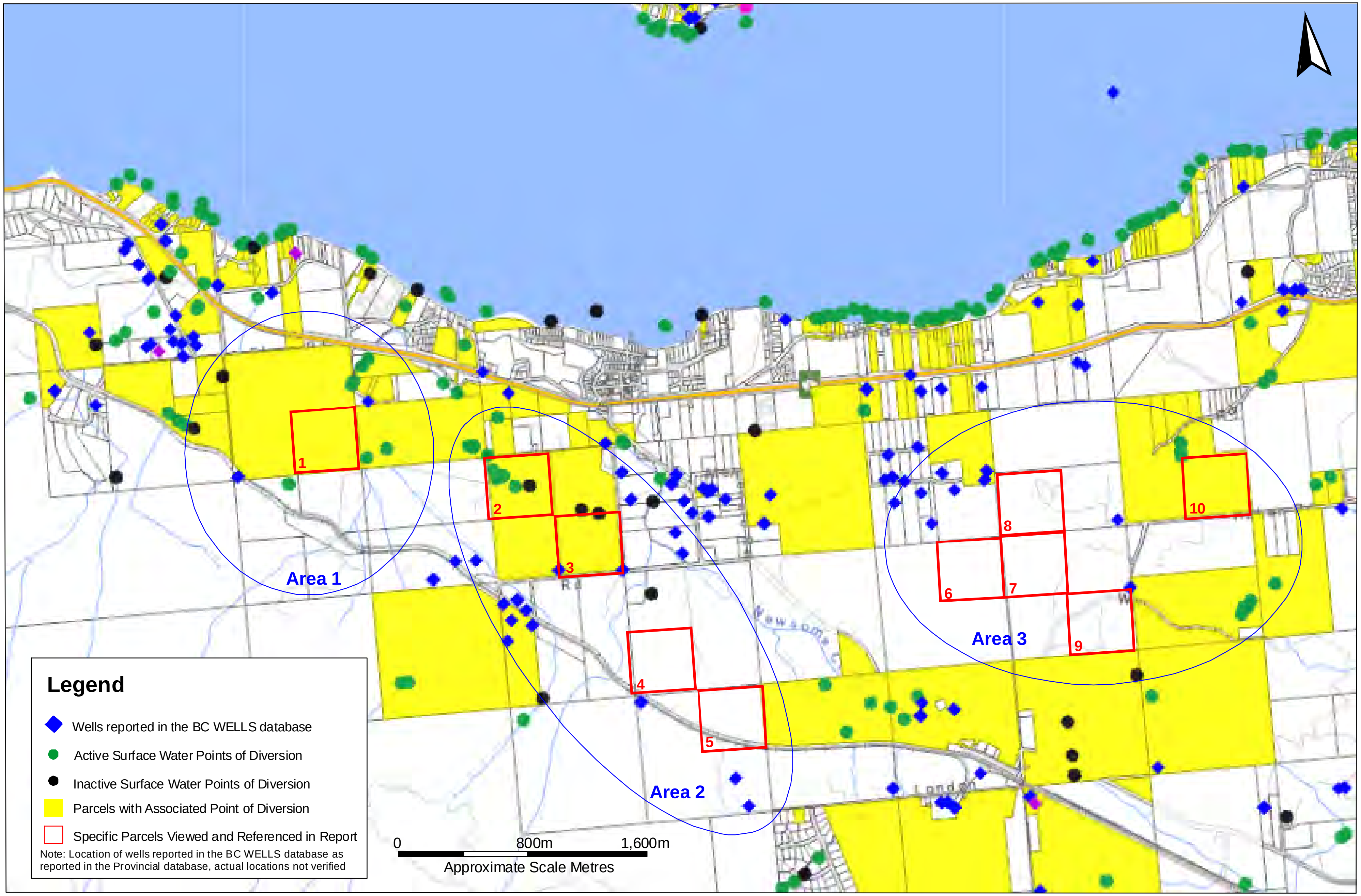


Figure 1 - General Location of Study Area

Date: Aug 2015	Image Source: BC Water Resources Atlas (MFLNRO 2015)	WWAL Project: 15-043-01
Drawn by: RR	Checked by: DG	Client: Gentech / CSRD

western water ASSOCIATES LTD
Consultants in Hydrogeology and Water Resources Management

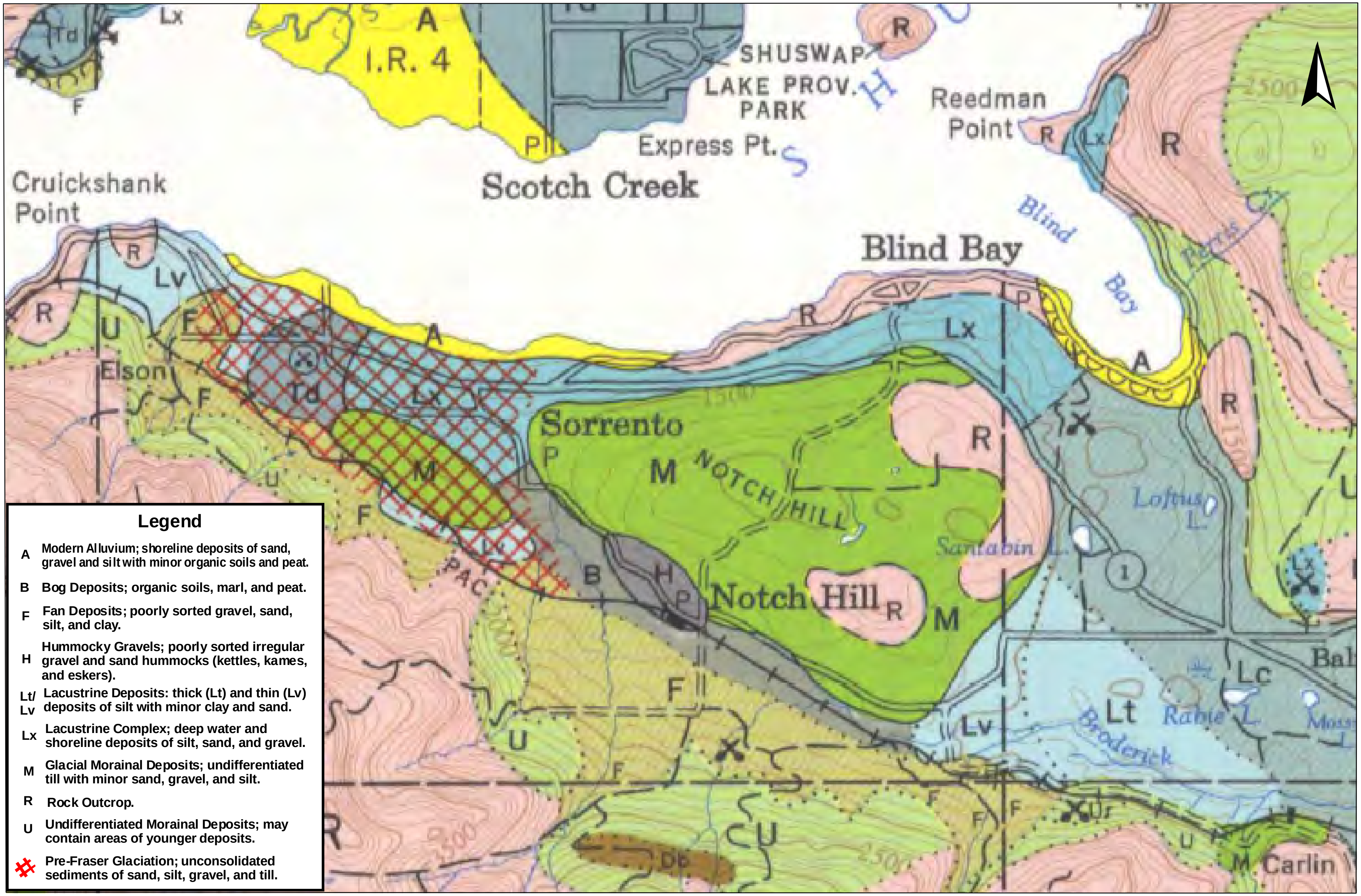


Figure 2 - Surficial Geology Mapping in the Sorrento Area

Date: Aug 2015	Image Source: Fulton, 1965	WWAL Project: 15-043-01
Drawn by: RR	Checked by: DG	Client: Gentech / CSRD

western water ASSOCIATES LTD
Consultants in Hydrogeology and Water Resources Management

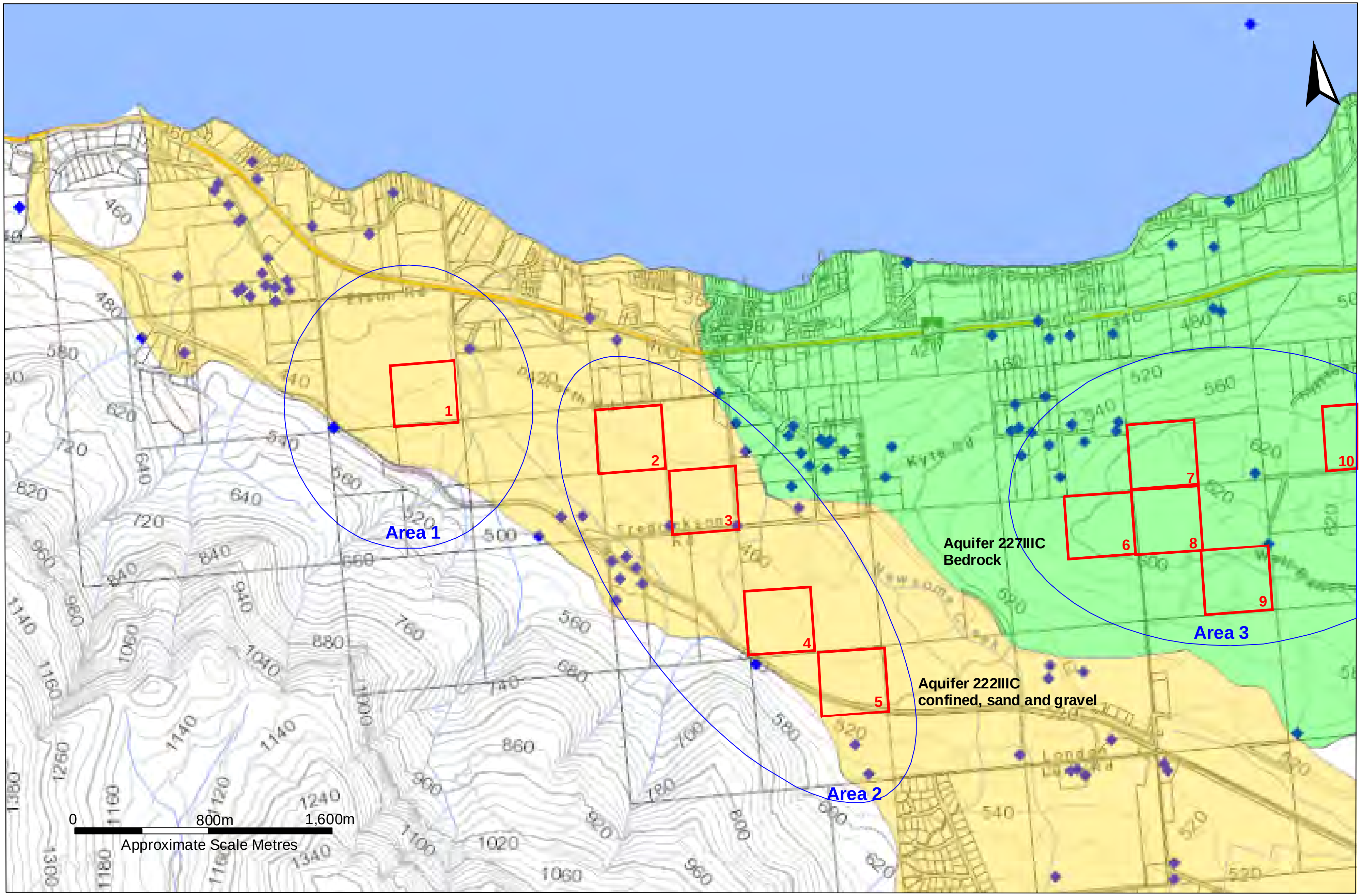


Figure 3 - Mapped Aquifers in the Sorrento Area		
Date: Aug 2015	Image Source: BC Water Resources Atlas (MFLNRO 2015)	WWAL Project: 15-043-01
Drawn by: RR	Checked by: DG	Client: Gentech / CSRD

western water
ASSOCIATES LTD
Consultants in Hydrogeology and Water Resources Management

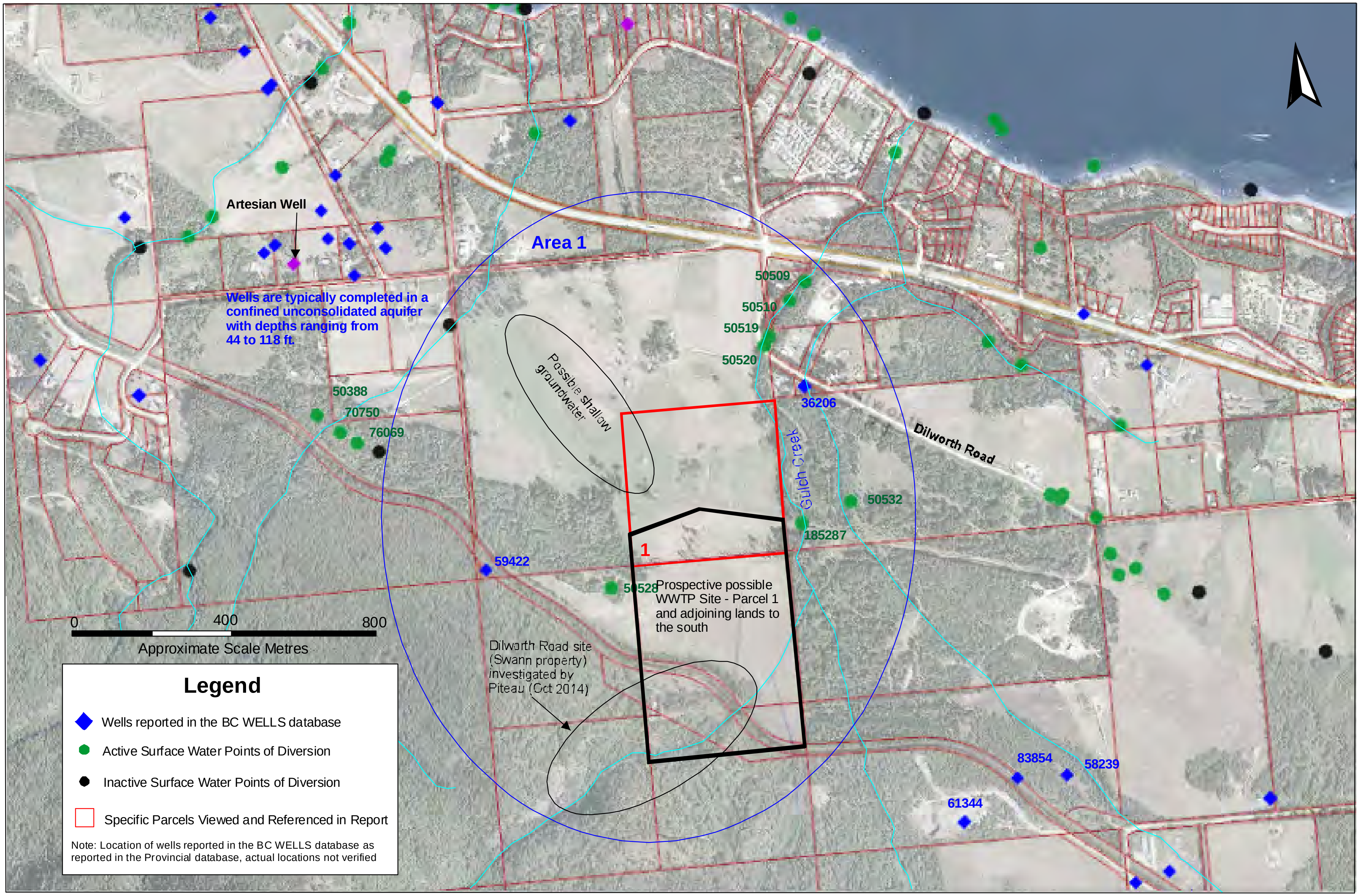


Figure 4 - Area 1 with reported wells, points of diversion and orthophoto coverage

Date: Aug 2015	Image Source: BC Water Resources Atlas (MFLNRO 2015)	WWAL Project: 15-043-01
Drawn by: RR	Checked by: DG	Client: Gentech / CSRD

western water ASSOCIATES LTD
Consultants in Hydrogeology and Water Resources Management

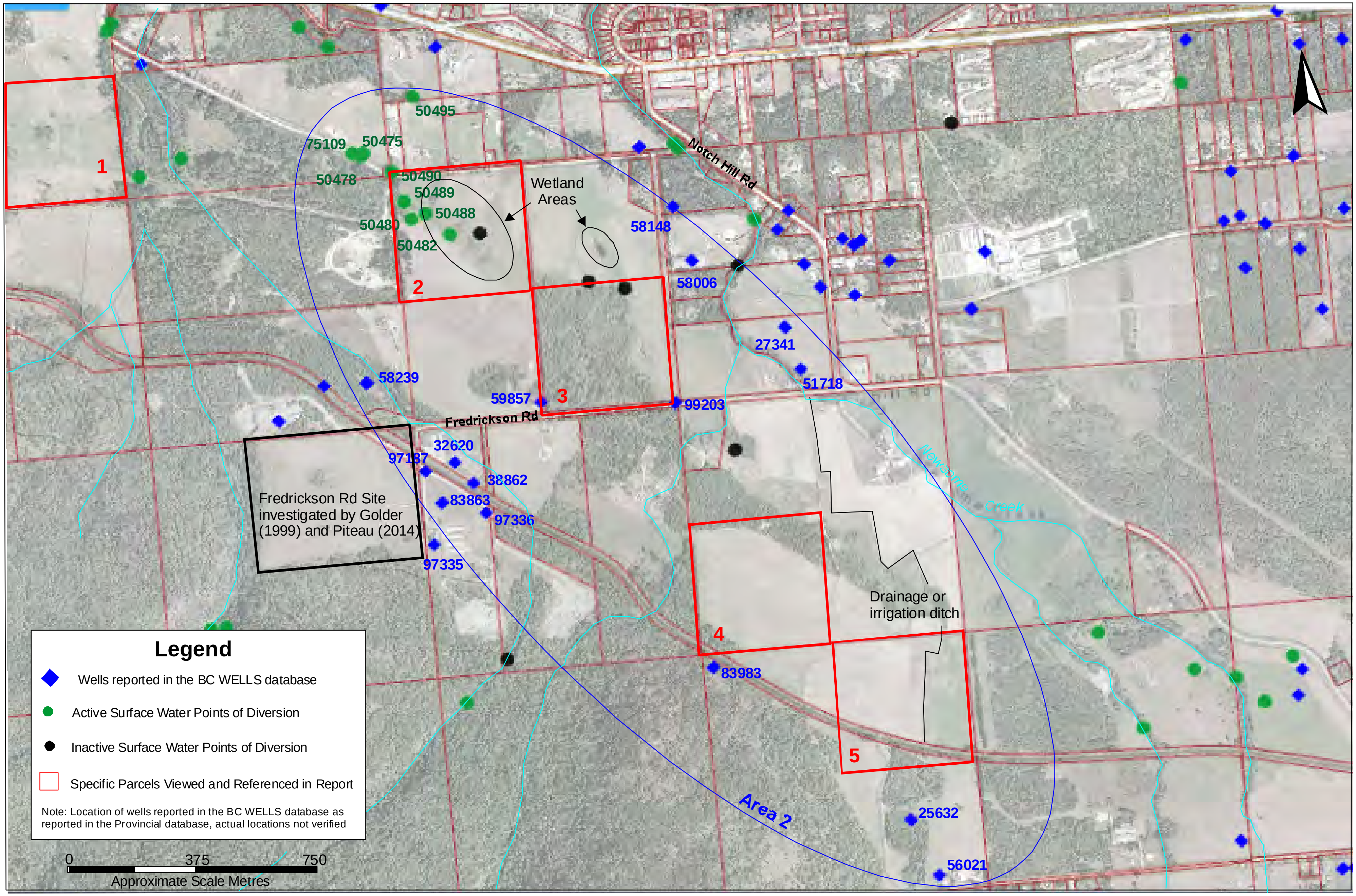


Figure 5 - Area 2 with reported wells, points of diversion and orthophoto coverage

Date: Aug 2015	Image Source: BC Water Resources Atlas (MFLNRO 2015)	WWAL Project: 15-043-01
Drawn by: RR	Checked by: DG	Client: Gentech / CSRD

western water ASSOCIATES LTD
Consultants in Hydrogeology and Water Resources Management

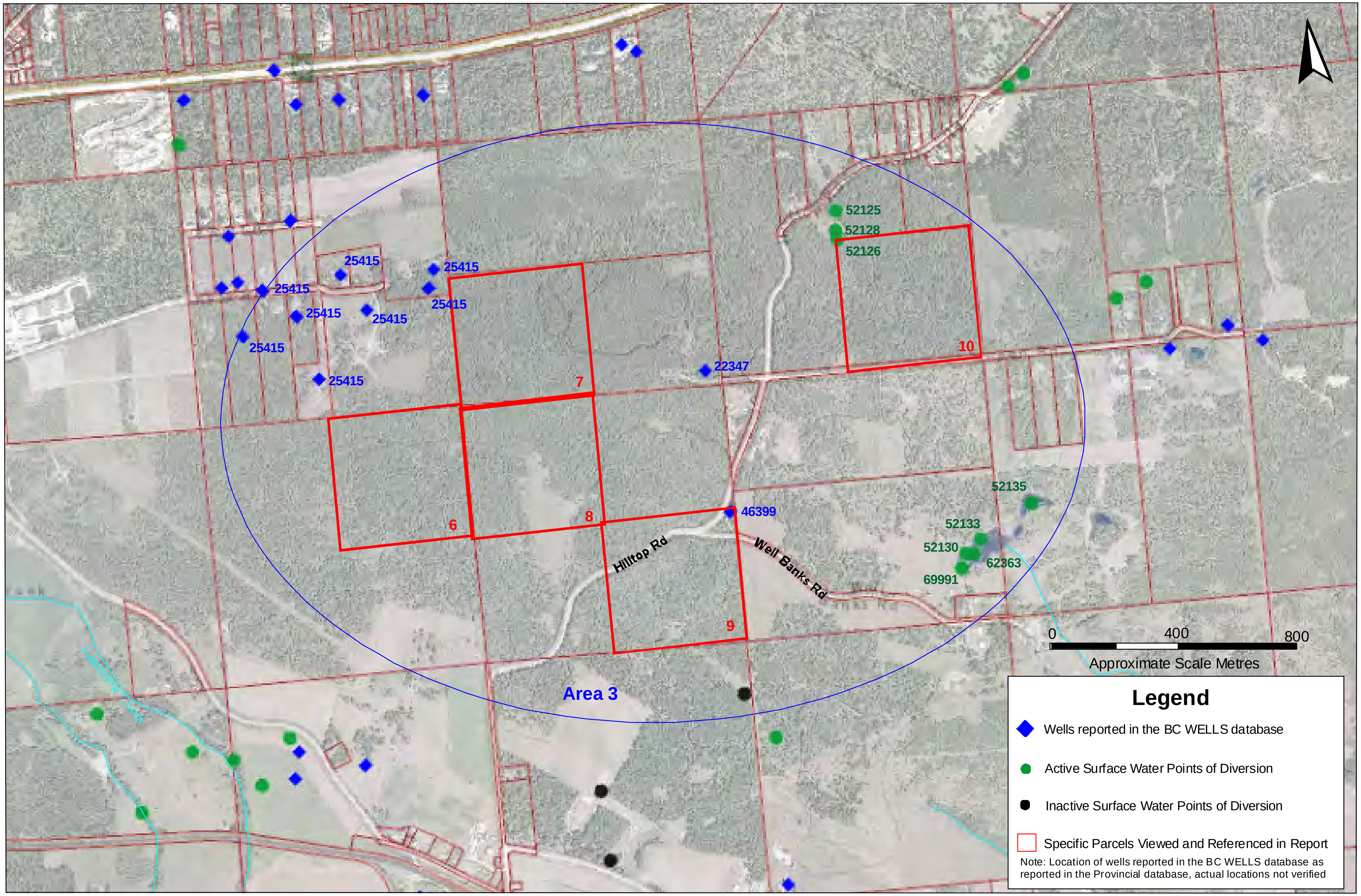


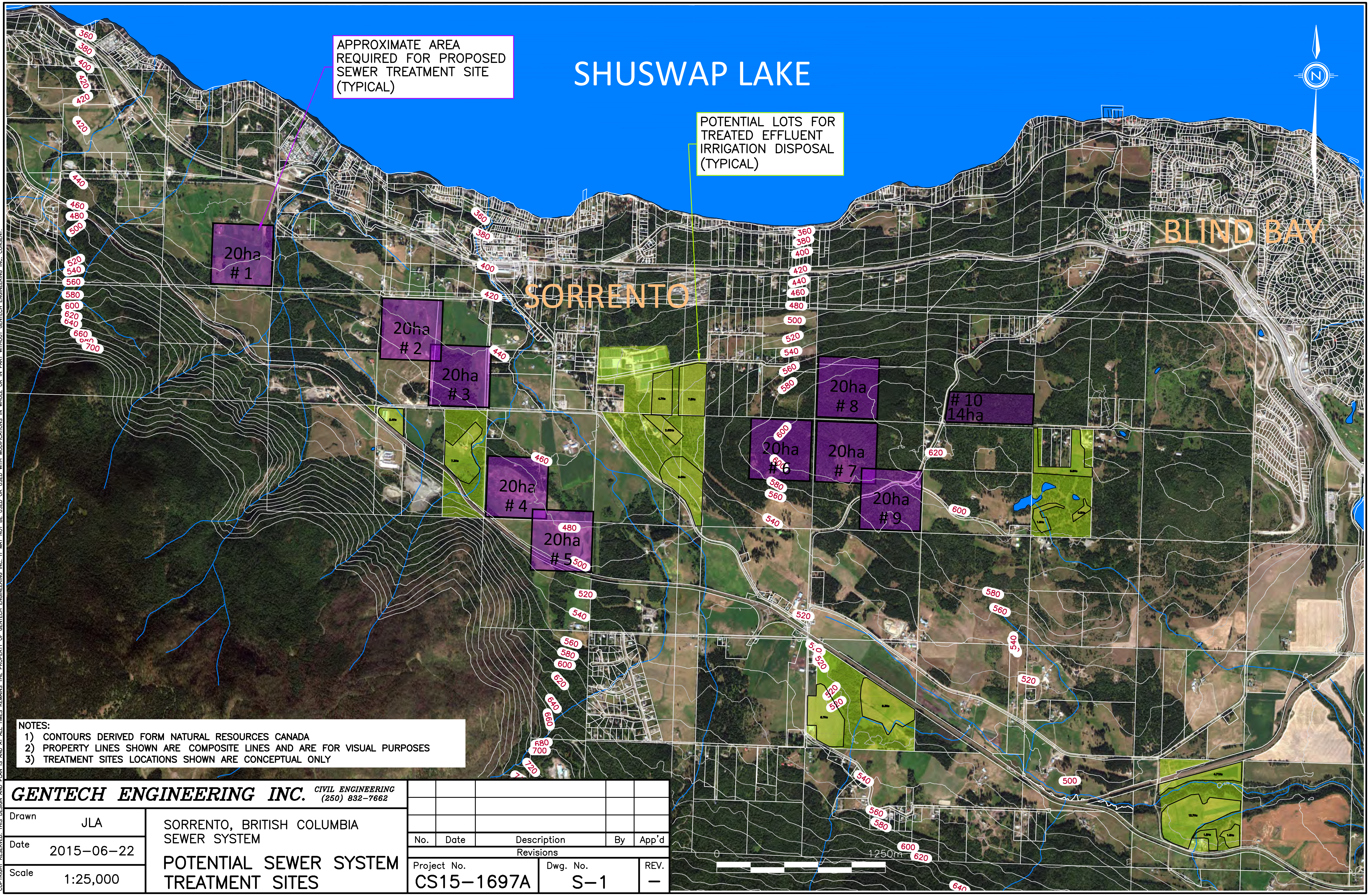
Figure 6 - Area 3 with reported wells, points of diversion and orthophoto coverage				western water ASSOCIATES LTD Consultants in Hydrogeology and Water Resources Management
Date: Aug 2015	Image Source: BC Water Resources Atlas (MFLNRO 2015)		WWAL Project: 15-043-01	
Drawn by: RR	Checked by: DG	Client: Gentech / CSRD		

Western Water Associates Ltd.
Standard Report Limitations

1. This Document has been prepared for the particular purpose outlined in the work scope that has been mutually agreed to with the Client.
2. The scope and the period of service provided by Western Water Associates Ltd are subject to restrictions and limitations outlined in subsequent numbered limitations.
3. A complete assessment of all possible conditions or circumstances that may exist at the Site or within the Study Area referenced, has not been undertaken. Therefore, if a service is not expressly indicated, it has not been provided and if a matter is not addressed, no determination has been made by Western Water Associates Ltd. in regards to it.
4. Conditions may exist which were undetectable given the limited nature of the enquiry that Western Water Associates Ltd. was retained to undertake with respect to the assignment. Variations in conditions may occur between investigatory locations, and there may be special conditions pertaining to the Site, or Study Area, which have not been revealed by the investigation and which have not therefore been taken into account in the Document. Accordingly, additional studies and actions may be required.
5. In addition, it is recognised that the passage of time affects the information and assessment provided in this Document. Western Water Associates Ltd's opinions are based upon information that existed at the time of the production of the Document. It is understood that the Services provided allowed Western Water Associates Ltd to form no more than an opinion of the actual conditions of the Site, or Study Area, at the time the site was visited and cannot be used to assess the effect of any subsequent changes in the quality of the Site, or Study Area, nor the surroundings, or any laws or regulations.
6. Any assessments made in this Document are based on the conditions indicated from published sources and the investigation described. No warranty is included, either expressed or implied, that the actual conditions will conform exactly to the assessments contained in this Document.
7. Where data supplied by the Client or other external sources, including previous site investigation data, have been used, it has been assumed that the information is correct unless otherwise stated.
8. No responsibility is accepted by Western Water Associates Ltd for incomplete or inaccurate data supplied by others.
9. The Client acknowledges that Western Water Associates Ltd may have retained sub-consultants affiliated to provide Services. Western Water Associates Ltd will be fully responsible to the Client for the Services and work done by all of its sub-consultants and subcontractors. The Client agrees that it will only assert claims against and seek to recover losses, damages or other liabilities from Western Water Associates Ltd.
10. This Document is provided for sole use by the Client and is confidential to it and its professional advisers. No responsibility whatsoever for the contents of this Document will be accepted to any person other than the Client. Any use which a third party makes of this Document, or any reliance on or decisions to be made based on it, is the responsibility of such third parties. Western Water Associates Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this Document.

Appendix 2

Dwg. No S-1
Potential Sewer System Treatment Sites
June 22, 2015



NOTES:
1) CONTOURS DERIVED FORM NATURAL RESOURCES CANADA
2) PROPERTY LINES SHOWN ARE COMPOSITE LINES AND ARE FOR VISUAL PURPOSES
3) TREATMENT SITES LOCATIONS SHOWN ARE CONCEPTUAL ONLY

GENTECH ENGINEERING INC. CIVIL ENGINEERING (250) 832-7662

Drawn	JLA
Date	2015-06-22
Scale	1:25,000

SORRENTO, BRITISH COLUMBIA
SEWER SYSTEM

POTENTIAL SEWER SYSTEM TREATMENT SITES

No.	Date	Description	By	App'd

Revisions

Project No.	Dwg. No.	REV.
CS15-1697A	S-1	–

PLOT April 5, 2016 COMPUTER-C-C:\PROJECTS\CSRD\CS15-1697A - SORRENTO COMMUNITY SEWER SYSTEM\CS15-1697A S-1 SORRENTO SEWER SITES.DWG (XREF-DWG-NAMES)

Appendix 3

Hubland Road Test Pit Logs 18Feb2016

Fletcher Paine Associates Ltd.
Consulting Geotechnical and Materials Engineers

Test Pit Location Plan	Figure: 6259-1	
	Date: 18-Feb-2016	Scale: nts

Record of Exploration - Test Pit No. 1

Project No: 6259
Project: Huband Road Test Pit Logs
Client: CSRD
Project Location: Sorrento, BC

Test Pit Location: See Figure 6259-1
Excavation Contractor: Mounce Construction Ltd.
Excavation Date: February 18, 2016
Excavation Method: metal tracked excavator

Depth (m)	Symbol	SUBSURFACE PROFILE — Description	Sample Number	Sample Type
		Ground Surface		
0		**TOPSOIL** forest floor, silty		
		SAND AND SILT gravelly, dense, brown, damp		
1			1	G
2				
		SAND some silt to silty, compact to dense, brown, damp	2	G
			3	G
3				
		SAND AND GRAVEL silty, very dense, brown, dry to damp		
			4	G
4		End of test pit at 4.0 m No groundwater seepage encountered during test pit excavation		

Fletcher Paine Associates Ltd.
2250 - 11th Avenue
Vernon, B.C. V1T 7X8
Ph. (250) 542-0377 Fax. (250) 542-1220
fletcherpaine@shawlink.ca

Record of Exploration - Test Pit No. 2

Project No: 6259
Project: Huband Road Test Pit Logs
Client: CSRD
Project Location: Sorrento, BC

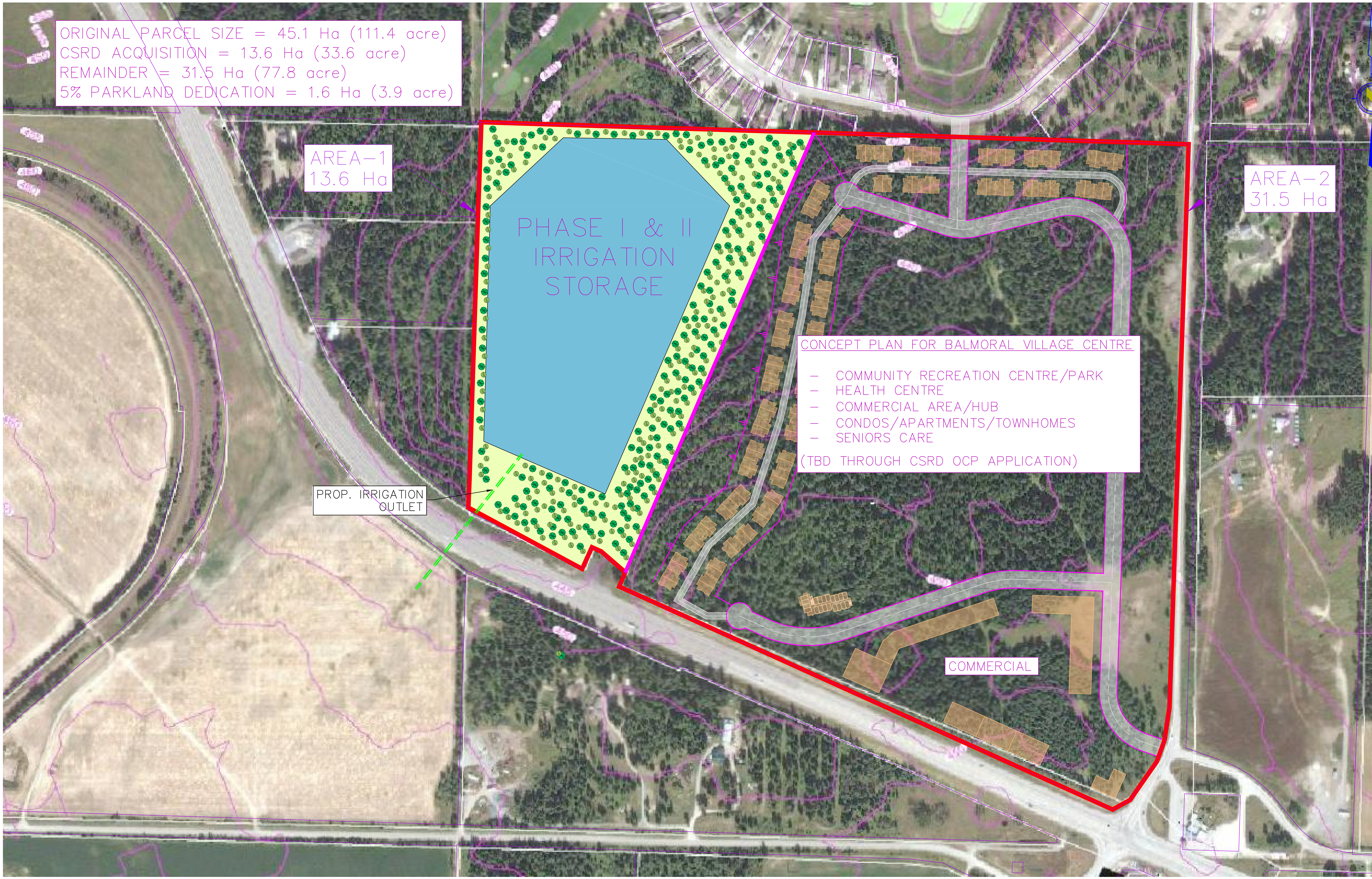
Test Pit Location: See Figure 6259-1
Excavation Contractor: Mounce Construction Ltd.
Excavation Date: February 18, 2016
Excavation Method: metal tracked excavator

SUBSURFACE PROFILE			SAMPLE	
Depth (m)	Symbol	Description	Sample Number	Sample Type
		Ground Surface		
0		**TOPSOIL** forest floor, silty		
		SAND AND SILT gravelly, trace cobbles, dense, brown, damp		
1			1	G
2		**SAND** silty, some gravel, compact to dense, brown, damp	2	G
		SAND AND GRAVEL silty, trace cobbles, very dense, brown, dry to damp		
3			3	G
		End of test pit at 3.4 m No groundwater seepage encountered during test pit excavation		
4				

Fletcher Paine Associates Ltd.
2250 - 11th Avenue
Vernon, B.C. V1T 7X8
Ph. (250) 542-0377 Fax. (250) 542-1220
fletcherpaine@shawlink.ca

EXHIBIT 8

Concept Plan for Balmoral Property



Shuswap Lake ESTATES

CONCEPT PLAN ONLY

SHUSWAP LAKE ESTATES

BLIND BAY VILLAGE CENTER

PROJECT: BLIND BAY VILLAGE CENTER

SCALE: 0 20 1:2000 100m

DRAWING TITLE: **CONCEPT PLAN**

DRAWING DATE: DECEMBER 2017

REVISION DATE:

DRAWING NUMBER: 17–101 – 030

REVISION: 0

EXHIBIT 9

Paul Demenok, Director Electoral Area C

Letter of Support

January 11, 2018

Agricultural Land Commission
133-4940 Canada Way
Burnaby, BC V5G 4K6

Email: ALCBurnaby@Vicotira1.goc.bc.ca

Dear Sirs,

This letter is to outline my strong support for the application to the Agricultural Land Commission from the Columbia Shuswap Regional District to exclude the land known as the Balmoral corner, located at the corner of Balmoral Road and Highway 1 for the purposes of constructing a reclaimed water storage facility. This application is fully consistent with the provincially-approved Liquid Waste Management Plan, as well as the Official Community Plan, for Area C of the CSRD. Please note that both of these plans underwent extensive community consultations and reflect the views of this community.

In addition to the above, there is a number of very good reasons to proceed with this important infrastructure project, and these include:

1. **Agricultural Benefits**- The use of treated effluent has proven to be a highly successful way to significantly enhance agricultural productivity in similar communities in this region, such as Armstrong. The effluent from this treatment plant will be used to support and improve local agricultural operations. In turn, agricultural use of the effluent will enhance the sustainability and economic viability of the farms in the Balmoral area. In effect, this will help to ensure that this land remains cultivated and contributes to the agricultural output of this province for generations to follow.
2. **Environmental Benefits**- There are thousands of homes and businesses in the Blind Bay/Sorrento area that utilize onsite septic systems to dispose of waste water. Over many decades of use, it is apparent that many, if not most of these septic systems are now in their end stages of useful life. Local water monitoring studies, supported by the CSRD, have shown that *e coli* and *fecal coliforms* are present in levels above Canadian raw water standards at a number of test locations, including ground water sites in Blind Bay and Sorrento. Appropriate treatment of waste water and disposal of the effluent to support agricultural operations more distant from Shuswap Lake will reduce the environmental pressures on the critically important Shuswap watershed. It should be noted that there are considerations to designate the Shuswap watershed as a sensitive receiving environment.

.../2

3. **Economic Benefits**- The implementation of community waste water treatment will provide significant economic benefits to the entire South Shuswap area. It will enable higher density developments, including assisted living and nursing home accommodations that are in very high demand in this area. It will allow for more affordable housing options and new amenities such as recreational, commercial, and medical facilities. Given that there is a population of about 8,000 people living in CSRD Area C, one can quickly appreciate why the community is so strongly supportive of this initiative.

4. **Social/Cultural Benefits**- The provincially-sponsored Age-Friendly study conducted in the South Shuswap indicated that infrastructure improvements are needed before the residents in this area can successfully age in place. With a majority of the population in Area C aged over 50 years, it is important to provide the infrastructure that will encourage residents to remain in this area.

Given these important and timely benefits, I would encourage the Agricultural Land Commission to approve the application to exclude this land from the Agricultural Land Reserve. It is clear that doing so will result in the achievement of a scenario where all interests, especially those related to agriculture, will strongly benefit.

Thank you very much for your kind consideration of this request.

Sincerely,

Paul Demenok
CSRD Electoral Area C Director

EXHIBIT 10

John Born

Letter of Interest
– 500 Acres of Spray Irrigation

John Born
Village Ranch Ltd.
2087 Peterson Rd
Box 481
Sorrento, BC V0E 2W0

September 15, 2017

To Whom It May Concern:

This letter is intended to provide the Columbia Shuswap Regional District with an indication of our interest in utilizing reclaimed water on our farm lands from a future waste water treatment system in the Blind Bay area.

The Village Ranch Ltd. has approximately 1000 acres of farm land, 500 of which is in close proximity to the planned reclaimed water storage reservoir and would be ideal for spray irrigation. Some of the farm land currently has limited irrigation and other portions have no irrigation at this time. The addition of reclaimed water will increase the productivity of these lands, particularly in dry years such as what we are currently experiencing in 2017.

If you have any questions, please do not hesitate to contact me.

Sincerely,

John Born, President
Village Ranch Ltd.

EXHIBIT 11

Chamber of Commerce

Letter of Support

November 15, 2017

Columbia Shuswap Regional District
Attention: Paul Demenok, Area C Director

Dear Mr. Demenok:

Re: Chamber Support for Shuswap Lake Estates

On behalf of the Board of Directors for the South Shuswap of Commerce, I write this letter in support of an application to the Agricultural Land Commission being made requesting release of the lands situated at the corner of Balmoral Road and the Trans Canada Highway.

On behalf of the business community, the South Shuswap Chamber of Commerce fully supports the Columbia Shuswap Regional District acting as agent on behalf of Shuswap Lake Estates to make application to the Agricultural Land Commission to request release of the aforesaid property from the Agricultural Land Reserve.

There is a gross shortage of available land for potential development and commercial use which restricts investment in our area. Our tax assessment is very unbalanced, being 97% residential and only 3% commercial. Together with our Economic Development Department, the Chamber would like to work towards remedying that situation through the attraction of new business to the area. Having the subject lands at Balmoral Road and the Trans Canada Highway will be a positive step in that direction.

Warm Regards,

Mark Lane, President
South Shuswap Chamber of Commerce

p: 250.515.0002 e:manager@southshuswapchamber.com w: southshuswapchamber.com
m: 2405 centennial road, blind bay, bc v0e 1h2

EXHIBIT 12

Mel Arnold, MP

Letter of Support

DM
PT
GC
CP

☐CAO ☑Works ☑DS ☐Fin/Adm	☐Agenda ☐Reg Board ☐In Camera ☐Other Mtg	Ownership: File# 04302003
DEC 22 2017		
☐Ec Dev ☐IT ☐Parks ☐SEP ☐HR ☐Other	RECEIVED ☐Staff to Report ☐Staff to Respond ☐Staff Info Only ☐Dir Mailbox ☐Dir Circulate	Ack Sent: ☐Fax ☐Mail ☐Email

↳ via email to Director Demenok please
LA/NB ? Mr. Arnold indicated the letter is for Director Demenok.
LA Shykora

Mel Arnold, MP
North Okanagan - Shuswap

Provincial Agricultural Land Commission
133-4940 Canada Way
Burnaby, B.C.
V5G 4K6

December 19, 2017

Dear Sir/Madam,

I am writing to express my support for the application to the Provincial Agricultural Land Commission from the Columbia Shuswap Regional District (CSRD) seeking an exclusion of the land known as the Balmoral corner, at the northwest corner of Balmoral Road and Highway 1 in the Shuswap Valley for the purposes of constructing a waste water treatment facility.

I understand that this application is consistent with the provincially-approved Liquid Waste Management Plan, as well as the Official Community Plan for Area C of the CSRD. There are a number of ecological, agricultural, economic and social benefits that this important infrastructure project could provide.

The proposed construction of a waste water treatment facility would eliminate the need for thousands of homes and businesses in the Blind Bay-Sorrento area to rely on onsite septic systems- many of which are in their end stages of operational life. Local water monitoring studies at test locations in Blind Bay and Sorrento have shown that e coli and fecal coliforms levels exceed thresholds prescribed by Canadian raw water standards.

Residents and businesses need the opportunity to transition off of their personal septic systems and the proposed waste water treatment facility would provide this opportunity. Given that there is a population of about 8,000 people living in CSRD Area C, one can quickly appreciate why the community is so strongly supportive of this initiative. Clearly, this is an important step towards reducing and eliminating the introduction of e coli and fecal coliforms to the Shuswap watershed.

The application of treated effluent in agricultural operations has been proven to safely enhance agricultural production in similar communities of this region, such as Armstrong, B.C. As such, the treated effluent from the proposed treatment plant will

Ottawa
218 Justice Building
House of Commons
Ottawa ON K1A 0A6
Tel: (613) 995-9095
Fax: (613) 992-3195
Mel.Arnold@parl.gc.ca

WWW.MELARNOLD.CA

Constituency
1-3105-29th St.
Vernon BC V1T 5A8
Tel: (250) 260-5020
Fax: (250) 260-5025
Toll Free: 1-800-665-5040
Mel.Arnold.C1@parl.gc.ca

be used to support and improve nearby agricultural operations and make them more sustainable.

The proposed waste water treatment facility will provide significant economic benefits to the entire South Shuswap area by allowing future development to occur sustainably. Future development of assisted living, nursing home accommodations, affordable housing and new amenities such as recreational, commercial, and medical facilities will require the services of this facility.

The proposed facility will also provide infrastructure that will help residents age in place- a need identified in the provincially-sponsored Age-Friendly study conducted in the South Shuswap. With a majority of the population in Area C aged over 50 years, it is important to provide the infrastructure that will support a sustainable lifestyle for all residents.

I would encourage the Provincial Agricultural Land Commission to consider these valuable ecological, agricultural, economic and social benefits as you undertake your assessment of CSRD's request for an exclusion of the lands in question from the Agricultural Land Reserve.

The construction of a waste water facility at Balmoral will greatly assist efforts to protect the Shuswap watershed while also providing residents with valuable benefits allowing them to grow and age in place.

Thank you very much for your kind consideration of this request.

Sincerely,

Mel Arnold, Member of Parliament
North Okanagan- Shuswap

Ottawa
218 Justice Building
House of Commons
Ottawa ON K1A 0A6
Tel: (613) 995-9095
Fax: (613) 992-3195
Mel.Arnold@parl.gc.ca

WWW.MELARNOLD.CA

Constituency
1-3105-29th St.
Vernon BC V1T 5A8
Tel: (250) 260-5020
Fax: (250) 260-5025
Toll Free: 1-800-665-5040
Mel.Arnold.C1@parl.gc.ca

EXHIBIT 13

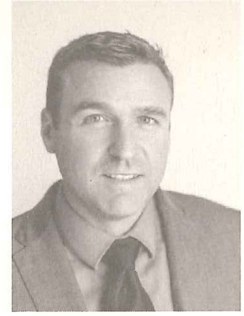
Greg Kyllo, MLA

Letter of Support

Legislative Office:
Parliament Buildings
Victoria, B.C. V8V 1X4
Phone: 250-953-0965
Fax: 250-387-9100

Constituency Office:
PO Box 607
202A - 371 Alexander Street NE
Salmon Arm, B.C. V1E 4N7
Phone: 250-833-7414
Fax: 250-833-7422
Toll Free: 1 877 771-7557
email: Greg.Kyllo.MLA@leg.bc.ca

Province of British Columbia
Legislative Assembly



Greg Kyllo, M.L.A.
Shuswap

Tuesday, December 19, 2017

Mr. Darcy Mooney
PO Box 978
781 Marine Park Drive NE
Salmon Arm BC, V1E 4P1

Dear Darcy Mooney,

As MLA for the Shuswap, I am happy to provide this letter of support to the Columbia Shuswap Regional District for their application to the Agricultural Land Commission in their efforts to exclude the land known as the Balmoral Corner from the Agriculture Land Reserve. This land is located at the corner of Balmoral Road and Highway 1.

I understand that this application for land exclusion is to construct a Waste Water Treatment facility and it is consistent with the provincially-approved Liquid Waste Management Plan, as well as the Official Community Plan for Area C of the CSRD.

Best of luck with your application.

Sincerely,

Greg Kyllo, MLA
Shuswap

EXHIBIT 14

Shuswap Watershed Council

Letter of Support

SHUSWAP watershed council #

#
19 December 2017

Agricultural Land Commission
133-4940 Canada Way
Burnaby, BC
V5G 4K6

RE: Support for the Columbia Shuswap Regional District's application for exclusion from ALR

Dear ALC Chair Frank Leonard and Okanagan Panel Vice Chair Gerald Zimmermann,

I am writing on behalf of the Shuswap Watershed Council (SWC) to express support for the Columbia Shuswap Regional District's (CSRD) application to the Agricultural Land Commission to have a parcel of land known as "Balmoral Corner" excluded from the Agricultural Land Reserve for the purpose of constructing a wastewater treatment plant.

The SWC's vision is *Enhanced water quality that supports human and ecosystem health and the local economy in the Shuswap watershed*. In principle, the SWC supports actions that improve and/or protect water quality in our watershed.

In addition to being consistent with the SWC's vision, I believe there are other reasons – in support of agriculture and water quality – to approve the exclusion application and enable the wastewater treatment project to proceed:

1. Agricultural benefits: the plan for the treatment plant includes the use of the plant's treated effluent in spray irrigation, which will support and improve local agricultural operations and enhance the sustainability of the farms in the Balmoral area.

2. Environmental benefits: Thousands of homes and businesses in the Blind Bay and Sorrento areas are currently utilizing on-site septic systems to dispose of waste water. Water monitoring has shown high levels of *E. coli* and fecal coliforms at a number of sites in Blind Bay and Sorrento. A wastewater treatment facility will reduce the environmental pressures on our critically important Shuswap watershed.

The benefits of the CSRD's planned wastewater treatment plant at Balmoral will benefit both agriculturalists and the water quality in our watershed. Therefore, we encourage the Agricultural Land Commission to approve the CSRD's exclusion application. I thank you in advance for your consideration.

Sincerely,

Paul Demenok
Chair, Shuswap Watershed Council
Director, Columbia Shuswap Regional District Area 'C' South Shuswap
pdemenok@csrd.bc.ca

EXHIBIT 15

Columbia Shuswap Regional District
Electoral Area C – South Shuswap

Official Community Plan

COLUMBIA SHUSWAP REGIONAL DISTRICT

Electoral Area 'C'
Official Community Plan
Bylaw No. 725

THIS CONSOLIDATED BYLAW IS NOT INTENDED TO BE USED FOR LEGAL PURPOSES

CONSOLIDATED FOR CONVENIENCE ONLY WITH:

Bylaw 725-02
Bylaw 725-08

August 24, 2017

INFORMATION SHEETS ON THE BYLAWS WHICH WERE CONSOLIDATED
INTO BYLAW NO. 725

BYLAW NO. 725-02 - Adopted February 19, 2015

- Added new subsection 3.3.2.9, Blind Bay Resort
- Amended Map

BYLAW NO. 725-08 - Adopted July 20, 2017

- Added new subsections, Section 3 - 3.4.2.7, Section 4 - 4.2.2.4, Section 12 -12.5.5.17,

COLUMBIA SHUSWAP REGIONAL DISTRICT

ELECTORAL AREA 'C' OFFICIAL COMMUNITY PLAN
BYLAW NO. 725

A bylaw to adopt the Electoral Area ‘C’ Official Community Plan Bylaw No. 725

WHEREAS the Board of the Columbia Shuswap Regional District wishes to adopt an Official Community Plan;

AND WHEREAS the Board has examined the plan in conjunction with its financial plan and waste management plans;

AND WHEREAS the Board has referred the plan to the Provincial Agricultural Land Commission; adjacent municipalities and regional districts; First Nations; school district board; and Provincial and Federal agencies for comment;

AND WHEREAS the Board has held a Public Hearing;

NOW THEREFORE the Board of the Columbia Shuswap Regional District, in open meeting assembled, hereby enacts as follows:

1. South Shuswap Official Community Plan Bylaw No. 700 and amendments thereto are hereby repealed.

2. PART 1 "BROAD OBJECTIVES AND POLICIES" of Schedule A of Kault Hill Rural Land Use Bylaw No. 3000 and amendments thereto are hereby repealed.

3. Schedule B (OCP Designations Maps) of Kault Hill Rural Land Use Bylaw No. 3000 and amendments thereto are hereby repealed.

4. The following schedules attached hereto are hereby made part of this bylaw and adopted as the Official Community Plan for Electoral Area ‘C’:

   a. Schedule A (the Official Community Plan text)
   b. Schedule B (Land Use Designations – Overview)
   c. Schedule C (Land Use Designations – Mapsheets)
   d. Schedule D (Aggregate Potential Map)
   e. Schedule E (ALR Map)
   f. Schedule F (Present and Proposed Parks, and Present and Proposed Public and Institutional)

5. If any section, subsection, sentence, clause, or phrase of this Bylaw is for any reason held to be invalid by the decision of any court of competent jurisdiction, the invalid portion shall be severed and the decision that is invalid shall not affect the validity of the remainder.

6. This Bylaw may be cited as the "Electoral Area 'C' Official Community Plan Bylaw No. 725."

READ a first time this 17th day of November, 2011.

READ a second time this 20th day of June, 2013.

PUBLIC HEARINGS held: 28th day of August, 2012;

15th day of January, 2013;

and 13th day of August, 2013.

READ a third time this 12th day of September, 2013.

RECEIVED THE APPROVAL of the Minister of Community, Sport and Cultural Development this

12th day of February, 2014.

ADOPTED this 20th day of March, 2014.

Charles A. Hamilton	David Raven
CHIEF ADMINISTRATIVE OFFICER	CHAIR
CERTIFIED true copy of Bylaw No. 725 read a third time.	CERTIFIED true copy of Bylaw No. 725 as adopted.
Chief Administrative Officer	Chief Administrative Officer

Table of Contents

Section 1. Plan Vision and Framework 1
1.1 Vision Statement 1
1.2 Sustainable Planning Principles 2
1.3 Plan Framework 3
1.4 Geographic Context & Existing Land Uses 4

Section 2. Protecting Our Lake Community 6
2.2 Watershed 7
2.3 Shoreline Environment 8
2.4 Fish and Aquatic Habitat 10
2.5 Watercraft Owners and Operators 10
2.6 Eurasian Water Milfoil 12

Section 3. Growing Gradually and Wisely 13
3.1 General Land Use Management 13
3.2 Village Centre (VC) 15
3.3 Secondary Settlement Areas 16
3.4 Residential 17
3.5 Residential Resort (RT) 18
3.6 Waterfront Development 19
3.7 Foreshore Water (FW) (Moorage) 19
3.8 Commercial 20
3.9 Industrial (ID) 21
3.10 Agriculture (AG) 21
3.11 Rural Resource (RSC) 22
3.12 Public and Institutional (PI) 23
3.13 Parks and Open Spaces (PK) 23
3.14 Golf Course (GC) 23
3.15 Railway Transportation Corridor (RW) 24

Section 4. Creating Diverse Housing Choices 25
4.1 Housing Choice 25
4.2 Housing for Seniors 26
4.3 Housing for Families 27
4.4 Housing for Seasonal Workers 27

Section 5. Diversifying the Local Economy 28
5.1 Tourism 28
5.2 Resource Industries 29
5.3 Economic Diversity 29
5.4 Home Occupations and Home Industries 30

Section 6. Respecting our Sensitive Environments 31
6.1 General Environment 32
6.2 Environmentally Sensitive Areas 32
6.3 Climate Change 34
6.4 Hazardous Areas 36
6.5 Forested Areas and Wildlife Habitat 37
6.6 Trees in Residential Areas 37
6.7 Groundwater and Soil Quality 38
6.8 Archaeology Sites 39

Section 7. Connecting our Community 40
7.1 Road System 40
7.2 Greenways 41
7.3 Public Transit 42
7.4 Rail Corridor 42

Section 8. Providing Recreational Choices 43
8.1 General Parks and Recreation 44
8.2 Waterfront Parks 45
8.3 Trail Corridor Parks 45
8.4 Community Parks and Recreation Facilities 46
8.5 Conservation Parks 46
8.6 Special Features Parks 47

Section 9. Planning Efficient Infrastructure 48
9.1 Infrastructure 48
9.2 Water Distribution 48
9.3 Liquid Waste Management 49
9.4 Solid Waste Management 49
9.5 Hydro, Gas and Communication Utilities 49

Section 10. Maintaining a Safe, Healthy Community 51
10.1 Fire Suppression 51
10.2 Building Safety 52
10.3 Personal Safety and Property Protection 52
10.4 Public Realm & Private Upkeep 53
10.5 Health Services 53
10.6 Services for Youth 54

Section 11. Fostering Community Vitality 55
11.1 Cultural 55
11.2 Social 56

Section 12. Development Permit Areas 57
12.1 Hazardous Lands Development Permit Areas *(Steep Slope)* 57
12.2 Foreshore and Water Development Permit Area 59
12.3 Lakes 100m Development Permit Area 62
12.4 Riparian Areas Regulation (RAR) Development Permit Area 64
12.5 Village Centre and Secondary Settlement Area Form and Character Development Permit Area 67
12.6 Industrial (ID) Development Permit Area 70
12.7 Commercial Development Permit Area 71

Section 13. Development Approval Information & Temporary Use Permits 73
13.1 Development Approval Information 73
13.2 Temporary Commercial and Industrial Permits 74

Section 1. Plan Vision and Framework

1.1 Vision Statement

The South Shuswap is a special place with a distinct character and ambience. Its unique qualities include Shuswap Lake (the Lake), which forms the heart of the community and offers beautiful views, recreational opportunities, a valuable fisheries resource, and a source of domestic water. Other components of this unique ambience include the upland community areas, the tree-clad mountains, their undulating silhouettes against the sky, the well-maintained farms and ranches and their functionally expressive architecture, and the diverse social and aesthetic qualities of the various neighbourhoods. This Plan seeks to have all new developments preserve and, if possible, enhance these qualities.

Looking forward 100 years, the vast majority of the South Shuswap will remain rural, with productive agriculture, extensive forests, rugged terrain, and natural shorelines.

Throughout the coming century, the sustainability of Shuswap Lake is paramount. All public and private decisions must protect the Lake from over-development, environmental pollution, human and agricultural wastes. Concurrently, agricultural land must also be protected.

In the next 20 years, development is anticipated to be at a moderate scale, and less intensive than the Okanagan Valley. Small pockets of settlement along Shuswap Lake will stay much as they are today. Sunnybrae, White Lake, and Eagle Bay will likely be serviced with sewer and water, making way for a modest amount of primarily residential development. The Sorrento Village Centre will be serviced with sewer and water, allowing for detached and multi-unit residential, commercial, and business-industrial uses. These uses will be concentrated around the Village Centre and away from the lakeshore. Higher density residential, commercial and industrial development outside the Village Centre and 'Balmoral Corner' will be strongly discouraged; although the OCP supports such uses at the 'Balmoral Corner', the lands are in the ALR and previous applications to exclude the land for uses other than agriculture have been refused by the ALC.

South Shuswap residents and businesses will practise stewardship to allow rural lands, parks and accesses to the lakes to be available for future generations. Developed areas will include greenways that encourage people to walk and bicycle, and will have ample undeveloped land to allow for plant and animal diversity.

1.2 Sustainable Planning Principles

Nine principles provide the foundation for the Plan. Together, they point towards a more "sustainable community", one that is continually adjusting to meet the social and economic needs of its residents within the context of the finite carrying capacity of the natural environment, and climate change, to accommodate these needs.

Principle 1
All measures to protect and restore the natural environment will be used, and emphasis placed on Shuswap Lake, White Lake and their interlinked watersheds and foreshores. The CSRD will collaborate with all other jurisdictions that have impact on these Lakes.

Principle 2
To maintain large areas of rural landscape throughout the South Shuswap while encouraging gradual, sustainable, moderate and efficient development in the existing settled areas.

Principle 3
A range of housing choices is supported, taking into account affordability for existing residents, particularly for young families and seniors. Only ground-oriented housing is appropriate near the Lakes; more dense forms of housing must be located away from the Lakes.

Principle 4
Agriculture, tourism and forestry are supported as the foundations of the economy, while economic diversification that has low impact on the area's character and natural environment is encouraged. The establishment of a business park that attracts clean industries and complements existing businesses is also encouraged.

Principle 5
Safe roads, improved public transit, and opportunities for safe cycling and walking are encouraged as an alternative to driving. Relocation of the Trans-Canada Highway around Sorrento and intersection upgrades to improve safety of the travelling public at the Trans-Canada Highway / Balmoral Road intersection are high priorities.

Principle 6
Public accesses to the shorelines of the lakes of the South Shuswap and, in particular, providing parks and facilities that are suitable for families with children and teens are encouraged. Further development of low-impact, outdoor recreation activities throughout the South Shuswap is encouraged, while expansion of commercial houseboat operations outside of municipal boundaries is discouraged.

Principle 7
A region-wide approach to correct inferior water and sewage treatment systems and a comprehensive, affordable liquid waste management plan that takes into account the latest technologies is supported, in order to fully protect groundwater, lakes and streams.

Principle 8
A concentration of community facilities in the Sorrento and Balmoral areas, including retail, cultural, health and emergency services is supported.

Principle 9
Active community involvement within the South Shuswap, including planning decisions related to land use, housing, servicing, parks and transportation is supported.

1.3 Plan Framework

Once adopted, the South Shuswap / Electoral Area C Official Community Plan (OCP or the Plan) will be one of the Columbia Shuswap Regional District (CSRD)'s most important documents. The Plan sets out objectives and policies to guide the CSRD Board of Directors future decisions pertaining to land use, buildings, infrastructure, and community services. There are several reasons for adopting a comprehensive Official Community Plan covering the entire lands and waters of the South Shuswap:

- Guides any works undertaken or bylaws enacted by the Regional District to be consistent with the Plan;
- Allows the Regional District to use two specific measures that are unavailable without an OCP, Development Permit Areas and Development Approval Information Areas ;
- Provides prospective developers and investors, as well as existing residents and businesses, with a "roadmap" to follow in the preparation of an application for development, buildings and other structures, including moorage;
- Conveys to other governments, including their ministries and agencies, the wishes of the community/local government with respect to the services provided by these other government entities;
- Gives assurance to other levels of government when considering potential funding for works and services that a long term Plan is in effect. Funding may be contingent on a Plan being in place for capital-intensive infrastructure such as water and sewer systems.

The CSRD also has a number of bylaws and policy plans that have influenced this Plan. One of these is the CSRD's Strategic Plan (2008-2012). That Plan has four guiding principles:

- Regional Collaboration
- Social Sustainability
- Economic Sustainability
- Environmental Sustainability

Where the CSRD does not have jurisdiction, the OCP may only state the broad objectives related to that matter. The following government entities have jurisdiction on certain matters, and have been consulted as part of this planning process:

- Agricultural Land Commission
- BC Interior Health Authority
- BC Ministry of Agriculture and Lands
- Ministry of Community, Sport & Cultural Development
- BC Ministry of Energy & Mines
- BC Ministry of Environment
- BC Ministry of Forests, Lands & Natural Resource Operations
- BC Ministry of Transportation & Infrastructure
- (Canada) Department of Fisheries and Oceans
- School District #83 (North Okanagan-Shuswap)
- The Little Shuswap Indian Band
- The Adams Lake Indian Band
- Thompson Nicola Regional District
- North Okanagan Regional District
- City of Salmon Arm

1.4 Geographic Context & Existing Land Uses

With a land area of 506 km2, Area C is the smallest electoral area in the Regional District. It covers just 2.0% of the total land area of the Columbia Shuswap Region, but is home to 15% of its population. The resident population at the 2011 Census of Canada was recorded as 7,662.

The countryside of Area ‘C’ varies from rolling hills at approximately 1500 metres to lush valleys and scenic lakeshores at approximately 350 metres.

The South Shuswap has a variety of land uses. Housing and cabins line Shuswap Lake and White Lake, while farms and ranches dominate the upland bench and valleys. Although there are no incorporated municipalities within Area C, there are a number of settled areas that have their own unique character and history — Sorrento, White Lake, Blind Bay, Eagle Bay, Reedman Point, Tappen, Sunnybrae, Notch Hill, Skimikin, Carlin and Wild Rose Bay. Some key local characteristics include:

- The areas around Notch Hill, Carlin and Tappen are well suited for the production of agricultural crops and value-added activities associated with agriculture. These areas are located away from the most populated areas of the community, and the majority of the land falls within the Provincially-designated “Agricultural Land Reserve”.

- The mountainous area that divides the Salmon Arm and the main West Arm of Shuswap Lake occupies over 300 square kilometres of rural resource lands. Most of this is Provincial Crown land, and dominated by forestry. There is also similar rugged terrain in the Skimikin area, west of the Tappen Valley. The timbered area consists of a variety of forest types – Douglas fir, spruce, pine, cedar and hemlock. The major biogeoclimatic zones are the Interior Cedar Hemlock and Interior Douglas Fir with smaller areas of Engelmann Spruce Subalpine Fir (ESSF). These upland areas provide recreational opportunities — hiking, wildlife viewing, cross country skiing and mountain biking — enjoyed by residents and visitors alike.

- Sorrento is a long-established commercial area with a fascinating history and a lively arts culture. Located along the Trans-Canada Highway towards the western edge of Area C, Sorrento has a mix of service and retail commercial, tourist accommodation, professional offices, and housing. The area has a water system and several privately-operated community sewer services. The Sorrento business community has been actively working on plans to improve the viability and appearance of the commercial area.

- Elsewhere within Area C, there areconvenience stores and services meeting the day-to-day needs of local residents and tourists.

- While the South Shuswap currently has a limited number of industrial enterprises, there is significant potential for employment growth. The Trans-Canada Highway and Canadian Pacific Rail both pass through the South Shuswap, providing transportation links to major centres across the country.

- The Shuswap has long been a favourite destination for summer vacationing, and a pattern of small motels, bed and breakfasts, and rental cabins and cottages has emerged. With improvements to the highway system, getting to the Shuswap is now safer and faster. At the time of writing of this plan, there were no major destination resorts in the South or North Shuswap.

- The community halls of the South Shuswap provide a venue for residents to meet and socialize, and the library hosts a range of services for the community. Two schools — in Carlin and Sorrento — provide elementary and middle schooling for students.

- Much of the property adjacent to the Lakes are privately owned, although there are a number of small accesses gradually being improved by the CSRD. Overnight camping facilities are available at Herald Provincial Park, White Lake Provincial Park, Cinnemousun Narrows Provincial Park and Skimikin Lake Recreation site.

Section 2. Protecting Our Lake Community

Sustainable Principle

All measures to protect and restore the natural environment will be used, and emphasis placed on Shuswap Lake, White Lake and their interlinked watersheds and foreshores. The CSRD will collaborate with all other jurisdictions that have impact on these Lakes.

The quality of Shuswap Lake is the most important issue to South Shuswap residents. Not only is Shuswap Lake an important amenity, it is the primary source of drinking water, and the habitat for a wide variety of aquatic life, waterfowl, and plants. It was evident throughout the planning process, that the Lake and its shoreline environment must be protected for the use and enjoyment of future generations.

As revealed through the concurrent Shuswap Lake Integrated Planning Process (SLIPP), 14 agencies from every level of government have legal jurisdiction over some aspect of the lakes.

The objectives and policies of this section focus on the sensitive environments in and around the Lake, and include measures to mitigate damage to the water quality and natural habitats that primarily fall within the jurisdiction of the Regional District.

2.1 Water Quality of Shuswap Lake

Shuswap Lake remains a relatively healthy aquatic environment. However, as the amount of development around the Lake intensifies, it becomes more susceptible to human contamination. Most properties have on-site septic systems. In proper conditions, these systems can adequately dispose of sewage; however when inadequate conditions exist, such as failed or saturated tile fields, it can lead to sewage leaching into groundwater or the Lake, causing serious contamination.

The mountains surrounding Shuswap Lake are formed of granite that results in a very low input of nutrients. Historically, Shuswap Lake has been very clear, with a high oxygen content owing to the low amount of organic matter. However, as a result of agricultural and human waste entering the groundwater, and the failure of some community sewer systems that discharge into the Lake, the nutrient levels have been increasing leading to unsightly and potentially hazardous situations. E. Coli has been detected in increasing concentrations in groundwater and levels of chloride, nitrates and sulphate have risen along the foreshore between Sorrento and Blind Bay. With clear evidence of deterioration of the Lake, the CSRD has renewed efforts towards sustainable, acceptable liquid waste management for the South Shuswap.

2.1.1 Objectives

.1 To protect the water quality of Shuswap Lake and its watershed.

.2 To maintain healthy aquatic and groundwater environments and protect people from contaminated water.

2.1.2 Policies

.1 Regardless of the level or type of treatment, the discharge of liquid waste (human, agricultural, industrial) into Shuswap Lake, White Lake and other natural waterbodies is unacceptable. In the event that a sewer system is available, properties within the service area will be required to connect to the system.

.2 Any new commercial, industrial, and institutional development must connect to a community sewage system. Existing residential development must connect to a community sewage system, when capacity is available.

The Regional District will:

.3 Implement its Liquid Waste Management Plan (LWMP);

.4 Assume control over private community sewage systems if the proper circumstances exist, and if there is support to do so from residents and the Provincial government, the users will fund the cost of operating and maintaining the system;

.5 Investigate opportunities for one or more marine pump-out(s) to a land-based discharge system located away from the residential areas of Shuswap Lake;

.6 Request the Interior Health Authority to prohibit any further use of dry wells for liquid waste management, and recommend that the Interior Health Authority continue to work with property owners towards replacement of these existing dry wells and failing septic systems as appropriate;

.7 Work to enhance environmental awareness and promote activities that protect the water quality and natural aquatic habitat;

.8 Use the full range of planning tools and regulatory measures to protect the watershed and water quality of Shuswap and White Lakes. These include zoning bylaws, development permits, building regulation, and, potentially, statutory covenants; and

.9 Work with federal and provincial ministries and agencies, including the Shuswap Lake Integrated Planning Process (SLIPP), to implement strategies that protect and enhance the quality of the lakes and streams of the South Shuswap.

2.2 Watershed

Shuswap Lake is a large lake system that is fed from a variety of sources, including Shuswap River, Salmon River, Eagle River, Adams River, Seymour River and Anstey River. Several small creeks and streams also flow into the Lake, including Scotch Creek, White Creek, Celista Creek and Adams Creek. There is only one outlet from the Lake — Little River at the west end of the Lake.

Activities within the watershed can significantly impact the water quality of the area lakes. Stormwater runoff in developed areas can contain contaminants that flow into rivers, streams or ditches, and eventually into the lakes. Agricultural operations can also impact the watershed, through the spreading of manure or livestock grazing too close to a watercourse. Poor forest practices can also have negative impacts on the watershed by increasing suspended solids in streams and lakes.

2.2.1 Objectives

.1 To protect Shuswap and White Lake watersheds from land uses and practices that jeopardize their water quality.

.2 To facilitate information exchange between local residents and environmental stewardship organizations and resources.

2.2.2 Policies

The Regional District will:

.1 Continue to work with SLIPP, and other government agencies and non-governmental agencies to facilitate collaboration and joint decision-making on issues that impact the watershed.

.2 Advise and expect agricultural operators to adhere to the Agricultural Control Regulation under the BC Environmental Management Act and the BC Health Act.

.3 Advise and expect agricultural operators to collaborate with the BC Agricultural Council in the implementation of the Canada-BC Environmental Farm Program.

.4 Advise and expect forestry companies to use responsible forestry practices when logging near a watercourse, and to follow the Federal Department of Fisheries and Oceans Habitat Management Operating Principles for Crown and Private Forest Harvesting.

.5 Disseminate educational information to the public about the importance of responsible stewardship of the watershed and expect property owners and developers to consider the use of permeable surfaces when landscaping their properties.

.6 Implement the Riparian Areas Regulation of the Fish Protection Act by establishing a Riparian Areas Regulation Development Permit Area along the Lakes, rivers, streams, and other watercourses, requiring proposed activities and development to be subject to a science based assessment conducted by a Qualified Environmental Professional (QEP).

2.3 Shoreline Environment

Shorelines are among the most sensitive natural environments, as they are where two ecosystems merge — an aquatic ecosystem and a terrestrial ecosystem. Shoreline environments experience a significant amount of pressure from human activity, including the impacts from watercraft use. Private boat docks are common throughout the South Shuswap.

Though much of the upland of Shuswap and White Lake is privately owned, the Provincial Crown owns nearly all areas located between the high and low watermarks of lakes, streams and rivers. Individuals cannot build on, or develop, aquatic Crown land without the Province's authorization. If an owner of the adjacent upland property proposes to construct moorage, a licence of occupation for moorage is required from the Integrated Land Management Bureau.

2.3.1 Objectives

.1 To maintain the unique physical and biological characteristics of the shoreline environment.

.2 To maintain shoreline habitats to protect them from undesirable development.

.3 To manage the foreshore to ensure appropriate use and prevent overdevelopment.

2.3.2 Policies

.1 Non-moorage uses other than passive recreation are not acceptable on the foreshore. These include facilities such as beach houses, storage sheds, patios, sun decks, and hot tubs. Additionally, no commercial uses, including houseboat storage or camping, are acceptable on the foreshore.

.2 Land owners must not alter the natural habitat and shoreline processes unless specifically authorized. The placement of fill and the dredging of aquatic land are not generally acceptable.

.3 Encourage the Integrated Land Management Bureau, when carrying out reviews of foreshore tenure applications, to take the foregoing objectives and policies into consideration, with emphasis on the environmental sensitivity of the foreshore areas, as well as ensuring an appropriate relationship with upland areas.

.4 Private moorage owners and builders will comply with the Ministry of Environment’s Best Management Practices for Small Boat Moorage on Lakes, and minor works policies published by Transport Canada, Navigable Waters Protection Division prior to construction of any foreshore moorage (works).

.5 Encourage Government agencies with mandates for protecting the environmental integrity of lakes in the South Shuswap to carry out scientific research and water quality testing to determine whether the quality of lake water near the shoreline is deteriorating, and if it is, to determine the cause(s) of the deterioration, and take steps toward correcting the situation.

The Regional District will:

.6 Assess and strive to protect sensitive fish habitat when implementing the boat launching facilities provisions of the Electoral Area C Parks Plan;

.7 Encourage waterfront owners to consider shared docks in the interests of having one larger dock that extends into deep water, rather than a number of individual docks that are in relatively shallow water with higher fish habitat values;

.8 Advise and expect property owners to replace older, on-site sewage systems with newer technology to prevent potential contamination of the shoreline;

.9 Advise and expect property owners not to remove vegetation along the shoreline that could result in erosion, loss of food and nutrients for fish, and loss of shade for young fish; landowners must refer to the Ministry of Environment's Best Management Practices for Hazard Tree and Non Hazard Tree Limbing, Topping or Removal; and

.10 Implement Lakes Zoning Bylaw 900 which sets out regulations pertaining to the placement of docks and buoys

2.4 Fish and Aquatic Habitat

Some of the most sensitive fish and aquatic habitats are in close proximity to the shoreline. Human activity along the shoreline can have a substantial impact on the health of aquatic habitats.

2.4.1 Objective

.1 To identify significant fish and aquatic habitat, including spawning habitat and protect these areas from human encroachment.

2.4.2 Policies

The Regional District will:

.1 Implement the Riparian Areas Regulation guidelines to help protect fish and aquatic habitats.

.2 Expect landowners and developers to refer to the Department of Fisheries and Oceans — Land Development Guidelines for the Protection of Aquatic Habitat, when constructing near any watercourse.

.3 Use data from the Shuswap Watershed Mapping Project to assist in its decision-making.

2.5 Watercraft Owners and Operators

Boating is a recreational activity enjoyed by many residents and visitors. There is a variety of watercraft on the lakes, including powerboats, sailboats, jet skis, houseboats, canoes and kayaks. When used responsibly, watercraft can have limited impact on the lake environment. However, misuse can lead to water quality degradation and destruction of fish and wildlife habitat. Examples of unlawful practices include dumping of black water (raw sewage) and “grey water” into the lakes. Irresponsible practices include boating through sensitive environments, gasoline spills and parking on sensitive shorelines. These concerns apply equally to commercial watercraft businesses and private owners.

With the increasing volume of motorized boating there are also concerns about impacts on human safety and quiet enjoyment. While it is recognized that greater education of the boating public and improved enforcement of existing regulations are necessary, some people feel that — in the interest of long-term sustainability — ways and means should be investigated to place limits on motorized boating.

2.5.1 Objective

.1 To be active, responsible stewards of the environmental quality of all lakes while enjoying boating in the South Shuswap.

2.5.2 Policies

.1 All watercraft users (commercial and private) will be required to dispose of liquid waste through pump-outs that connect into a community sewer system.

The Regional District will:

.2 Work with the houseboat industry to protect the quality of Shuswap Lake. This includes the expectation that Shuswap houseboat rental companies will install grey water holding tanks on houseboats;

.3 Expect the houseboat / watercraft industry to develop more sewage pump out stations, or other methods of appropriate sewage treatment, along Shuswap Lake;

.4 Advise and expect privately-operated houseboat owners to meet the same standards as the commercially-operated houseboat industry;

.5 Encourage the BC Ministry of Environment to more consistently enforce the prohibition of the dumping of grey water into Shuswap Lake.

.6 Continue to enforce the marine noise control bylaw;

.7 Develop public boat launching facilities in appropriate locations as recommended in the Electoral Area C Parks Plan, and provide these facilities with sufficient parking and washroom facilities to meet the needs of the public;

.8 In co-ordination with watercraft users and the houseboat industry, create public awareness of sensitive shorelines and ecosystems, and advise watercraft users against entering these areas; and

.9 In consultation with all interests, initiate a study of motorized boating on Shuswap Lake (and, potentially, White Lake). At a minimum, there will be three goals to this study: to investigate the impact of motorized boating; to investigate a maximum capacity of motorized boating; and to consider various strategies to minimize negative impacts of motorized boating.

2.6 Eurasian Water Milfoil

Aquatic plants are an important part of the biology of lakes and other water bodies, providing food, habitat and rearing areas for a variety of organisms. Some aquatic plants, including the Eurasian water milfoil, have undesirable effects, especially when they are too abundant or become established in unwanted locations.

Eurasian water milfoil is not native to North America. It was first observed in B.C. in Okanagan Lake in 1970. It has since spread to the lakes of the South Shuswap. Management strategies include preventive efforts (education, surveillance of non-infested areas), placing bottom coverings on new populations to prevent lake-wide infestations, root removal and harvesting.

2.6.1 Objective

.1 To manage and try to prevent the further spread of milfoil in the lakes of the South Shuswap.

2.6.2 Policy

.1 The Regional District, along with community environmental groups and the boating industry, expects boaters to reduce the spread of water milfoil and other aquatic weeds by clearing all plant material from boats, motors, trailers, wet wells, and anchors. These plants should be disposed of far away from water bodies.

Section 3. Growing Gradually and Wisely

Sustainable Principles

Large areas of rural landscape throughout the South Shuswap will be maintained while encouraging gradual, sustainable, moderate and efficient development in the existing settled areas.

A range of housing choices is supported, taking into account affordability for existing residents, particularly for young families and seniors. Only ground-oriented housing is appropriate near the Lakes; more dense forms of housing must be located away from the Lakes.

Agriculture, tourism and forestry are supported as the foundations of the economy, while economic diversification that has low impact on the area's character and natural environment is encouraged. The establishment of a business park that attracts clean industries and complements existing businesses is also encouraged.

3.1 General Land Use Management

The policies of this Plan aim to protect the rural character of this area, yet allow modest growth in settled areas that are, or will be, serviced by community water and sewer systems. By directing growth to the Village Centre and Secondary Settlement Areas as shown on Schedule B Land Use Designations – Overview, and Schedule C Land Use Designations - Mapsheets, there will be less impact on the rural and natural areas of the community, thereby protecting natural habitat and preserving the area's highly valued rural character. This settlement pattern will also facilitate shorter vehicle trips, as well as encourage more walking, bicycling and the use of public transit.

3.1.1 Objectives

.1 To be thoughtful and careful stewards of the lands and waters of the South Shuswap to allow future generations an opportunity to appreciate and benefit from wise choices made by today's elected decision-makers.

.2 To manage growth by directing development and redevelopment in existing settled areas and to discourage development outside these areas.

.3 To provide a clear separation between rural and non-rural lands to preserve both rural and non-rural lifestyle choices.

.4 To prevent inappropriate uses of shorelines, especially in areas with high fish habitat values.

.5 To support the growth and long-term viability of the agricultural industry in the South Shuswap.

.6 To support forestry, mining and recreational uses provided they follow all Provincial regulatory requirements, and avoid conflicts with residential areas.

.7 To work towards providing a range of housing types in the South Shuswap, principally within the Village Centre and Secondary Settlement Areas.

.8 To provide for a range of commercial services within the Village Centre and Neighbourhood Commercial designations that meet the needs of South Shuswap residents and visitors.

3.1.2 Policies

.1 Land uses and activities that adversely affect safety, health, or liveability within Area C are not supported. Temporary use permits are not supported.

.2 The Sorrento Village Centre, established on Schedules B and C, will accept much of the residential, retail and business development in Area C and will be connected to community water and sewer systems. Future development of a Balmoral Village Centre, at the northwest corner of the Balmoral Road/Highway #1 intersection, is dependent on approval from the ALC, as it lies within the ALR; this plan does not presume the ALC's position on the future uses of this land and does not support development pressure or speculation based on the plan's support of this area as a Village Centre as previous applications to exclude these ALR lands have been refused by the ALC.

.3 Secondary Settlement Areas in the South Shuswap are established on Schedules B and C, as Blind Bay, Sunnybrae, White Lake and Eagle Bay.

.4 Outside the Village Centre and Secondary Settlement Areas, new residential development is generally discouraged unless co-located with an agricultural use. Strip commercial development between these development areas is not acceptable.

.5 Development will only be considered in areas with lower environmental values within the Village Centre and Secondary Settlement Areas, thereby allowing for the protection of areas with higher environmental values as well as agricultural lands.

.6 Except as required to improve the health and safety of existing development, no public funds will be expended for the capital cost of extending water and sewer servicing to lands outside the Village Centre and Secondary Settlement Areas.

.7 Agricultural uses on ALR lands are supported in all land use designations. Agricultural uses on non-ALR lands may be supported in all land use designations subject to compatibility with adjacent land uses and setbacks set out in the zoning bylaw.

.8 As per the authority granted under the Local Government Act s.904 and s.905, consider creating an 'Amenity Policy' to guide developers making applications to the CSRD, and to assist staff and the Board in considering land use applications. The policy should detail a range of density bonusing alternatives and voluntary contributions that are of a community benefit such as parkland dedication, infrastructure development, affordable housing, and public facilities.

.9 At the time of introducing zoning regulations to unzoned areas, existing uses and structures may be recognized in the zoning bylaw and that recognition will be considered as conforming to this OCP. New development, however, must conform to the policies and land use designations in this OCP.

3.2 Village Centre (VC)

3.2.1 Objective

To allow for a variety of residential and commercial development within Sorrento.

3.2.2 Policies

.1 This designation applies to areas within Sorrento as outlined on Schedules B and C.

.2 Permitted land uses within the Village Centre include: residential (see *Policy 3*), retail including food services, offices, business and personal services, community and health-related services, public and institutional uses, recreation, arts and cultural activities, highway commercial uses, personal, professional and financial services. Small-scale light industrial uses whose operations are compatible with adjacent uses are also permitted.

.3 Residential development is subject to the following housing forms and maximum densities:

Detached	5 units/ac (1 unit/0.2 ac) 12 units/ha (1 unit/0.08 ha)
Semi-detached	8 units/ac (1 unit/0.13 ac) 20 units/ha (1 unit/0.05 ha)
Townhouse	12 units/ac (1 unit/0.13 ac) 30 units/ha (1 unit/0.03 ha)
Apartment	30 units/ac (1 unit/0.03 ac) 74 units/ha (1 unit/0.01 ha)

.4 Residential units above ground floor commercial establishments and live-work units may be permitted and encouraged.

.5 New development in the form of pedestrian- oriented “mainstreet” building types or infill that creates enclosed nodes/courtyards is strongly encouraged.

.6 Resilient “mainstreet” building types are encouraged that allow development of a mix of uses (retail, office, residential) and which can be adjusted in response to market demands. In Sorrento, predominantly commercial buildings are encouraged to locate within or adjacent to already established commercial parcels to build on a contiguous commercial core.

.7 All new subdivisions and all new rezoning applications which would increase existing residential densities or require additional sewer or water capacity must be connected to both a community sewer system and a community water system. Where community sewer and water system servicing is not feasible, the maximum allowable density is 1 unit / ha (1 unit / 2.47 ac).

.8 Where possible, new development will include dedicated pedestrian and non-motorized linkages to and through the development.

.9 Main street mixed use building types are encouraged to improve the quality of the streetscape along the corridor, to increase the density and vitality of the core, and to make better use of vacant and under- used sites. This will create a stronger definition of the pedestrian environment. Building facades should have active frontages, where entries and active uses (food service patios, display areas, or public realm enhancements) orient towards the street. This will also help to create a village core in which it is possible to more easily walk between stores and services, providing maximum pedestrian activity along the public street.

.10 New commercial, industrial, multi-family and intensive residential development within the Village Centre is subject to the Form & Character Development Permit Area Guidelines.

3.3 Secondary Settlement Areas

3.3.1 Objective

.1 To allow for predominantly residential development and some neighbourhood commercial development within Blind Bay, Eagle Bay, Sunnybrae and White Lake.

3.3.2 Policies

.1 This designation applies to areas within the Blind Bay, Eagle Bay, Sunnybrae and White Lake Secondary Settlement Area boundaries, as outlined on Schedules B and C.

.2 Permitted land uses within the Secondary Settlement Areas include: residential, neighbourhood commercial uses, recreational residential, community and health- related services, institutional uses, recreation, arts and cultural activities.

.3 Residential development is subject to the housing forms and maximum densities of each land use designation within the Secondary Settlement Area Boundaries (i.e. Neighbourhood Residential (NR), Country Residential (CR), etc).

.4 Expansion of the Blind Bay Secondary Settlement Area south of the Trans-Canada Highway may be supported if there is both community sewer and community water servicing available and if the majority of the land to be included is non-ALR land.

.5 In the Eagle Bay and White Lake Secondary Settlement Areas, re-designation to Medium Density may be supported through a successful rezoning application and connection to both community water and sewer systems. For the White Lake community, a road capacity assessment should be completed prior to new Medium Density development.

.6 All new subdivisions and all new rezoning applications which would increase existing residential densities or require additional sewer or water capacity must be connected to both a community sewer system and a community water system. Where community sewer and water system servicing is not feasible, the maximum allowable density is 1 unit / ha (1 unit / 2.47 ac).

.7 Where possible, new development will include dedicated pedestrian and non-motorized linkages to and through the development.

.8 New commercial, industrial, multi-family and intensive residential development within the Secondary Settlement Areas is subject to the Form & Character Development Permit Area Guidelines.

BL725-02

.9 Notwithstanding subsections 3.1.2.5, 3.3.2.2, 3.6.1.1, 3.6.2.1, 3.7.2.1, 3.7.2.2, 3.8.2.1 and 3.8.2.2, the waterfront portion of the Blind Bay Resort properties, legally described as Lot A, Section 17, Township 22, Range 10, W6M KDYD, Plan 14713 and that part of Strata Lot C Section 17 Township 22 Range 10 W6M KDYD, Strata Plan KAS3359 lying north of Blind Bay Road can be considered for re-designation to Resort Commercial and for rezoning to allow an extension of the resort development onto the waterfront portion of the aforementioned properties.

3.4 Residential

3.4.1 Policies

.1 New residential development will be directed to the Village Centre and Secondary Settlement Areas identified on Schedules B and C. Outside these areas, residential development is discouraged unless co-located with an agricultural use.

.2 Residential development is subject to the following land use designations, housing forms and maximum densities:

Land Use Designation	Housing Form	Maximum Density
Medium Density (MD)	Detached	5 units/ac (1 unit/0.2 ac) 12 units/ha (1 unit/0.08 ha)
	Semi-detached	8 units/ac (1 unit/0.13 ac) 20 units/ha (1 unit/0.05 ha)
	Townhouse	12 units/ac (1 unit/0.13 ac) 30 units/ha (1 unit/0.03 ha)
Neighbourhood Residential (NR)	Detached, Semi-detached	2 units per 1 acre (1 unit/0.2 ha)
Country Residential (CR)	Detached, Semi-detached	1 unit per 1 acre (0.4 ha)
Rural Residential (RR)	Detached, Semi-detached	1 unit per 2.5 acres (1 ha)
Rural Residential 2 (RR2)	Detached, Semi-detached	1 unit per 5 acres (2 ha)
Small Holdings (SH)	Detached, Semi-detached	1 unit per 10 acres (4 ha)
Medium Holdings (MH)	Detached, Semi-detached	1 unit per 20 acres (8 ha)
Large Holdings (LH)	Detached, Semi-detached	1 unit per 25 acres (10 ha)
Rural Holdings (RH)	Detached, Semi-detached	1 unit per 148 acres (60 ha)

.3 Cluster forms of development are encouraged within the Sorrento Village Centre and Secondary Settlement Areas to reduce the amount of land affected by residential growth when the permitted number of units is clustered on part of the site, and the remaining area is protected in a natural state. Where cluster developments are located near natural features, such as waterbodies, the cluster development should be directed away from the natural features. Areas near the features should be protected common or public areas.

.4 Bed and Breakfast businesses are appropriate provided they are consistent with the residential character of the neighbourhood and provide adequate on-site parking. Additional conditions for Bed and Breakfast businesses will be included in the zoning bylaw.

.5 One secondary suite is appropriate in a detached home provided it is compatible with surrounding residential uses. Additional conditions related to a secondary suite will be included in the zoning bylaw.

.6 Agricultural uses are appropriate in all designations. Outside ALR lands, agricultural uses are supported to an intensity compatible with surrounding uses. On ALR lands, agricultural uses are subject to the Agricultural Land Commission Act and Regulations.

BL725-08 .7 Notwithstanding 3.4.2.2, above, maximum allowable density within the MD designation are permitted to increase to a total of 19.0 units/ha on Lots 1 and 2, Sections 7 and 8, Township 22, Range 10, West of 6th Meridian, Kamloops Division Yale District, Plan KAP79111, only.

3.5 Residential Resort (RT)

3.5.1 Objective

.1 To recognize existing residential resort developments and provide for limited potential within Secondary Settlement Areas.

3.5.2 Policies

.1 Residential resort refers to recreational vehicles, modular homes and recreational cabins located in a park-like setting with shared amenities.

.2 New applications for Residential Resort (RT) will be directed to locate in the Secondary Settlement Areas, but must be located away from the waterfront.

.3 All new subdivisions and all new rezoning applications which would increase existing densities or require additional sewer or water capacity must be connected to both a community sewer system and a community water system. Where community sewer and water system servicing is not feasible, the maximum allowable density is 1 unit / ha (1 unit / 2.47 ac).

.4 The maximum density for new recreational residential dwellings is 12 units/ac (30 units/ha).

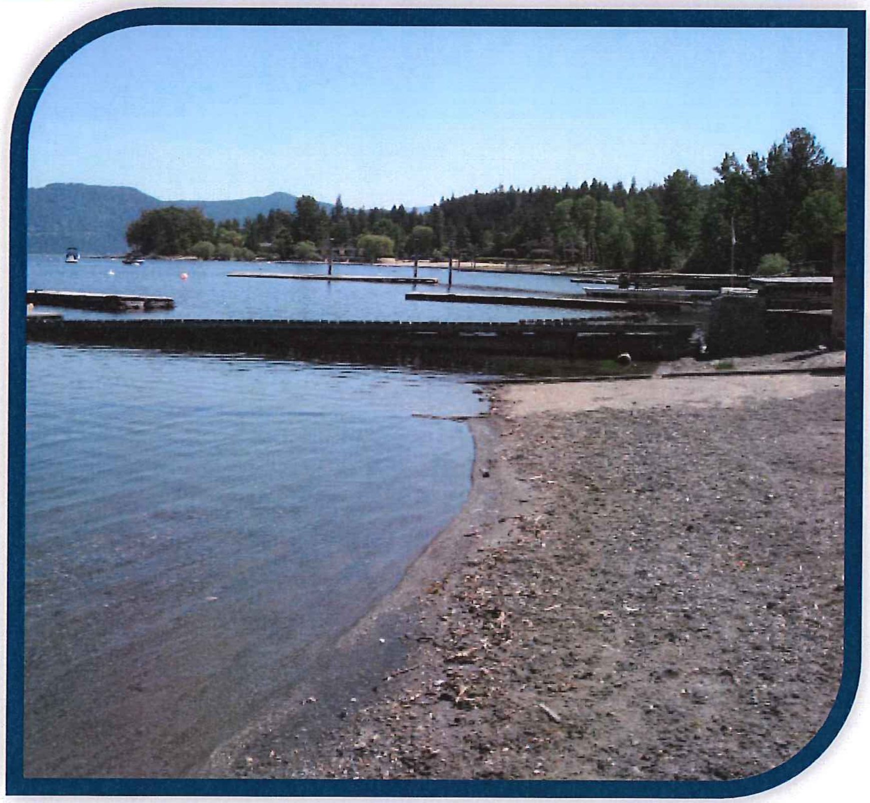
EXHIBIT 16

Western Water Associates Ltd

2016 Groundwater Monitoring Report – Blind Bay & Sorrento

western water
ASSOCIATES LTD
Consultants in Hydrogeology and Environmental Science

2016 GROUNDWATER MONITORING REPORT COLUMBIA SHUSWAP REGIONAL DISTRICT BLIND BAY AND SORRENTO, B.C.



Prepared for:

Columbia Shuswap
Regional District
555 Harbourfront Drive NE
PO Box 978
Salmon Arm, B.C. V1E 4P1

Prepared by:

Western Water Associates Ltd.
#106 - 5145 26th Street
Vernon B.C. V1T 8G4

December 2016

Project: 14-024-12

western water
ASSOCIATES LTD
Consultants in Hydrogeology and Environmental Science

Dec. 30, 2016

Project # 14-024-12

Hamish Kassa, Environmental Services Coordinator
Columbia Shuswap Regional District
555 Harbourfront Drive NE
P.O. Box 978
Salmon Arm, B.C., V1E 4P1

Dear Mr. Kassa:

Re: 2016 Blind Bay and Sorrento Groundwater Quality Monitoring Report

Western Water Associates Ltd. (WWAL) is pleased to provide the 2016 Groundwater Monitoring Report for Blind Bay and Sorrento, B.C.

This report summarizes the background, method, and results for the monitoring program conducted at Blind Bay and Sorrento in 2016. Further, the report also provides recommendations for the program in subsequent years.

We trust that the professional opinions and advice presented in this document are sufficient for your current requirements. Should you have any questions, please contact the undersigned.

WESTERN WATER ASSOCIATES LTD.

PROFESSIONAL PROVINCE OF B. R. MANWELL # 35085 BRITISH COLUMBIA ENGINEER

Morgan Jackson, B.Sc.
Environmental Scientist

Bryer Manwell, M.Sc., P.Eng.
Hydrogeological Engineer

Reviewed by:

Douglas Geller, M.Sc., P.Geo.
Senior Hydrogeologist

TABLE OF CONTENTS

1. INTRODUCTION 1
1.1 PROJECT BACKGROUND 1
1.2 OBJECTIVE AND SCOPE 1
2. SITE DESCRIPTION 2
2.1 LOCATION 2
2.2 GEOLOGY 2
2.3 CLIMATE, HYDROLOGY AND HYDROGEOLOGY 3
2.4 MONITORING NETWORK 4
3. METHODS 6
3.1 SAMPLING PARAMETERS 7
3.2 SAMPLING METHOD 7
4. RESULTS AND DISCUSSION 8
4.1 NITRATE 11
4.2 CHLORIDE, SODIUM AND ELECTRICAL CONDUCTIVITY 12
4.2.1 CHLORIDE 12
4.2.2 SODIUM 14
4.2.3 ELECTRICAL CONDUCTIVITY 15
4.3 PHOSPHORUS 16
4.4 SULPHATE 16
4.5 PATHOGENIC BACTERIA 16
5. CONCLUSIONS 20
6. RECOMMENDATIONS 20

List of Figures (following text except where noted)

Figure 1 General Project Site Location
Figure 2 Sampling Locations Blind Bay
Figure 3 Sampling Locations Sorrento
Figure 4 Nitrate and Chloride at Blind Bay Time Series Plots
Figure 5 Sulphate and Conductivity at Blind Bay Time Series Plots
Figure 6 Nitrate and Chloride at Sorrento Time Series Plots
Figure 7 Sulphate and Conductivity at Sorrento Time Series Plots
Figure 8 Dissolved and Total Sodium Time Series Plots at Blind Bay and Sorrento

List of Tables

Table 1: Monthly Average Climate Data (STN 1166R45: 1982 - 2007) 3
Table 2: 2016 Monitoring Program Blind Bay 5
Table 3: 2016 Monitoring Program Sorrento 6
Table 4: 2016 Water Quality Exceedances by Guideline at Blind Bay 9
Table 5: 2016 Water Quality Exceedances by Guideline at Sorrento 10
Table 6: Summary of 2016 Water Quality Results at Newly Sampled Locations 11
Table 7: Blind Bay - Statistics for Select Water Quality Parameters (2000 to 2016) 17
Table 8: Sorrento - Statistics for Select Water Quality Parameters (2000 to 2016) 19

List of Appendices

Appendix A Well Logs

Appendix B Water Quality Database

Appendix C 2016 Laboratory Reports

1. INTRODUCTION

1.1 Project Background

In 1983, upon the request of the Columbia Shuswap Regional District (CSRD), Urban Systems Ltd. conducted a study of drainage and sewage disposal for the communities of Blind Bay and Sorrento (Figure 1). Potential private sewage disposal system (PSDS) breakout locations and foreshore aesthetics (e.g. effluent odour along Shuswap Lake shoreline) were identified in the study and recommendations for diverting surface drainage were made (Urban Systems Ltd. 1983).

The groundwater monitoring program for the Blind Bay and Sorrento areas is part of a larger study that currently involves the following other communities in the CSRD: Celista/Magna Bay, Sunnybrae, Swansea Point, White Lake, Anglemont, Malakwa, and Seymour Arm. This report details the findings of monitoring events conducted in 2016 at Blind Bay and Sorrento. Urban Systems Ltd. conducted water quality monitoring from 1995 to 1999, and Golder subsequently monitored from 2000 to 2007 (Golder 2007). No sampling was done in 2008 and Associated Engineering (formerly Summit Environmental Consultants Inc.) executed the monitoring between 2009 and 2013. In 2014 Western Water Associates Ltd. (WWAL) was awarded the regional monitoring contract and we are pleased to provide the results of the groundwater program at Blind Bay and Sorrento in this report.

In 1994, Golder Associates (Golder) performed a preliminary assessment of groundwater quality and found that at Blind Bay and Sorrento deteriorating water quality, most likely related to septic impacts was occurring. Blind Bay was observed to have more issues of PSDS breakout and surface drainage than Sorrento (Urban Systems Ltd., 1983). In 1995, Golder conducted a drilling program and installed eight groundwater monitoring wells at Blind Bay and Sorrento. Two of the installed wells were dry (BH-1 and BH-5), two were completed in bedrock (BH-3 and BH-7), and four were completed in unconsolidated deposits of sand or silt (BH-2, BH-4, BH-6, and BH-8). Well logs for the monitoring wells are provided in Appendix A. The Liquid Waste Management Plan for Area C Stage 3 Report recommended development of a community sewer system and wastewater treatment plant (AECOM 2009). Plans to install the system began in 2013-2014, and may cover both areas in one system or potentially separate projects for Sorrento and Blind Bay. Water quality monitoring is being continued during the planning process. More recently (2015), Western Water Associates Ltd. and Gentech Engineering have collaborated to provide CSRD with preliminary treatment facility site evaluations for an initial component of the sewerage project that would involve just Sorrento.

1.2 Objective and Scope

To meet the goal of assessing potential impacts of PSDS on groundwater quality at Blind Bay and Sorrento (the "site"), the objectives of the program are to collect and analyze groundwater samples, and interpret analytical results. The tasks undertaken were as follows:

- Collect and submit to the laboratory, water samples from a network of domestic and monitoring wells, foreshore locations, and surface water sites;
- Analyze the data and prepare the final annual report (this document); and
- Review the results with the CSRD Project Manager at the end of each year and revise the program for future years, if warranted.

2. SITE DESCRIPTION

This section describes geographic location, bedrock and surficial geology of the study area, historical climate data, hydrologic data, and hydrogeology data for Blind Bay and Sorrento. Further, a description of the monitoring network that was sampled in 2016 is provided.

2.1 Location

Neighbouring communities Blind Bay and Sorrento are located on the southern shore of the western arm of Shuswap Lake. The communities of Sorrento and Blind Bay are approximately 19 km and 25 km east of Chase, B.C., respectively and directly across Shuswap Lake from Scotch Creek (Figure 1). Sorrento, approximately 6 km due west of Blind Bay, straddles Trans-Canada Highway 1 (Highway 1), while Blind Bay is mostly situated on the northeast (lake) side of Highway 1. Topography consists of north and northeast facing slopes, ranging in elevation from 350 metres above sea level (m asl) near the lake to approximately 500 m asl in upland regions at Blind Bay and Sorrento. Blind Bay has more steeply sloped topography than Sorrento. Figures 2 and 3 show monitored sample locations as well as site overviews for Blind Bay and Sorrento, respectively.

Blind Bay's population was 1,738 and Sorrento's population was 1,255 in the last published census in 2011 (StatsCan 2011). As we understand, residents at Blind Bay and Sorrento operate individual PSDS. We are aware of three lake-based community water systems in the area: Sorrento (Sorrento Waterworks) and Blind Bay (Cedar Heights Waterworks) are CSRD owned systems that provide water to portions of each area, while the remaining homes in outlying areas are serviced by private individual or community water wells except for Shuswap Lake Estates who also operate a privately-owned community water system with a lake intake. Residential development at Blind Bay is largely within 1 km of the shoreline. Areas upslope to the southwest of Highway 1 are largely forested with limited urban development. The majority of residential development at Sorrento is within 500 m of the Shuswap Lake. Land use along the upper reaches of Newsome Creek, which runs north through Sorrento eventually discharging into Shuswap Lake (Figure 3), is agricultural, as is much of the region southwest of Highway 1.

2.2 Geology

Bedrock geology underlying the sites is comprised of sedimentary and metamorphic rocks including limestone, conglomerate, greenstone, skarn, micaceous and calcareous quartzite, and marble from the Mount Ida Assemblage (Massey et al 2005). The formation was formed during the Paleozoic Era, approximately 250 to 540 million years ago. Bedrock geology just west of Sorrento consists predominately of sedimentary rocks sandstone, shale, and coal and igneous rocks andesite, basalt, tuff, and breccias of the Kamloops Group (66 to 23 million years ago) (Massey et al 2005). Blind Bay has more predominant bedrock outcropping than Sorrento.

Surficial geology consists primarily of alluvium, glaciofluvial tills, and collapsed lacustrine sediments (Massey et al 2005; Fulton 1995). Low-lying areas near the foreshore include alluvial, channel, and shoreline deposits with the occasional bedrock outcropping.

The near surface sediments (upper 2 m) in the Blind Bay area are silt with clay and fine to medium sand lacustrine and fluvial in origin and shoreline deposits of sand and gravels (Fulton 1995). Bedrock is typically encountered at depths of 3 m to 15 m. Notch Hill is the predominant topographic feature of Blind Bay and extends to Shuswap Lake. There are several natural drainage channels (gullies) in the area.

Near surface sediments (upper 2 m) at Sorrento are comprised of sandy silt, lacustrine origin, and sand and gravels, which are beach deposits and fluvial in origin (Fulton 1995). Predominant materials below these upper sediments are clay, sands, silts, gravels, and bedrock. Bedrock is encountered at various depths, typically from 12 m to 30 m (MoE 2015).

2.3 Climate, Hydrology and Hydrogeology

Climate data for the region are derived from the Salmon Arm Airport climate station (Climate STN ID 1166R45), approximately 20 km south of the site and at an elevation of 527 masl. Climate averages for this station are available from 1980 to 2010. During this period, the recorded average annual temperature and total precipitation at the climate station were 7.4°C and 653 mm/year, respectively (Environment Canada 2016). The recorded mean monthly temperatures ranged from -3.7°C in January and December to 19.1°C in July. The recorded mean monthly precipitation ranged from 33.9 mm in February to 82.4 mm in November. Table 1 summarizes the climate data.

Table 1: Monthly Average Climate Data (STN 1166R45: 1982 - 2007)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Avg.
Temperature													
Daily Average (°C)	-3.7	-1.6	3	8	12.5	16.2	19.1	18.5	13.2	6.7	0.6	-3.7	7.4
Precipitation													
Rainfall (mm)	11.2	14.7	32.5	43.1	59.4	65.7	46.1	37.5	43.4	53.6	50.7	11	468.9
Snowfall (cm)	56.2	19.2	9.2	0.6	0	0	0	0	0	0.7	31.6	66.8	184.2
Precipitation (mm)	67.4	33.9	41.7	43.6	59.4	65.7	46.1	37.5	43.4	54.2	82.4	77.8	653

Source: Canadian Climate Normals (Environment Canada, 2016)

Blind Bay and Sorrento are both located on the western arm of Shuswap Lake, in the South Thompson River watershed. Historically, the closest monitored hydrometric station was Shuswap Lake near Sorrento (STN 08LE047). Although the station is no longer active (1923 to 1979), basin characteristics at this location make this station a good reference for water discharge in the area. The 1979 hydrograph for Shuswap Lake indicates that the highest levels occur in early June after spring freshet. This is also evidenced by the Shuswap lake hydrometric station near Salmon Arm (STN 08LE070) and the Adams River near Squilax Station (STN 08LD001) with peak water level in May and June and lowest water levels between late September through February prior to freshet. The yearly hydrologic cycle, driven by snow melt in the upper watershed, influences the regional and local groundwater flow at the site; therefore, we use the hydrograph to help select the most appropriate water quality sampling dates.

There are three provincially mapped aquifers in the Blind Bay study area. Bedrock aquifer 227IIIC is mapped across the western region of Blind Bay and is classified as having a low productivity, low demand, and low vulnerability. Sand and gravel aquifer 232IIIC is mapped in the upper (southern) region of Blind Bay in the lacustrine deposits of the Fraser Glaciation, and is classified as having a low demand, moderate productivity, and low vulnerability. To the east, a second bedrock aquifer 233IIIB is recorded as having low demand, low productivity, and moderate vulnerability. Demand describes local reliance on the groundwater water source, productivity indicates relative well yields, and vulnerability describes the potential for contaminants to move from the surface into the aquifer. The general location of these aquifers is shown in Figure 2. Well logs for monitoring wells BH-2, BH-3, BH-4, BH-6, and BH-7, all of which are in the Blind Bay area, show sand or sand and gravel to depths ranging from 3.4 metres below ground surface (m bgs) to 7.6 m bgs. Bedrock was intercepted in BH-3 and BH-7 at depths of 3.4 and 7.6 m bgs, respectfully. Monitoring well logs are provided in Appendix A.

In the Sorrento area, there are two provincially mapped aquifers, which include bedrock aquifer 227IIC to the east and sand and gravel aquifer 222IIIC to the west. Aquifer 222IIIC is situated within the lacustrine and fluvial deposits and is described as having a low demand, moderate productivity, and low vulnerability.

There are approximately 115 provincially registered wells in the Blind Bay and Sorrento area; with most of the wells located in the upper regions along community boundaries. Of these 115 registered wells, approximately 40 are completed within the underlying bedrock aquifer and the remainder have either unknown completion depths or are completed within the unconsolidated sand and gravels. The well depths within the unconsolidated aquifers (Aquifers 232IIIC and 222IIIC) range between 10 m (33 ft) and 121 m (397 ft), with an average depth of 37 m (121 ft). Inferred groundwater flow direction is typically from south (uplands) to north towards Shuswap Lake, driven by topography. Local groundwater flow within the unconsolidated aquifers bordering Shuswap Lake may show more fluctuation in flow direction due to seasonal changes in lake stage. Preferential flow pathways of fine-grained deposits, either natural or artificial in origin, can allow water into underlying sands where it may travel rapidly for considerable distances. In places, shallow stratigraphy along the Shuswap Lake foreshore features alternating grain sizes or buried paleo-channels that result in variable permeability of the sediments and complex groundwater flow paths (Golder 1994).

2.4 Monitoring Network

The monitoring network at Blind Bay and Sorrento includes foreshore, surface water, private domestic wells, and monitoring wells. Minor changes to the program occurred during the spring 2015 sampling event. The existing program did not include sampling along the western edge of the site at Sorrento, where large to moderate size residences have been developed. Based on the 2015 investigation, a foreshore (hyporheic zone) sample location (MPL-6) was added to the program in 2016, which was sampled in May 2016 only. Alternatively, in October 2016, WWAL field staff investigated two other areas along the western section of Sorrento, where development of large size residences has occurred in recent years. During the investigation, a culverted stream flowing through a property onto the beach and discharging into Shuswap Lake (Culvert Stream) and a foreshore location (HZ-5) along the same property was sampled for select water quality parameters.

Previously sampled domestic well LOC-12 has been considered the background well in the past; however, the chloride concentrations at LOC-12 are elevated, indicating anthropogenic input, see Appendix B for historic water quality results. A new background domestic well (DMW-1) was added to the program in 2015 and was monitored in 2016. DMW-1 is located farthest upgradient and situated in an area of relatively minimal residential development; therefore, it is ideal to represent background (ambient) groundwater quality at the site. Monitoring well BH-6 (Blind Bay) was not sampled in 2016 as it has been dry since 2000. Further, Sorrento irrigation well LOC-17IW has not been sampled since 2011 and LOC-17SW was not sampled in October 2016 due to inability to access the well head.

The 2016 monitoring network included the following sites:

Blind Bay:

- two domestic water supply wells (LOC-16, DMW-1);
- four monitoring wells (BH-2, BH-3, BH-4, BH-7);
- two groundwater springs (surface water) (LOC-11, LOC-24); and
- three foreshore locations (MPL-2, MPL-3, MPL-5).

Sorrento:

- one water supply well (LOC-17SW);
- one monitoring well (BH-8);
- two surface water locations, Shuswap Lake and a groundwater spring (SW-1, LOC-2b);
- three foreshore locations (MPL-1, MPL-4, and MPL-6); and
- one exploratory foreshore location (HZ-5) and one exploratory surface water location (Culvert Stream).

Monitoring location descriptions are provided in Table 2 and 3 for Blind Bay and Sorrento, respectively and all sample locations are shown on Figure 2 and 3, respectively. The location of monitoring wells was selected based on a preliminary assessment of groundwater quality in Blind Bay and Sorrento by Golder in 1994. This assessment showed PSDS indicators along the lake shore and other downgradient locations (groundwater supply wells and surface water springs) were elevated in PSDS indictors, showing localized impact areas (Golder 1994).

Sampling at the site occurs twice annually with the 2016 sampling events occurring on May 24 and October 18, 2016.

Table 2: 2016 Monitoring Program Blind Bay

Site location	Depth of Well (m)	Aquifer Type	Location Description
Groundwater Sites			
DMW-1	5	Unconfined	South side of Trans Canada Hwy 1, at east on Husband Road.
LOC-16	n/a	Unconfined (clay, sand & rock)	On Blind Bay Road, approximately 170 m east of Centennial Drive.
BH-2	7.8	Unconfined (sand)	Near Shuswap Lake on Centennial Drive.
BH-3	9.8	Bedrock	At the corner of Centennial Drive and Woodland Place.
BH-4	8.1	Unconfined (sandy silt)	At the corner of Leisure Road and Chalet Drive.
BH-7	10.4	Bedrock	On Blind Bay Road at the Cedar Heights water system pump house.

Surface Water Sites	
LOC-11	Groundwater spring in the back yard of residence on Blind Bay Road approximately 100 m west of MPL-5.
LOC-24	Groundwater spring on the west side of residence on Blind Bay Road approximately 230 m east of Marine Drive.
Foreshore Sites	
MPL-2	At beach access on the corner of Blind Bay Road and Centennial Drive.
MPL-3	Eastern shore of Blind Bay at the boat launch on Eagle Bay Road.
MPL-5	At the beach access on Blind Bay Road, approximately 100 m east of LOC-11.

Note: n/a indicates information that was unavailable; Aquifer lithology for LOC-16 is inferred from nearby well logs.

Table 3: 2016 Monitoring Program Sorrento

Site location	Depth of Well (m)	Aquifer Type/ Primary Lithology	Location Description
Groundwater Sites			
LOC17-SW	n/a	n/a	At the community park on Davidson Road.
BH-8	3.9	Unconfined (gravelly sand)	At the corner of Dieppe Road and Caen Road near the Caen Road Community Park.
Surface Water Sites			
SW-1			Shuswap Lake on private dock, west of MPL-1 and BH-8.
LOC-2b			Groundwater spring beside Markwart Road Boat Launch.
Culvert Stream			Along the shore of Shuswap Lake, approximately 320 m east of Cobeaux Road.
Foreshore Sites			
MPL-1			At the Caen Road Community Park.
MPL-4			On the beach at the Sorrento Place on the Lake mobile home park on Buckley Road.
HZ-5			Along the shore of Shuswap Lake, approximately 300 m east of Cobeaux Road.

Note: n/a indicates information that was unavailable.

3. METHODS

The following section outlines the program methods, including parameters sampled and field techniques used for the program.

3.1 Sampling parameters

The 2016 laboratory assessed water quality parameters included the following:

- Alkalinity, total (as CaCO3);
- Nutrients: ammonia (as N), nitrate (as N), nitrite (as N), dissolved phosphorus, and orthophosphate;
- Anions (bromide, chloride, fluoride, and sulphate)
- Bacteriological: Escherichia coli, fecal coliforms, and total coliforms (monitoring and domestic wells only);
- Hardness, dissolved (as CaCO3); and
- Dissolved metals (total metals for SW-1 and LOC-2b; once per year).

Field measurements of pH, electrical conductivity (EC), temperature, and oxidation-reduction potential (ORP) were also recorded during purging and immediately before sampling.

The Culvert Stream and the foreshore location (HZ-5) along the western edge of Sorrento were analyzed for field parameters (pH, EC, temperature, ORP), along with anions (chloride, bromide, fluoride, and sulphate), nutrients (nitrate [as N], nitrite [as N], and orthophosphate), and alkalinity.

3.2 Sampling Method

WWAL sampling protocol follows procedures described in the British Columbia Field Sampling Manual for Continuous Monitoring and the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment, and Biological Samples (MoE 2013).

The following outlines the procedures used to sample monitoring wells at Blind Bay and Sorrento. Low flow sampling was performed with a peristaltic pump was used to extract water from the well until parameter stabilization (field measured EC, pH, temperature and ORP) was observed. Once purging of the wells was complete, water samples were collected directly from the outflow tube into new sample bottles provided by the laboratory. Clean nitrile gloves were worn while purging and sampling. Dedicated tubing was used at each sample locations, which is replace each year.

Foreshore samples were collected by extracting water from a small pit dug a few metres from the shoreline of the lake. The top few inches of water in each hand pit was skimmed off to remove the initial water released from storage by the adjacent sediments. Prior to sample collection, field-measured parameters were recorded. Samples were then collected directly from the foreshore locations.

The surface water samples were taken in accordance with MoE procedures and protocols.

All samples were stored in coolers with ice, and transported under chain-of-custody protocol to CARO Analytical Services, a laboratory accredited by the Canadian Association for Environmental Analytical Laboratories. Samples were submitted to the laboratory within the required holding time for bacteriological analysis.

A triplicate sample, taken in 2016 for the groundwater monitoring program, showed relative percent difference (RPD) lower than 10% for all parameters except copper, lead, sulphur and ammonia which were above 17% RPD. Further, microbiological parameters showed significant variability with high RPD but this is not unusual when sampling living organisms. From results of the triplicate sampling we see that the quality of the data does not affect conclusions made in this report.

4. RESULTS AND DISCUSSION

The following section describes the results of the water quality sampled at the sites in 2016. Water quality guideline exceedances in 2016 (Blind Bay - Table 4 and Sorrento - Table 5), along with temporal and spatial trends for the Blind Bay and Sorrento groundwater monitoring program are discussed (Figures 4 to 8). Table 6 summarizes pertinent water quality results for the new locations sampled in 2016 (HZ-5, and Culvert Stream). The descriptive statistics (average, maximum, minimum and count) for select water quality results from between 2000 and 2016 are summarized in Tables 7 (Blind Bay) and Table 8 (Sorrento) with the full water quality database for all historic and current results provided in Appendix B. The 2016 analytical reports provided by the laboratory are found in Appendix C.

Our analysis of potential septic impacts on the receiving environment employs two main approaches:

- direct comparison of monitoring results to guidelines (i.e. does a problem exist); and
- trend analysis (i.e. is the situation changing over time or spatially, and if so, in what direction).

Our findings can then be used to inform decisions about future monitoring priorities as well as provide insight into which CSRD communities should be prioritized for centralized wastewater treatment. Sometimes, the results are inconclusive, pointing to the need for more data. Gaps in data are typically filled by adding wells and eliminating redundant sample locations, and more rarely, by modifying the list of sampling parameters. In this way, the monitoring process is iterative in nature.

The purpose of sampling at foreshore locations is to assess concentrations of septic indicator parameters in the hyporheic zone (zone of mixing between groundwater and surface water) just before groundwater discharges into Shuswap Lake. Concentrations of indicator parameters may vary in the hyporheic zone depending on the dynamics of groundwater and surface water interaction. During spring freshet, the lake stage will be higher than the adjacent groundwater level, creating flow reversal and potently flooding of PSDS closest to the lake. During the fall sampling, there is less dilution the groundwater caused be snowmelt runoff in the spring, and

The groundwater monitoring sites were selected to sample shallow, potentially PSDS impacted groundwater, upgradient of the lake and downgradient of the residentially developed areas at Blind Bay and Sorrento. Surface water samples are taken from groundwater springs (LOC-2b, LOC-11, and LOC-24), Culvert Stream, and Shuswap Lake (SW-1) to evaluate water quality of the surface water receptors (see Figures 2 and 3 for sampled site locations).

Time series plots are provided for the indicator parameters nitrate, chloride, sodium and electrical conductivity. Figure 4 shows nitrate and chloride for Blind Bay, Figure 5 shows Sulphate and electrical conductivity for Blind Bay and Figure 6 shows nitrate and chloride Sorrento, Figure 7 shows Sulphate and electrical conductivity for Sorrento. Figure 8 shows dissolved and total sodium for both Blind Bay and Sorrento. Plotted results below the reportable detection limit are displayed as one-half the reportable detection limit.

Assessing potential impact on the receiving environment from operation of PSDS is the objective of the current groundwater monitoring program at Blind Bay and Sorrento. The receptors of concern are the shallow groundwater adjacent to the lakes and the surface water bodies, Newsome Creek (Sorrento) and Shuswap Lake. Therefore, the 2016 water quality results were compared to the following applicable guidelines and standards:

- Guidelines for Canadian Drinking Water Quality Maximum Acceptable Concentration (health-based guideline) (GCDWQ MAC) and Aesthetic Objective (based on aesthetic considerations) (GCDWQ AO) (Health Canada 2014);
- B.C. Approved Water Quality Guidelines for freshwater aquatic life (BCAWQG AL) and Working Water Quality Guidelines for freshwater aquatic life (BCWWQG AL) (MoE 2015); and
- B.C. Contaminated Sites Regulation 375/96, Schedule 6, Generic Numerical Water Standards for Freshwater Aquatic Life (CSR AW) (MoE 1997).

Table 4 (Blind Bay) and Table 5 (Sorrento) provide a list of exceedances in water quality guidelines relevant to operation of PSDS. Therefore, exceedances in metal species (iron, manganese, aluminum, chromium, uranium, selenium, and arsenic) not associated with PSDS impact likely related to the proximity to bedrock and the naturally high mineral content of the groundwater in the area are not listed in Tables 4 and 5. However, Appendix B lists all water quality exceedances for reference.

Note that the BCAWQG AL and BCWWQG AL guidelines are intended to be applied to surface waters; whereas the CSR AW standards are intended to be applied to groundwater within the vicinity of surface water bodies. This distinction is important when assessing exceedances of phosphorus as at the majority of monitored sites phosphorus exceeds the BCAWQG AL and BCWWQG AL; however, phosphorus does not exceed the CRS AW standards at any of the monitored locations.

Owners of domestic wells were notified by WWAL of any exceedances of the GCDWQ MAC.

Table 4: 2016 Water Quality Exceedances by Guideline at Blind Bay

Sampling Location	Guideline	2016 Exceedances
Surface Water Locations		
LOC-11	BCAWQG AL	Phosphorus (dissolved)
	GCDWQ MAC	E. coli (counts), Fecal coliforms (counts), Total coliforms (counts)
LOC-24	GCDWQ AO	pH [F]
Foreshore Locations		
MPL-2	GCDWQ AO	pH [F], Temperature [F]
MPL-3	BCAWQG AL	Phosphorus (dissolved)
	GCDWQ AO	Temperature [F]
MPL-5	BCAWQG AL	Phosphorus (dissolved), Sulphate
	GCDWQ AO	pH [F], Sulphate, Temperature [F]

Groundwater Locations		
DMW-1	BCAWQG AL	Phosphorus (dissolved)
	GCDWQ MAC	Total coliforms (counts)
LOC-16	GCDWQ MAC	E. coli (counts), Fecal coliforms (counts), Total coliforms (counts)
	GCDWQ AO	pH [F]
BH-2	BCAWQG AL	Phosphorus (dissolved)
	GCDWQ AO	pH [F]
BH-3	BCAWQG AL	Phosphorus (dissolved), Sulphate
	GCDWQ AO	pH [F], Sulphate
	BC CSR AW	Sulphate
BH-4	BCAWQG AL	Phosphorus (dissolved)
	GCDWQ AO	pH [F]
BH-7	GCDWQ AO	pH [F]

Note: MPN= most probable number (a unit of measurement for pathogenic bacteria – see guideline notes in Appendix B)
[F] = field result(s)

Table 5: 2016 Water Quality Exceedances by Guideline at Sorrento

Sampling Location	Guideline	2016 Exceedances
Surface Water Locations		
Loc-2b	BCAWQG AL	Phosphorus (dissolved)
Foreshore Locations		
MPL-1	BCAWQG AL	Phosphorus (dissolved)
MPL-4	BCAWQG AL	Phosphorus (dissolved)
MPL-6	BCAWQG AL	Phosphorus (dissolved)
Groundwater Locations		
BH-8	BCAWQG AL	Phosphorus (dissolved)
	GCDWQ MAC	Total coliforms (MPN)
LOC-17-SW	BCAWQG AL	Phosphorus (dissolved)
	GCDWQ MAC	Total coliforms (counts)

Note: MPN= most probable number (a unit of measurement for pathogenic bacteria – see guideline notes in Appendix B)
[F] = field result(s)

Table 6: Summary of 2016 Water Quality Results at Newly Sampled Locations

		Sample Location	Culvert Stream	HZ - 5
		Sample Date	October 18, 2016	October 18, 2016
Analyte	Units	GCDWQ Standards		
Conductivity	µS/cm	N/A	555	841
pH	pH units	7 - 10.5	8.7	7.3
Temperature	°C	AO 15	10.5	10.9
Chloride	mg/L	AO<=250	31.9	8.58
Nitrate as N	mg/L	MAC=10	0.066	0.368
Nitrite as N	mg/L	MAC=1	<0.01	<0.01
Phosphate, Ortho as P	mg/L	N/A	<0.01	<0.01
Sulfate	mg/L	AO<=500	10.5	11.1
Alkalinity, Total as CaCO3	mg/L	N/A	370	469

4.1 Nitrate

Nitrate is a septic associated parameter of direct concern for its potential effect on human health and the environment. Generally, nitrate concentrations greater than 3 mg/l are typically considered to reflect human impacts (MoE 2007).

Surface Water

Water quality at the surface water locations in both Blind Bay and Sorrento has remained relatively stable since 2000. Concentrations of nitrate at the Blind Bay locations (LOC-11 and LOC-24) remain elevated, with averages (2000 to 2016) between 2.5 mg/l and 8 mg/l, respectively. See Table 7, which provides the descriptive statistics of select water quality parameters. The groundwater spring in Sorrento (LOC-2b) also has elevated concentrations of nitrate with average of 3.51 mg/l, indicating anthropogenic impact at these locations. Nitrate at SW-1 (Shuswap Lake at Sorrento) is low compared to all other routinely sampled surface water locations at an average concentration of 0.16 mg/l and ranges between 0.01 mg/l and 0.58 mg/l. Nitrate at the Culvert Stream (Sorrento) was below average concentrations at all other surface water locations in Blind Bay and Sorrento at 0.066 mg/l (Table 6).

Foreshore

Blind Bay foreshore location MPL-5 historically exceeds GCDWQ MAC guidelines for nitrate (2011, 2012, and 2014); however, in 2016 concentrations were among the lowest observed at this location at 3.37 mg/l and 4.24 mg/l in May and October 2016. Nitrate remains variable and elevated above all other foreshore locations at MPL-5. Foreshore sites MPL-2 and MPL-3 (Blind Bay) are similar and have remained relatively low (< 3 mg/l) and stable since 2000. A spike in nitrate occurred in May 2016 at MPL-2 (2.23 mg/l), which is two orders of magnitude higher than the previous (<0.01 mg/l; November 2015) and the subsequent (0.013 mg/l; October 2016) sampling events. MPL-4 (Sorrento; added to the program in 2010) has been slightly more variable and elevated above Blind Bay foreshore locations MPL-2 and MPL-3; however, concentrations have remained below 0.7 mg/l since 2012. Foreshore location MPL-1 (Sorrento) is variable compared to other foreshore sites with a range of 5.82 mg/l (Figure 6). Similar to MPL-2, a spike occurred at MPL-1 in May 2016, where concentrations increased by an order of magnitude to 4.29 mg/l from 0.89 mg/l (November 2015). Concentrations have since fallen to historical levels at 0.418 mg/l (October 2016).

Nitrate at the new foreshore investigation site (MPL-6; 0.732 mg/l) in Sorrento is similar to average concentrations at MPL-4, above average concentrations at MPL-2 and MPL-3 and below average concentrations at MPL-1 and MPL-5 (Tables 7 and 8). Similar to MPL-2 and MPL-3, the concentration of nitrate at exploratory sample HZ-5 is low (0.368 mg/l). Blind Bay foreshore location MPL-5 remained elevated above other foreshore locations at the site in 2016 and has shown this trend since sampling started at that location in 2010. MPL-5 is located on the shoreline in the sand and gravel aquifer 222IIIC and directly downgradient of a densely-developed area in Blind Bay.

Groundwater

The nitrate concentrations at Sorrento wells BH-8 and LOC-17(SW) have been stable over time and are similar to or below ambient levels (DMW-1). Blind Bay wells BH-2 and BH-3 are slightly elevated above background and Sorrento locations, yet remain stable with average concentrations at or below 1 mg/l (Figure 4 and Table 7). BH-7 is slightly more variable with an obvious seasonal trend; concentrations during spring sampling elevated above fall sampling (Figure 4). Concentrations at BH-7 have been as high as 6.69 mg/l (May 2011) and as low as <0.01 mg/l (November 2011, 2013, and 2015). Sampling locations BH-4 and LOC-16 (Blind Bay) have average nitrate concentrations slightly above 3 mg/l, which is the highest average concentrations of all other monitored wells at both Blind Bay and Sorrento. In contrast, the average nitrate concentration at background location DMW-1 is 0.023 mg/l. Monitoring well BH-4 is located in a subdivision at the centre of Blind Bay and LOC-16 is located downgradient at a residence near the shoreline of Shuswap Lake. Elevated nitrate concentrations at these locations likely indicate localized anthropogenic impact to groundwater, most likely from PSDS.

Elevated nitrate concentrations at surface water sites LOC-2b (Sorrento), LOC-11, LOC-24 (Blind Bay), foreshore sites MPL-1 (Sorrento) and MPL-5 (Blind Bay) and groundwater sites BH-4, BH-7, and LOC-16 (Blind Bay) are of concern as they are elevated above background concentrations and are likely a result of septic related impact. Nitrate concentrations at BH-7 are typically lower than BH-4 and LOC-16 likely due to its location downgradient of a less developed area of Blind Bay. However, concentrations at all sampling locations appear to be relatively stable with no consistent increases or decreases over the long term, which indicates the level of impact is not increasing over time.

4.2 Chloride, Sodium and Electrical Conductivity

Chloride, sodium, and electrical conductivity are of less direct concern to human health. However, the presence of these water quality indicators above background (ambient) concentrations can indicate the severity of impact on water from operation of PSDS. Chloride is an indicator of anthropogenic impact and it is a conservative ion, meaning it does not sorb to soil or degrade in the environment. We use chloride as a principal indicator of PSDS impact; however, chloride can be present due to other anthropogenic activities such as road salting, industrial processes, agricultural activity, or use of home water softeners.

4.2.1 Chloride

All sampling locations were below provincial aquatic life and drinking water guidelines for chloride (600 mg/l and 250 mg/l, respectively) in 2016. The hyporheic zone sample MPL-6 along the western edge of Sorrento showed elevated chloride at 125 mg/l (Table 8), which is well above background (25.4 mg/l; DMW-1) and all other foreshore locations at the site including exploratory foreshore site HZ-5. Average concentrations at surface water LOC-11, LOC-24, and LOC-2b are similar and elevated above background (Tables 7 and 8). SW-1 (Shuswap Lake) and the Culvert Stream have lower average concentrations at 2.8 mg/l and 31.9 mg/l, respectively. Foreshore and monitoring well locations are similar at both Blind Bay and Sorrento with average concentrations between 15.5 mg/l and 48 mg/l, with exception of LOC-17SW which has an average concentration of 6 mg/l. Monitoring well BH-8 and foreshore location MPL-1 at Sorrento and monitoring well BH-7 and foreshore location MPL-2 at Blind Bay are far more variable than concentrations at the other sampled locations, likely due to variation in lake stage, subsurface lithology, and their proximity to the Shuswap Lake shoreline. New background well DMW-1 showed an average chloride concentration of 25.4 mg/l, similar to typical concentrations at previously sampled background well LOC-12.

Surface Water

Historically, concentrations of chloride at the groundwater springs in Blind Bay (LOC-11 and LOC-24) and Sorrento (LOC-2b) have been higher than those at other Blind Bay and Sorrento sampling locations averaging 87 mg/l, 80 mg/l, and 86 mg/l, respectively. Chloride concentrations at LOC-11 have been gradually increasing since 2006, and remain elevated in 2016 at 110 mg/l. Chloride concentration at Sorrento surface water location SW-1 (Shuswap Lake) is much lower than concentrations observed at Blind Bay (average 2.8 mg/l); likely due to the dilution effect of large surface water bodies.

Foreshore

Chloride concentrations at foreshore locations in Blind Bay (MPL-2, MPL-3, and MPL-5) are typically more variable (Table 7). Sorrento location MPL-4 has the lowest concentration of all foreshore locations at an average of 10.7 mg/l while MPL-1 (Sorrento) and MPL-6 have the highest average concentrations at 67 mg/l and 125 mg/l, respectively in 2016. In contrast to MPL-6, exploratory foreshore location HZ-5 (also near the western edge of Sorrento) did not exhibit elevated chloride (8.58 mg/l). Foreshore locations MPL-1 (Sorrento) and MPL-2 (Blind Bay) exhibit the largest variability (ranging over 100 mg/l) and MPL-2 experienced an increase from 2.67 mg/l in May 2016 to 24.4 mg/l in November 2016. Some seasonal variability is observed at MPL-2 and MPL-5 with elevated concentrations during the spring sampling compared to fall.

Groundwater

Average chloride at DMW-1 (ambient) is 25.4 mg/l. Chloride levels have increased over time at some of the monitoring wells installed in the sand and gravel aquifer (Aquifer 232 IIC and Aquifer 222 IIC), including BH-3 (Blind Bay), BH-4 (Blind Bay), and BH-8 (Sorrento). For example, BH-8 has increased from 20.6 mg/l in April 2000 to 61.5 mg/l in October 2016 (Figure 6). Monitored wells BH-3, BH-7, and BH-4 wells show seasonal fluctuations in chloride, with higher concentrations typically in spring at BH-3 and BH-7 and fall at BH-4. The chloride concentrations at BH-7, the only well installed entirely within the bedrock aquifer, and BH-8 appear highly variable over time, varying by more than 60 mg/l and 73 mg/l, respectively. Chloride at LOC-17SW (Sorrento) is the lowest of all sampled groundwater wells and well below ambient (DMW-1) at an average of 6 mg/l, indicating LOC-17SW is highly influenced by surface water with less anthropogenic influence that is observed at DWM-1.

The observed chloride concentrations at hyporheic zone location MPL-6 and MPL-1 along with locations LOC-11, LOC-24, LOC-2b, BH-2, and BH-8 suggest possible PSDS effects or other human-related impacts. Chloride at monitoring wells BH-3, BH-4, and BH-7 are similar to the new background well DMW-1, which suggests possible PSDS or other human-related impacts at all of these locations including the new background well.

4.2.2 Sodium

Similar to chloride, all sampling locations were well below drinking water guidelines for sodium (200 mg/l) in 2016. Sodium appears to be slightly more elevated at Blind Bay than at Sorrento, yet concentrations appear to relatively steady at all sampled locations. It is important to note surface water locations have historically been sampled for both dissolved and total metals during different sampling events. In 2016 both SW-1 and LOC-2b in Sorrento were sampled for total metals (sodium) as has been sampled in the majority of past sampling events. LOC-11 and LOC-24 in Blind Bay were sampled for dissolved metals in 2016, which is consistent with parameters sampled in the past so that results can be compared to other groundwater sample locations. Table 7 and Table 8 display results for both total and dissolved sodium at surface water locations and Figure 8 shows dissolved metals for Blind Bay and Sorrento separately and total metals for surface water locations at the site (SW-1, LOC-2b, LOC-11, and LOC-24).

Surface Water

Surface water (groundwater springs) locations LOC-11 and LOC-24 (Blind Bay) have the highest observed concentrations of sodium, above the other sample locations with average dissolved sodium concentrations at 53 mg/l and 49 mg/l, respectively. At the Sorrento surface water location SW-1, total sodium concentration remained low (<2 mg/l); however, historical levels at LOC-2b (slightly inland of SW-1) were all above 20 mg/l. LOC-2b is located near a road, runoff from which may contribute to elevated concentrations of sodium, chloride, and conductivity. Sodium was not measured at the exploratory Culvert Stream sample in Sorrento.

Foreshore

Foreshore locations MPL-2, MPL-3, and MPL-5 (Blind Bay) and MPL-1, and MPL-4 (Sorrento) were found to have sodium levels elevated above or at background concentrations (16 mg/l). At Blind Bay, foreshore locations MPL-3 and MPL-5 have been stable throughout the recorded history; however, locations MPL-2 (Blind Bay) and those at Sorrento have been variable. For example, concentrations at MPL-2 range from 4.3 mg/l to 83.7 mg/l, at MPL-1 range from 16.3 mg/l to 34.1 mg/l, and at MPL-4 from 5.08 mg/l to 24.9 mg/l. MPL-2 (Blind Bay), MPL-5 (Blind Bay), and MPL-1 (Sorrento) have the highest average concentrations of sodium, which is consistent with elevated values of conductivity and chloride at those locations.

Groundwater

Sodium was not measured at LOC-17SW in 2016 as this location was not sampled in October 2016; however historical concentrations are below background (DMW-1; 16.6 mg/l) at LOC-17SW with an average of 8 mg/l and have remained stable since 2000. Sodium at BH-8 is similar to background concentrations with a slight upward trend since 2004 (Table 7, Table 8 and Figure 8). Sodium concentrations are elevated above background at Blind Bay groundwater locations LOC-16, BH-2, BH-3, BH-4, and BH-7 with average concentrations all above 21 mg/l. However, these locations have remained stable since 2000 with no obvious temporal trends, indicating little change to groundwater quality at this site.

4.2.3 Electrical Conductivity

There are no guidelines or standards applicable to electrical conductivity, but it is a useful indicator parameter analogous to total dissolved solids and readily measured in the field. Average electrical conductivity at all sampling locations except Sorrento locations SW-1, MPL-4, and LOC-17SW and Blind Bay location MPL-3 are elevated above background levels (DMW-1) at the site. The new background well DMW-1 shows slightly elevated conductivity (908 uS/cm) compared to typical results found at the previous background well LOC-12 at (about 640 uS/cm; Appendix B). The elevated conductivity may be due to naturally high mineral content in the groundwater or anthropogenic impact; regardless of this unknown, based on the location of DMW-1, away from residential development, we will consider DMW-1 to reparent ambient groundwater in the area.

Surface Water

Surface water location SW-1 exhibited low electrical conductivity (average 112 uS/cm) with levels decreasing between 2010 and 2014 and remaining stable at about 88 uS/cm since. Blind Bay surface water locations LOC-11 and LOC-24 and Sorrento surface water location LOC-2b have remained elevated with averages of 1467 uS/cm, 1400 uS/cm, and 1063 uS/cm, respectively (Tables 7 and 8). This is expected as these are groundwater springs, which are likely to have higher mineral content compared to Shuswap Lake. Electrical conductivity at the Culvert Stream is below levels at the groundwater springs but higher than Shuswap Lake at 555 uS/cm (Table 6).

Foreshore

Foreshore location MPL-5 (Blind Bay) exhibits significantly higher conductivity than all the other foreshore locations as well as all other locations throughout both communities (average 2129 uS/cm). This is consistent with elevated levels of chloride, sodium, sulphate, and nitrate also found at this location. Conductivity at Sorrento location MPL-1 is also elevated above background at 1064 uS/cm, as is the other foreshore site along the western edge of Sorrento (MPL-6) at an average of 1305 uS/cm. Foreshore MPL-2 and MPL-3 at Blind Bay and exploratory location HZ-5 are slightly lower than background (Tables 6 and 7). MPL-4 (Sorrento), is considerably lower in conductivity, with an average of 424 uS/cm (Table 8). Conductivity has remained relatively stable at all sampled foreshore locations throughout the dataset analyzed.

Groundwater

Monitoring wells LOC16, BH-2, BH-3, BH-4 and BH-7 at Blind Bay have higher conductivity values then those found at Sorrento. Conductivity at monitoring well locations BH-3 and BH-4 are variable, most specifically at BH-3 with a range of more than 2300 uS/cm. Although there is significant variability at these locations there is no continuous trend upwards or downwards over-time. LOC-16 and BH-7 showed variability between 2003 and 2007, however, levels have remained stable since June 2009 at about 1300 uS/cm (Figure 5). Sorrento well LOC-17SW has remained stable throughout the record at about 600 uS/cm with exception of one result in 2007 (1259 uS/cm). The long-term stability of electrical conductivity indicates little change to water quality input over time at these locations. Similar to sodium, conductivity at BH-8, in Sorrento shows a gradual and variable increase since 2003, from 937 uS/cm in June 2003 to 1025 uS/cm in October 2016. Values at this location are still lower then wells located at Blind Bay.

4.3 Phosphorus

Potential impact to aquatic life can occur from increased loading of phosphorus present in septic effluent. Phosphorus in septic effluent is a concern because this nutrient can impact surface water quality even at very low concentrations. Phosphorus is an essential plant nutrient and is often the most limiting nutrient to plant growth in fresh water as such, phosphorus is rarely found in significant concentrations in surface waters. Inputs of phosphorus to fresh water systems can cause proliferations of algal growth, and are one of the prime contributing factors to eutrophication in fresh water systems (MoE 1998).

Dissolved phosphorus concentrations exceeded provincial aquatic life guidelines at most foreshore and groundwater locations except foreshore and groundwater locations MPL-2, BH-7, LOC-16 at Blind Bay in 2016. As noted above, provincial aquatic life guidelines apply to surface water bodies. Guidelines were exceeded for phosphorus at the surface water samples LOC-11 and LOC-2b in 2016. Average concentrations at surface water locations at LOC-24 (Blind Bay) and SW-1 (Sorrento) were the same, at 0.01 mg/l. Average concentrations at Blind Bay location LOC-11 are elevated above guidelines and background at 0.02 mg/l. Phosphorus at Sorrento surface water location LOC-2b was double those found at the other surface water locations at 0.04 mg/l.

4.4 Sulphate

Similar to chloride, sodium, and electrical conductivity, sulphate is of less direct concern to human health. However, the presence of these water quality indicators above background (ambient) concentrations can indicate anthropogenic impact on groundwater or surface water from operation of PSDS.

Similar to historical results, sulphate was above GCDWQ AO and BCAWQG AL at both foreshore location MPL-5 and monitoring well BH-3 at Blind Bay in 2016. Furthermore, sulphate was above CSR aquatic life guideline at BH-3. Sulphate was below guidelines at all other locations at both Blind Bay and Sorrento.

Overall, concentrations of sulphate at Blind Bay are elevated above those found at Sorrento. For example, average concentrations at all Sorrento locations, except BH-8 (average 67 mg/) are lower than background (48.4 mg/l). Average concentrations at sample locations in Blind Bay are all above 90 mg/l. Sulphate has remained relatively stable and low at most sample locations since 2000 (SW-1, MPL-1, BH-7, LOC-16, LOC-11, LOC-24, MPL-2, MPL-3). Concentrations at both BH-3 and MPL-5 are elevated, well above all other locations (Figure 5). Sulphate at BH-3 shows a slight increasing trend, while concentrations at MPL-5, BH-2, BH-8, and to a lesser extent MPL-4 and LOC-2b show a slight decreasing trend. For example, at BH-3 sulphate increased from 672 mg/l in April 2000 to 1120 mg/l in October 2016, and at BH-8 sulphate decreased from 82 mg/l in April 2000 to 61.3 mg/l in October 2016 (Figures 5 and 7). Seasonal variability occurs at BH-2, BH-3, and BH-4 (Blind Bay) with lower concentrations in spring and elevated concentrations in fall. Sulphate at the Culvert Stream and HZ-5 are similar at 10.5 mg/l and 11.1 mg/l, respectively and are similar to average concentrations at Sorrento location LOC-17SW. Compared to Sorrento surface water sites (< 31 mg/l), sulphate is elevated at the groundwater springs in Blind Bay (LOC-11 and LOC-24) at 264 mg/l and 209 mg/l, respectively.

4.5 Pathogenic Bacteria

Foreshore and surface water locations were not sampled for bacteriological parameters in 2016 with exception for Blind Bay groundwater springs LOC-11 and LOC-24 in October 2016. The presence of pathogenic bacteria in surface water location LOC-11 may be avian or anthropogenic in origin; therefore, these exceedances do not, in and of themselves, indicate impact from the PSDS. In 2016, groundwater well locations BH-8 (Sorrento), DMW-1, and LOC-16 (Blind Bay) had total coliform concentrations above guidelines. Fecal coliform and *E.coli* were also detected at LOC-16 but below detection limits at other locations sampled. Historically, these affected groundwater locations have had detectable concentrations of pathogenic bacteria in spring and/or fall sampling events. The presence of pathogenic bacteria at BH-8, and LOC-16 suggest that PSDS are affecting the shallow groundwater at Blind Bay and Sorrento. Note that groundwater well BH-8 consistently has flowing artesian conditions (water level above the top of the well casing). The well is equipped with a J-plug, which prevents the surface water runoff from entering the monitoring well and WWAL field staff added a coupling to the top of the well in 2016 so the water level remains below the top of casing.

Table 7: Blind Bay - Statistics for Select Water Quality Parameters (2000 to 2016)

Analyte	Sampling Location	Unit	Average	Minimum	Maximum	Count	Number of Exceedances
Alkalinity (total, as CaCO3)	LOC-11	mg/L	520	464	598	29	none
	LOC-24	mg/L	543	482	584	29	none
	MPL-2	mg/L	328	91	511	15	none
	MPL-3	mg/L	456	270	1200	18	none
	MPL-5	mg/L	413	355	484	14	none
	DMW-1	mg/L	438	422	446	3	none
	LOC-16	mg/L	398	144	475	28	none
	BH-2	mg/L	389	293	499	32	none
	BH-3	mg/L	404	262	457	29	none
	BH-4	mg/L	379	243	518	22	none
	BH-7	mg/L	446	421	479	29	none
Chloride	LOC-11	mg/L	87	66	114	29	none
	LOC-24	mg/L	80	66.8	99.5	29	none
	MPL-2	mg/L	35	2.67	105	15	none
	MPL-3	mg/L	15.5	0.8	40.7	18	none
	MPL-5	mg/L	30.9	21.4	45.6	14	none
	DMW-1	mg/L	25.4	17.4	29.8	3	none
	LOC-16	mg/L	36.9	5.24	48.9	28	none
	BH-2	mg/L	42.4	33.3	56.7	33	none
	BH-3	mg/L	26	15.7	43	30	none
	BH-4	mg/L	28	7.3	47.2	22	none
	BH-7	mg/L	27	5.93	66.3	29	none
Conductivity	LOC-11	µS/cm	1467	1150	1777	25	none
	LOC-24	µS/cm	1400	147	1830	23	none
	MPL-2	µS/cm	888	197	1184	13	none
	MPL-3	µS/cm	847	460	1170	14	none
	MPL-5	µS/cm	2129	1563	2500	14	none
	DMW-1	µS/cm	908	865	955	3	none
	LOC-16	µS/cm	1231	366	1961	24	none
	BH-2	µS/cm	1290	810	1680	25	none
	BH-3	µS/cm	2030	230	2610	23	none
	BH-4	µS/cm	1081	580	1598	15	none
	BH-7	µS/cm	1348	962	2065	23	none

Analyte	Sampling Location	Unit	Average	Minimum	Maximum	Count	Number of Exceedances
Nitrate (as N)	LOC-11	mg/L	5	2.51	6.8	29	none
	LOC-24	mg/L	5.6	3.47	8.04	29	none
	MPL-2	mg/L	0.2	<0.005	2.23	6	none
	MPL-3	mg/L	0.2	<0.005	2.64	14	none
	MPL-5	mg/L	8.3	3.05	14.5	14	3
	DMW-1	mg/L	0.023	<0.010	0.035	2	none
	LOC-16	mg/L	3.2	0.269	5.83	28	none
	BH-2	mg/L	0.5	0.006	2.69	26	none
	BH-3	mg/L	1	0.289	5.17	30	none
	BH-4	mg/L	3.9	1.31	9.98	22	none
	BH-7	mg/L	1.8	<0.010	6.69	26	none
Phosphorus (dissolved)	LOC-11	mg/L	0.02	<0.0020	0.04	7	3
	LOC-24	mg/L	0.01	<0.0020	0.04	7	2
	MPL-2	mg/L	0.03	<0.002	0.07	6	4
	MPL-3	mg/L	0.07	0.018	0.172	7	7
	MPL-5	mg/L	0.03	0.006	0.11	7	4
	DMW-1	mg/L	0.014	0.006	0.02	3	2
	LOC-16	mg/L	0.02	0.003	0.04	9	3
	BH-2	mg/L	0.02	<0.0020	0.04	9	5
	BH-3	mg/L	0.02	<0.0020	0.05	8	6
	BH-4	mg/L	0.05	0.01	0.181	9	8
	BH-7	mg/L	0.04	<0.0020	0.15	7	5
Sodium (dissolved/total[1])	LOC-11	mg/L	53/51[1]	48/<0.001[1]	66.9/63.3[1]	17/12[1]	none
	LOC-24	mg/L	49/54.2[1]	43/46.7[1]	59.6/58.6[1]	16/8[1]	none
	MPL-2	mg/L	27	4.3	83.7	12	none
	MPL-3	mg/L	18.2	9.3	29.1	13	none
	MPL-5	mg/L	29.5	21.6	44.9	12	none
	DMW-1	mg/L	16.6	16.6	16.6	1	none
	LOC-16	mg/L	34	9.4	43.8	18	none
	BH-2	mg/L	35	27.3	43.6	24	none
	BH-3	mg/L	42	28	51.2	23	none
	BH-4	mg/L	27	10.2	39	18	none
	BH-7	mg/L	21	10.2	39.1	22	none
Sulphate	LOC-11	mg/L	264	142	414	29	none
	LOC-24	mg/L	209	177	257	29	1
	MPL-2	mg/L	170	26.9	323	15	none
	MPL-3	mg/L	90	25.5	144	18	none
	MPL-5	mg/L	1027	653	1280	14	14
	DMW-1	mg/L	48.4	47.5	49.1	3	none
	LOC-16	mg/L	293	43	409	28	none
	BH-2	mg/L	385	194	550	33	14
	BH-3	mg/L	991	123	1390	30	29
	BH-4	mg/L	96	12.2	298	22	none
	BH-7	mg/L	340	180	544	29	4

Note: 1 = indicates results for total sodium

Table 8: Sorrento - Statistics for Select Water Quality Parameters (2000 to 2016)

Analyte	Sampling Location	Unit	Average	Minimum	Maximum	Count	Number of Exceedances
Alkalinity (as CaCO3)	SW1	mg/L	48	34	81.8	12	none
	Loc-2b	mg/L	452	416	471	11	none
	MPL-1	mg/L	464	270	577	25	none
	MPL-4	mg/L	221	120	416	13	none
	MPL-6	mg/L	550	550	550	1	none
	LOC-17SW	mg/L	333	293	363	30	none
	BH-8	mg/L	437	388	475	33	none
Chloride	SW1	mg/L	2.8	0.5	10.6	13	none
	Loc-2b	mg/L	86	68.6	103	11	none
	MPL-1	mg/L	67	3.6	105	25	none
	MPL-4	mg/L	10.7	1.74	33	13	none
	MPL-6	mg/L	125	125	125	1	none
	LOC-17SW	mg/L	6	2.42	24.7	30	none
	BH-8	mg/L	48.6	6.88	80.2	33	none
Conductivity	SW1	µS/cm	112	9.7	220	12	none
	Loc-2b	µS/cm	1063	930	1171	11	none
	MPL-1	µS/cm	1064	666	1308	20	none
	MPL-4	µS/cm	424	220	700	11	none
	MPL-6	µS/cm	1305	1305	1305	1	none
	LOC-17SW	µS/cm	618	411	1259	23	none
	BH-8	µS/cm	969	551	1200	26	none
Nitrate (as N)	SW1	mg/L	0.16	0.01	0.58	12	none
	Loc-2b	mg/L	3.51	2.84	4.29	11	none
	MPL-1	mg/L	1.9	0.007	5.83	22	none
	MPL-4	mg/L	0.55	<0.010	2.75	12	none
	MPL-6	mg/L	0.732	0.732	0.732	1	none
	LOC-17SW	mg/L	0.1	0.001	1.89	19	none
	BH-8	mg/L	0	<0.005	0.291	4	none
Phosphorus (dissolved)	SW1	mg/L	0.01	0.002	0.03	7	2
	Loc-2b	mg/L	0.04	0.025	0.05	6	6
	MPL-1	mg/L	0.19	0.01	1.2	8	7
	MPL-4	mg/L	0.05	<0.002	0.08	7	6
	MPL-6	mg/L	0.066	0.066	0.066	1	1
	LOC-17SW	mg/L	0.02	0.007	0.05	8	5
	BH-8	mg/L	0.06	<0.0020	0.128	9	8
Sodium (dissolved/total[1])	SW1	mg/L	4.13/1.7[1]	3.92/1[1]	4.34/2.6[1]	Feb-81	none
	Loc-2b	mg/L	23/24.4[1]	21.9/21.8[1]	23.4/27[1]	Apr-81	none
	MPL-1	mg/L	27.5	16.3	34.1	18	none
	MPL-4	mg/L	14	5.08	24.9	11	none
	MPL-6	mg/L	n/a	n/a	n/a	0	none
	LOC-17SW	mg/L	8	7.4	10.6	21	none
	BH-8	mg/L	16	10.2	21.5	26	none
Sulphate	SW1	mg/L	6.6	4.9	11	12	none
	Loc-2b	mg/L	30.3	27.8	34.2	11	none
	MPL-1	mg/L	40	28.9	74.8	25	none
	MPL-4	mg/L	17.7	3.2	48	13	none
	MPL-6	mg/L	26.1	26.1	26.1	1	none
	LOC-17SW	mg/L	11	2.8	18	30	none
	BH-8	mg/L	67	53	90	33	none

Note: 1 = indicates results for total sodium

5. CONCLUSIONS

The following conclusions are based on assessment of Blind Bay and Sorrento water quality data from 2000 to 2016:

C1 Water quality at Sorrento sample locations LOC-17SW and SW-1 appears to show limited to no impact from PSDS operation.

C2 Water quality at the following locations indicate some input from PSDS based on elevated chloride, sodium, conductivity, sulphate, and nitrate concentrations compared to new background well DMW-1:

- surface water (groundwater springs) locations LOC-11, LOC-24, and LOC-2b;
- foreshore locations MPL-1 and MPL-4 (Sorrento) and MPL-2, MPL-3, MPL-5 (Blind Bay); and
- groundwater locations BH-8 (Sorrento) and BH-2, BH-3, BH-4, BH-7, and LOC-16 (Blind Bay).

C3 Groundwater locations LOC-16, BH-2, BH-3, and BH-4 and foreshore location MPL-5 appear to show the highest degree of anthropogenic impact at Blind Bay; while BH-8, LOC-2b, and MPL-1 appear to be the most affected locations at Sorrento.

C4 Hyporheic zone (foreshore) location MPL-6 along the western edge of Sorrento shows a degree of anthropogenic impact based on elevated chloride, conductivity, and nitrate concentrations. Exploratory sample locations HZ-5 and Culvert Stream (sampled October 2016), located near the western edge of Sorrento, showed much lower concentrations of septic indicator parameters compared to MPL-6.

C5 The variance of indicator parameters has been relatively stable at all sampled locations at Blind Bay between 2000 and 2016. At Sorrento, groundwater location BH-8 shows a slight increase in concentrations of indicator parameters chloride, sodium, and conductivity and decrease in sulphate since 2000.

C6 Similar to previous years, exceedances in pathogenic bacteria were observed at the site in 2016; however, exceedances were not observed at as many locations in 2016 compared to historical results (Appendix B). Total coliform concentrations exceeded guidelines at Sorrento and Blind Bay groundwater locations BH-8, LOC-16, and background location DMW-1 and fecal coliform and *E.coli* exceeded guidelines at LOC-16.

6. RECOMMENDATIONS

Based on the findings of the 2016 program, we provide the following recommendations moving forward:

R1 Continue monitoring groundwater quality at Blind Bay and Sorrento in 2017 at surface water locations LOC-2b, LOC-11, LOC-24, and SW-1, foreshore locations MPL-1, MPL-2, MPL-3, MPL-4, MPL-5, and MPL-6, and groundwater wells LOC-17SW, LOC-16, BH-2, BH-3, BH-4, BH-7, and BH-8 twice annually (May/June and October/November).

R2 Based on the lack of shallow wells upgradient of the site, continue to use DMW-1 as the new background well location and keep LOC-12 as a back-up well if DMW-1 is dry or cannot be accessed. Although DMW-1 showed elevated conductivity and other septic indicator parameters (nitrate, chloride, sulphate, etc.) were relatively low.

R3 Based on low concentrations of septic indicator parameters at exploratory locations Culvert Stream and HZ-5, discontinue sampling at these locations. However, we recommend continuing to sample water quality at MPL-6, along the western edge of Sorrento, based on elevated concentrations of septic associated parameters.

REFERENCES

AECOM. 2009. CSRD Liquid Waste Management Plan Area C Stage 3 Report. Prepared for the Columbia Shuswap Regional District. January 2009.

British Columbia Ministry of Environment (MoE). 1997. Contaminated Sites Regulation. Effective April 1, 1997, latest amendment January 31, 2014. B.C. Reg. 375/96. Queen's Printer, Victoria, British Columbia. http://www.env.gov.bc.ca/epd/remediation/leg_regs/csr.htm.

British Columbia Ministry of Environment (MoE). 1998. Guidelines for Interpreting Water Quality Data. Resources Information Standards Committee. http://www.ilmb.gov.bc.ca/risc/pubs/aquatic/interp /index.htm

British Columbia Ministry of Environment (MoE). 2013. British Columbia Field Sampling Manual for Continuous Monitoring Plus the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment, and Biological Samples. 2013 Edition. http://www2.gov.bc.ca/gov/content/environment/research-monitoring-reporting/monitoring/sampling-methods-quality-assurance/bc-field-sampling-manual

British Columbia Ministry of Environment (MoE). 2007. Water Stewardship Information Series Nitrate in Groundwater. February 2007. http://www.for.gov.bc.ca/hfd/library/documents/bib106076_nitrate.pdf

British Columbia Ministry of Environment (MoE). 2015. British Columbia Approved and Working Water Quality Guidelines. British Columbia Ministry of Environment. Updated May 2015. http://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines/approved-water-quality-guidelines

British Columbia Ministry of Environment (MoE). 2016. Water Resources Atlas. http://vvvvw.env.gov.bc.ca/wsd/data_searches/wrbc/

Environment Canada. 2016. Canadian Climate Normals. http://climate.weather.gc.ca/climate_normals/

Environment Canada. 2016. Online Water Survey. http://www.wateroffice.ec.gc.ca/index_e.html

Fulton, R.J. 1995. Surficial Materials of Canada, Geological Survey of Canada. Map 1880A, scale 1:5,000,000

Golder Associates (Golder). 1994. Preliminary Groundwater Testing Program for Indicators of Wastewater Discharge from Domestic Septic Systems Sorrento and Blind Bay Area, B.C. Prepared for Urban Systems Ltd. July 1994. Report No. 942-3027

Golder Associates (Golder). 2007. Years 2004 to 2006 Groundwater Monitoring Report Sorrento / Blind Bay, B.C. Prepared for CSRD. June 2007. Report No. 04-1430-040.

Health Canada 2014. Guidelines for Canadian Drinking Water Quality. October 2014. Health Canada. Prepared by the Federal-Provincial-Territorial Committee on Drinking Water of the Federal-Provincial-Territorial Committee on Health and the Environment.

Massey, N.W.D., MacIntyre, D.G., Desjardins, P.J. and Cooney, R.T. 2005. Geology of British Columbia; British Columbia Geological Survey. Geoscience Map 2005-3, scale 1: 1,000,000

Opus DaytonKnight Consultants Ltd (Opus DK). 2014. Columbia Shuswap Regional District Community Sewer System Plan for Sorrento/Blind Bay Area 'C' Summary Report. Prepared for CSRD. December 6, 2013. Report No. 39901.00.

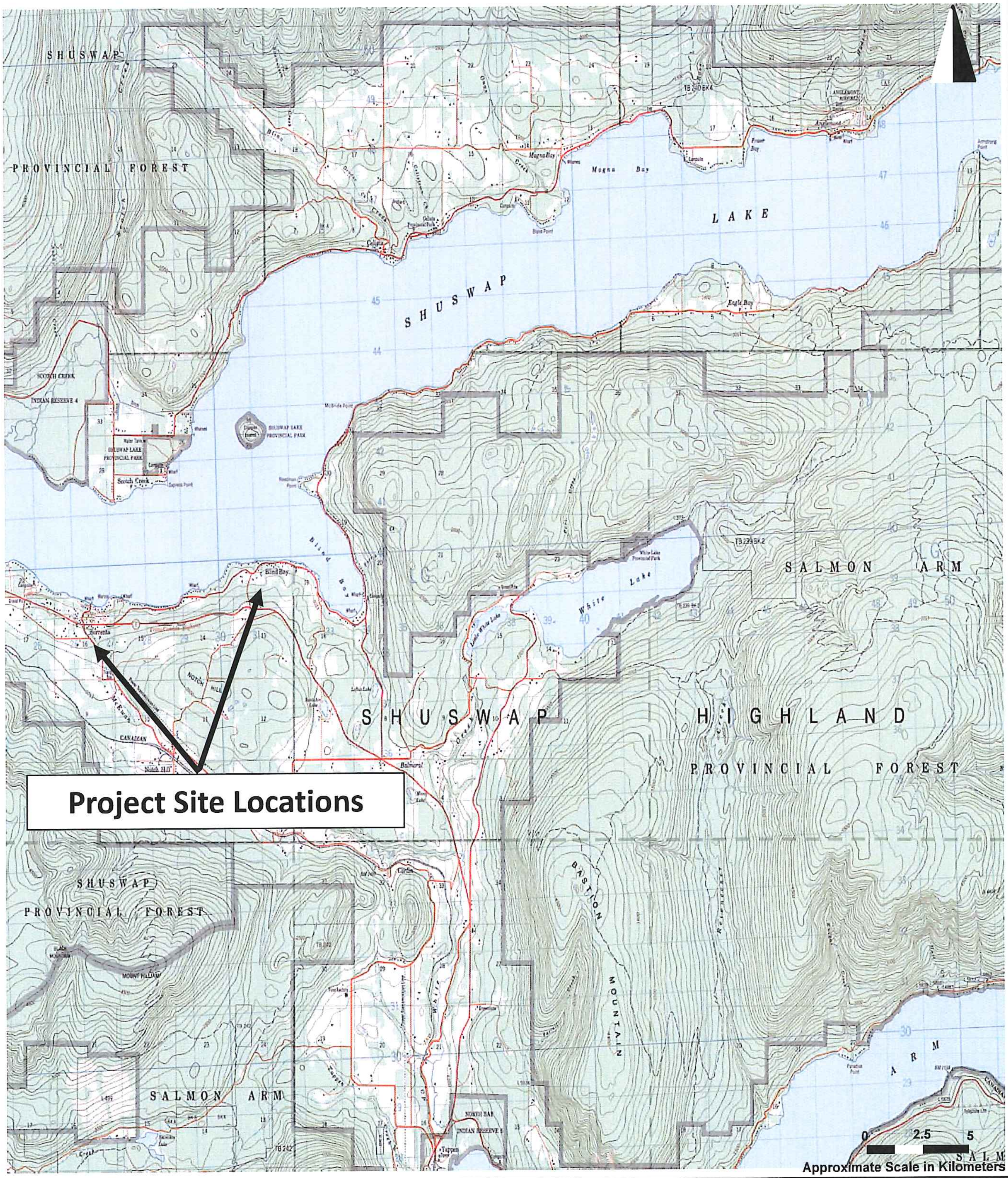
Statistics Canada. (StatsCan). 2011. Online Census Profile. http://www12.statcan.gc.ca/census-recensement/index-eng.cfm

Summit Environmental Consultants Inc. (Summit). 2013. 2013 Groundwater Monitoring Report – Blind Bay and Sorrento, B.C. Prepared for the CSRD January 2014. http://www.csrd.bc.ca/services/groundwater-monitoring.

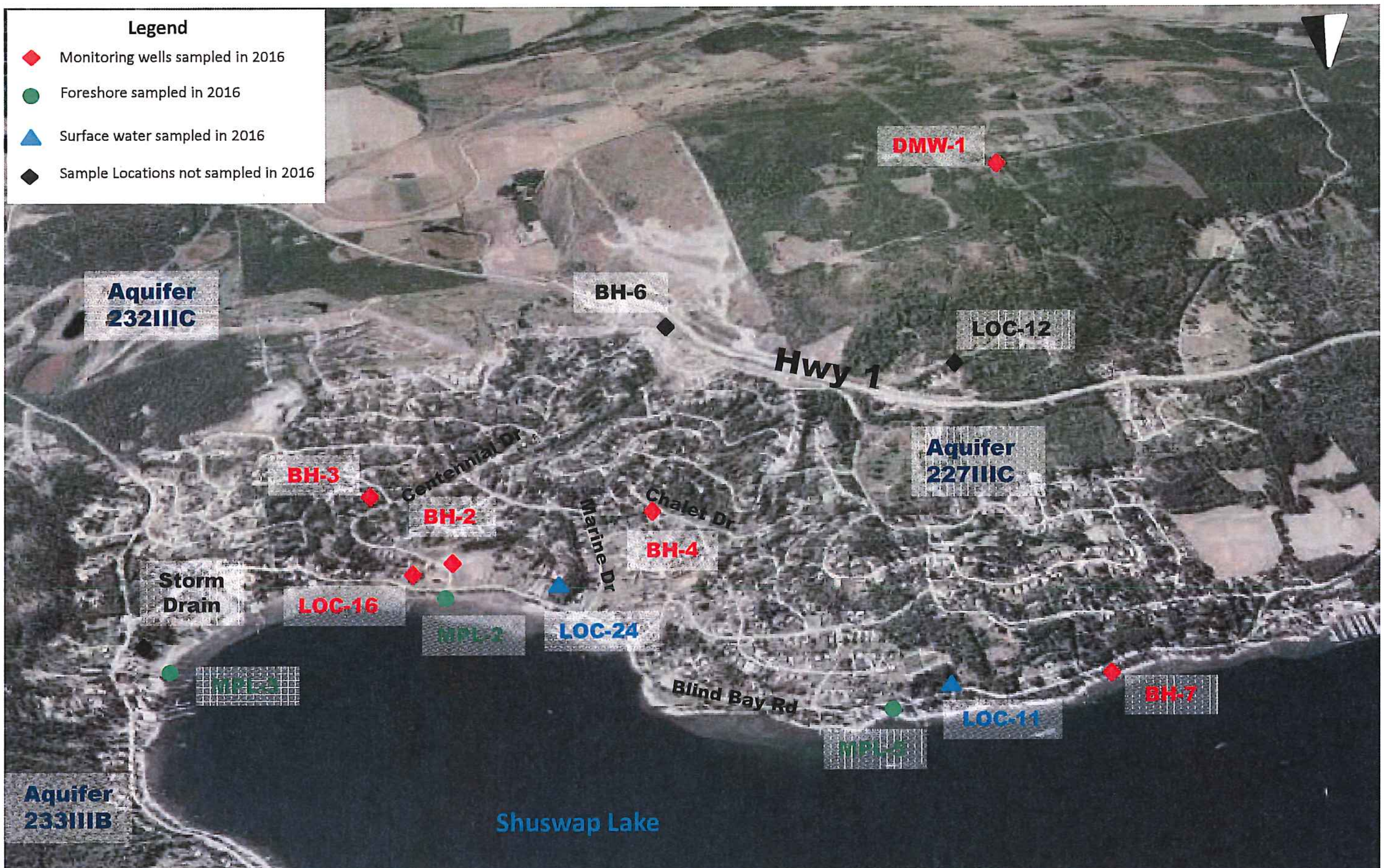
Urban Systems Ltd. 1983. Blind Bay - Sorrento Drainage and Sewage Disposal Study. Report No. KS-A476¬5 prepared for CSRD on February 10, 1983.

Western Water Associates Ltd (WWAL). 2015. 2015 Groundwater Monitoring Columbia Shuswap Regional District, Blind Bay and Sorrento, B.C. Prepared for the CSRD December 2015. Accessed online: http://www.csrd.bc.ca/services/groundwater-monitoring.

Figures

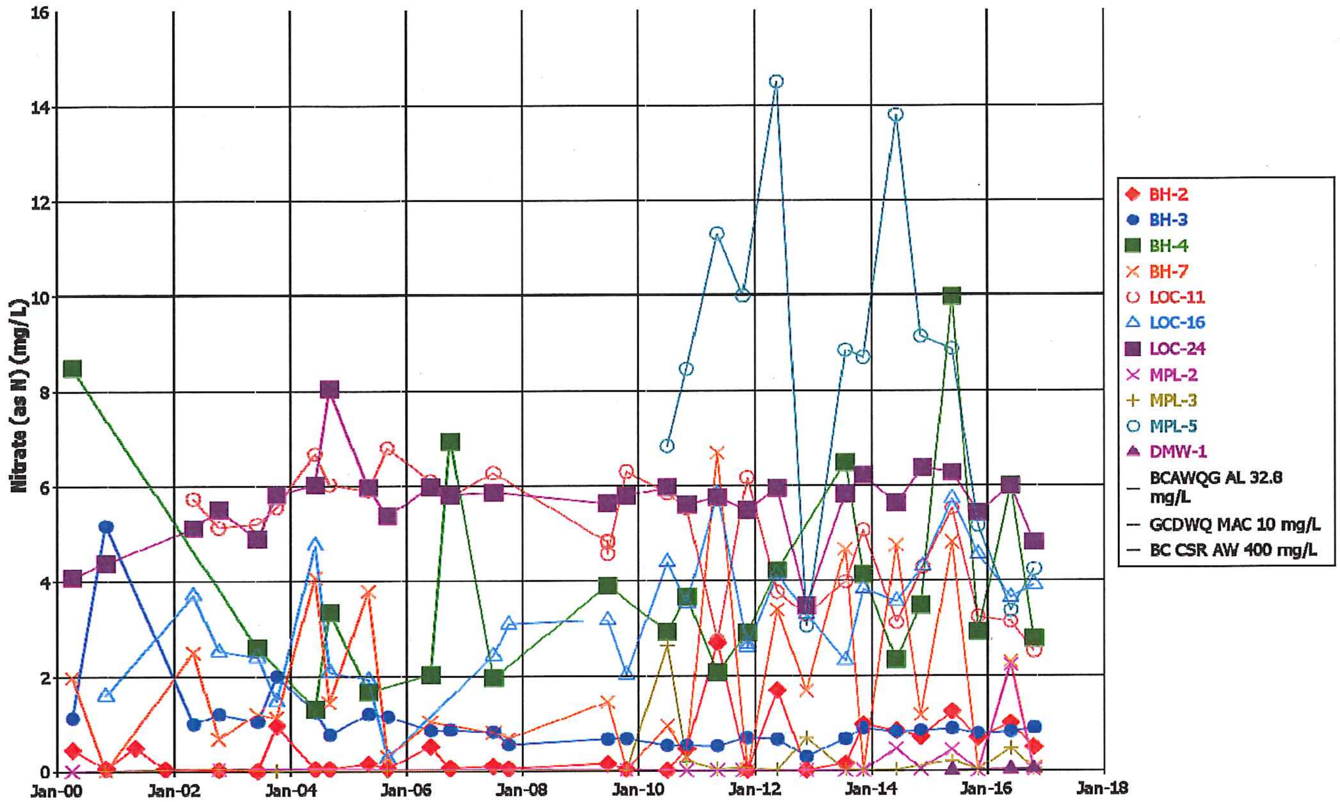


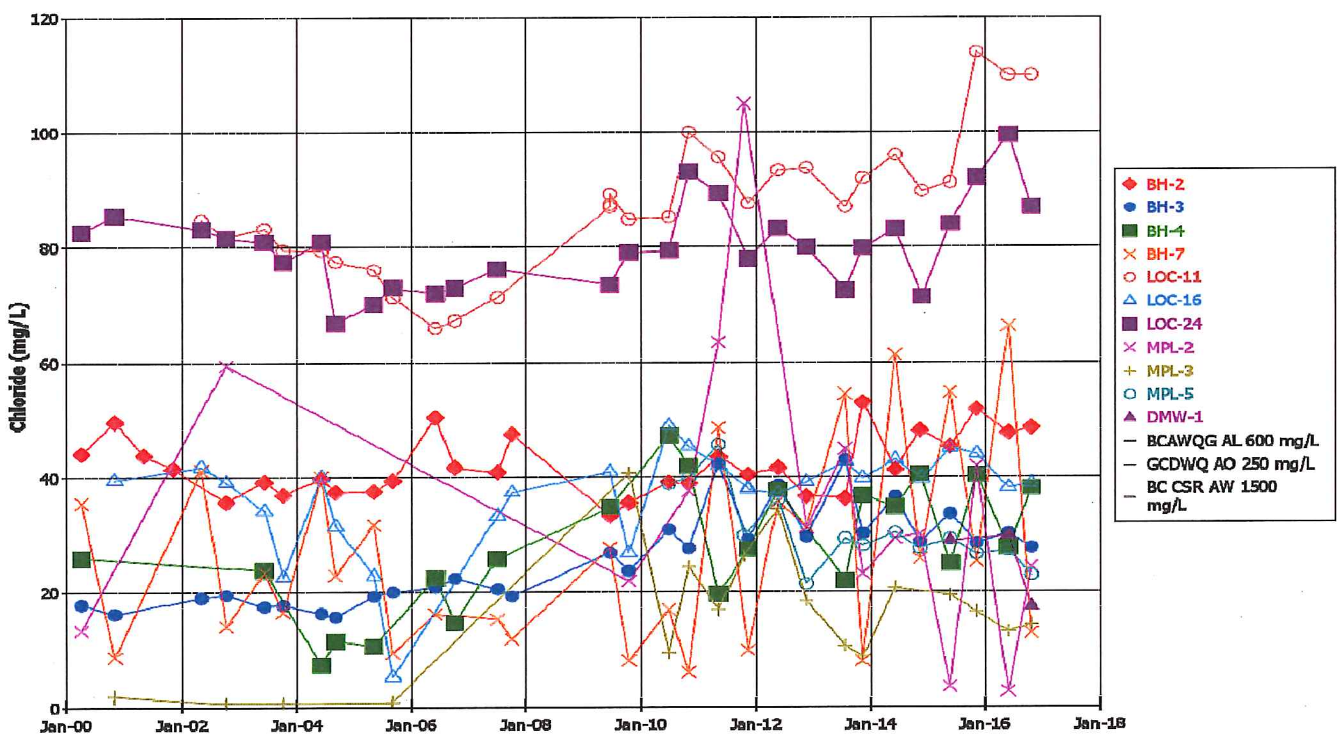
Columbia Shuswap Regional District	TITLE **Figure 1:** General Project Site Location, Blind Bay and Sorrento, B.C.					
western water ASSOCIATES LTD	DRAWN	MJ	DATE	December 2016	PROJECT NO.	14-024-12
	CHECKED	BRM	SCALE	See Figure	DWG. NO.	n/a
	REVIEWED	DG	FILE NO.		FIGURE REV. NO.	



Columbia Shuswap Regional District	TITLE **Figure 2:** Sampling Locations at Blind Bay, B.C.		
western water ASSOCIATES LTD	DRAWN MJ	DATE December 2016	PROJECT NO. 14-024-12
	CHECKED BRM	SCALE Varies Based on GE Ortho Photo	DWG. NO. n/a
	REVIEWED DG		FIGURE VERSION NO.

Columbia Shuswap Regional District	TITLE **Figure 3:** Sampling Locations at Sorrento, B.C.		
western water ASSOCIATES LTD	DRAWN MJ	DATE December 2016	PROJECT NO. 14-024-12
	CHECKED BRM	SCALE Varies Based on GE Ortho Photo	DWG. NO. n/a
	REVIEWED DG		FIGURE VERSION NO.





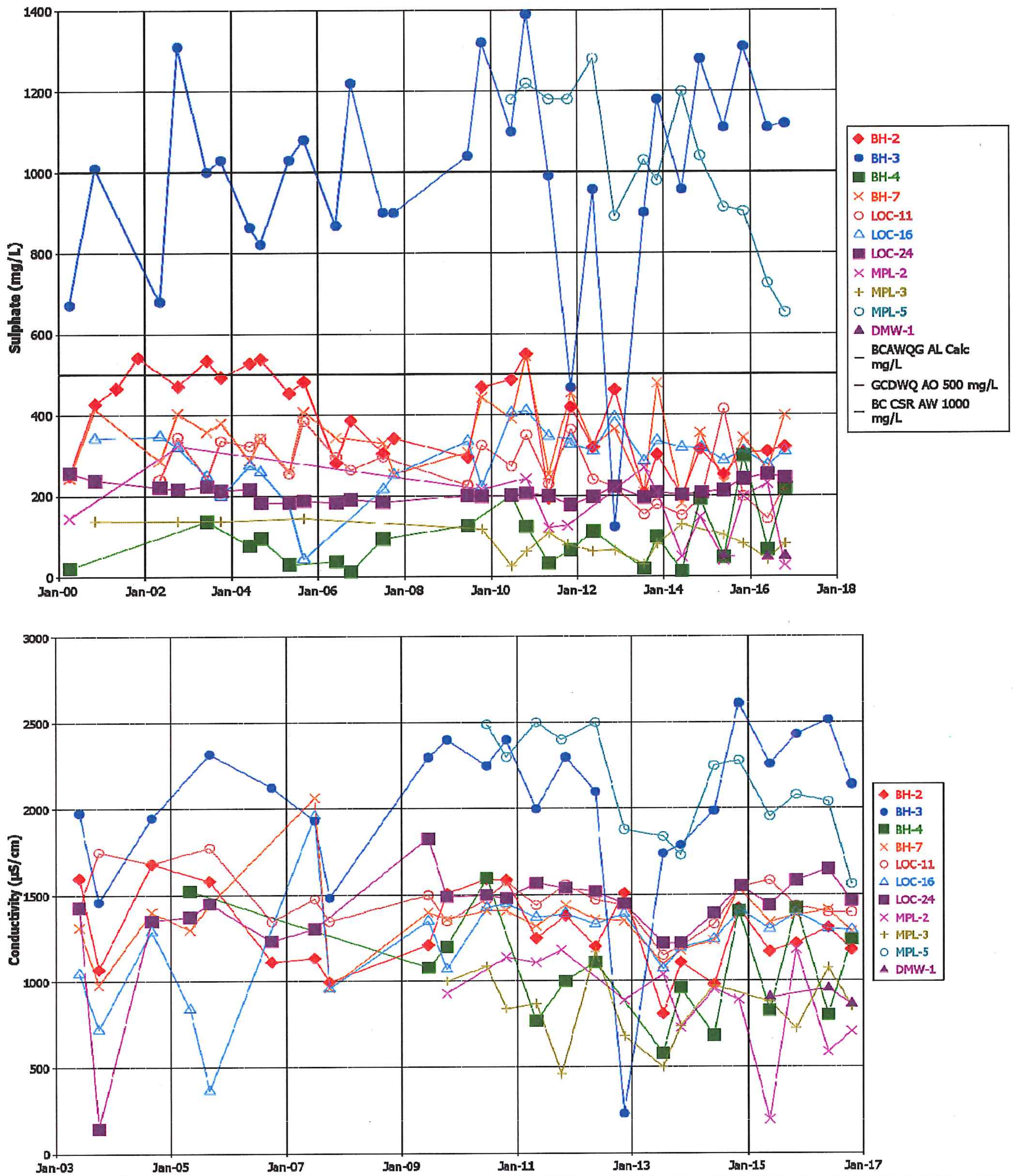
Columbia Shuswap Regional District

TITLE

Figure 4: Nitrate (Top) and Chloride (Bottom) Time Series Plots, Blind Bay, B.C.

western water
ASSOCIATES LTD

DRAWN	MJ	DATE	December 2016	PROJECT NO.	14-024-12
CHECKED	BRM	SCALE	n/a	DWG. NO.	n/a
REVIEWED	DG	FILE NO.		FIGURE REV. NO.	



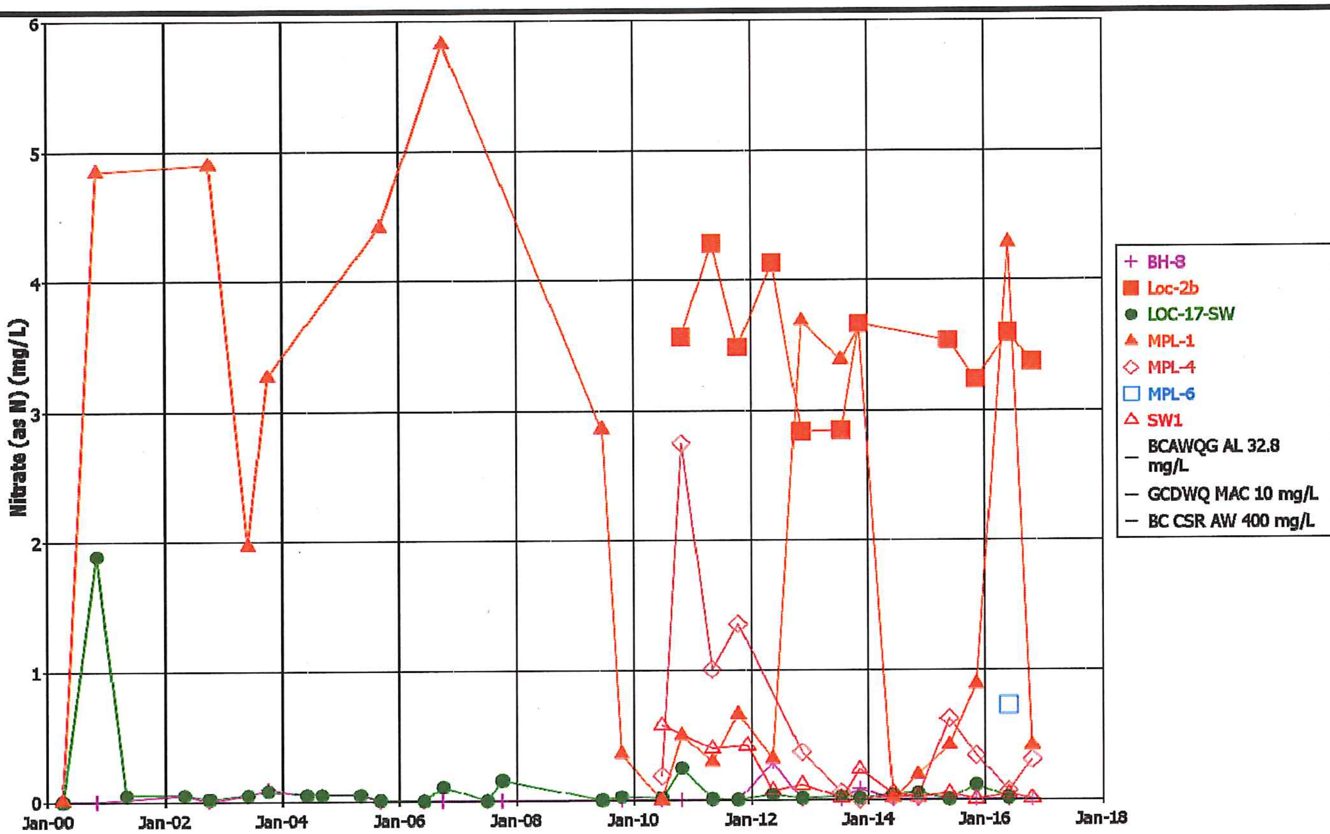
Columbia Shuswap Regional District

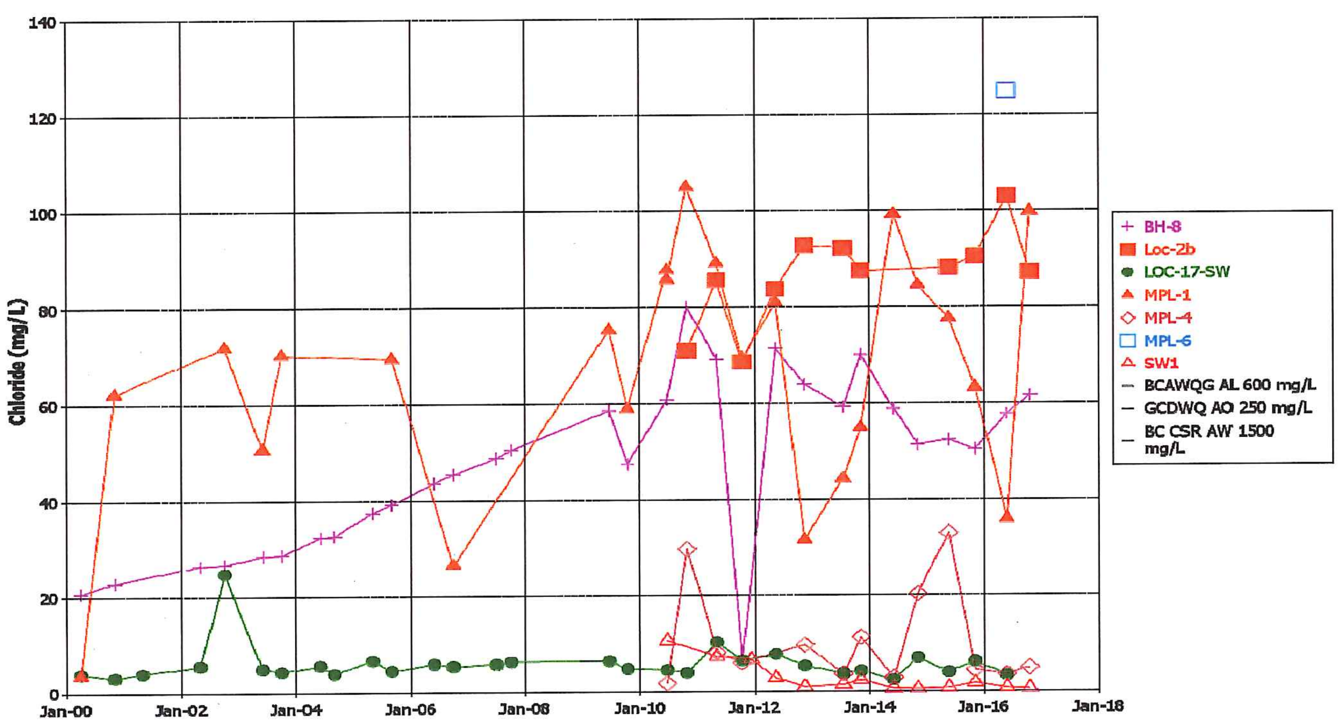
TITLE

Figure 5: Sulphate (Top) and Conductivity (Bottom) Time Series Plots, Blind Bay, B.C.

western water ASSOCIATES LTD

DRAWN	MJ	DATE	December 2016	PROJECT NO.	14-024-12
CHECKED	BRM	SCALE	n/a	DWG. NO.	n/a
REVIEWED	DG	FILE NO.		FIGURE REV. NO.	





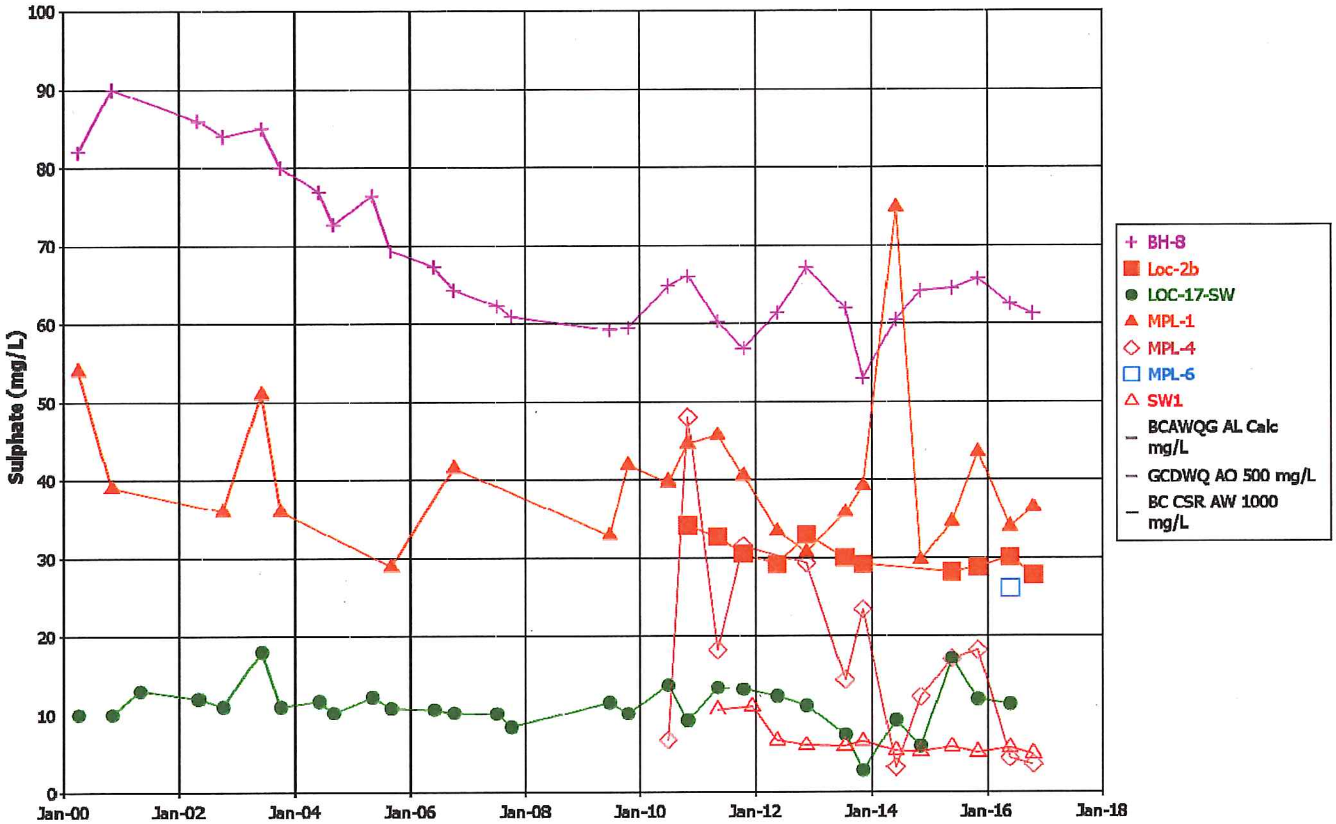
Columbia Shuswap Regional District

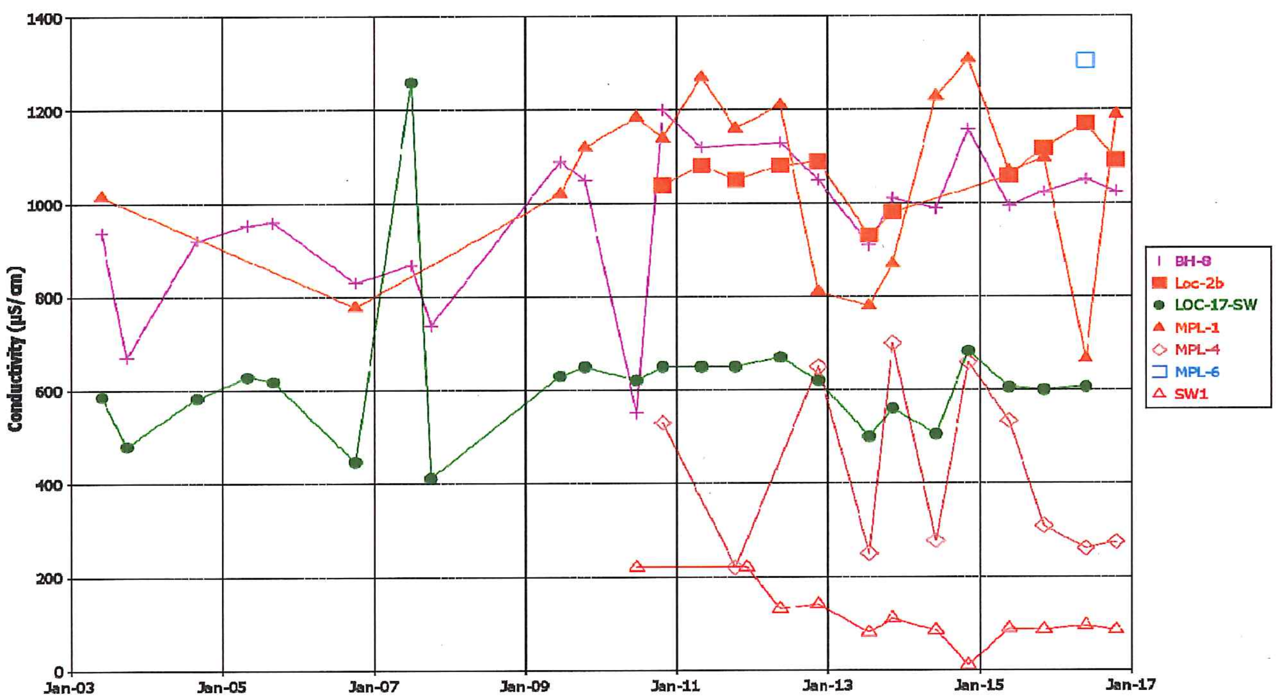
TITLE

Figure 6: Nitrate (Top) and Chloride (Bottom) Time Series Plots, Sorrento, B.C

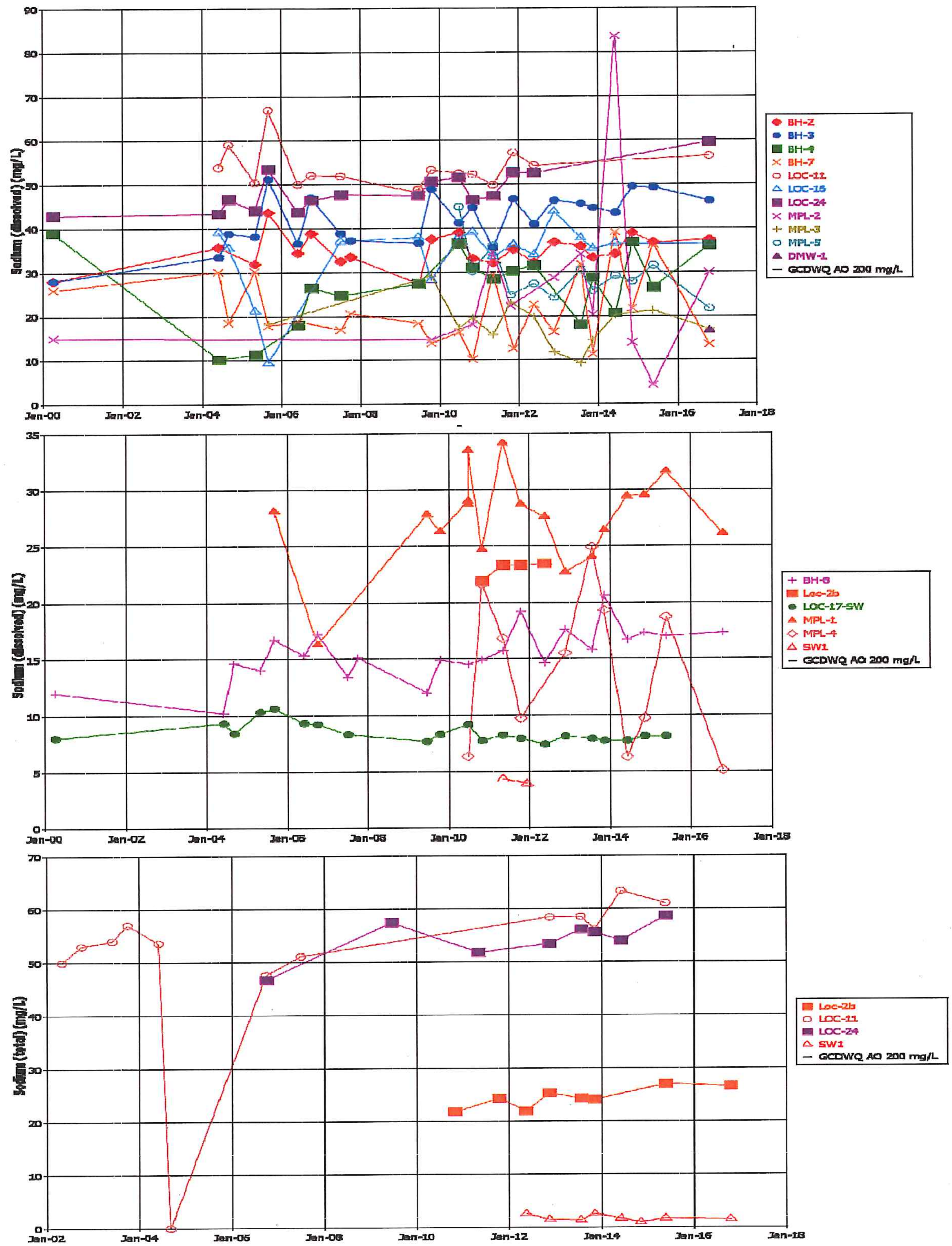
western water ASSOCIATES LTD

DRAWN	MJ	DATE	December 2016	PROJECT NO.	14-024-12
CHECKED	BRM	SCALE	n/a	DWG. NO.	n/a
REVIEWED	DG	FILE NO.		FIGURE REV. NO.	





Columbia Shuswap Regional District	TITLE **Figure 7:** Sulphate (Top) and Conductivity (Bottom) Time Series Plots, Sorrento, B.C.		
western water ASSOCIATES LTD	DRAWN MJ	DATE December 2016	PROJECT NO. 14-024-12
	CHECKED BRM	SCALE n/a	DWG. NO. n/a
	REVIEWED DG	FILE NO.	FIGURE REV. NO.



Columbia Shuswap Regional District	TITLE **Figure 8:** Dissolved Sodium, Blind Bay (Top) and Sorrento (Middle) and Total Sodium Blind Bay and Sorrento (Bottom) Time Series Plots.		
western water ASSOCIATES LTD	DRAWN MJ	DATE December 2016	PROJECT NO. 14-024-12
	CHECKED BRM	SCALE n/a	DWG. NO. n/a
	REVIEWED DG	FILE NO.,	FIGURE REV. NO.

EXHIBIT 17

Earth Tech / AECOM

Liquid Waste Management Plan
– Stage 3 Report

COLUMBIA SHUSWAP REGIONAL DISTRICT

Liquid Waste Management Plan

AREA 'C'

Stage 3 Report

Prepared for:
Columbia Shuswap Regional District
PO Box 978, 781 Marine Park Drive NE
Salmon Arm, BC
V1E 4P1

January, 2009
Project No. 97166

EARTH TECH | AECOM

TABLE OF CONTENTS

SECTION/TITLE PAGE

TABLE OF CONTENTS 2
LIST OF TABLES 3
LIST OF FIGURES 4
EXECUTIVE SUMMARY 5
1.0 PROCESS 10
2.0 PREFERRED AND FUTURE POTENTIAL SOLUTIONS 11
2.1 AREA–WIDE PREFERRED SOLUTIONS 11
Public Education, Monitoring and Bylaws 12
2.2 LAKE DISCHARGE CONTROLS FROM PRIVATE SOURCES 15
2.3 ALL NEW SEWER SYSTEMS TURNED OVER TO THE CSRD 21
2.4 PREFERRED SOLUTION FOR THE SORRENTO, BLIND BAY AND REEDMAN POINT AREAS 21
North Shuswap (Area 'F') Servicing 25
2.5 ALTERNATIVE PREFERRED SOLUTIONS FOR THE SORRENTO, BLIND BAY AND REEDMAN POINT AREAS 26
2.6 POTENTIAL FUTURE SOLUTION FOR THE SUNNYBRAE AREA 27
2.7 POTENTIAL FUTURE SOLUTIONS FOR THE WHITE LAKE AREA 30
2.8 CLOSED LOOP INTEGRATED WASTE MANAGEMENT 30
3.0 PUBLIC CONSULTATION 32
3.1 OVERALL COMMUNICATION PLAN OBJECTIVES 32
3.2 TARGET AUDIENCES & ASSOCIATED OBJECTIVES: 32
4.0 BYLAW IMPLEMENTATION 36
4.1 MANDATORY SEPTIC TANK PUMP-OUT BYLAW 36
4.2 MANDATORY WATER CONSERVATION 37
4.3 MANDATORY SOURCE CONTROL 38
4.4 LAKE DISCHARGE CONTROLS 38
4.5 MANDATORY TURN-OVER OF NEW SYSTEMS TO CSRD 38
4.6 MANDATORY CONNECTION TO A PUBLICLY OWNED SEWER SYSTEM 39
4.7 DEVELOPMENT COST CHARGE BYLAW 39
4.8 BORROWING BYLAW 39
5.0 ADDITIONAL IMPLEMENTATION CONSIDERATIONS 41
5.1 ON-SITE SEWER TO THE PROPERTY LINE 41
Typical On-Site Works and Estimated Costs 42
Potential Options for Improving Affordability of On-Site Works 43
5.2 TAKING ADVANTAGE OF OTHER CAPITAL PROJECTS TO REDUCE COSTS 44
5.3 USING TAX DEFERMENT PROGRAMS TO IMPROVE AFFORDABILITY 45
5.4 ADDRESSING FAILURES OF EXISTING ON-SITE SYSTEMS 46
5.5 TYPICAL ENGINEERING PROJECT SEQUENCE 47
5.6 DELIVERY OF SERVICE MODELS FOR SEWER SYSTEMS 48
6.0 CONCLUSIONS AND RECOMMENDATIONS 49

LIST OF TABLES

TITLE **PAGE**

Table 1: Average Household Costs for Preferred Solutions 11
Table 2: Estimated Capital Costs for SLE Regional Facility 24
Table 3: Potential Population Wastewater Flow Projection for North Shuswap Area 25
Table 4: Cost Breakdown for Regional Facility in the Balmoral Area 27
Table 5: Cost Breakdown for Sunnybrae Collection and Forcemain to Salmon Arm 28
Table 6: Internal Communication Tactics and Deliverables 33
Table 7: External Communication Tactics and Deliverables 34
Table 8: Typical Household Costs for a Residential Gravity Connection 42
Table 9: Typical Household Costs for a Residential Pumped Connection 43
Table 10: Summary of Total Household Costs By Area 51

LIST OF FIGURES

TITLE **PAGE**

FIGURE 1: SERVICING PLAN OVERVIEW FOR SORRENTO, BLIND BAY AND REEDMAN POINT 16
FIGURE 2: BLIND BAY AREA SERVICING PLAN 17
FIGURE 3: SORRENTO AREA SERVICING PLAN 18
FIGURE 4: REEDMAN POINT AREA SERVICING PLAN.. 19
FIGURE 5: SERVICING SCHEMATIC FOR A REGIONAL FACILITY IN THE BALMORAL AREA 20
FIGURE 6: SUNNYBRAE SERVICING OPTIONS 29
FIGURE 7: SCHEMATIC OF ON-SITE WORKS FOR A GRAVITY CONNECTION TO A SEWER MAIN................ 41

EXECUTIVE SUMMARY

During Stage 1, the Advisory Committee, the general public, CSRD staff and the consultant identified a number of options for the management of liquid waste issues in CSRD Electoral Area “C”. The brainstorming of ideas was encouraged and no filters were applied to eliminate or reduce the number of options. In Stage 2 the options were expanded to allow the Advisory Committee and the general public to understand the environmental, health, social and cost aspects for each option.

The task of the Advisory Committee in Stage 2 was to review all the detailed options and identify their preferred set of options for the management of liquid wastes throughout the plan area. The preferred options as well as the other options were presented to the public and their feedback and comments solicited. The options preferred by the public and by the Advisory Committee are documented in the Stage 2 report and are summarized in Table ES-2. This set of preferred options was adopted by the CSRD Board.

Based on the results of the Stage 2 Liquid Waste Management Plan, the CSRD should begin implementing the recommendations of the Advisory Committee. Key recommendations from this plan are:

1. For the entire Area ‘C’, preferred solutions include public education, water quality monitoring and bylaws. These programs serve to minimize the environmental and health impacts of existing septic systems and set the stage for management of new and existing community sewer systems in a way that is consistent with the values of the community.

   The objective of the public education component is to reduce health and environmental impacts by developing public education programs which are directed towards:

   - Optimal septic tank operation and maintenance (Includes recommended pump-out frequency)
   - Water conservation
   - Source control

   The monitoring program component involves the establishment of a series of monitoring programs to determine the health and environmental impacts from development in the LWMP area. The monitoring program would include sampling programs for lakes, streams and wells and the recording of baseline data for trend determination.

   Implementation of bylaws provides an incentive to comply with the public education programs noted above. The bylaws that were suggested are:

   - Mandatory septic tank pump-out program
   - Mandatory water conservation
   - Mandatory source control
   - Lake discharge controls

- Mandatory turn-over of new systems to CSRD
- Mandatory connection when a publicly owned and operated sewer system is available within the identified sewerage area
- Development Cost Charge Bylaw
- Borrowing Bylaw

2. Implementing and enforcing some of the recommended bylaws will require developing some level of building inspection. As a result, introduction of a Building Regulation Bylaw for Area 'C' is recommended.

3. To address potential public health and environmental conflicts surrounding private lake discharge, this LWMP recommends that all private discharges of treated effluent, included treated grey water from nautical vessels, be prohibited from Shuswap Lake and White Lake.

4. For the Sorrento, Blind Bay and Reedman Point area, development of a new community sewer system and wastewater treatment plant is recommended. Based on the results of preliminary negotiations with Shuswap Lake Estates, the option of developing the Shuswap Lake Estates treatment plant as a regional facility has been dropped as the preferred option. As a result, purchase of land in the Balmoral area for a treatment plant and storage should be investigated. This will entail entering into discussions with the Agricultural Land Commission (ALC) for approval to construct a wastewater treatment plant and storage reservoir on ALR land. There is precedent for approval of this request from the ALC.

5. A back-up ground infiltration system may be needed for the new effluent irrigation system. Once a new site in the Balmoral area is established for a new wastewater treatment plant and storage reservoir, a hydrological review of the area should be undertaken and an infiltration site identified.

6. In order to be affordable, the cost of developing the Sorrento, Blind Bay and Reedman Point sewer system will need to be funded by Provincial and Federal grants. The household cost documented in the Stage 2 report and presented to the public assumes that the grants will cover 2/3 of the capital cost of the system. The CSRD should apply for the grant at the earliest opportunity once the Area C LWMP is approved by the CSRD Board of Directors and the Minister of the Environment.

7. Distribution of household cost for the remaining 1/3 capital cost should be based on assessed value of improvements.

8. The homeowner will also be responsible for the on-site costs to tie-in to the new sewer system. This cost is estimated to be on average $4,305 for a gravity connection and $4,840 for a pumped connection. The household costs, both for on-site and off-site works, may be communicated to the public through a newsletter, the CSRD website, and other means. The CSRD should provide a list of qualified and available contractors to the residents of the sewer service area and provide information to assist the residents in selecting a preferred contractor.

9. Long term effluent supply contracts should be established with farmers for the disposition of the reclaimed water.

10. As part of the preliminary design stage of the Regional treatment plant, a long-range servicing plan should be developed. In the event that a mandatory septic tank pump-out program is contemplated and there is a lack of capacity by the private sector to handle the volumes and work load associated with such a program, this plan should incorporate a plan for developing a septage handling facility to accommodate pumped waste from septic tanks.

11. Due to its relatively small size initially, hiring a contractor to operate the new sewer system and treatment plant will help to minimize costs. However, as the system grows, the CSRD should consider taking over operation and maintenance of the system.

12. As part of the development of the new sewer system and treatment plant, the CSRD should develop an integrated waste management plan that includes agricultural waste (manure) and any waste by-product from the treatment plant.

13. For the Sunnybrae and White Lake area, water quality monitoring should be initiated to assess the impact of existing development on the lake and groundwater. The results of the testing may serve as a trigger for development of a new community sewer system.

14. It is recommended that holding tanks be allowed for homes within a proposed sewerage area to address the failure of an existing on-site system. Installation of the holding tank is intended to assist the homeowner is avoiding a large expenditure for an on-site system upgrade in an area where a community sewer system is planned.

Table ES-1 provides a summary of annual household cost by sub-area, based on the summary conclusions and recommendations made in this report.

The CSRD obtained a legal opinion from its solicitor concerning a public assent process. The opinion states "…if the proposed sewer service and related borrowing are for the purpose of implementing the proposed LWMP, then once that LWMP is approved by the Minister, the Regional District would be able to adopt the service establishment bylaw and borrowing bylaw without the assent of the electors…" Although an assent process is not required, an assent process may be implemented at the call of the Area Director or Board of Directors. From a timing perspective, an assent process should follow approval of the grant application from senior government.

As a final recommendation, the CSRD Board should adopt Stage 3 LWMP Report as a bylaw and submit it to the Minister of Environment for approval.

Table ES-1: Summary of Total Household Costs By Area

Area	Estimated Annual Cost (Based on 20 Year Amortizaton at 6% Interest)				Comments
	Solution 1 - Public Education, Water Quality Monitoring, and Bylaws	Capital Cost for Development of a Community Sewer System	Annual Operation and Maintenance Cost for Sewer System	Total Estimated Average Annual Cost	
1. Blind Bay, Sorrento and Reedman Point	$40	$646	$110	**$796**	1. Estimated cost assumes that a new Regional facility is constructed in the Balmoral area. 2. The additional on-site cost to install a service from the home to the property line is estimated to be on average $4,300 to $4,840 3. O&M costs may be higher if servicing is phased.
2. Sunnybrae	$40	-	-	**$40**	The Sunnybrae area may require a new community sewer if water quality monitoring detects an impact - under this scenario, the total household cost will increase to an estimated $1,456 per year.
3. White Lake	$40	-	-	**$40**	The White Lake area may require a new community sewer if lake water quality monitoring detects an impact - under this scenario, the household cost wil increase.
4. Rural Areas (Balmoral, Notch Hill, Tappen Valley, Carlin, Skimikin, Eagle Bay and Wild Rose Bay	$40	-	-	**$40**	

Table ES-2: Summary of Design Criteria for Each of the Selected Options

Decision Criteria Category	SELECTED PREFERRED AND POTENTIAL OPTIONS						
	1.) Public Education, Monitoring and Bylaws	**2.) Controls for Lake Discharge from Private Sources**	**3.) All New Sewer Systems Turned Over to the CSRD**	**4.) Develop Shuswap Lake Estates WWTP as a Regional Facility****	**5.) Construct a New Regional Facility in the Balmoral Area (*Alternative Option for 4.*)**	**6.) Pump Wastewater from Sunnybrae to the Salmon Arm Sewer System**	**7.) Pump Wastewater from White Lake to Regional facility**
Environmental and Human Health & Safety	• Protects water quality through adoption of optimal maintenance practices • Monitoring will identify emerging problems • Facilitates future recycling programs	• Minimizes potential health risks to drinking and recreational water users • Avoids potential proliferation of lake dischargers	• Reduces risk of failed systems	• Excellent effluent reuse potential in the area • Water quality protected through use of effluent for irrigation	• Excellent effluent reuse potential in the area • Water quality protected through use of effluent for irrigation	• No beneficial reuse of effluent	• Excellent effluent reuse potential in the Balmoral area
Financial	• $40 /yr/household†† • Relatively low cost distributed over entire Area 'C'	• No capital cost	• Reduced operational costs from economies of scale	• $602 /yr/household for system construction†† • $110 /yr/household for operation of lagoon system	• $646 /yr/household for system construction†† • $110 - $130 /yr/household for operation of system	• $814 /yr/household for system construction†† • $248 /yr/household for operation of system	• $428 /yr/household for pumping to SLE
Technical	• Data obtained can be used to select objective technical solutions	• Eliminates pollution associated with seasonal start-up of treatment processes and unqualified operators	• Ensures consistent design and operational standards	• Provides excellent treatment reliability • Includes backup emergency infiltration system	• Provides excellent treatment reliability	• Operation of system provided by existing utility • Requires a lake forcemain	• Provides excellent treatment reliability
Social	o Allows for proactive protection of the environment	• Community has expressed opposition to lake discharge from private sources	• There is a higher level of public confidence in local government • Greater accountability	• Utilizes an existing treatment plant • Provides for earliest installation of a sewer system	• Requires constructing a new STP on agricultural land • Provides for installation of a sewer system		
Educational	• Provides for increased public awareness		• Increased potential for water conservation initiatives				
Administrative & Planning	• Data acquired can be used to make land-use decisions		• Promotes community sewer systems, consistent with draft OCP's	• Good buffers in-place • Compatible with draft OCP • Eliminates two parallel systems in the Blind Bay area	• Good buffers available • Compatible with draft OCP	• Compatible with draft OCP	• Allows for future servicing if required • Compatible with draft OCP

** Based on the results of preliminary negotiations with Shuswap Lake Estates, the option of developing the Shuswap Lake Estates WWTP as a regional facility is not recommended.
†† Based on an average annual household cost

1.0 PROCESS

During Stage 1, the Advisory Committee, the general public, CSRD staff and the consultant identified a number of options for the management of liquid waste issues in CSRD Electoral Area “C”. The brainstorming of ideas was encouraged and no filters were applied to eliminate or reduce the number of options. In Stage 2 the options were expanded to allow the Advisory Committee and the general public to understand the environmental, health, social and cost aspects for each option.

The task of the Advisory Committee in Stage 2 was to review all the detailed options and identify their preferred set of options for the management of liquid wastes throughout the plan area. The preferred options as well as the other options were presented to the public and their feedback and comments solicited. The options preferred by the public and by the Advisory Committee are documented in the Stage 2 report. This set of preferred options was adopted by the CSRD Board.

The Advisory Committee adopted the following series of principles as part of the Stage 1 to guide the process.

1. The communities within Area ‘C’ and the Shuswap watershed rely on Shuswap Lake for drinking water and recreation and place a high value on its aesthetics. Preserving the environmental quality of the lake is of paramount importance in the context of a liquid management plan. Therefore, the committee believes the plan needs to emphasize minimizing environmental impacts of wastewater effluent.

2. Foreshore water quality testing in Shuswap Lake has detected an impact from human activities and a “do nothing” approach is no longer acceptable.

3. The Advisory Committee favours options that emphasize re-using effluent for irrigation and habitat enhancement, followed by ground disposal. The Advisory Committee does not support lake discharge of effluent.

4. The committee supports establishment of appropriate bylaws and public education programs to achieve the LWMP objectives.

LWMPs are encouraged by the Ministries of Environment and Health, especially for rural areas dependent upon on-site treatment and disposal systems, to investigate existing circumstances, research viable alternatives and improvements and with public input recommend the most financially, socially, and environmentally acceptable solutions.

2.0 PREFERRED AND FUTURE POTENTIAL SOLUTIONS

A summary of all the preferred and future potential solutions is provided in this section. Additional information available after the completion of the Stage 2 report was added as necessary. Options that were considered but not selected for implementation can be referenced in the Stage 2 report.

Table 1 provides a summary of costs associated with the preferred solutions.

Table 1: Average Household Costs for Preferred Solutions

Preferred Solutions	Contributing Area	Total Net Cost	Cost Distributed By Parcel		Cost Distributed By Assessed Value of Improvements			
		Total Net Cost with 2/3 Grant Funding If Eligible ($ Million)	Average Net Parcel Cost ($)	Average Annual Household Cost Financed Over 20 Years at 6% Interest ($)	Total Assesed Value in Contributing Area ($ Million)	Cost per $100,000 Assessed Value ($)	Annual Cost per $100,000 Assessed Value Financed Over 20 Years at 6% Interest ($)	Average Annual Household Cost Financed Over 20 Years at 6% Interest ($)
1. Public education, Water Quality Monitoring, and Liquid Waste Management Bylaws	Area 'C'	$0.240	$52	**$52**	$946.2	$25	$25	**$40**
2. Controls for Lake Discharge from Private Sources	Area 'C'	-	-	-	-	-	-	**-**
3. All New Sewer Systems Turned Over to the CSRD	Area 'C'	-	-	-	-	-	-	**-**
4. Shuswap Lake Estates as a Regional acility	Sorrento/Blind Bay/Reedman Point	$18.7	$8,000	**$658**	$436	$4,293	$353	**$602**
5. Develop a New Regional Facility in the Balmoral Area (*Only If Solution 4 Does Not Proceed*)	Sorrento/Blind Bay/Reedman Point	$20.1	$8,600	**$707**	$436	$4,613	$379	**$646**

2.1 AREA–WIDE PREFERRED SOLUTIONS

Area wide preferred solutions appear here in an abbreviated form.

The option of doing nothing, while not appearing in the Stage 1 report was presented to the public as "*Option 0*", at both of the Public Information Meetings. The option is not a realistic approach for dealing with the existing and potential liquid waste issues identified in Area 'C'. However, there are some areas where the current approach of on-site septic systems is adequate. For example, large lots greater than 1 hectare located in rural areas and in good soil conditions could continue to be serviced by on-site systems with minimal impacts.

Under a *status quo* scenario, everyone currently served by septic tanks, dry wells or collection and treatment systems would continue to be served in the same manner. Any new lots relying on on-site treatment systems would need to be sufficiently large to satisfy the Ministry of Health design standards (*Sewerage System Standard Practice Manual*). Furthermore, under the Ministry of Community Services standards, any lots that utilize a well for drinking water and an on-site septic system would be required to have a minimum size of 1 hectare.

As an area-wide solution, the "Do Nothing" options cannot address problems in areas where nutrient and bacteria associated with septic systems is being measured in the Lake and groundwater. Nor can this option identify or prevent emerging contamination issues like those in Sunnybrae.

As a result, the option of doing nothing is not an approach that can be considered on its own. For this reason, additional options for dealing with liquid waste management issues are required.

PUBLIC EDUCATION, MONITORING AND BYLAWS

This option requires a combination of public education, water quality monitoring and bylaws to manage the impacts of liquid waste in the environment. Each of these components is considered below.

PART 1: EDUCATION

The objective of this component is to reduce health and environmental impacts by developing public education programs which are directed towards:

- Optimal septic tank operation and maintenance (Includes recommended pump-out frequency)
- Water conservation
- Source control

Under this option, annual information mail-outs, incentive rewards, and website updating could be provided. Staff and consultant time would be required to undertake these tasks.

As part of this option, the database on septic systems begun in 2004 should also be further developed and include tracking of septic tank pump-outs to confirm the efficacy of the educational programs. Subsequent to the 2002 LWMP, summer students were hired to conduct a survey of the septic systems in the existing Shuswap OCP area including Cruikshank Point, Sorrento, Notch Hill/Balmoral areas, Blind Bay, Eagle Bay and Reedman Point. This survey identified that a large number of dry wells were being used in the place of disposal fields. The parcels missed in the first survey could be re-contacted. In addition, the survey should be extended to the White Lake and Sunnybrae areas.

Additional information on maintenance and pump out frequency of septic systems gained by the survey would be valuable for future planning and decision making. In particular, if the survey showed the educational program was not resulting in better care and maintenance of on-site septic systems, a pump-out bylaw could be implemented.

An allowance of $70,000 for the first year is suggested for an educational program which includes a one-time septic system survey component. The annual cost in subsequent years should decrease. If the $70,000 annual cost is distributed over the entire plan area of 4,621 homes (*Obtained from BC Stats 2006 Census*) the annual cost per household is approximately $15 for the first year. This cost would apply to all parcels in Area 'C' as everyone would benefit. The development of educational programs could be initiated shortly after the LWMP is approved and so may be considered a "Short Term" option.

This option is relatively inexpensive, simple to implement and should result in extended on-site system life. The estimated cost of replacing a septic system to meet current standard is $10,000 to $25,000. In relative terms, the education program could have significant value to the homeowner by avoiding a potentially unnecessary failure.

This option would likely provide protection for public health and the environment as long as the public in the area recognize that it is in their best interest to follow the recommendations of the educational programs. If the follow-up survey suggests that the education programs are ineffective and can show risks to public health and the environment, a mandatory pump-out program may be required.

PART 2: MONITORING

This program component involves the establishment of a series of monitoring programs to determine the health and environmental impacts from development in the LWMP area. The monitoring program would include sampling programs for lakes, streams and wells and the recording of baseline data for trend determination.

Currently, the CSRD partners with MOE on a lake monitoring program. The program is paid for by a levy. Of the maximum $25 levy that the Board authorized for education, septic tank survey, and monitoring, currently approximately $5 to $7 is spent on monitoring. The current lake and groundwater monitoring program would be continued or expanded as one component of the overall program. The specific monitoring programs would need to be developed in consultation with environmental specialists from MOE. Also, consideration should be given to continuing sediment core sampling in the Salmon Arm area. MOE has indicated that the data obtained from the sediment core sampling could shed light on the water quality changes being detected in the Salmon Arm portion of Shuswap Lake.

A levy similar to the existing amount of $25 should remain in-place to address monitoring requirements. The levy amounts to an annual budget of $115,000, assuming a total of 4,621 homes in the CSRD Area 'C' *(BC Stats 2006 Census)*. Development of new monitoring programs could begin shortly after plan approval and may be considered a "Short Term" option. In particular, the water quality monitoring should continued in the North Arms of Shuswap Lake and be initiated in the Salmon Arm and in White Lake.

It is recommended that all water quality monitoring be undertaken in conjunction with Shuswap Lake Integrated Planning Process (SLIPP), as well as any other related government agencies. To maximize resources, water quality monitoring by SLIPP, Ministry of Environment, Interior Health and CSRD should be coordinated to avoid duplication. An annual meeting could be convened to review sampling programs by the various stakeholders and ensure consistent standards and protocols are met.

The implementation of this option for each area is relatively inexpensive and it would provide trends and current status of the environment in each area. The establishment of a trigger would provide an indication of when selected remedial measures noted in the LWMP should be implemented, such as installation of a sewer system at Sunnybrae and White Lake.

PART 3: BYLAWS

Under this program component, health and environmental impacts would be reduced by developing, implementing and enforcing bylaws. This option provides an incentive to comply with the public education programs noted above. The bylaws that were suggested are:

- Mandatory septic tank pump-out program
- Mandatory water conservation
- Mandatory source control
- Lake discharge controls
- Mandatory turn-over of new systems to CSRD
- Mandatory connection when a publicly owned and operated sewer system is available within the identified sewerage area
- Development Cost Charge Bylaw
- Borrowing Bylaw

Under a Bylaw program, enhanced septic tank pump-out tracking will track the frequency of septic tank pump-out, either paid directly by the homeowner or taxed by the Regional District. A bylaw enforcement approach to managing on-site septic systems should only be implemented if the educational programs are not producing satisfactory results. In addition, sufficient data on the on-site septic systems should have been acquired under the education program to support the bylaw option. In the absence of a good database on where the least effective septic systems are located, a bylaw enforcement program could be inefficient.

The estimated cost to implement this option is $120,000 a year, which when spread over the entire plan area of 4621 homes (*Obtained from BC Stats 2006 Census*) represents an annual cost of $26 per household. The cost estimate includes provision for legal consultation, administration, inspection services and bylaw enforcement. This cost would apply to everyone in the LWMP area as everyone would benefit. Bylaws require enforcement personnel in order to be effective. The development and implementation of the three bylaws would likely take some time and may be considered as "Long Term" options.

2.2 LAKE DISCHARGE CONTROLS FROM PRIVATE SOURCES

The *Municipal Sewage Regulation* (MSR) provides criteria for discharge of effluent to the lake from private sources to occur. The MSR allows for the discharge of effluent to the lake within Area ‘C’, only if specific quality criteria are met. However, the installation or planned installation of lake outfalls for discharge of treatment plant effluent has resulted in considerable concern within the community.

There are concerns that some sewage treatment plants used to service private developments may not be able to maintain an acceptable effluent quality due to operational challenges with seasonal fluctuations in flows, and unqualified personnel operating the systems. With the proliferation of lake outfalls, the effluent could represent a significant health risk to the many residents that use the lake as a source of potable water. This option is intended to address the risks associated with private outfalls by imposing restrictions on lake discharge of effluent.

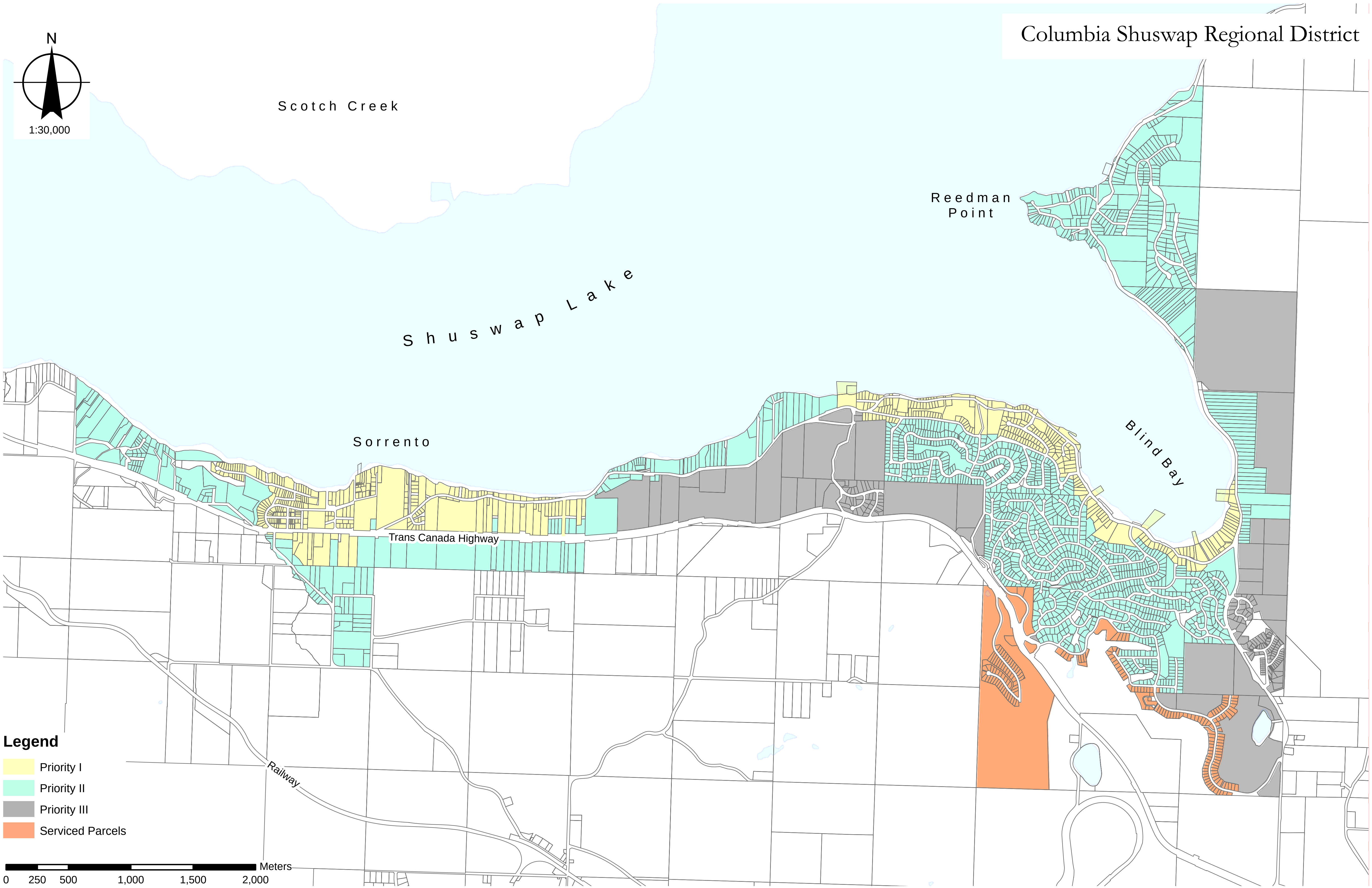
Treatment plants in the Okanagan that discharge effluent to the lake system are required to be owned and operated by a local government. This regulation recognizes that local governments have a long-term interest in maintaining a sewage treatment plant. In addition, local governments have the ability through grant funding and taxation authority to adequately operate and when appropriate upgrade these facilities. Residents of small subdivisions often do not have the funding or resources to adequately maintain sewage collection and complex treatment systems.

In addition, the Ministry of Environment has received interest from nautical vessel operators to implement standards for grey water treatment systems. Under this scenario, grey water would be treated on-board the vessel rather than be pumped out at a regulated marina and treated at a Regional facility. Effluent from the on-board treatment system would be discharged directly to the lake. The Advisory Committee is opposed to the approach of on-board treatment of grey water treatment because it constitutes a potential health risk to residents using the lake as a drinking water source.

To address potential public health and environmental conflicts surrounding private lake discharge, this LWMP recommends that all private discharges of treated effluent, included treated grey water from nautical vessels, be prohibited from Shuswap Lake and White Lake.

Once this LWMP is approved by the MOE and a Bylaw has been adopted by Board, the Ministry will no longer grant registrations for the disposal of effluent to the lake from private sources.

Liquid Waste Management Plan - Stage III



Servicing Plan Overview

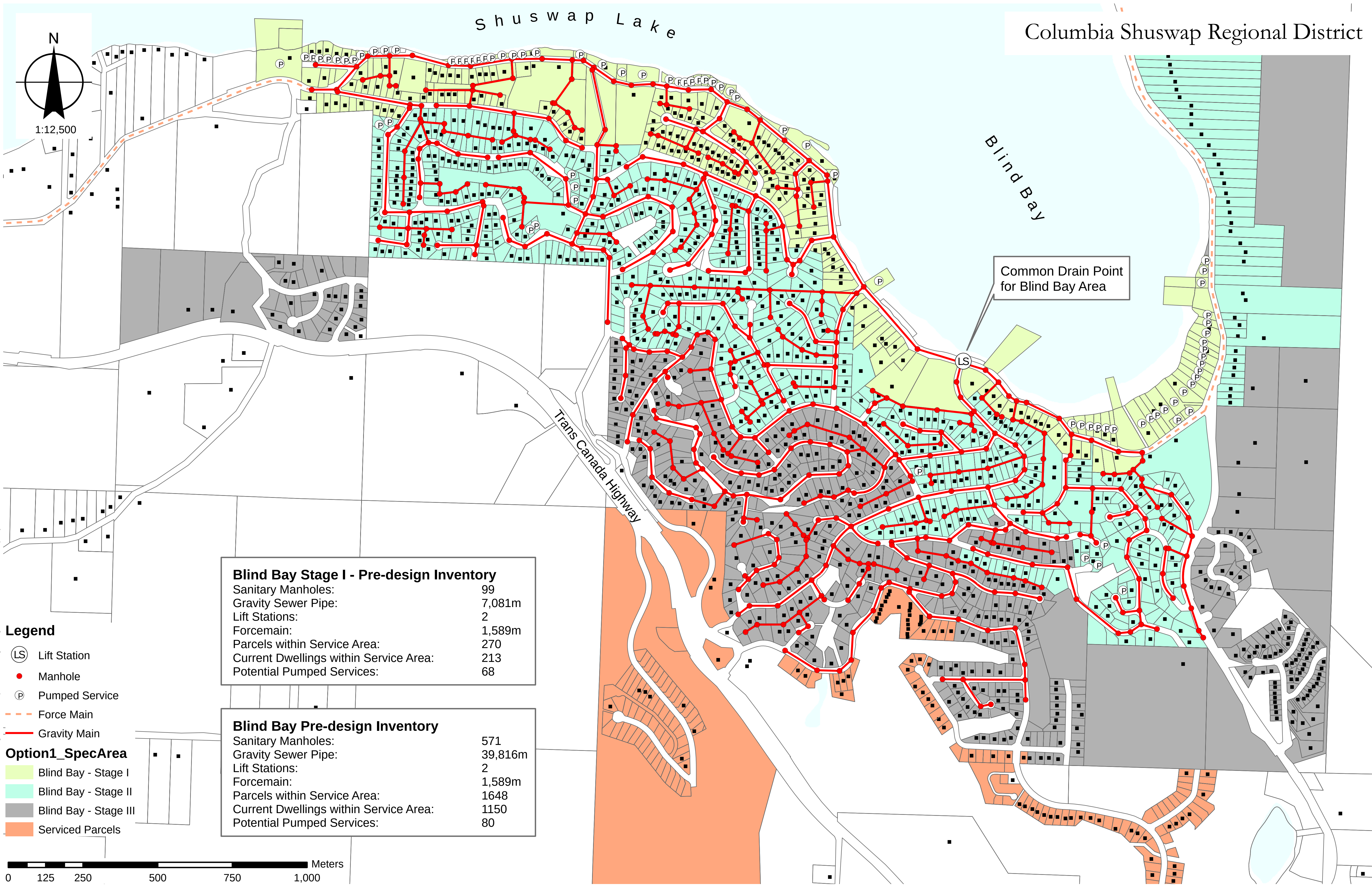
Sorrento, Blind Bay, and Reedman Point

Figure

01

Columbia Shuswap Regional District

Blind Bay Area Servicing Plan

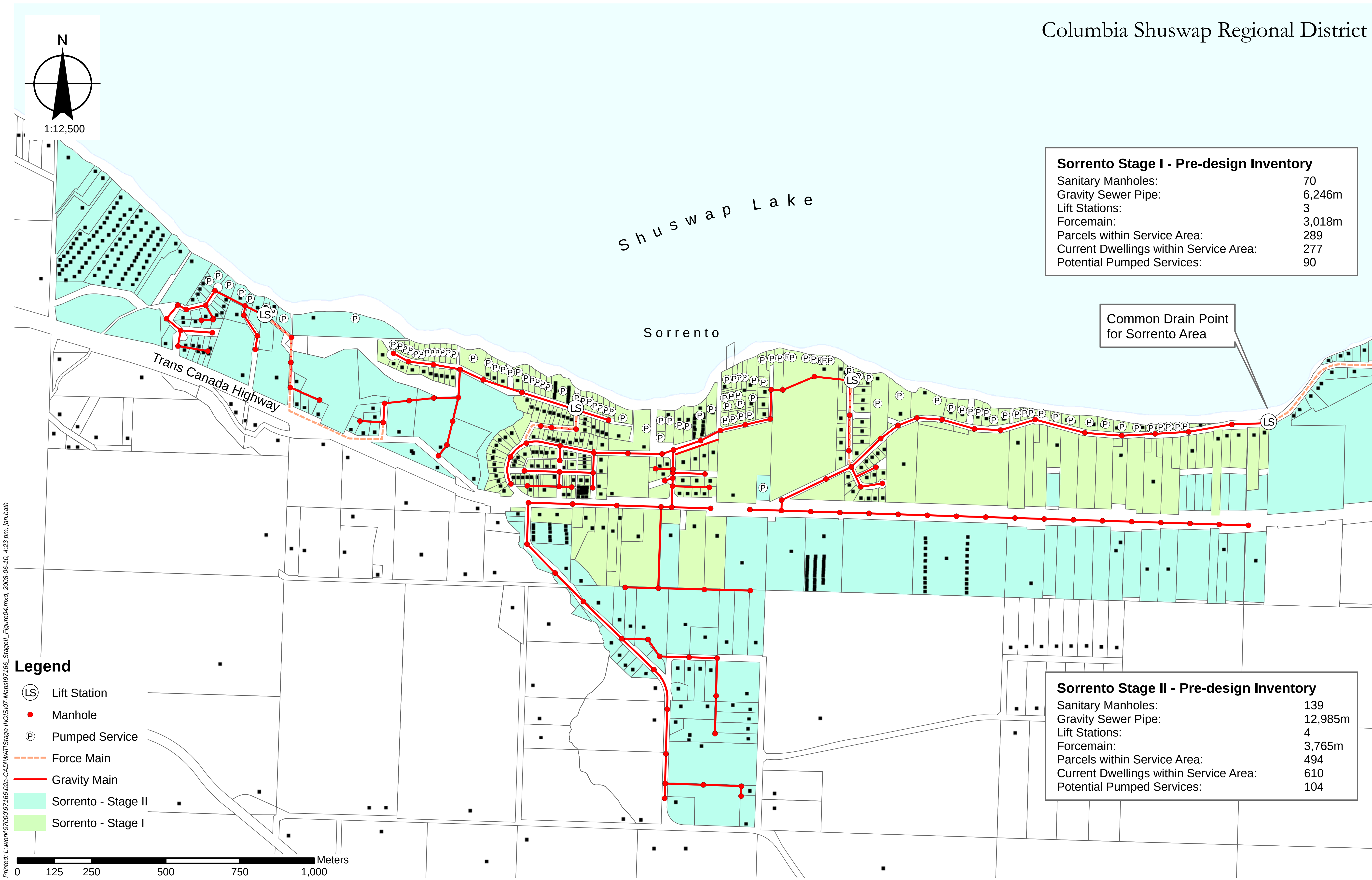


Blind Bay Stage I - Pre-design Inventory	
Sanitary Manholes:	99
Gravity Sewer Pipe:	7,081m
Lift Stations:	2
Forcemain:	1,589m
Parcels within Service Area:	270
Current Dwellings within Service Area:	213
Potential Pumped Services:	68

Blind Bay Pre-design Inventory	
Sanitary Manholes:	571
Gravity Sewer Pipe:	39,816m
Lift Stations:	2
Forcemain:	1,589m
Parcels within Service Area:	1648
Current Dwellings within Service Area:	1150
Potential Pumped Services:	80

Figure

02

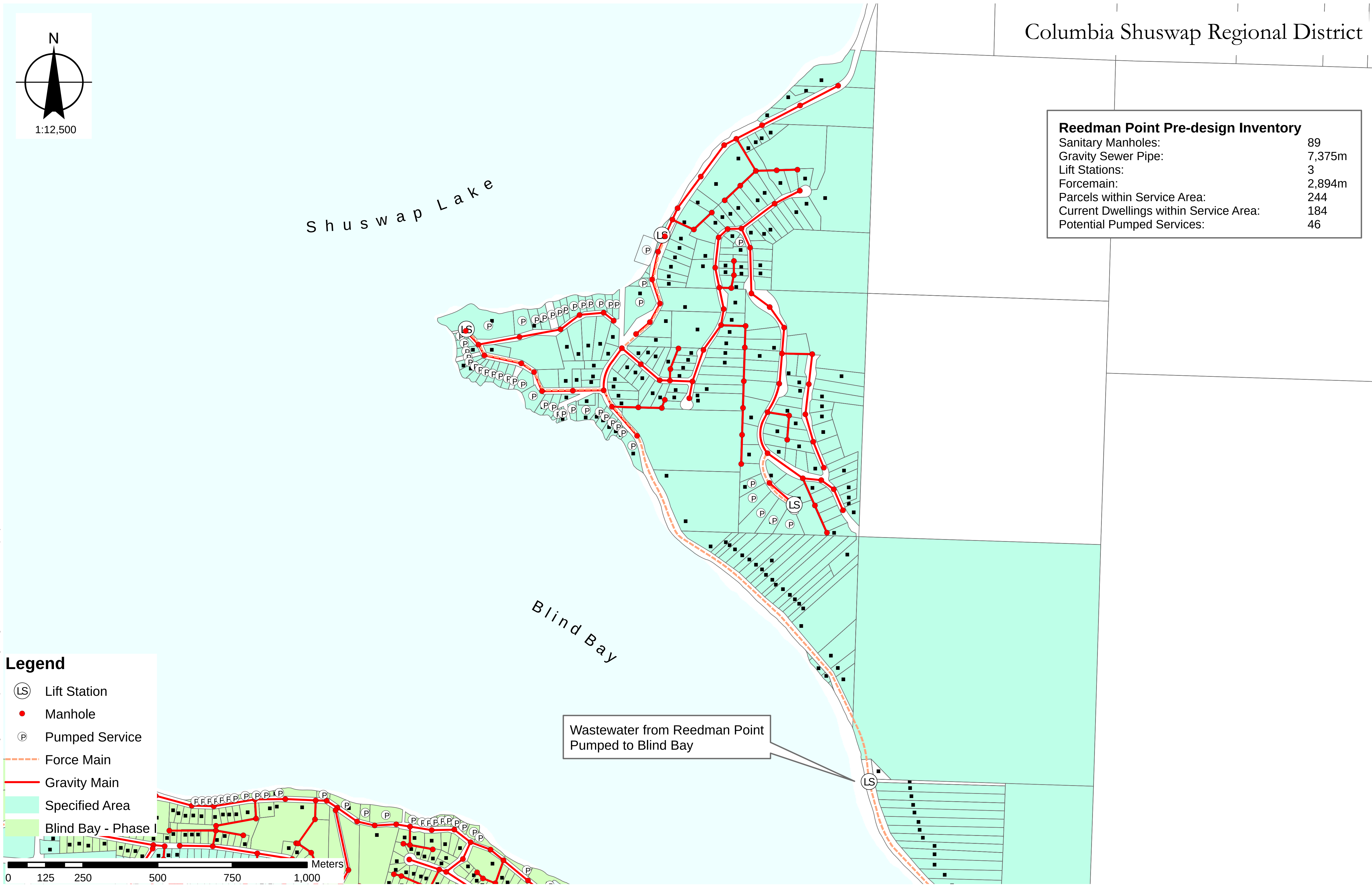


Sorrento Area Servicing Plan

Figure

03

Reedman Point Area Servicing Plan

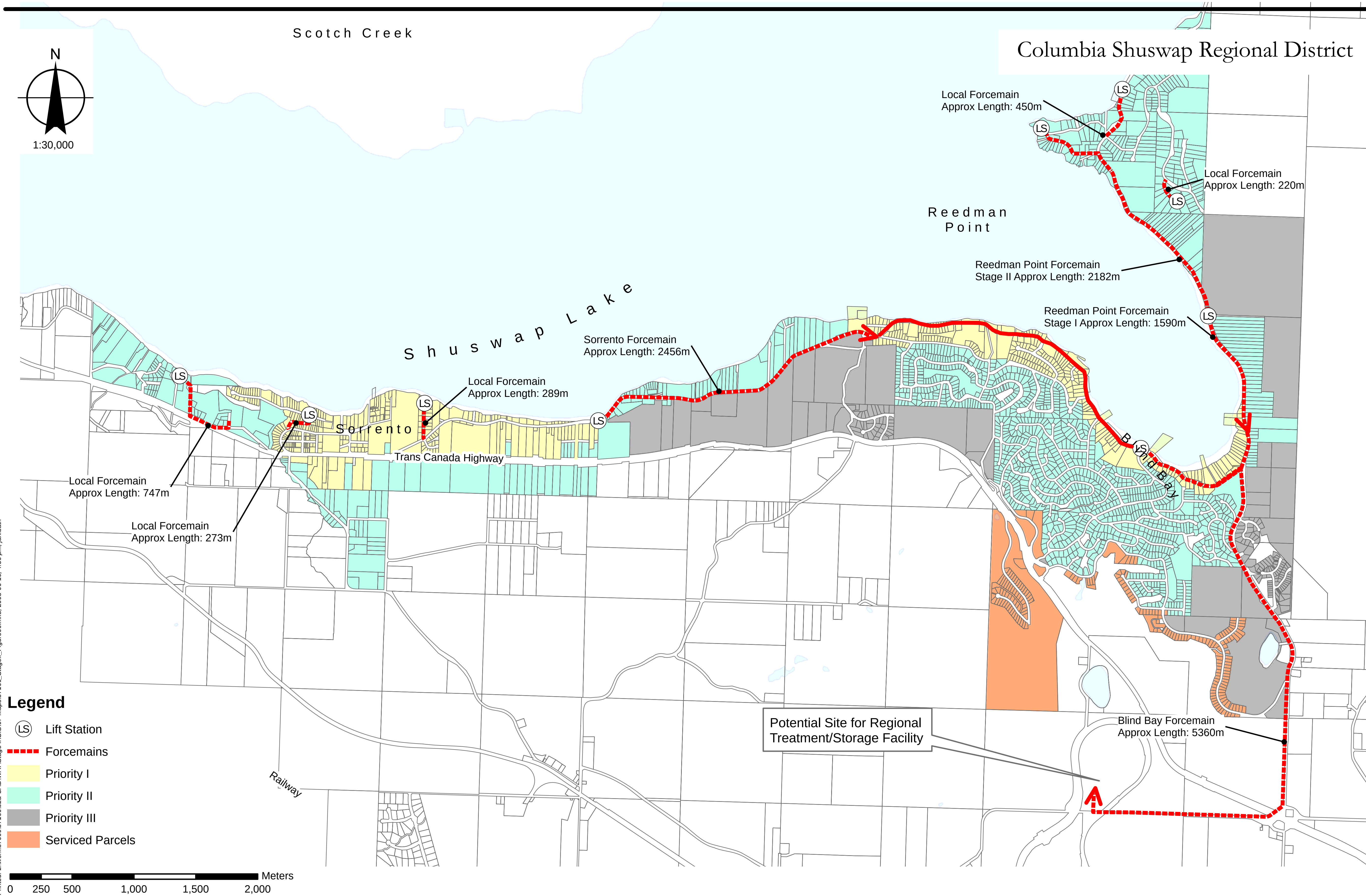


Reedman Point Pre-design Inventory

Sanitary Manholes:	89
Gravity Sewer Pipe:	7,375m
Lift Stations:	3
Forcemain:	2,894m
Parcels within Service Area:	244
Current Dwellings within Service Area:	184
Potential Pumped Services:	46

Figure
04

Liquid Waste Management Plan - Stage III



Servicing Schematic for a Regional Facility in the Balmoral Area

Sorrento, Blind Bay, and Reedman Point

Figure

05

2.3 ALL NEW SEWER SYSTEMS TURNED OVER TO THE CSRD

Under this option, new treatment plants and community sewer systems constructed to service private developments in Area 'C' would be required to be transferred to the CSRD once operational. In effect, the private sewer system becomes publicly owned through the transfer. A developer would construct each of the systems to CSRD criteria, using standard pumps, pipe and fittings to reduce CSRD inventory requirements and facilitate replacement of worn out or defective parts and equipment. The transfer would be at no cost to the CSRD. After the transfer is complete, the CSRD would own and operate the systems, either directly or through a contractual arrangement with an established utility company. Sewer fees would be collected from residents to pay the operational and replacement costs.

Some additional administrative costs might be incurred by the CSRD by a transfer which would need to be passed on to the homeowners within the sewerage area. This cost would vary depending on the size and location of the system.

2.4 PREFERRED SOLUTION FOR THE SORRENTO, BLIND BAY AND REEDMAN POINT AREAS

Under this preferred plan, the Shuswap Lake Estates (SLE) wastewater treatment plant is developed as a "Regional Facility" using reclaimed water irrigation for the dispersal of the effluent. This solution is contingent upon a successful purchase agreement by CSRD for the SLE wastewater treatment plant. [‡] If an agreement cannot be concluded, the alternative solution for the Sorrento, Blind Bay and Reedman Point area (see Section 2.5) would become the preferred option. Under both solutions, wastewater collected from the Sorrento, Blind Bay and Reedman Point area is treated and made available for irrigation water for the SLE golf course and local farmers.

The total cost for purchasing and upgrading the SLE plant would be spread out among all the residents who will be serviced by this treatment facility. These areas include Blind Bay, Sorrento and Reedman Point which contain an estimated 2,339 parcels.

The current value of the Shuswap Lake Estates Lagoon treatment plant infrastructure has been calculated to be about $1.7 million. Similarly, the current land value of the SLE treatment plant is estimated to be $1.3 million. The total purchase price for SLE based on these current appraisals would then be about $3.0 million.

[‡] Note that concurrent with the Stage 3 process, negotiations with Shuswap Lake Estates was undertaken and a final draft Memorandum of Understanding (MOU) was presented at the December 8, 2008 Advisory Committee meeting. However, the Advisory Committee was unanimously opposed to the terms of the MOU and did not support continued negotiations. As a result, the option of developing a new Regional wastewater treatment facility in the Balmoral area will be pursued. A copy of the December 8, 2008 meeting minutes is provided as Appendix A.

As the wastewater flowrate into the SLE treatment plant approaches its maximum capacity, additional treatment works and reclaimed water storage will be required. Currently, the SLE wastewater treatment plant is estimated to have treatment capacity to service approximately 400 homes. However, with upgrades to the aeration equipment and other required infrastructure there is sufficient storage and lagoon capacity to service approximately 1,000 homes. Once the capacity is reached, an upgrade to the existing treatment plant and expansion of the storage facility is required. An area of farmland south of the Trans Canada Highway in the Balmoral area could potentially be purchased for construction of an effluent storage reservoir. The reservoir site is sufficiently large to accommodate a storage reservoir which would service the remaining future build-out of the sewerage area. Furthermore, this site could serve as an alternate site for construction of new treatment plant in the future or in the event the CSRD does not acquire the treatment plant at Shuswap Lake Estates.

Effluent from the treatment plant would be used primarily for irrigation of farmland in the Balmoral area and the Shuswap Lake Estates Golf Course.

Given the strong interest shown by members of the agricultural community in the vicinity of the SLE treatment plant and the limited water supply, there appears to be significant demand for effluent for irrigation. Excess demand ensures that the effluent demand, even under a wet year, is greater than the available supply.

A backup dispersal system may be required to address a situation where there is excessive rainfall during the irrigation season and abnormally low application of reclaimed water takes place. During these infrequent and unusual wet years the reservoir could contain too much stored effluent at the end of the irrigation season. Under this scenario there may be insufficient reservoir capacity available through the winter to store effluent at time when irrigation water is not being applied. To address the risk of exceeding the design storage volume, costing for this option also includes provision for an infiltration basin to serve as an emergency backup system.

Single Phase Approach to Developing the System

If construction of the sewer system and purchase of the treatment plant were developed as a single phase, the total capital cost is estimated to be $56.2 million (Table 2). Each parcel's contribution to the capital cost amounts to $8,003 with 2/3 grant funding. Assuming a 20 year loan and 6% financing, the annual cost would be $658.

Multiple Phasing of the System

Under a phased approach, sewage from the foreshore area would be collected first and pumped to the SLE treatment plant through a forcemain.

For Phase 2 servicing, the relatively dense Blind Bay area, Reedman Point, as well as the upper Sorrento area were identified as requiring servicing next. The Phase 3 area includes the larger parcels of land in the Blind Bay and Sorrento area or parcels located at the edge of the sewerage area.

Under this phased approach, the SLE treatment plant would need to be purchased by the Regional District as part the first phase of sewer service construction. An upgrade to the SLE treatment plant would be required to accommodate the first and subsequent phases.

Table 2 provides a summary of the costs for Option 1. The total cost to sewer Phase 1 of Blind Bay and Sorrento is estimated to be $14.4 million. The total number of units serviced under Phase 1 is 548.

Phase 2 would involve servicing the bulk of the Blind Bay, Sorrento and Reedman Point area. The cost to complete Phase 2 is estimated to be $41.7 million and will connect an additional 1,791 parcels.

The cost associated with upgrading the SLE Regional Facility was estimated based on an expansion in capacity to 2.4 ML/d from approximately 1.0 ML/d. The cost to install the RBC units would be about $3.0 million. An alternative for expansion of the SLE facility is to install an additional aeration lagoon. The cost of the additional lagoon, including liner and aeration equipment, will be similar to the RBC option.

During Stage 2 of the Regional Facility upgrade, a new storage area is also required as the existing reservoir adjacent to the plant would be at capacity. An agricultural parcel south of the Trans Canada Highway in the Balmoral area bounded by the Canadian Pacific railway could serve as site for new effluent storage lagoons. This piece of land would easily contain a reservoir and would be ideally situated near the farms where the effluent would be used for irrigation. The costs of the reservoir land purchase and construction should be spread over the 2,339 parcels that would eventually be connected to the sewer carrying wastewater to the SLE Regional Facility

Parcels associated with Phase 3 would tie-in to the system as demand or the opportunity arises.

The estimated cost of the SLE Regional Facility includes provision for an emergency infiltration basin.

Table 2 provides a summary of costing for each of the assumed phases. The costing assumes that those properties currently connected to the SLE facility would not contribute to the purchase cost since these homeowners have already contributed to the cost of the existing system.

Table 2: Estimated Capital Costs for SLE Regional Facility

Sewer Sub-Area	Number of Parcels	Capital Cost Estimate ($ Million)			Cost per Parcel		
		Pipes and Pumps	Treatment Plant, Reservoir & Backup Infiltration	Total	Net Cost	Net Cost with 2/3 Grant Funding	Annual Cost Assuming 20 Year Loan
Phase 1	548	$11.4	$3.0	$14.45			
Phase 2 & 3	1,791	$33.4	$8.3	$41.71			
Sub-Total	*2,339*	*$44.82*	*$11.33*	*$56.2*	*$24,008*	*$8,003*	*$658*

Financing and Staging Considerations

Due to the large capital cost required to undertake the sewer servicing in a single phase, various mechanisms could be considered for financing this option in order to make it affordable. In order for this option to proceed, it is assumed that 2/3 Provincial grant will be required. Development Cost Charges (DCC's) are another mechanism for funding upgrades to the treatment plant or expansion of the sewer system.

The system could be implemented in multiple phases, if the full grant amount were not made available. Under this scenario, an annual sewer levy should be considered for those parcels that may not be initially connected to the sewer but who will benefit in the future. For example, a large portion of the Phase 1 servicing plan includes installation of a mainstem interceptor collection and pumping system that will be used to service Phase 2 parcels.

A levy paid by all the non-serviced parcels in this ultimate sewerage area will assist in paying for a portion of the infrastructures up-front costs. The levy accounts for future deferred benefits and increases the level of affordability for everyone. The levy will depend on the level of Provincial and Federal funding and would be established when the first grant is received. However, if only the Phase 1 area sewer were constructed the levy required for Phase 2 and 3 parcels would be approximately $60 per year. This levy would be designed to limit payment of Phase 1 homeowners to the average value of $658 per year.

Each homeowner serviced will be required to pay a portion of the cost to operate and maintain the sewer system and treatment plant. The operational cost of the treatment plant and sewer system at build-out including labour, power, chemicals, equipment replacement, lab testing and insurance is estimated to be $275,000 per year. This cost would be distributed over the 2,339 parcels serviced under a full build-out scenario plus the 150 existing parcels currently serviced by Shuswap Lake Estates WWTP. On this basis, each parcel's contribution to the annual operation and maintenance cost is estimated to be $110.

Since most of the costs associated with operating a sewer system are fixed costs (ie, labour, insurance, etc.), the operation and maintenance costs under a phased scenario will not change significantly. Power and chemical usage will vary directly with the wastewater flow. As a result, under a phased sewer development the household operation and maintenance costs could approach $250 - $325 per year for the dwellings connected to the system in Phase I.

To minimize the operational costs of the sewer system under a phased scenario, the CSRD hire a private contractor to carry out the operational and maintenance activities. Hiring a private maintenance contractor will be cost-effective when the work is not necessarily full-time. Initially, when the sewer system is small and the required operational and maintenance activities are intermittent hiring a private contractor will be less expensive than hiring full-time staff.

NORTH SHUSWAP (AREA 'F') SERVICING

Consideration could be given to servicing the Area 'F'. If the North Shuswap LWMP supports the concept of the Scotch Creek becoming integrated with the South Shuswap sewerage area, and the South Shuswap agrees to accept it, wastewater could be pumped through a submerged pipeline in the lake to the SLE Regional Facility. The concept of pumping wastewater through a submerged pipeline is used in the Okanagan to optimize wastewater treatment capacity. For example, the District of Peachland is connected to the Westbank wastewater treatment plant by a 6 kilometer forcemain under Okanagan Lake.

Scotch Creek is the primary area of growth in North Shuswap and the area proposed for connection to Area 'C'. However, the Lee Creek and Celista areas are also possible areas that could be integrated into the Sorrento – Blind Bay sewerage area. Based on the current draft Stage 2 Area 'F' LWMP population projections, the wastewater flow from the potential North Shuswap sewerage area could approach 5,440 m^3/d

Table 3: Potential Population Wastewater Flow Projection for North Shuswap Area

Area	Projected Future Population	Design Wastewater Flow (m^3/d)
Scotch Creek	7,200	3,200
Lee Creek	2,300	920
Celista	3,300	1,320
Combined Potential North Shore Sewerage Area	12,800	5,440

If the North Shuswap is connected to the South Shuswap, Area 'F' residents serviced by this new system would pay for the cost of constructing the lake forcemain and pumpstation and contribute to the cost of developing and operating the wastewater treatment plant. The economies of scale would result in a cost saving, since one treatment plant is more economical to construct and operate than two smaller ones. As a result, both the North Shuswap and Shuswap could benefit. Furthermore, given the larger scale and potential environmental benefit consolidation of the North and South Shuswap sewerage areas will increase the likelihood of grant funding.

To accommodate the North Shore area, design of the conveyance pumps and pipes will need to include the additional capacity. Once the pipes are installed and commissioned, the ability to increase capacity becomes complex and expensive. Selection of pipe alignments and pumpstation sites will be influenced by tie-in to the North Shore lake forcemain. Decisions around treatment process upgrades of the SLE facility will also need to account for ultimate wastewater flows. Therefore, the decision on whether to combine sewerage areas should be made prior to completion of the preliminary design of the first stage of the South Shuswap sewer system.

The Area ‘C’ Advisory Committee has not discounted the option of servicing the North Shore area. Integrating the North and South Shuswap into a common sewerage area has potential overall benefits. Wastewater treated on the south shore would be reused in a beneficial way, thereby minimizing any potential lake or groundwater contamination.

2.5 ALTERNATIVE PREFERRED SOLUTIONS FOR THE SORRENTO, BLIND BAY AND REEDMAN POINT AREAS

A Regional Treatment Facility could be constructed on property acquired in the Balmoral area (Figure 5). Under this option, effluent would used for reclaimed water irrigation. This option is independent of SLE and would store reclaimed water in a new reservoir also located in the Balmoral area.

The land purchase cost and construction of the reservoir for storing effluent for reuse is estimated to be $7.2 million.

The costs for constructing the Regional Facility under this option would be spread out among all the residents who will ultimately be serviced by this treatment plant. These areas include Blind Bay, Sorrento and Reedman Point with the estimated total number of parcels to be 2,339.

Single Phase Approach to Developing the System

Table 4 provides a summary of the total capital costs for this option. If undertaken as a single stage each parcel’s contribution to the capital cost is estimated to be $8,600 with 2/3 grant funding. The annual debt associated with cost of this option would be $707 per parcel. However, the required grant of $60 million to complete the system in one phase is unlikely. As a result, there is a need to plan for a phased approach.

Multiple Phasing of the System

A staged expansion of the sewage collection system would occur as grant funding becomes available. Under this scenario, a similar, staged approach to servicing could be undertaken as in Option 1. In Phase 1, the foreshore would be serviced first to mitigate the impact of septic systems on the lake. The Phase 1 sewer system would also be designed to provide a mainstem collection and conveyance system to facilitate future connection of the remaining sewerage area and allow for development of marina pump-out facilities.

The cost for land purchase and construction of a secondary treatment plant, such as an RBC or aerated lagoon, was estimated to be around $5.4 million for the capacity of 1.0 ML/d. The total number of parcels to be serviced by this plant initially is 548 parcels. To accommodate the build-out population, an additional treatment plant expansion would be required. An upgrade to 2.4 ML/d capacity could entail the addition of more RBC units or aeration lagoons at the cost of about $3.7 million.

A backup disposition system is required to address a situation where the land base for utilizing the reclaimed water is insufficient to handle the volume produced. A rapid infiltration system could serve as a back-up. As a result, provision for an emergency infiltration basin has been included in the cost estimate.

Table 4: Cost Breakdown for Regional Facility in the Balmoral Area

Sewer Sub-Area	Number of Parcels	Capital Cost Estimate ($ Million)			Cost per Parcel		
		Pipes and Pumps	Treatment Plant, Reservoir and Backup Infiltration	Total	Net Cost	Net Cost with 2/3 Grant Funding	Annual Cost Assuming 20 Year Loan
Phase 1	548	$16.3	$11.1	$27.5			
Phase 2 & 3	1,791	$29.2	$3.7	$32.9			
Total	2,339	$45.5	$14.8	$60.3	$25,796	$8,599	$707

Financing and Operational Considerations

Operation and maintenance costs are expected to be similar to the Option 1 at build-out. On a parcel basis, the operational and maintenance costs are estimated to be $110, if a lagoon treatment system is selected. The operating cost would be higher if an RBC system is required. Similar to the SLE scenario, the operating and maintenance costs will be higher for the dwellings connected to the system in Phase I until the other phases are connected.

2.6 POTENTIAL FUTURE SOLUTION FOR THE SUNNYBRAE AREA

Based on an assessment of options identified as part this LWMP, servicing the Sunnybrae are by a sewer connection to the Salmon Arm system was proposed. An underwater pipeline could be constructed to convey the collected wastewater from Sunnybrae to the sewage collection system that connects to the Salmon Arm tertiary sewage treatment plant (Figure 6). Sunnybrae residents would be serviced only when and if the monitoring program indicates that an environmental or health issue is actually occurring or is developing.

Implementation of this option will require future public consultation with area residents as the Sunnybrae residents were evenly split in support for or opposition to this option.

Furthermore, the option of pumping wastewater to the Salmon Arm system should be re-assessed in the future using an up-to-date OCP to account for a growth scenario.

The estimated cost of constructing the sewer collection system for Sunnybrae and lake forcemain is estimated to be about $5.0 million or $10,700 per parcel with grant funding. The total cost of $10,700 per parcel does not include the cost for expansion of the Salmon Arm treatment plant due to the flow increase or any disposal fees charged by Salmon Arm for the wastewater. To assess the cost of treatment, it is assumed that the City of Salmon Arm would charge residents the current sewer component of the development cost charge of $2,890 per single family parcel to connect to their system. This cost amounts to an additional $0.49 million.

Based on these assumptions the total system cost is estimated to be $5.5 million or $10,700 per parcel after two thirds grant funding. The annual cost to service this debt is estimated to be $880 per year for each parcel.

Table 5 provides a summary of the total capital and parcel costs.

Table 5: Cost Breakdown for Sunnybrae Collection and Forcemain to Salmon Arm

Sewer Sub-Area	Number of Parcels	Capital Cost Estimate ($ Million)			Cost per Parcel		
		Pipes and Pumps	Treatment Plant	Total	Net Cost	Net Cost with 2/3 Grant Funding	Annual Cost Assuming 20 Year Loan
Phase 1	171	$5.0	$0.49	$5.5			
Phase 2 & 3	-	-	-	-			
Total	171	$5.0	$0.5	$5.5	$32,106	$10,702	$880

It is assumed that if this option is implemented, Sunnybrae would become part of the City's sewerage area and residents charged the same annual sewer levy paid by all homeowners in Salmon Arm. Currently, the annual sewer charge is $248.

This option requires pumping wastewater from Sunnybrae to the tertiary treatment facility at Salmon Arm with the treated effluent discharged to the lake via an existing outfall. Currently no portion of the effluent is utilized directly as reclaimed water for irrigation, although the water is returned to the lake system from where it may be extracted further downstream in the watershed for irrigation or other purposes.

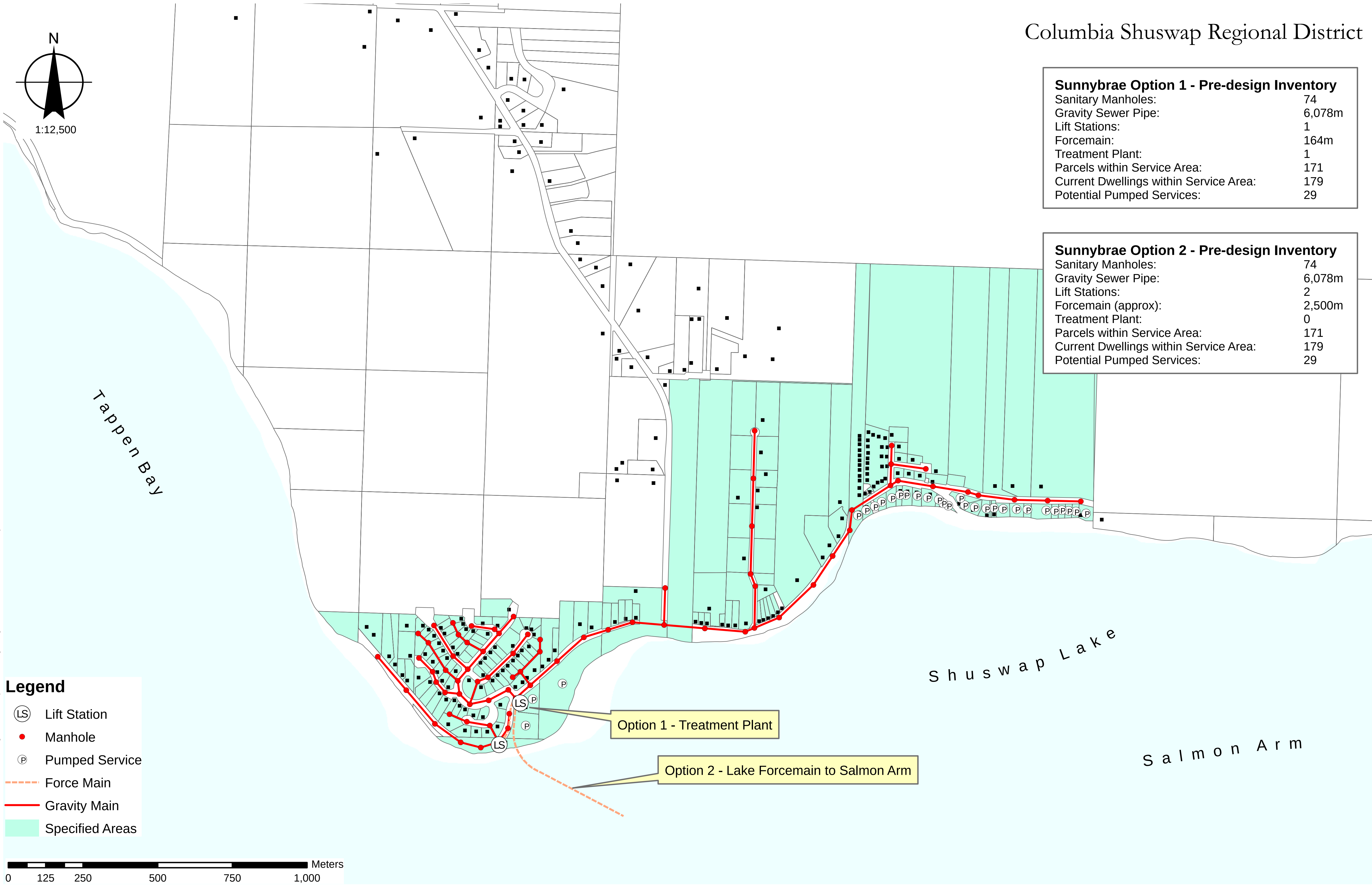
Columbia Shuswap Regional District

Sunnybrae Option 1 - Pre-design Inventory

Sanitary Manholes:	74
Gravity Sewer Pipe:	6,078m
Lift Stations:	1
Forcemain:	164m
Treatment Plant:	1
Parcels within Service Area:	171
Current Dwellings within Service Area:	179
Potential Pumped Services:	29

Sunnybrae Option 2 - Pre-design Inventory

Sanitary Manholes:	74
Gravity Sewer Pipe:	6,078m
Lift Stations:	2
Forcemain (approx):	2,500m
Treatment Plant:	0
Parcels within Service Area:	171
Current Dwellings within Service Area:	179
Potential Pumped Services:	29



Printed: L:\work\97000\97166\02a-CAD\WAT\Stage II\GIS\07-Maps\97166_StageII_Figure09.mxd, 2008-06-11, 9:14 am, jan.bath

Sunnybrae Servicing Options

Figure

06

2.7 POTENTIAL FUTURE SOLUTIONS FOR THE WHITE LAKE AREA

There are no known environmental issues or concerns in the White Lake area and any remedial measures would only be undertaken if the monitoring program noted in the Area 'C' wide recommended water quality monitoring program showed that an environmental problem existed or was developing. Two options were identified for the White Lake area. The first option involves developing a new treatment plant at White Lake while the second option would convey wastewater to a Regional facility, at Shuswap Lake Estates or the Balmoral area.

The first alternative, a treatment plant at White Lake would include effluent dispersal works. The plant would be relatively small and construction and operating costs would be higher on a per capita basis than if the sewage were directed to a larger regional facility due to economy of scale. It is unlikely that it would be economically feasible to utilize the effluent for beneficial reuse. Effluent dispersal is likely to use an infiltration system if appropriate soils could be found in the White Lake area.

The second alternative would have the collected sewage directed to the Regional facility at either Shuswap Lake Estates or the Balmoral area.

While the capital cost of developing a pumped system to convey wastewater to SLE is higher than developing a treatment plant, the operational cost of a satellite treatment plant would be higher. Furthermore, connecting to a Regional facility will provide greater flexibility for establishing a sewer system and minimizes the risk of negatively impacting the groundwater quality. Treating small wastewater flow rates or variable flow rates and maintaining a high effluent quality is more challenging with small satellite systems. As a result, a pumped connection to a Regional facility represents the best technical solution for servicing the White Lake area. The Advisory Committee selected the option of pumping wastewater to a Regional facility. This option would need to be revisited when or if the monitoring program shows that there are environmental issues developing in the White Lake area due to on-site septic systems.

2.8 CLOSED LOOP INTEGRATED WASTE MANAGEMENT

As the population of the Shuswap Lake watershed increases and impacts associated with global warming unfold, adopting sustainable design practices becomes imperative. Under this option, some opportunities for sustainable design are considered and include optimized energy use and recovery.

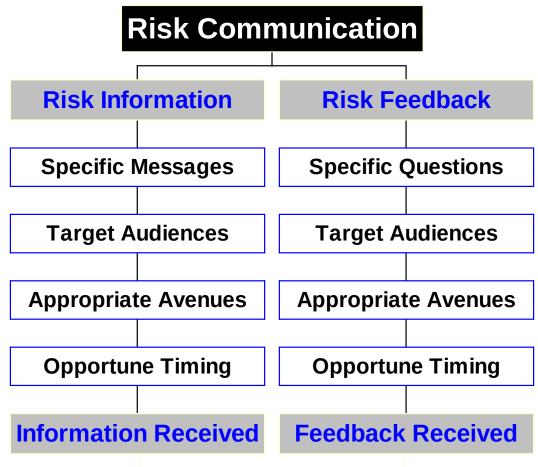
There were a number of options that were considered under this option including: Effluent reuse, energy management, Leadership in Energy and Environmental Design (LEED), effluent energy recovery, optimized biogas production and utilization, and biodiesel production. Most of these concepts require that the sewage treatment facility be developed and in operation as they are essentially an addition. The exception is the LEED design approach which can and should be incorporated throughout the design and construction of each of the recommended solutions.

In principle, the committee supported the option of a closed loop integrated waste management system. However, given the relatively high costs of this system this option should be pursued as a long-term strategy, implementing components as grants are made available. In particular, as the effluent reuse system is expanded demand for an integrated waste management system could serve as a nucleus for change. For example, secondary effluent contains nutrients which will reduce substantially the need to apply waste manure as a fertilizer source. For those farms that generate significant manure, use of effluent for irrigation may necessitate a method for manure disposal. The resulting surplus manure is a resource which through digestion could be used to produce methane gas and utilized as a fuel source or to generate electricity. Furthermore, once digested the stabilized manure sludge will have low odour and pathogen potential and could be sold as a soil amendment.

3.0 PUBLIC CONSULTATION

The following report outlines tactics, deliverables, and timelines used for the communications plan associated with Stages 1 & 2 of the CSRD's Liquid Waste Management Plan for Area 'C'.

The communications plan was built on a strong foundation of proven 'risk communication' principles.



Risk communication is defined by the US Environmental Protection Agency as "any purposeful exchange of information and interaction between interested parties regarding health, safety, or environmental risks." It is an interactive process involving a 'sender' and a 'receiver'. 'Risk information' is provided by the sender to the receiver, who responds with 'risk feedback'. Both are equally important in the process. As shown at right, a successful exchange occurs when information and feedback are received and appropriately responded to.

3.1 OVERALL COMMUNICATION PLAN OBJECTIVES

The following objectives were established at the initiation of the LWMP:

- Provide multiple opportunities for public education and feedback on the draft document and proposed options for managing liquid wastes
- Increase support for liquid waste planning and programs
- Leverage media coverage to increase target audience reach
- Coordinate and facilitate consistent messaging throughout the process
- Educate residents about their contribution to effective liquid waste management (e.g., maintaining their septic systems).

It is the opinion of the project team that all of the above objectives were met.

3.2 TARGET AUDIENCES & ASSOCIATED OBJECTIVES:

The campaign was designed to meet the communication needs of internal and external stakeholders.

Internal stakeholders were defined as primary and secondary. Primary stakeholders included the project team, while secondary stakeholders included CSRD staff and Single Advisory Committee members.

The objectives of internal communications were to:

- inform all internal stakeholders of project parameters and processes, meeting dates and times, and contact people and information;
- provide information and respond to requests about meeting outcomes, draft reports, survey information, media responses, etc.; and
- verify particular people's responsibilities throughout the project.

The following tactics, deliverables, tasks, and timelines guided the campaign for internal communications (Table 6). It is the opinion of the project team that the objectives for internal communications were met.

Table 6: Internal Communication Tactics and Deliverables

Tactics	Deliverables	Tasks	Timeline
To provide all internal stakeholders with timely and pertinent project information	Broadcast emails	▪ Prepare and maintain list	Ongoing
	Phone list	▪ Prepare and maintain list	Ongoing
	Regular meetings or conference calls to ensure full understanding and support for strategies, tactics, and deliverables	▪ Arrange regular project meetings and prepare follow-up information	Ongoing
	Project Updates	▪ Prepare updates and distribute to internal stakeholders via email	As needed
	Closed working meetings		February 26th, 2007 April 12th, 2007 September 6th, 2007 January 31st, 2008 February 26th, 2008 March 4th, 2008 June 17th, 2008 October 27th, 2008 November 10th, 2008 December 8th, 2008

External stakeholders included residents, community associations, businesses and business associations, the agricultural community, environmental groups, and the media. The objectives of external communications were to:

- provide CSRD Area C residents with ongoing information about the LWMP process;
- enable and encourage residents' participation in the LWMP process (e.g. via meetings, open houses, surveys, faxes, e-mails, website responses, letters);
- encourage public participation in selecting the preferred wastewater treatment and disposal option(s).

The following tactics, deliverables, tasks, and timelines guided the campaign for external communications (Table 7). It is the opinion of the project team that the objectives for external communications were met.

Table 7: External Communication Tactics and Deliverables

Tactics	Deliverables	Tasks	Timeline
To update residents about the process who have shown an interest via meeting and/or open house attendance	Project Updates	▪ Prepare Project Updates with input from project team ▪ Get final approval from Deputy Manager Works Services before printing ▪ Prepare and distribute Project Updates to residents who have shared email or mailing addresses	December 2006 February 2007 March 2007 March 2008
To provide local media with information to share with external stakeholders about the project and associated opportunities for public input	News releases and advertisements	▪ Prepare releases and ads with input from internal stakeholders ▪ Get final approval from Deputy Manager Works Services before distribution ▪ Distribute to all media outlets within CSRD jurisdiction	News releases sent: ▪ October 31, 2006 ▪ November 8th, 2006 ▪ January 16th, 2007 ▪ January 29th, 2007 ▪ February 20th, 2007 ▪ March 7th, 2007 ▪ March 20th, 2007 ▪ April 3rd, 2007 ▪ April 16th, 2007 ▪ April 7th, 2008 Ads published: ▪ November 3rd, 2006 ▪ January 19th, 2007 ▪ February 23rd, 2007 ▪ March 23rd, 2007 ▪ April 6th, 2007 ▪ April 16th, 2008
To utilize the CSRD's website to help educate and involve residents in the LWMP process	Website updates and email comments	▪ Prepare update material with input from internal stakeholders ▪ Link with EarthTech website where appropriate ▪ Post meeting agendas, minutes, reports, etc. ▪ Get final approval from Deputy Manager Works Services before information is uploaded	Before and after each public meeting and throughout the project as required

Tactics	Deliverables	Tasks	Timeline
To educate external stakeholders about the options included in the Stage 2 and 3 Reports (and possibly new options) and to consult with external stakeholders about their support for the recommended option(s)	Newsletters	▪ Produce newsletter (including mail-in survey) with input from internal stakeholders ▪ Get final approval from Deputy Manager Works Services before printing and distribution ▪ Distribute to all homes within Area C boundaries via addressed mail ▪ Compile and analyze survey results ▪ Present survey results to AC ▪ Upload survey results to website	Newsletter #1: January 2007 Newsletter #2: April 2007 Newsletter #3 & mail-in survey: April 2008
To educate the advisory committee members and the public about the process, the issues, and options.	Public Meetings	▪ Arrange facility rental ▪ Prepare and distribute news releases ▪ Facilitate meetings ▪ Document meeting minutes ▪ Upload minutes to website	Meeting #1: Nov 6, 2006 Meeting #2: Jan 23, 2007 Meeting #3: Feb 27, 2007 Meeting #4: Mar 26, 2007
To educate external stakeholders about the options included in the Stage 2 and 3 Reports (and possibly new options) and to consult with external stakeholders about their support for the recommended option(s)	Open Houses	▪ Prepare presentation materials for open house ▪ Get final approval from Deputy Manager Works Services before printing ▪ Prepare news releases and advertisements for distribution to local media ▪ Prepare handouts	Open House #1: April 10th & 11th, 2007 Open Houses #2: April 21st & 22nd, 2008
To determine residents opinions about the process and proposed options	Surveys		Open House Exit Survey Stage 1 Mail-in Survey Stage 2
To inform the regional board of the AC's recommendations	Board presentations		July 19th, 2007 July 17th, 2008

4.0 BYLAW IMPLEMENTATION

There are a number of bylaws that will need to be developed as a result of the implementation of this LWMP. A description of each of the required bylaws is provided below.

4.1 MANDATORY SEPTIC TANK PUMP-OUT BYLAW

A mandatory septic tank pump-out bylaw will involve regulating a minimum pump-out frequency for septic systems. A pump-out program will benefit the homeowner by maximizing the life of the septic disposal field. In addition, by reducing the propensity for organics carry-over, the treatment efficiency of the septic system will be maximized.

Septage is the slurry pumped from septic tanks and contains a high level of suspended solids and nutrients, in addition to coarse inorganics (rocks, plastic, etc.). Currently, one private septage dewatering facility operates within Area ‘C’ under a Ministry of Environment permit.

There are three basic approaches for implementing a septic tank pump-out program. The options require a varying level of capital and operating costs

1. *CSRD Owns and Operates Equipment to Provide Pump-out Service:* the CSRD could purchase a specialized pumper truck and hires staff to conduct the septic tank pump-outs. The cost to operate the equipment and manage the program would be funded by an annual tax on homes serviced by a septic field. The bylaw would provide for a pump-out of every septic tank at a regular interval.

   This option has relatively high start-up costs as a result of having to buy a pumper truck and constructing a septage receiving station at a Regional wastewater treatment plan. A septage facility provides pre-treatment prior to being discharged into the treatment plant. Pre-treatment is required to remove the coarse inorganics (rocks, plastics, etc.) and as much of the suspended solids as possible. In addition, in order to avoid over-loading the treatment plant, a septage system must provide for attenuation of the liquid fraction prior to being discharged into the treatment system.

   The cost of supplying a septage pumper trunk is estimated to be $300,000. Furthermore, the CSRD would need to hire one or two additional staff to operate the pumper truck and supervise the program.

2. *CSRD Hires a Septic Pump Service to Deliver Service*: this option is similar to the previous option except that a licensed, private contractor is used to provide for the regular pump-out. The septage would be disposed of at a regulated facility. An annual tax collected from the homeowner would be used to finance the septage pump service. The CSRD could include record keeping, scheduling, promotion, and communication with property owners in the contract specifications or additional CSRD administrative resources will be required.

3. *CSRD Requires Confirmation of Pump-out*: under this option, the CSRD would issue a notice reminding the homeowner of the scheduled pump-out. The homeowner would then be required to submit proof by way of an invoice of a pump-out or face a potential fine. This option requires a higher level of bylaw enforcement effort and will entail at least one-half of a full-time equivalent officer.

Based on a general consideration of the principle factors, option 2 is the preferred alternative.

All the options considered entail having access to one or more regulated septage receiving facility(s) to accommodate the increased volume from the area. At the present time, there is one septage facility under permit with the MoE that is located in the Balmoral area. In the event that education programs are not producing satisfactory results and a mandatory septic tank pump-out program is being considered, the CSRD Economic Development team could play a role in generating interest in the private sector to invest in the construction of a septage receiving facility to handle the significant increase in work load and volumes.

In the event that private industry cannot meet the demand for the septage volumes generated from Area 'C', the CSRD could supplement private industry and develop its own septage receiving facility. Based on recent construction costs of a septage facility in Penticton, the cost of a new septage receiving facility could approach $1,500,000, assuming sufficient treatment capacity is available. Although the cost is relatively high, all of it could be recovered through user fees.

A plan for managing septage wastes needs to be integrated with the servicing plan for wastewater treatment plant and solid waste management plan. Therefore, once Shuswap Lake Estates treatment plant has been taken over or another facility established in the Balmoral area, a treatment plant servicing plan should be undertaken to determine how to implement a septage receiving facility to accommodate pumped septic tank wastes.

4.2 MANDATORY WATER CONSERVATION

A water conservation bylaw has two positive impacts.

First, as a demand side management tool, water conservation can reduce the impacts on the water source and minimize the amount of water treated and pumped to the home. Both irrigation and household water consumption components are addressed as part of any demand side water conservation measures.

Second, a water conservation program can reduce the wastewater generation rates from homes, thereby reducing the cost of pumping and treatment. Only the household water consumption component is addressed as part of wastewater reduction program.

From a liquid waste management perspective reducing the wastewater generation rates is most relevant. However, both features should be considered in designing a water conservation bylaw.

Reducing the irrigation demand component typically involves education and regulating the timing of lawn sprinkling. In addition, local governments have used sliding scale water rates for managing irrigation consumption. This involves charging a premium for water beyond an allotment for domestic consumption. Water meters are required to implement variable water rates. The Cedar Heights CSRD water system should have water meters installed and water rates charged on a user pay basis, and non-CSRD water systems located in the proposed Blind Bay/Sorrento sewer service area should be encouraged to have water meters installed.

Reducing the household demand will involve specifying low-flow fixtures for new construction or renovations. Currently, the CSRD does not have a building inspection service to regulate installation of these fixtures. As a result, a Building Regulation Bylaw should be implemented for Area C.

4.3 MANDATORY SOURCE CONTROL

A source control bylaw is an important feature of any community sewer system. The Source control bylaw provides limits on the type of wastewater and constituents that can be discharged to the sewer system.

The source control bylaw protects the treatment process from being overloaded by a high strength wastewater. In addition, the bylaw restricts products or chemicals that could end up in the effluent which is destined for agricultural reuse (ie, heavy metals or chemicals).

The source control bylaw could be developed by staff in consultation with a wastewater consultant. In addition, nearby municipalities with reuse systems could be contacted and their experiences used as a check. The source control bylaw should be in place before the community sewer system has been commissioned.

4.4 LAKE DISCHARGE CONTROLS

To address potential public health and environmental conflicts, this LWMP recommends that all private discharges of treated effluent be prohibited from Shuswap Lake and White Lake. All proposed private systems regulated by the Municipal Sewage Regulation, including discharges from nautical vessels, are affected by this prohibition.

Although a lake discharge control would be covered off by amendments to the Municipal Sewage Regulation through the recommendation of this LWMP, developing a lake discharge bylaw is required to support the Municipal Sewage Regulation. The criteria should be developed by staff with the final wording refined by legal counsel to ensure consistency with the Municipal Sewage Regulation. The development of this bylaw should proceed immediately after the LWMP has been approved.

4.5 MANDATORY TURN-OVER OF NEW SYSTEMS TO CSRD

The intent of this bylaw is to provide the CSRD the authority to take-over operation of all new treatment plants serving new residential subdivisions, resorts and commercial developments. Under this scenario, the CSRD would manage all new community sewer systems regardless of whether the effluent is discharged to ground or re-used.

Developers would be required to construct each new system to CSRD criteria, using standard pumps, pipe and fittings to reduce CSRD inventory requirements and facilitate replacement of worn out or defective parts and equipment. These sewage systems would then be turned over to the CSRD provided all criteria have been met.

The drafting of this bylaw should proceed immediately after the LWMP has been approved. A definition of what comprises a community sewer system eligible for CSRD control would need to be provided as part of the bylaw.

4.6 MANDATORY CONNECTION TO A PUBLICLY OWNED SEWER SYSTEM

A bylaw which gives the CSRD authority to require existing developments to connect to a publicly owned and operated sewer system is required. The bylaw will minimize the number of satellite treatment plants within the Area.

The basis for takeover will need to be defined as part of the bylaw. However, as a minimum, mandatory connection should only occur if a publicly owned sewer system were available and at the property line. Furthermore, the bylaw should give the Manager of Works Services the discretion to develop terms and timelines for any mandatory connection. Providing for this discretion to negotiate terms of a connection allows the Manager to address an instance where mandatory connection of a particular system may not be in the best interest of the community.

The drafting of this bylaw should be in-place once the Shuswap Lake Estates treatment plant has been taken over by the CSRD or a new treatment plant established in the Balmoral area.

4.7 DEVELOPMENT COST CHARGE BYLAW

Costing for the sewer system is based on a servicing existing development. However, in reality there will be some growth within the sewerage area, as dictated by the Official Community Plan (OCP). As a result, additional capacity will need to be provided in the wastewater conveyance and treatment system to accommodate this growth. The cost to oversize pipes or provide for a higher treatment capacity will be offset by Development cost charges (DCCs).

Development cost charges are monies that municipalities and regional districts collect from land developers to offset costs incurred to provide services to their development. Under the Community Charter, development of a DCC bylaw will be required in order to recoup the developer's portion of capital costs for developing the sewer system. The DCC bylaw could be initiated once the OCP is complete for Area 'C' and a growth scenario can be developed.

4.8 BORROWING BYLAW

Borrowing bylaws may be required for the implementation of some of the recommended solutions. The loans would be required to fund a portion of the capital sewer projects not covered by grant funding. The CSRD could borrow money from the Municipal Finance Authority on a short-term basis to cover the deficit. Once the works are complete and homeowners have connected, repayment of the loan would be made through a lump sum or annual tax. The authority and restrictions for borrowing by the CSRD is contained in the Community Charter.

The Regional District Treasurer and the treasurer's department already have considerable familiarity with developing borrowing bylaws and it is recommended that they be the lead agency in the development of the necessary bylaws.

5.0 ADDITIONAL IMPLEMENTATION CONSIDERATIONS

The previous sections provide a summary of the preferred options and implementation requirements. Additional planning considerations which would improve implementation of the plan include:

- communicating the on-site sewer service requirements and costs;
- utilizing latecomer agreements and other capital projects;
- using Provincial tax deferment options to improve affordability; and
- providing an interim on-site treatment option in the event a septic system failure.

5.1 ON-SITE SEWER TO THE PROPERTY LINE

The various servicing options were based on costing of facilities for conveying wastewater from the property line of a parcel to the wastewater treatment plant. Assessment of the on-site works was not included in this assessment. On-site works include the piping and pumping located on private property and are required to convey wastewater from the home to the property line. Facilities located on private property are not eligible for Provincial or Federal grant funding. As a result, the full cost of installing these services is the responsibility of the homeowner.

Figure 7: Schematic of On-Site Works for a Gravity Connection to a Sewer Main

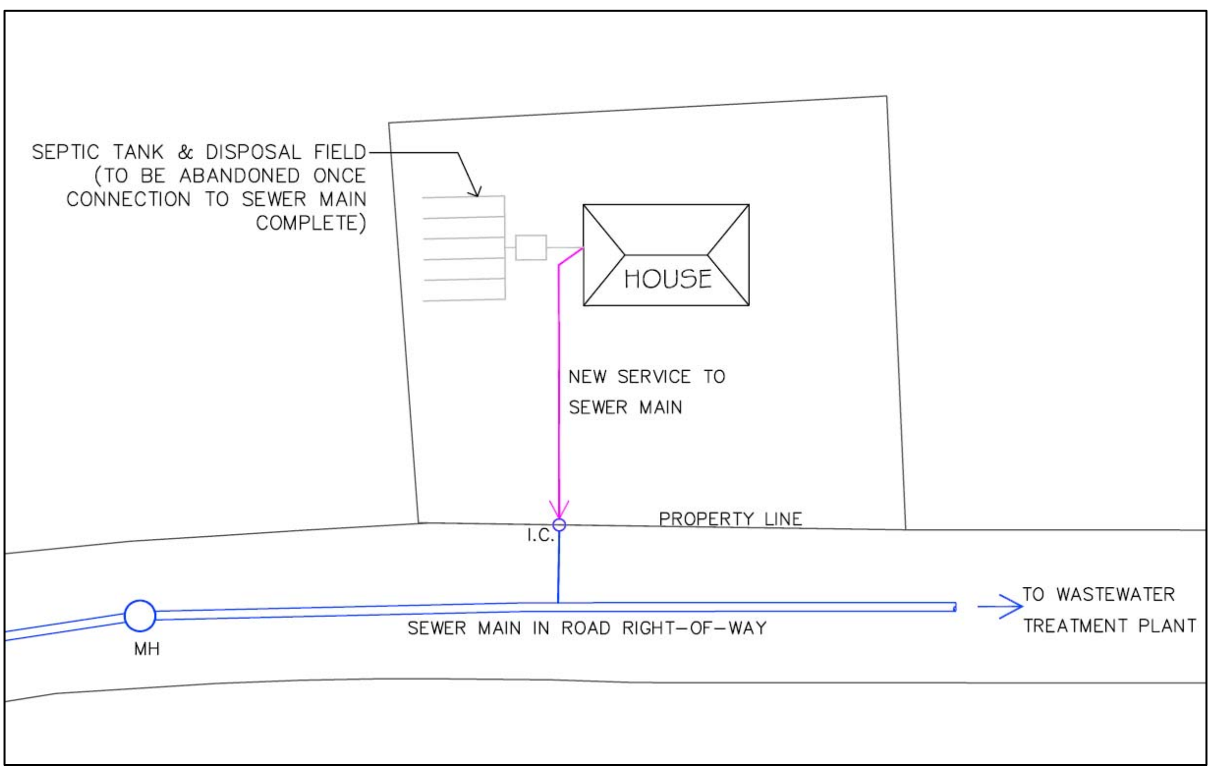


Figure 7 provides a schematic showing the on-site requirements for a gravity connection to a sewer main. In the event that the property is lower than the sewer main, a small pump is installed near the home and is used to convey the wastewater.

Typical On-Site Works and Estimated Costs

Table 8 provides a cost estimate for installation of a gravity service to connect a home to the sewer trunk located on the street or right-of-way. The estimate is based on a typical 33 metre (100 ft) service. It should be noted that the distance from the home to the property varies. In some cases the distance between the home and trunk sewer is longer which will result in a higher cost. Conversely, there may situations where the household cost will be considerably less.

Table 8: Typical Household Costs for a Residential Gravity Connection

Item	Unit	Quantity	Cost/Unit	Total Cost
1.) 100mm diameter gravity pipe from home to I.C. at property line (includes provision for utility locates and average 1.5m trench depth)	Lineal metres	33	$42	$1,383
2.) Fittings	Allowance	1	$200	$200
3.) Trench excavation	m^3	43	$14	$595
4.) Bedding sand (import and compaction)	m^3	5.2	$40	$209
5.) Trench backfill and compaction (native soil)	m^3	37	$9	$336
6.) Landscape restoration (grass sod)	m^2	37	$6	$224
7.) Off-site disposal	m^3	5.2	$20	$104
8.) 100mm clean-out	each	1	$250	$250
9.) 100mm flap gate for back flow prevention	each	1	$250	$300
10.) Disconnect and pump-out existing septic tank and back-fill with sand for decommissioning	each	1	$500	$500
			Sub-Total	$4,100
			GST & PST Taxes (5%)	$205
			Total (Rounded)	**$4,300**

Where the home is lower than the sewer trunk, a small pump must be installed. The pump transfers wastewater from the home to the trunk and requires an electrical connection. A cost estimate for installation of a pumped connection is provided in Table 9.

Table 9: Typical Household Costs for a Residential Pumped Connection

Item	Unit	Quantity	Cost/Unit	Total Cost
1.) Grinder pump kit (incl. supply & installation)	LS	1	$1,500	$1,800
2.) 50mm diameter forcemain from home to I.C. at property line (includes insurance, minor landscape restoration, utility locates and clean-outs)	Lineal metres	33	$70	$2,310
3) Disconnect and pump-out existing septic tank and back-fill with sand for decommissioning	ea	1	$500	$500
			Sub-Total	$4,610
			Taxes (5%)	$231
			Total (Rounded)	**$4,840**

Potential Options for Improving Affordability of On-Site Works

Various concepts were considered to minimize on-site connection costs for homeowners. The options were discussed with engineering representatives of several local governments in the Okanagan Valley and are summarized below.

a) **Local government retains contractor**: The CSRD could retain a contractor to install the connections to the home and decommission the septic tank. This approach has the potential for providing the lowest possible cost to the homeowner. However, this option has a high risk of exposing the CSRD to liability risk. If a homeowner was not satisfied with the way that the sprinkler system, the driveway or shrubbery was restored they may look to the CSRD to resolve the deficiency. Furthermore, if the line should fail at some future date the CSRD could also potentially be held liable. As a result of the liability issues, this option is not recommended.

b) **Local government obtains fixed rate installation quotes from contractors**: The CSRD could ask several contractors for a fixed rate for the installation of the sewer connection. Unfortunately, all lots are not created equal and some will have longer lines than others, site conditions will be different, rock, gravel sand silt etc and this could create a situation where some homeowners are perceived as subsidizing other homeowners. This could create controversy and problems between homeowners and the CSRD. If the contractor did not perform up to expectations or if there were deficiencies with the restoration or pipe work the CSRD could be liable. This option was not recommended.

c) **Local government identifies licensed installers:** The CSRD posts a list of names of contractors on it's website that have business licenses in the municipality. In this case the posting of information bears no responsibility or liability for the CSRD. The CSRD would post a recommendation that the homeowner obtain three quotes, asks for references and then check out the references. Due diligence on the part of the homeowner through obtaining quotes and checking references is very important. This was the approach supported by the majority of those municipalities canvassed.

d) **Local government provides inspection services to protect the homeowner:** Building inspection is provided by local government to ensure that Building Code standards are followed by the contractor. This service serves to protect the homeowner. A similar service could be provided for homeowners for the duration of the sewer installation project to ensure that sewer services are installed properly. Under this scenario, the CSRD would hire staff or contract a firm to provide inspection services. The contractor would be obliged to have the sewer service inspected at various stages through the installation process to ensure it meets requirements of the BC Building Code. Full payment of the installation would be contingent on successful inspection. While this approach would serve to protect the homeowner, it would not reduce the installation cost.

e) **Municipality retains contractor for small number of homes that require pumps:** The CSRD could retain a contractor in the case where sewage lift pumping is required to ensure that all the pumps were standard and repairs and replacement was simplified. Two of the local governments canvassed suggested that this approach worked for them in small pockets of homes where the lot conditions were similar, the lines were similar in length and everyone needed a grinder pump to convey their sewage to the city system. This approach could work in certain circumstances but careful review of technical specifications would be needed to minimize liability issues.

In all instances, minimizing liability was a principle decision making consideration for the engineering staff. As representatives of the public, local government staff must take into consideration the element of risk that may expose the corporation to liability. The Risk Manager from the Municipal Insurance Association recommends the CSRD proceed with Option C. On this basis, the CSRD should proceed with option C which involves education and providing the property owners a list of a number of qualified contractors.

5.2 TAKING ADVANTAGE OF OTHER CAPITAL PROJECTS TO REDUCE COSTS

The process for implementing a sewer system involves first making application under various Federal and Provincial grant programs for funding. While the contribution provided under these grant programs increases affordability, the timing is uncertain. The availability of funding programs and their priorities changes from year-to-year. Making application does not guarantee any or all the funds. As a result, the CSRD should be prepared to take advantage of other options which will allow for affordable development of parts of the sewer system. Taking advantage of utility or road installations or upgrades by private developers and other government agencies could provide a means to improve affordability.

Development of properties within the Area may require upgrades or extensions to roads or water systems. Where this occurs, and if appropriate, the CSRD could make provision for installation of a section of sewer. A large portion of the cost of installing a sewer is the result of digging the trench and restoring the roadway. As a result, the premium to install a sewer pipe as part of a roads or water project is only a portion of the total cost of sanitary sewer installation. Provided that the section of pipe installed could be tied to the rest of the sewer system, this approach would reduce the overall cost.

Furthermore, the CSRD could require in the future that sewer service for a new development to connect to an existing publicly-owned sewer system. Under these instances, the CSRD could also require that the sewage works be designed with enough capacity to service properties that are situated near the service. These works are termed ‘excess’ or ‘extended’ services. The CSRD could pay up-front for the premium to construct the excess service. Alternatively, the CSRD could require the developer to pay the costs under a Latecomer Agreement.

Under a Latecomer Agreement, the developer pays for the excess sewer service and is entitled to recover a portion of the costs from the owners of the serviced properties when they connect. Under this scenario, the CSRD would collect a pre-determined Latecomer tax or fee. The Latecomer fee is payable at the time a homeowner connects to the service or the use begins. Under the Community Charter, the Latecomer Agreement cannot exceed a period of 10 years which can be extended by the CSRD to 15 years. Any homeowner that connects to the sewer within the latecomer agreement period is obliged to pay the latecomer fee. After the agreement expires, there is no cost to connect.

The ability to piggy-back construction of a community sewer on other utility projects or new development requires a pre-designed sewer network, and close inter-department and inter-agency communication. A pre-designed sewer network will allow servicing refinements or new options to be investigated.

5.3 USING TAX DEFERMENT PROGRAMS TO IMPROVE AFFORDABILITY

The British Columbia Property Tax Deferment Program is a loan program that allows homeowners to defer their annual property taxes provided certain eligibility criteria are met. This program could be used to defer payment of the sewer capital cost by those homeowners on limited incomes.

The program is available to Canadian citizens and permanent residents who have lived in British Columbia for at least one year prior to applying for the program. You must occupy the home as your principal residence. Second residences, such as summer cottages or rental properties, do not qualify for tax deferment.

After deducting the Home Owner Grant, all or part of the unpaid balance of residential property taxes for the current year can be deferred. All penalties, interest, previous years' property taxes, and utility user fees cannot be deferred.

Taxes can be deferred as long as the taxpayer owns and lives in the home and continues to qualify for the program. The deferred taxes must be fully repaid, with interest:

- before the home can be legally transferred to a new owner, other than directly to a surviving spouse; and
- upon the death of the agreement holder(s).

Simple interest is charged on deferment accounts at a rate not greater than 2% below the prime rate of the Province's principal banker. The interest rate is set every six months by the Minister of Small Business and Revenue.

If the home is refinanced, the mortgage holder may require full repayment of the deferred taxes upon refinancing. All or part of the deferred taxes, fees and interest can be paid at any time without penalty.

5.4 ADDRESSING FAILURES OF EXISTING ON-SITE SYSTEMS

On-site septic systems have a finite life, and the risk of a failure increases as their age increases. Carry-over of solids from the septic tank causing plugging of the drain field is the primary cause of failures and can be accelerated if the septic tanks are not pumped out frequently or if the field is undersized. Re-building failed systems to current standards can be costly and disruptive. This is especially true in the Blind Bay and Sorrento area where some lot sizes are insufficient to support a conventional drain field. In these instances, a higher level of treatment must be achieved, thereby, increasing the upgrade cost. Within the proposed sewer area, a septic system failure can have a relatively large financial consequence. In addition to the cost of a septic system failure, the homeowner is faced with financial implications of paying for and connecting to a new community sewer system. As a result, in order to minimize the financial consequence of a septic system failure, provision for a holding tank should be provided.

A holding tank is a large tank installed in the yard which would capture and hold the wastewater from the home. When the tank nears its full capacity, a septic pump service would empty the contents and transport the wastewater to the treatment plant. Pumping of the tank would need to be undertaken by a licensed contractor and the wastewater disposed of at an approved wastewater treatment plant.

Interior Health has in the past allowed for a holding tank for houses that are in areas to be sewered. The conditions for such a system include provision for an alarm if the water level exceeds a pre-determined level and holding a contract with a septic pump-out service. These systems have only been allowed for areas that are expected to have a community sewer installed. For the Area ‘C’ plan, this would include the proposed areas designated for a community sewer.

Installing a holding tank should be considered carefully by the homeowner. While the cost to install the tank would be significantly less than installing a new septic system that meets current design standards, the operational costs are higher. The tank would need to be pumped out relatively frequently. A 10 cubic metre holding tank could take 10 to 30 days to fill by a single family home, depending on the number of residents and number of water conservation measures employed. Assuming the cost of a pump-out is similar to that of a septic tank (approximately $300) the annual operational cost could be in the range of $3,700 to $11,000.

Allowing for a holding tank as an interim measure for failed systems or new homes in areas where a new sewer system is planned will provide the homeowner an opportunity to avoid a large expenditure for an on-site system upgrade while still having a positive environmental impact. However, the operational cost is large enough that it must be weighed carefully against the option of installing a new on-site system.

5.5 TYPICAL ENGINEERING PROJECT SEQUENCE

The process of implementing a wastewater collection and treatment system will involve various distinct stages.

The LWMP can be considered part of the Conceptual Design stage. During this process, high level decisions have been made which provide direction for subsequent stages. Of particular significance has been the decision to develop a wastewater collection and treatment system for the Sorrento, Blind Bay and Reedman Point areas and to utilize effluent irrigation as a principle means of dispersal. Application for grant funding can be supported by the approved LWMP. Once the CSRD Board of Directors and the Minister of the Environment have approved the LWMP, the first step will be for the CSRD to apply for grant funding from senior government at the first opportunity.

As part of the Conceptual Design stage, the CSRD may also give consideration to undertaking an assent process. However, based on a legal opinion from its solicitor, the CSRD is not obligated to undertake a public assent process. The opinion states "…if the proposed sewer service and related borrowing are for the purpose of implementing the proposed LWMP, then once that LWMP is approved by the Minister, the Regional District would be able to adopt the service establishment bylaw and borrowing bylaw without the assent of the electors…" Although an assent process is not required, an assent process may be implemented at the call of the Area Director or Board of Directors. If implemented, an assent process should be presented to the public once approval is received on a minimum two thirds grant funding from senior government.

In the next Preliminary Design stage, the collection and treatments systems developed in the Conceptual Design stage will be advanced. Of particular importance is selection of a site and process for the treatment plant and refinement of the conveyance infrastructure. Major decisions, key plans and data that will need to be developed in advance or as part of the Preliminary Design will include:

- Decision on the ultimate sewerage area (ie, whether to integrate portions of Area 'C' and Area 'F');
- Final Official Community Plan and associated growth projections;
- Hydraulic and wastewater loading associated with any proposed vessel pump-out facilities;
- Estimates of septage volumes; and
- Updated topography (1 metre contours) and associated digital aerial mapping.

Prior to finalizing the Preliminary Design stage, the CSRD should consider conducting a public information meeting to communicate household costs, system plans and schedules. Long term effluent supply contracts with area farmers to utilize the reclaimed water should be entered into prior to this stage.

In the Pre-Design and Detailed Design phases, the elements developed as part of the Preliminary Design will be developed further. This will include sizing of pumps and pipes; development of vertical and horizontal alignment of pipes; securing easements; and arrangement of new buildings and treatment processes.

5.6 DELIVERY OF SERVICE MODELS FOR SEWER SYSTEMS

There are two service delivery models that could be considered for the new wastewater treatment plant and collection system.

With the first conventional approach the CSRD operates the system utilizing qualified staff it hires. The CSRD is responsible for ensuring the treatment plant is producing effluent that meets regulatory requirements.

Under the second model, the CSRD would contract out operational services for the treatment plant and collection system to a firm. The staff hired to undertake the operational services would all be qualified staff. The contract would stipulate a term, the minimum staffing levels, maximum treatment flow rates and equipment maintenance schedules. This approach provides a low risk approach to managing wastewater systems with predictable costs. The firm typically has significant experience it can draw from to resolve operational issues.

Under the Phase 1 servicing scenario, the sewer system proposed for either the Sorrento – Blind Bay area or Sunnybrae area can be categorized as a small system. Private contracting of small wastewater treatment systems has advantages. Due to its small size, a full-time operator may not always be necessary. Under this instance, the CSRD would need to find additional work in other areas in order to fully utilize the employee. Furthermore, reliance on a single person to operate the wastewater system can create problems if the staff member decides to leave.

Supervising operators of water or wastewater conveyance and treatment systems must be certified at a level equivalent to the complexity of the system by the Environmental Operators Certificate Program (EOCP). A secondary treatment plant which is being proposed for the Area 'C' would require either a Level 2 or 3 operator, depending on the complexity and size of the plant. In order to maintain this status, a minimum level of on-going education is required. The EOCP establishes a standard of skill and proficiency for plant operators that requires on-going investment by the employer in training and learning. As result, with each staff change-over there is a risk that the effluent quality will be negatively impacted due to this gap in learning.

Due to the relatively small size of the proposed wastewater systems for the Sorrento – Blind Bay and Sunnybrae areas, and the limited available CSRD resources, the recommendation of this LWMP is to consider contracting out operations. However, this recommendation should be reviewed every 5 years or if the treatment plant is upgraded for additional complementary services like septage receiving, composting, etc. As the system grows and staffing levels increase, there will a greater advantage to having in-house wastewater operations expertise for long-term maintenance planning.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the Stage 2 Liquid Waste Management Plan, the CSRD should begin implementing the recommendations of the Advisory Committee. Key recommendations from this plan are:

1. For the entire Area 'C', preferred solutions include public education, water quality monitoring and bylaws. These programs serve to minimize the environmental and health impacts of existing septic systems and set the stage for management of new and existing community sewer systems in a way that is consistent with the values of the community.

2. Implementing and enforcing some of the recommended bylaws will require developing some level of building inspection. As a result, introduction of a Building Regulation Bylaw for Area 'C' is recommended.

3. To address potential public health and environmental conflicts surrounding private lake discharge, this LWMP recommends that all private discharges of treated effluent, included treated grey water from nautical vessels, be prohibited from Shuswap Lake and White Lake.

4. For the Sorrento, Blind Bay and Reedman Point area, development of a new community sewer system and wastewater treatment plant is recommended. Based on the results of preliminary negotiations with Shuswap Lake Estates, the option of developing the Shuswap Lake Estates treatment plant as a regional facility has been dropped as the preferred option. As a result, purchase of land in the Balmoral area for a treatment plant and storage should be investigated. This will entail entering into discussions with the Agricultural Land Commission (ALC) for approval to construct a wastewater treatment plant and storage reservoir on ALR land. There is precedent for approval of this request from the ALC.

5. A back-up ground infiltration system may be needed for the new effluent irrigation system. Once a new site in the Balmoral area is established for a new wastewater treatment plant and storage reservoir, a hydrological review of the area should be undertaken and an infiltration site identified.

6. In order to be affordable, the cost of developing the Sorrento, Blind Bay and Reedman Point sewer system will need to be funded by Provincial and Federal grants. The household cost documented in the Stage 2 report and presented to the public assumes that the grants will cover 2/3 of the capital cost of the system. The CSRD should apply for the grant at the earliest opportunity once the Area C LWMP is approved by the CSRD Board of Directors and the Minister of the Environment.

7. Distribution of household cost for the remaining 1/3 capital cost should be based on assessed value of improvements.

8. The homeowner will also be responsible for the on-site costs to tie-in to the new sewer system. This cost is estimated to be on average $4,305 for a gravity connection and $4,840 for a pumped connection. The household costs, both for on-site and off-site works, may be communicated to the public through a newsletter, the CSRD website, and other means. The CSRD should provide a list of qualified and available contractors to the residents of the sewer service area and provide information to assist the residents in selecting a preferred contractor.

9. Long term effluent supply contracts should be established with farmers for the disposition of the reclaimed water.

10. As part of the preliminary design stage of the Regional treatment plant, a long-range servicing plan should be developed. In the event that a mandatory septic tank pump-out program is contemplated and there is a lack of capacity by the private sector to handle the volumes and work load associated with such a program, this plan should incorporate a plan for developing a septage handling facility to accommodate pumped waste from septic tanks.

11. Due to its relatively small size initially, hiring a contractor to operate the new sewer system and treatment plant will help to minimize costs. However, as the system grows, the CSRD should consider taking over operation and maintenance of the system.

12. As part of the development of the new sewer system and treatment plant, the CSRD should develop an integrated waste management plan that includes agricultural waste (manure) and any waste by-product from the treatment plant.

13. For the Sunnybrae and White Lake area, water quality monitoring should be initiated to assess the impact of existing development on the lake and groundwater. The results of the testing may serve as a trigger for development of a new community sewer system.

14. It is recommended that holding tanks be allowed for homes within a proposed sewerage area to address the failure of an existing on-site system. Installation of the holding tank is intended to assist the homeowner is avoiding a large expenditure for an on-site system upgrade in an area where a community sewer system is planned.

Table 10 provides a summary of annual household cost by sub-area, based on the summary conclusions and recommendations made in this report.

Table 10: Summary of Total Household Costs By Area

Area	Estimated Annual Cost (Based on 20 Year Amortizaton at 6% Interest)				Comments
	Solution 1 - Public Education, Water Quality Monitoring, and Bylaws	Capital Cost for Development of a Community Sewer System	Annual Operation and Maintenance Cost for Sewer System	Total Estimated Average Annual Cost	
1. Blind Bay, Sorrento and Reedman Point	$40	$646	$110	**$796**	1. Estimated cost assumes that a new Regional facility is constructed in the Balmoral area. 2. The additional on-site cost to install a service from the home to the property line is estimated to be on average $4,300 to $4,840 3. O&M costs may be higher if servicing is phased.
2. Sunnybrae	$40	-	-	**$40**	The Sunnybrae area may require a new community sewer if water quality monitoring detects an impact - under this scenario, the total household cost will increase to an estimated $1,456 per year.
3. White Lake	$40	-	-	**$40**	The White Lake area may require a new community sewer if lake water quality monitoring detects an impact - under this scenario, the household cost wil increase.
4. Rural Areas (Balmoral, Notch Hill, Tappen Valley, Carlin, Skimikin, Eagle Bay and Wild Rose Bay	$40	-	-	**$40**	

The CSRD obtained a legal opinion from its solicitor concerning a public assent process. The opinion states "…if the proposed sewer service and related borrowing are for the purpose of implementing the proposed LWMP, then once that LWMP is approved by the Minister, the Regional District would be able to adopt the service establishment bylaw and borrowing bylaw without the assent of the electors…" Although an assent process is not required, an assent process may be implemented at the call of the Area Director or Board of Directors. From a timing perspective, an assent process should follow approval of the grant application from senior government.

As a final recommendation, the CSRD Board should adopt Stage 3 LWMP Report as a bylaw and submit it to the Minister of Environment for approval.

Appendix A

Advisory Committee Meeting Minutes

Columbia Shuswap Regional District, Area 'C'

Liquid Waste Management Plan

Meeting Minutes

PURPOSE:	**CSRD, Area 'C' LWMP Committee Meeting**
MEETING DATE/TIME:	**October 27, 2008, 5:30pm**
MEETING LOCATION:	**Steamers**
FACILITATOR:	**Joanne de Vries, Alliance Communications**

Minutes

1. SLE Dam Inspection

- MOE staff has undertaken an inspection of the SLE dam.
- Consequences of failure is low - a dam failure would be contained by Loftus Lake.
- The inspection did not uncover anything that would suggest the dam is unstable.
- While the inspection has not identified any major issue, there is still a need to conduct engineering investigations as a condition of any purchase.
- The issue of whether the dam toe relative to Loftus Lake constitutes an encroachment needs to be resolved.

2. SLE Negotiations

- Negotiations are proceeding.
- Gary will consider any comments provided by AC.
- Ultimately, if the terms of the M.O.U. is not in the best interest of the community development of a new facility in the Balmoral (i.e. the back-up option should be pursued.)

3. Meeting with Area Farmers

- Gary summarized results of an expression of interest for effluent supply and a meeting held with area farmers. The results of the expression of interest are encouraging. Farmers from Armstrong attended the meeting and discussed their experiences using effluent.

PARTICIPANTS

Name	Name
Advisory Committee	
Bob Mor	Gary Kennedy
Carol Ferguson	Melany Dyer
Chris Addison (absent)	Mike Johnstone
Dennis Roberts	Stephen Jackson
	Vic Morandini
Columbia Shuswap Regional District	
Darcy Mooney	Jay Simons
Gary Holte	Ted Bacigalupo
	Marcin Pachcinski
Agencies and Other Stakeholders	
Carol Danyluk - Ministry of Environment	Jean Ferry - Environment Canada (absent)
Tanya Mrowietz - Interior Health	Larry Gardner – Ministry of Environment (absent)
Joe Rowlett – Interior Health	Robert Niewenhuizen – City of Salmon Arm
Consultants	
Joanne de Vries (Alliance Professional Services)	
Tim Forty (Earth Tech)	
Piero Galvagno (AECOM)	

Columbia Shuswap Regional District, Area 'C'

Liquid Waste Management Plan

Meeting Minutes

PURPOSE:	**CSRD, Area 'C' LWMP Committee Meeting**
	Stage 3 Report Review
MEETING DATE/TIME:	**November 10, 2008, 5:30pm**
MEETING LOCATION:	**Toby's Restaurant**
FACILITATOR:	**Joanne de Vries, Alliance Communications**

Minutes

1. Carol

- Septic benchmark- Pumping has doubled in recent yrs.
- Licensed hauler- need to be to a regulated facility

2. Gary Kennedy

- M.O.U Process- Comments to be forwarded to consultant- final M.O.U to be vetted by CSRD executive staff and Board, Legal Counsel
- The issue of whether sufficient capacity will be available to providing for a sewer system in the Sorrento – Blind Bay area needs to be addressed. (Dennis R.)

3. Vic. M.

- The issue of Scotch Creek needs to be decided before proceeding.
- Septage capacity needs to exist.
- Clean-up reference to BNR – should be tertiary treatment
- Is an amendment to the Permit required? If the SLE facility is taken over by CSRD the existing permit would be cancelled and the LWMP would govern (Carol D.)

4. Melany

- P. 10 - Add "Effective enforcement"
- P.11 - Define community sewer vs publicly owned
- It may be worth the extra cost to go to Balmoral site first
- What about old systems takeover? An exisiting policy exists which provides for voluntary takeover (Gary H.).
- The MOU will be a public document at some point. (Gary H.)
- Agricultural users will have to invest in infrastructure to use the effluent, as a result, it doesn't makes sense to try to make a profit (Gary H.)

5. Steve J.

- Main concern is that capacity may not exist in the existing SLE facility to solve the problem.
- The lack of OCP is a concern and needs to be brought into the picture.
- Public acceptance of the M.O.U. is a concern- it appears that the benefit currently is to the SLE. If not accepted by the public, the Plan could fail.

6. Joe R.

- M.O.U. is a parallel process. The process will take time.
- Additional terms may be included in M.O.U. to address concerns of A.C.
- Tying in North shore is promising and will be a benefit to the entire shuswap.
- Incorporating the SLE facility into the process is a good thing.
- The public has shown support for the decisions made.
- From a public health persepective, the process is going well.

7. Carol D.

- Incorporating North Shuswap will be advantageous from a Grant perspective.
- The anxiety with the M.O.U. is understandable and it would be beneficial for the CSRD to include wording to address the issues.
- MOE has been approached by a commercial vessel company to utilize an onboard Grey Water Treatment System. However, MOE is requesting feedback from the Advisory Committee.
- In effect, this goes contrary to the spirit of this LWMP which was to remove private systems. (Ted B.)
- Treated greywater is difficult to treat and will put drinking water at risk. (Melany D.)

8. Tanya

- Section 6- P.42, 3rd paragraph - Build inspection needs to be highlighted as beneficial for other reasons.

9. Ted B.

- The tone of the process has changed. It appears the AC is hesitant to move forward without seeing the final M.O.U. Consideration should be made to develope the Balmoral site. Under the circumstances, it is difficult to see how the process could proceed.
- Until the OCP is completed it's difficult to know what treatment capacity is required. Growth needs to be considered.

10. Jay.

- For each of the development stages, the SLE must apply to the CSRD. There is no guarantee that SLE will get approval even with the capacity guarantees of the MOU.

11. Dennis. R.

- P. 19 – The recommendation that those lots already serviced would not pay again needs to be highlighted.
- P. 22 – The solution is not preferred, given the survey response.
- P. 34 – Mandatory connection and taxes. On-site costs should be more detailed.

<u>Solution #1</u>

Tanya M. - Building Inspection needs to be incorporated into an Area-wide position – it should also be on a basin wide recommendation.

Gary H. - Survey and cost of education should drop over time.

Melany D. - Stongly support building inspection

Dennis R. - assessed value should include property value.

Solution #2

Carol D. - Include discussion regarding proposal to provide on-board grey water treatment.

All - include statement which does not support grey water treatment (ie, prohibition of on-board grey water treatment of private sources).

Solution #3

Gary K. – hand-over should be voluntary

Gary H. - definition and community sewer system needs to be linked

Ted B. - can a development permit deal with this option.

- this option was supported by public and should not be re-considered (Joe R., Carold D.)

Jay S. – development permit area does not effectively deal with issue well.

Melany D. - There were many benefits to this option.

Carol D. – will this option deal with a shared interest development? Zoning will be developed to eliminate hared intereat development. (Jay S.)

Solution #6

Carol F.- concern exists in the community dut to costs.

Gary H. - there is going to be a long monitoring period and the option should be revisted.

- there are many unanswered questions that need to be answered prior to making any decisions to proceed. (Carol D.)

Melany D. – indicate or reiterate the A.C.'s position that lake discharge is not supported.

Carol F. - would like to see all lake discharge prohibited.

- my support for connection to the Sunnybrae system was contingent on Salmon Arm upgrading to provide for effluent reuse.

Solution #4/#5

- The AC supports a community sewer system for the Blind Bay – Sorrento area.
- The AC is uncomfortable with the MOU. As a result, the CSRD will bring a final MOU back to AC for consideration. If takeover is not in the best interest of the public then the Balmoral option will be advanced (Gary H.)

- The main concern of the MOU is that capacity is being reserved for SLE at potentially the detriment of the community. (Carol D.)
- The concern is that private enterprise is being subsidized by taypayer money. (Ted B.)

Joe R. - MOU is usually a broad, high level scheme with details included in a separate document.

Gary H. - Assessment of the facility will be by an engineering consultant and the price taken off the final sale price.

Carol D .- Grant funding may be compromised by a leasing arrangement.

Gary H. - ALC has indicated that the agricultural land proposed for development by SLE will only be allowed to be removed from the ALR if the CSRD owns the SLE sewer system and utilizes the effluent to the enhancement of agriculture. The land proposed for the Balmoral STP site is ALR land but would not be removed from the ALR.

Ted B. - There will be both winners and losers on takeover of the SLE system. However, we need to move forward.

The AC endorses distribution of costs based on assessed value of improvements.

Ted B. - with respect to inspection, setting up a building inspection will cost $250-350,000. Can building inspection costs be incorporated in the LWMP for sewer connection in the growth area?

This is probably not possible from a legislative perspective. The cost would be nominal at start-up and would be user-pay after that. (Jay S.)

PARTICIPANTS

Name	Name
Advisory Committee	
Bob Mor	Gary Kennedy
Carol Ferguson	Melany Dyer
Chris Addison (absent)	Mike Johnstone
Dennis Roberts	Stephen Jackson
	Vic Morandini
Columbia Shuswap Regional District	
Darcy Mooney	Jay Simons
Gary Holte	Ted Bacigalupo
	Marcin Pachcinski
Agencies and Other Stakeholders	
Carol Danyluk - Ministry of Environment	Jean Ferry - Environment Canada (absent)
Tanya Mrowietz - Interior Health	Larry Gardner – Ministry of Environment (absent)
Joe Rowlett – Interior Health	Robert Niewenhuizen – City of Salmon Arm
Consultants	
Joanne de Vries (Alliance Professional Services)	
Tim Forty (Earth Tech)	
Piero Galvagno (AECOM)	

Columbia Shuswap Regional District, Area 'C'

Liquid Waste Management Plan

Meeting Minutes

PURPOSE:	**CSRD, Area 'C' LWMP Committee Meeting**
	Stage 3 Report Review
MEETING DATE/TIME:	**December 8, 2008, 7:00pm**
MEETING LOCATION:	**Carlin Hall**
FACILITATOR:	**Joanne de Vries, Alliance Communications**

Agenda

1. Introduction

- Process started in Fall 2006
- Gary Holte
  - Mandate was to provide a LWMP for Area 'C'.
  - Single Advisory Committee was selected combining public & technical committees.
  - Education a large component of the process.
  - AC is assertive, bold & challenging, dedicated, inquisitive, resourceful.
  - Adopting the concept of interest based negotiations was done in Stage 1 and was suggested by Dennis Roberts.
- Joanne De Vries
  - The AC was committed to completing the LWMP.
  - A communication plan was presented and adopted by the Advisory Committee
- Tim Forty
  - A Large number of presentations were prepared to review technology, present potential options and develop solutions.

2. Presentation by Kathy & Larry Pilcher

- Three areas of concern were presented:
  1. Dam Safety - There is a concern based on photos and observations that the dam is not constructed properly or may be leaking.
  2. Capacity - There is concern that the existing capacity cannot meet future growth, as well as, servicing plans for the Sorrento, Blind Bay & Reedman Point area.
  3. FOI Request – Request that questionnaire is filled out by advisory committee members.

3. Status of Memorandum of Understanding (Dave Morris)

- Dave Morris was tasked with faciliatating discussions and developing a Memorandum of Understanding (MOU), if appropriate.
- Devloping the Shuswap Lake Estates (SLE) treatment plant as a regional facility allows for quicker servicing and addresses water quality problems associated the lake quicker.
- In addition, there are some potential cost savings over other options and taking over the plant eliminates duplication of services.
- A MOU is a legal intent and is not binding. It sets out principles that would lead to an agreement.
- SLE has capacity for approx. 426 homes, assuming 1,000 L/house/day design.
- There are approximately 414 units planned for SLE and an additional 540 homes are proposed for Phase 1.
- Total required servicing from CSRD (Phase 1, 2, 3) is 2,339 homes.
- Current SLE sees approximately 440 L/home/day of wastewater in the treatment plant – if this is projected there may be extra capacity in the near future.
- MOU has been modified following a meeting in November which Melany attended.
- Conditions for final agreement include:
  - (i.) Payment & money.
  - (ii.) Assessment by a competent geotechnical engineer.
  - (iii.) Commitment by SLE to upgrade systems to 1,000 m^3/d or approximately 1,000 homes, including a holdback.
  - (iv.) If CSRD receives funding, the CSRD could design and construct the upgrade.
  - (v.) If there is no grant money, there is no agreement.
  - (vi.) Commitment to reuse effluent in a beneficial way.

- It appears that SLE gets its future capacity for free (Dennis R.)
- The final value of the SLE facility will depend on negotiations. However, the intention of SLE is to get reimbursed for upgrades and not get charged for future connections (Gary H., Dave M.)
- The fact that SLE appears to get its future capacity for free is a major problem with the agreement. Deferal of DCC's for up to 446 homes (ie, the existing plant capacity) is reasonable. However, DCC's should be charged for everything above this (Melany D.)
- By doing nothing, SLE has 10 years capacity (Ted B.)
- Rational for paying for upgrades appears to have been to buy future capacity (Ted B.)
- Does it make sense to pay around $3M for 5 years capacity or to go directly to Balmoral? (Ted B.)
- The decision to purchase SLE or go to Balmoral is really up to Ted & CSRD (Vic M.)
- If we didn't comment on the MOU concerns of residents will not be expressed (Melany D.)
    - The AC has considerable influence on the ground rules (Bob M.)
    - One of the key considerations is to have the treatment plant in public hands and has been forgotten (Joe R.)
    - It has became apparent that the existing SLE needs to be substantially upgraded. The option of developing the Balmoral site appears more sustainable (Steve J.)
    - The option of developing the Balmoral site is becoming more attractive (Carol F.)
- 10 voting members of AC
    - Do you support MOU #11 as it stands? No Hands (0 of 10). Given that 2/3 majority is required, MOU is not supported by AC.
    - Do you support MOU #11 with changes? 6 of 10. Since 2/3 majority is required, MOU #11 will not be advanced.

5. <u>Acceptance of Stage 3 Report</u>

- Color-code on-site & off-site costs
    - Add to comments column
- P. 14 – reference to number of bylaws differs
- P. 15 & 38 – regarding nautical vessel – add to P. 15
- P. 14 – monitoring should be continued in all arms of Shuswap Lake

- Add bylaw recommending no private discharges (Carol D.)
- Septic pump-outs – in the case where there is only one person living in the residence, consideration should be given to reducing the pump out frequency
- P. 32 –should indicate that report was uploaded to CSRD website
- Need to highlight the fact that distance from home to property line varies
- Add "The AC does not support lake discharge of effluent" to principles adopted by committee.
- Do you support the Stage 3 Report contingent on changes discussed here? 10/10 Based on this vote, the Stage 3 will finalized and presented to the Board for approval.

PARTICIPANTS

Name	Name
Advisory Committee	
Bob Mor	Gary Kennedy
Carol Ferguson	Melany Dyer
Chris Addison (absent)	Mike Johnstone
Dennis Roberts	Stephen Jackson
	Vic Morandini
Columbia Shuswap Regional District	
Darcy Mooney	Jay Simons
Gary Holte	Ted Bacigalupo
	Marcin Pachcinski
Agencies and Other Stakeholders	
Carol Danyluk - Ministry of Environment	Jean Ferry - Environment Canada (absent)
Tanya Mrowietz - Interior Health	Larry Gardner – Ministry of Environment (absent)
Joe Rowlett – Interior Health	Robert Niewenhuizen – City of Salmon Arm
Consultants	
Joanne de Vries (Alliance Professional Services)	
Tim Forty (Earth Tech)	
Piero Galvagno (AECOM)	