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March 2, 2011

Sean DePol
Manager, Wastewater Services
Regional District of Nanaimo
6300 Hammond Bay Road
Nanaimo, BC. V9T 6N2

Re: Feasibility Study for Area-H Bowser Community Sewer Servicing Study

Dear Sean,

Please find attached the Feasibility Study for Area-H Bowser Community Sewer Servicing Study.

The feasibility study included an assessment of the sewage flow projections based on the development plans of the Bowser Community Stakeholders participating in the subject study. In addition, options for collecting, treating and disposing the projected sewage were considered and the costs associated with each option were prepared to a Class D cost estimate.

The study proposed two feasible options for the sewer servicing systems of the stakeholder lots, analyzed the costs associated with the both systems and highlighted the next steps required to move the project forward to preliminary and detail design.

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

We appreciate this opportunity and we are looking forward to providing our services and working again with you in the future.

Sincerely,

CHATWIN ENGINEERING LTD.

Zaid Azaizeh
Project Designer and Coordinator

David Shearer, P.Eng.
Vice President, Civil Engineering Division

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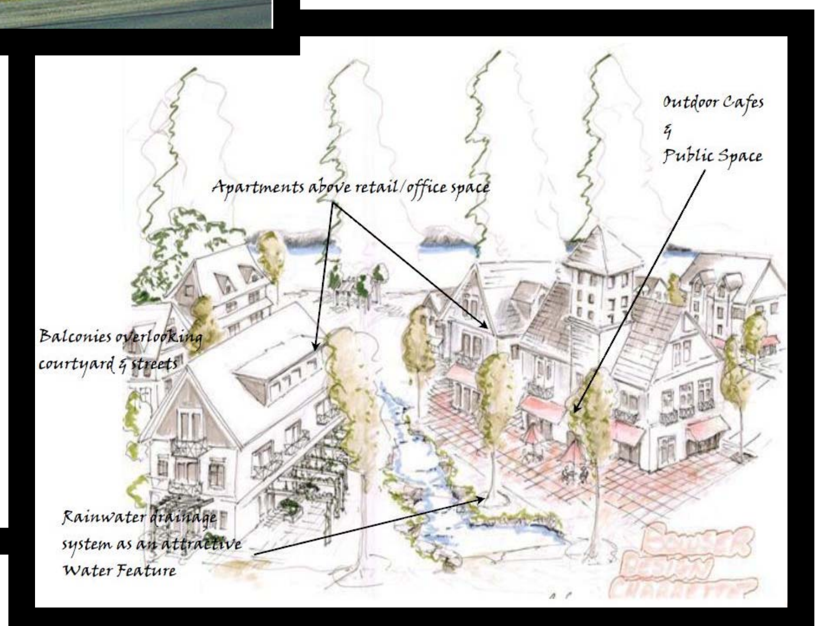
BOWSER

Sewage Feasibility Study



February 2011

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GLOSSARY

ADWF – Average Dry-Weather Flow
AWWF – Average Wet-Weather Flow
BCS – Bowser Community Stakeholder
BV – Bowser Village
cap - Capita
DFO – Department of Fisheries and Oceans
EC – Environment Canada
GD – Ground Disposal
ha – Hectare
l – Litre
m – Metre
MD – Marine Disposal
MOE – Ministry of Environment
MOT – Ministry of Transport
MSR – Municipal Sewage Regulations
OCP – Official Community Plan
O&M – Operations and Maintenance
PDWF – Peak Dry-Weather Flow
PWWF – Peak Wet-Weather Flow
RDN – Regional District of Nanaimo
SCS – Sanitary Collection System
SSR – Sewerage Standard Regulations
STP – Sewage Treatment Plant

EXECUTIVE SUMMARY

Population Projections and Sewage Capacity

Population projections and sewage capacity for the Bowser Community Stakeholder (BCS) group were calculated based on stakeholders' development plans and Official Community Plan (OCP) criteria and land use distribution. The maximum figures represented in the year 2030 are summarized in Table 1.

Table 1: Projections Summary

Units	540 units
Population	889 people
Sewage Capacity (Average Dry Weather Flow)	320 m^3/d

The assumptions made to calculate these numbers are based on:

- Official Community Plan (OCP) criteria for unit and population densities and land use distribution.
- The average dry weather flow (ADWF) per capita rate for sewage was taken as 360l/cap/day.

Collection System

Two alternative collection systems were considered, gravity collection system and low-pressure collection system. The alignment of the proposed systems allows for flexibility during the detailed design stage to accommodate for expansion and future connections to the network.

Table 2 summarizes the Class-D construction costs of the two systems (including 30% for engineering and contingency), the operations and maintenance costs and the present worth of each system. Present worth is calculated based on a 5% interest rate over a period of 20 years.

Table 2: Collection Alternatives Cost Comparison

System	Construction Cost (plus 30% engineering and contingency)	Annual Operations and Maintenance Costs	Present Worth
Gravity Sewer	$ 991,593	$ 16,000	$ 1,190,989
Low-pressure Sewer	$ 811,038	$ 25,000	$ 1,122,593

The assumptions made in calculating the above costs are:

- MOT will allow open trench excavation within roadways.
- Asphalt re-instatement is required where the trenches and pipe alignment are within Highway 19A or any asphalted road.
- The number of septic tanks to be decommissioned is 7 tanks.
- Ground conditions are suitable for open trenches and no major obstructions, such as rocks or contaminated soils, exist along the pipe alignment.

Treatment Plant

The treatment process is based on a packaged treatment plant using the Upflow Sludge Blanket Filtration (USBF).

Two effluent levels were considered, Class A and Class B, to facilitate disposal alternatives.

The treatment plant expansion is phased in two stages, 160m^3/d for Phase-1 and maximum capacity of 320m^3/d at Phase-2.

The Class-D cost estimates associated with the treatment plant at maximum capacity, 320m^3/d, for both effluent classes is as shown in Table 3. The present worth is based on an interest rate of 5% per year over a period of 20 years.

Table 3: Treatment Alternatives Cost Comparison

Effluent Class	Construction Cost (plus 30% engineering and contingency)	Annual Operations and Maintenance Costs	Present Worth
Class A	$ 1,300,000	$ 137,000	$ 3,007,323
Class B	$ 780,000	$ 113,000	$ 2,188,230

Treated Effluent Disposal

The two alternatives considered for disposing treated effluent are Ground and Marine.

Ground Disposal - a scoping geotechnical assessment and site visits were done on several ground disposal sites for suitability and potential for ground disposal.
The site where ground conditions were suitable for infiltration and where there is possibly enough area to accommodate 320m^3/d ADWF was Crown lands located about 2.5Km away from Bowser Village Centre and 40m higher in elevation.

Marine Disposal – Two alternative outfall locations were considered in the course of the study. One is to the Northwest of Bowser in the direction towards Courtney and the other is to the Southeast of Bowser in the direction towards Nanaimo city; parallel to the Northern bank of Nile Creek and to the South of BC Hydro substation.

Both outfall locations have taken into consideration the extent of the aquaculture farms offshore at Bowser and a 600m setback to satisfy regulatory requirements.

The outfall towards Southeast of Bowser Village was considered the more feasible option. This is because it is more in compliance with regulations and also provides a larger setback from aquaculture farms, which may help mitigate concerns from the BC Shellfish Growers Association.

The Class-D cost estimates associated with the disposal alternatives at maximum capacity, $320m^3/d$ ADWF, is as shown in Table 4. The present worth is based on an interest rate of 5% per year over a period of 20 years.

Table 4: Disposal Alternatives Cost Comparison

Disposal Alternative	Construction Cost (plus 30% engineering and contingency)	Annual Operations and Maintenance Costs	Present Worth
Ground	$ 2,053,220	$ 33,000	$ 2,464,473
Marine	$ 2,170,610	$ 6,500	$ 2,251,614

The assumptions made in calculating the above costs are:

- Land for ground disposal can be acquired. The value of land for ground disposal is assumed at $7,000/Ha. This is derived from RDN's GIS Mapping website for the value of land adjacent to the proposed disposal site.
- Electricity, to power the infiltration basin equipment, is supplied from a source relatively close to the disposal site such as the Inland Island Highway.
- The marine outfall pipe can be aligned close to the borderline of BC Hydro's ROW.
- The alignment is set to maintain the setbacks from significant aquaculture farms and tenures. Smaller shellfish farms may exist and thus impact the proposed alignment.

Option Analysis

Based on the feasibility and cost analysis of each component of the sewer servicing system, two options were considered viable, these are as show in Table 5.

Table 5: System Options

System Component	Option-1	Option -2
Collection	Low-Pressure System	Low-Pressure System
Treatment	Class B Effluent	Class A Effluent
Disposal	Ground Disposal	Marine Disposal

Low-pressure collection system is favoured over gravity system in both options because it has lower capital costs. Although, it has higher annual operations and maintenance costs than gravity collection system, it still has lower life cycle cost.

The low pressure collection system is also recommended because it offers more flexibility in terms of pipe alignments at bends and curves which is due to the fact that the pipe sizes are smaller than those used in the gravity system. This is achieved by installing more manholes in the gravity system, thus higher costs and more space requirement.

The treated effluent quality was recommended based on the disposal option. Class B effluent is acceptable when using infiltration basins for ground disposal as long as the soil conditions and surrounding environment allow for that. Based on the broad geotechnical assessment, the soil types in the proposed site seem to possess good infiltration capacities. The site is bordered by Thames Creek from the North, however an adequate setback distance seems to be available.

On the other hand, it is recommended to achieve highest treatment levels for marine disposal. Moreover, due to the sensitivity of the area and the existence of aquaculture tenures around Bowser, Class-A effluent would be the preferred treatment alternative for marine disposal as outlined in Option-2.

The cost analysis for these options is listed in Table 6 and Table 7.

Table 6: Cost Analysis for Option-1

Option-1			
	Construction Cost (plus 30% engineering and contingency)	Annual Operations and Maintenance Costs	Present Worth
Low-Pressure System	$ 811,038	$ 25,000	$ 1,122,593
Class B Effluent	$ 780,000	$ 113,000	$ 2,188,230
Ground Disposal	$ 2,053,220	$ 33,000	$ 2,464,473
Total	**$ 3,644,258**	**$ 171,000**	**$ 5,775,296**

Table 7: Cost Analysis for Option-2

Option-2			
	Construction Cost (plus 30% engineering and contingency)	Annual Operations and Maintenance Costs	Present Worth
Low-Pressure System	$ 811,038	$ 25,000	$ 1,122,593
Class A Effluent	$ 1,300,000	$ 137,000	$ 3,007,323
Marine Disposal	$ 2,170,610	$ 6,500	$ 2,251,614
Total	**$ 4,281,648**	**$ 168,500**	**$ 6,381,530**

Conclusion

The analysis shows that construction cost for Option-1, with ground disposal, is 15% less costly than Option-2, whereas the former's annual O&M costs are about 1.5% higher. The Present Worth of Option-1 is 10.5% less than Option-2.

Ground disposal is a less costly solution for the BCS group and the disposal fields may be designed to include recreational uses such as trails and community forests. On the other hand, it may pose limitations to expansion if the entire Bowser community decides to connect to the communal system because additional land would be required for further expansion and there may be risks associated with the possibility of acquiring those lands in the future. Furthermore, the cost of $7,000/ha used in the cost calculations for land acquisition may not reflect the true current market value. Moreover, the value of land will probably rise in the future and the expansion is further restricted by the availability of Crown land adjacent to the proposed site. Thus, private land may require procurement which could be priced at much higher rates. Given that, the total construction cost associated with expanding the ground disposal site to accommodate the entire Bowser village is estimated at an additional $2,135,900, including 30% contingency and engineering costs.

Marine disposal option is slightly more costly than the ground disposal for the subject BCS group and it also has its challenges regarding receiving water quality, public acceptance and the existence of the aquaculture farms. However, those challenges can be overcome and the costs associated with the solutions can return higher benefits and unlimited access to a disposal option that can serve larger capacities and support the growth and development of Bowser without incurring additional costs.

The option for a marine outfall is likely a more viable solution to meet the development plans for Bowser Village and its capacity for future expansion. Although this option will entail more detailed studies to ensure compliance with all regulatory requirements, it has the advantage to meet the development plans for Bowser Village and its future expansion and to avoid additional construction costs in the long term.

Interim scenario

The cost comparison is based upon full development of the BCS group properties. A cost saving interim approach to lower initial capital costs is possible by phasing the construction of the treatment plant.

The treatment plant construction can be phased according to sewage capacity; Phase-1 can be built to treat 160m^3/d. Based on the development plans of BCS group, this capacity is reached approximately in the year 2019. The costs associated with phasing the treatment plant are as shown in Table 8. This would defer a portion of the capital cost until the development reaches levels where further upgrading is required, as shown in Table 9 and Table 10.

Table 8: Treatment Plant Costs (Interim)

Cost (Interim)	Class A	Class B
Capital Cost	$ 910,000	$ 520,000
O&M Annual Costs	$ 107,000	$ 89,000

Table 9: Cost Analysis for Option-1 (Interim)

Option-1 (Interim)		
	Construction Cost (plus 30% engineering and contingency)	Annual Operations and Maintenance Costs
Low-Pressure System	$ 811,038	$ 25,000
Class B Effluent	$ 520,000	$ 89,000
Ground Disposal	$ 2,053,220	$ 33,000
Total	**$ 3,384,258**	**$ 147,000**

Table 10: Cost Analysis for Option-2 (Interim)

Option-2 (Interim)		
	Construction Cost (plus 30% engineering and contingency)	Annual Operations and Maintenance Costs
Low-Pressure System	$ 811,038	$ 25,000
Class A Effluent	$ 910,000	$ 107,000
Marine Disposal	$ 2,170,610	$ 6,500
Total	**$ 3,891,648**	**$ 138,500**

Recommendation

It is recommended to proceed with further consultation with key stakeholders to more clearly define the best disposal option. Key consultation groups that need to be involved in the process are the following:

- Bowser Community Stakeholders to review the proposed feasible options and cost associated with them.
- Bowser Village community to determine whether or not more members are willing to participate in the communal sewer system, which could impact the sewage flow projections and determine the best suitable disposal option.
- BC Shellfish Growers Association with regards to the marine disposal option.
- MOT to assess the viability for the pipeline ROW's within the island Highway 19A.
- BC Lands, and perhaps private land owners, to more precisely evaluate the cost of land for ground disposal and explore the various terms of acquisition.

1.0 Introduction

1.1 Objective/Purpose of Feasibility Study

The community of Bowser Village (BV) within Electoral Area H of the Regional District of Nanaimo (RDN) has collectively participated in drafting an Official Community Plan (OCP) for the village centre which was published in June 2010. The OCP outlined various aspects of the community's vision for the village in terms of zoning criteria, sustainability principles, social perspectives, etc.

Following the OCP, the community of Bowser has requested RDN for assistance in developing a community sewer servicing system, to collect, treat and dispose liquid waste which would help in their progression towards those plans. A group of stakeholders, referred to as Bowser Community Stakeholders (BCS), came forward and requested assistance from RDN with undertaking a feasibility study, to identify community liquid waste handling options and a Class-D cost estimates associated in order for them to move their development plans forward.

1.2 Study Area

The study area is Bowser Village located on the east coast of Vancouver Island in the province of British Columbia in Canada. Bowser Village Centre is within Electoral Area-H of RDN located approximately 66Km Northeast of the City of Nanaimo and almost 38Km Southwest the City of Courtney. Highway 19A, otherwise known as West Island Highway, passes right through the centre of Bowser Village and crosses with the E&N railway. Figure 1, is a location map indicating Bowser Village and Figure 2 shows Bowser Village boundaries.

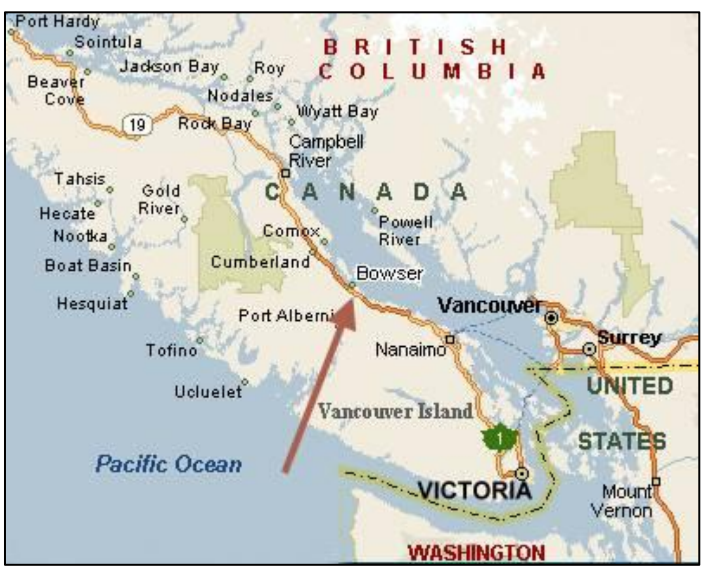

Figure 1: Bowser Village Location Map

Figure 2: Bowser Village Boundaries

1.3 Stakeholders

The study focuses on servicing the lots of the Bowser Community Stakeholder (BCS) group who are taking forward this initiative for a communal sewer servicing system.

The land lots of the BCS group are mainly clustered around the centre of the village; at the intersection of Highway 19A and E&N railway. Table 11 identifies the stakeholders and details of their lots and Figure 3 indicates the location of the lots.

Table 11: Stakeholders

Stakeholder	Plan Number	Area (Ha)
Canadian Legion	VIP2076	1.61
Seniors Housing	VIP2076 (Crown Lot 1 and 2)	1.40
Coral Ice	VIP86668 Lot 3	0.61
Magnolia Enterprises	VIP80074	4.81
AG Project Management	VIP87894	1.90
Tomm's Food Market	VIP87535	3.38
Green Thumb Nursery	VIP86668 Lot 1 and 2	4.81
Total		**18.52**

Figure 3: Stakeholder Lot Locations

1.4 Study Approach

The feasibility study included various tasks such as:

- Consultation with the BSC group in order to obtain information on each stakeholders development plans, to share basic regulatory and technical knowledge with the stakeholders and to engage the stakeholders in the study.

- Consultation with regulatory approving agencies with regards to new regulations that may impact the study or future plans and to obtain information relevant to the study.

- Reviewing topographical maps, land ownership maps, reviewing previous reports relevant to the area, reviewing regulatory procedures, etc.

- Site visits and inspections to identify potential opportunities for the various components of the sewer servicing system and to identify the constraints that may be encountered.

- The feasibility study covered the technical, regulatory aspects and costs for three components of a sewage servicing system which are:
  - Sewage Collection System (SCS)
  - Sewage Treatment
  - Treated Effluent Disposal

1.5 Study Team

The study was prepared with a collaborative effort from various consultants, including the following:

Consultant	Contact Person	Contact Number	Email
Chatwin Engineering Limited (CEL) – Civil Engineering Division	David Shearer, PEng Zaid Azaizeh	+1-250-753-9171 +1-250-753-9171	daveshe@chatwinengineeging.com zaid@chatwinengineering.com
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Trax Development Ltd – Geotechnical Consultant	Ian Ralston, BSc Pg Dip Ag Eng ROWP	+1-250-597-3155	onsite@traxdev.com
Payne Engineering Geology – Hydro-geological Advisor	Michael Payne, PEng, PGeo	+1-250-655-3604	PayneEngineering@shaw.ca
AECOM – Water and Wastewater Engineering Department	David Lycon, PEng	+1-604-444-6487	David.Lycon@aecom.com

1.6 Reference Documents

The reference documents used to complete this study are mainly but not limited to the following list,

- Bowser Village Centre Plan, Regional District of Nanaimo, June 8 2010.

- Land Use and Subdivision Bylaw 500, 1987, Regional District of Nanaimo, August 2009.

- Regional District of Nanaimo GIS Mapping website, http://rdn.bc.ca/cms.asp?wpID=419, last accessed on Feb 2011.

- Soils of Southern Vancouver Island. BC Ministry of Environment. Technical Report 17.

- Imapbc website, Integrated Land Management Bureau of British Columbia website, http://webmaps.gov.bc.ca/imfx/imf.jsp?site=imapbc . Last accessed on Feb 2011.

- BC Water Resources Atlas website, BC Ministry of Environment, http://www.env.gov.bc.ca/wsd/data_searches/wrbc/ . Last accessed on Feb 2011.

- BC Sewerage System Standard Practice Manual Version 2.

- Municipal Sewage Regulation. BC Regulation 129/99. Environmental Management Act. Queen's Printer for BC, Victoria, 2008. (Amended)

2.0 Design Parameters

2.1 Design Criteria

The design criteria used to derive the population projections and sewage capacities from the stakeholders development plans, which are based on the OCP of Bowser Village. This is summarized in Table 12.

Table 12: Projection criteria

Criteria	Unit
Current (2010) Units Density	1.6 units/ha
Commercial Mixed Use Units Density	35 units/ha
Civic and Cultural Units Density	35 units/ha
Medium Density Use Units Density	35 units/ha
High Density Use Units Density	45 units/ha
Population Density	2.1 people/unit
Population Diversification Factor	50% for Commercial Mixed Use, and Civic and Cultural Areas
Setback area allowance (Roads, services, etc)	20 % of total area

The land use plan of Bowser village according to the Official Community Plan of Bowser Village Centre and Electoral Area-H is as shown in
Figure 4.

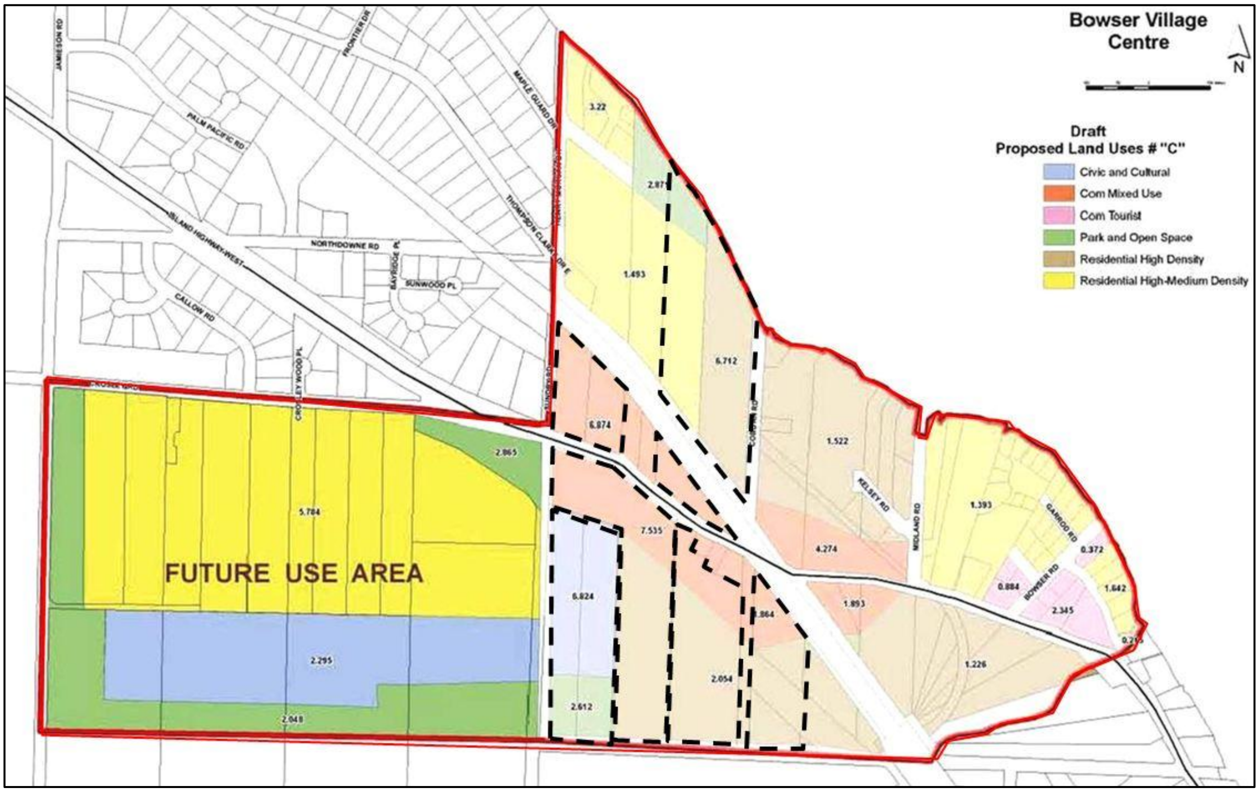

Figure 4: Land Use Plan (Source: Bowser Village, Area-H OCP)

2.2 Design Horizon

2010 was selected to be the base year as that is the year when some of the stakeholders are pursuing their development plans.

The design horizon for the study was taken as 20 years, i.e. 2030 is the year when the BCS group is anticipating having its developments built and operational.

2.3 Existing Population

The existing population of BCS group was derived from the criteria set in the OCP. According to that and as outlined in Table 12, the unit density of the current year, 2010, within Bowser Village is 1.6 units/ha and the population density is 2.1 people/unit.

2.4 Population Projections and Sewage Capacities

The population projections are prepared according to the anticipated development plans of each of the BCS group which are based on the number of new units developed by each stakeholder over time. The populations are projected by using the urban planning criteria and growth parameters outlined in the Official Community Plan (OCP) of Bowser village. The population projections and sewage capacities generated from each of the group members are detailed in the following subsections, sections 2.4.1 to 2.4.7, which conclude with the total sum of the entire group, section 2.4.8.

Moreover, the sewage and infiltration rates used to derive the average and maximum daily sewage flows for dry weather and wet weather conditions are based on the Regional District of Nanaimo (RDN) Bylaw 500 Schedule-4D for Community Sewer System Standards. These flow rates are as follows in Table 13.

Table 13: Sewage and Infiltration Flow Rates

Rate	Unit
Average Daily Sewage Rate	360 l/capita/day
Peak Factor	3
Maximum Daily Sewage Rate	1,080 l/capita/day
Infiltration Rate	10 m^3/ha/d

2.4.1 Projections – Canadian Legion

Table 14: Projection Criteria – Canadian Legion

Canadian Legion	
Total Area, (ha)	1.61
Developable Area, (ha) - 20% for setbacks, roads and services	1.29
Current (2010) Unit Density (units/ha) - according to OCP	1.60
Land Use - according to OCP	Commercial Mix Use
Unit Density, (units/ha) - according to OCP	35
Maximum Units, (units) - based on OCP criteria	45
Population Density, (Capita/unit) - according to OCP	2.1
Population Diversity Factor, (%) - according to OCP	50% for Commercial Mix use, and Civic and Cultural land uses.
Maximum Population, (capita) - based on OCP criteria	47
Average Dry Weather Sewage Rate, (l/capita/d)	360
Sewage Peak Factor	3
Infiltration rate, (m^3/ha/d) - according to RDN Bylaw 500	10
Infiltration rate, (m^3/d)	16.1

Table 15: Projections – Canadian Legion

Year	2010		2015		2020		2025		2030
Developed Units (units)	3		42		42		42		45
Average Units Added Annually (units/year)		7.9		-		-		0.6	
Total Population (capita)	5.4		44.1		44.1		44.1		47.3
Average Dry Weather Sewage Flow, (m^3/d)	1.9		15.9		15.9		15.9		17.0
Peak Dry Weather Sewage Flow, (m^3/d)	5.8		47.6		47.6		47.6		51.0
Average Wet Weather Sewage Flow, (m^3/d)	18.0		32.0		32.0		32.0		33.1
Peak Wet Weather Sewage Flow, (m^3/d)	21.9		63.7		63.7		63.7		67.1

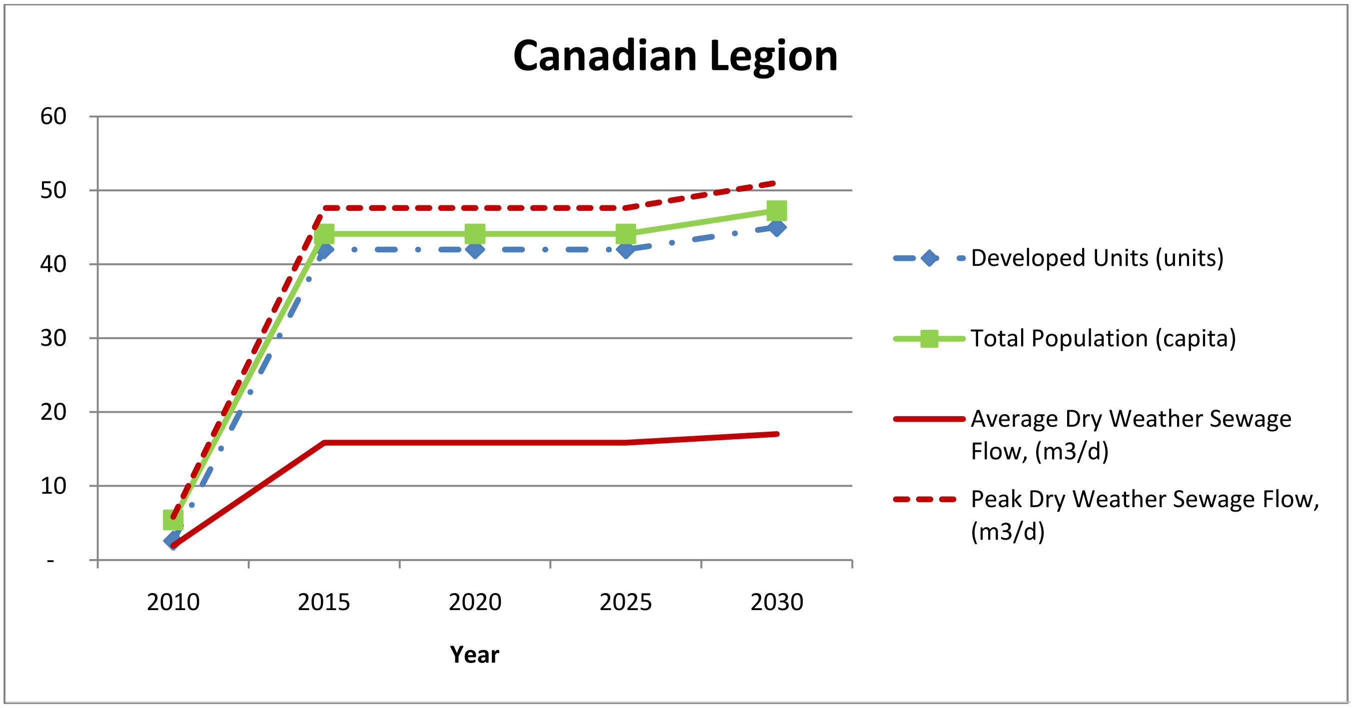

Figure 5: Projections – Canadian Legion

2.4.2 Projections – Seniors Housing

Table 16: Projection Criteria – Seniors Housing

Seniors Housing	
Total Area, (ha)	1.40
Developable Area, (ha) - 20% for setbacks, roads and services	1.12
Current (2010) Unit Density (units/ha) - according to OCP	1.60
Land Use - according to OCP	Civic and Cultural
Unit Density, (units/ha) - according to OCP	35
Maximum Units, (units) - based on OCP criteria	39
Population Density, (Capita/unit) - according to OCP	2.1
Population Diversity Factor, (%) - according to OCP	50% for Commercial Mix use, and Civic and Cultural land uses.
Maximum Population, (capita) - based on OCP criteria	41
Average Dry Weather Sewage Rate, (l/capita/d)	360
Sewage Peak Factor	3
Infiltration rate, (m^3/ha/d) - according to RDN Bylaw 500	10
Infiltration rate, (m^3/d)	14

Table 17: Projections – Seniors Housing

Year	2010		2015		2020		2025		2030
Developed Units (units)	2		18		24		30		39
Average Units Added Annually (units/year)		3.2		1.2		1.2		1.8	
Total Population (capita)	4.7		18.9		25.2		31.5		41.0
Average Dry Weather Sewage Flow, (m^3/d)	1.7		6.8		9.1		11.3		14.7
Peak Dry Weather Sewage Flow, (m^3/d)	5.1		20.4		27.2		34.0		44.2
Average Wet Weather Sewage Flow, (m^3/d)	15.7		20.8		23.1		25.3		28.7
Peak Wet Weather Sewage Flow, (m^3/d)	19.1		34.4		41.2		48.0		58.2

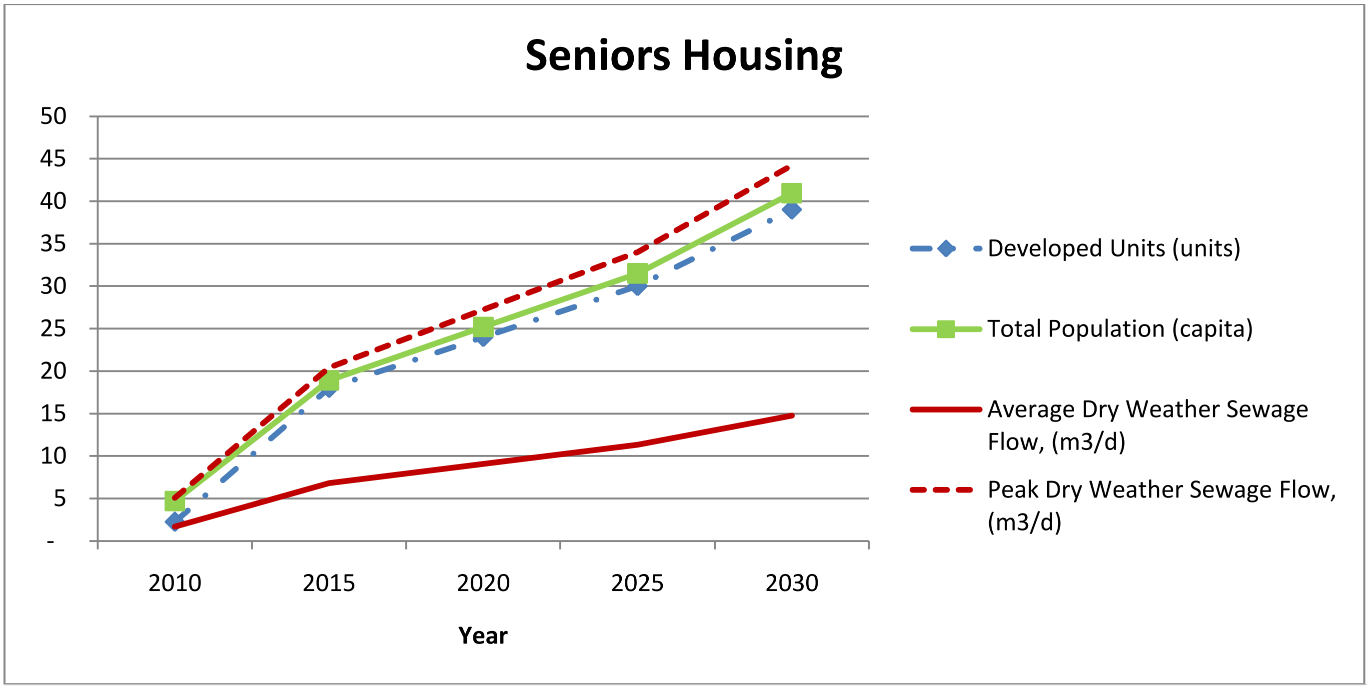

Figure 6: Projections – Seniors Housing

2.4.3 Projections – Coral Ice

Table 18: Projections Criteria – Coral Ice

Coral Ice	
Total Area, (ha)	0.61
Developable Area, (ha) - 20% for setbacks, roads and services	0.49
Current (2010) Unit Density (units/ha) - according to OCP	1.60
Land Use - according to OCP	Commercial Mix Use
Unit Density, (units/ha) - according to OCP	35
Maximum Units, (units) - based on OCP criteria	17
Population Density, (Capita/unit) - according to OCP	2.1
Population Diversity Factor, (%) - according to OCP	50%for Commercial Mix use, and Civic and Cultural land uses.
Maximum Population, (capita) - based on OCP criteria	18
Average Dry Weather Sewage Rate, (l/capita/d)	360
Sewage Peak Factor	3
Infiltration rate, (m^3/ha/d) - according to RDN Bylaw 500	10
Infiltration rate, (m^3/d)	6.1

Table 19: Projections – Coral Ice

Year	2010		2015		2020		2025		2030
Developed Units (units)	1		5		9		13		18
Average Units Added Annually (units/year)		0.8		0.8		0.8		1.0	
Total Population (capita)	2.0		5.3		9.5		13.7		18.9
Average Dry Weather Sewage Flow, (m^3/d)	0.7		1.9		3.4		4.9		6.8
Peak Dry Weather Sewage Flow, (m^3/d)	2.2		5.7		10.2		14.7		20.4
Average Wet Weather Sewage Flow, (m^3/d)	6.8		8.0		9.5		11.0		12.9
Peak Wet Weather Sewage Flow, (m^3/d)	8.3		11.8		16.3		20.8		26.5

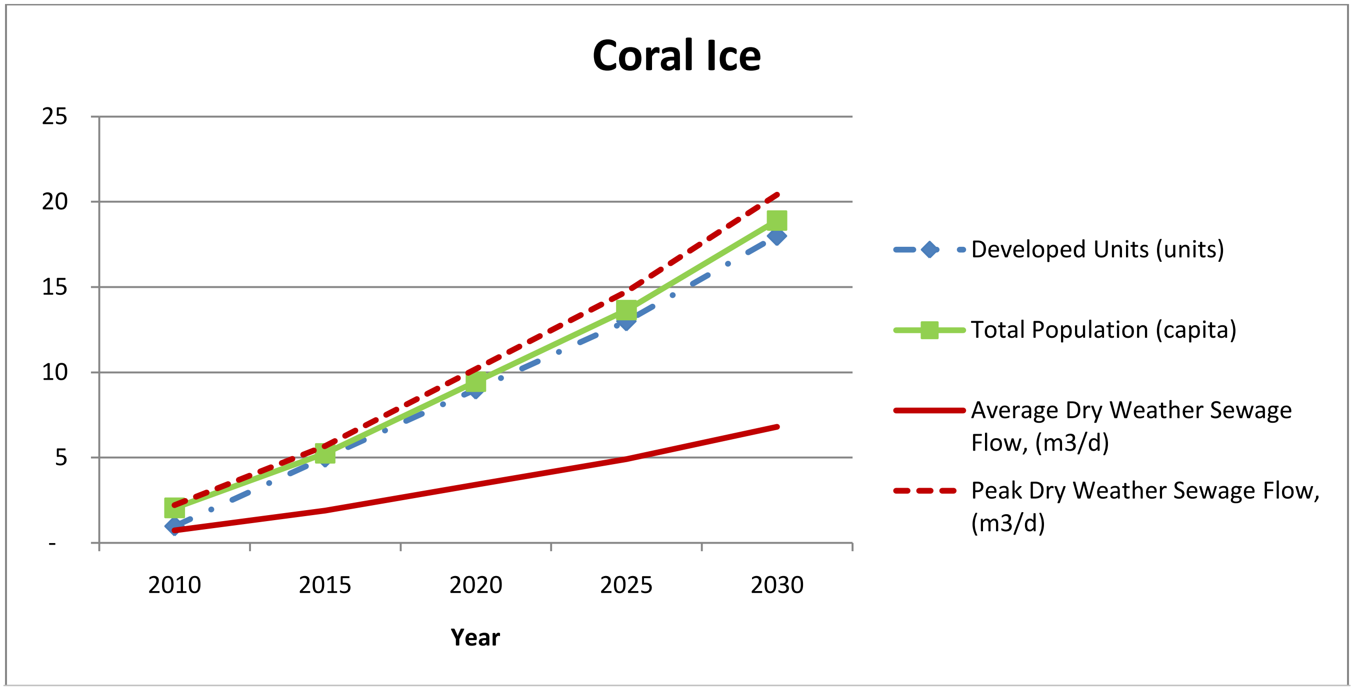

Figure 7: Projections – Coral Ice

2.4.4 Projections – Magnolia Enterprises

Table 20: Projection Criteria – Magnolia Enterprises

Magnolia Enterprises		
Total Area, (ha)	4.81	
Developable Area, (ha) - 20% for setbacks, roads and services	3.85	
Current (2010) Unit Density (units/ha) - according to OCP	1.60	
Land Use - according to OCP	40% Commercial Mix Use	60% High Density Residential
Unit Density, (units/ha) - according to OCP	35	45
Maximum Units, (units) - based on OCP criteria	158	
Population Density, (Capita/unit) - according to OCP	2.1	
Population Diversity Factor, (%) - according to OCP	50% for Commercial Mix use, and Civic and Cultural land uses.	
Maximum Population, (capita) - based on OCP criteria	265	
Average Dry Weather Sewage Rate, (l/capita/d)	360	
Sewage Peak Factor	3	
Infiltration rate, (m^3/ha/d) - according to RDN Bylaw 500	10	
Infiltration rate, (m^3/d)	48.1	

Table 21: Projections – Magnolia Enterprises

Year	2010		2015		2020		2025		2030
Developed Units (units)	8		24		91		158		158
Average Units Added Annually (units/year)		3.3		13.4		13.4		-	
Total Population (capita)	16.2		40.3		152.9		265.4		265.4
Average Dry Weather Sewage Flow, (m^3/d)	5.8		14.5		55.0		95.6		95.6
Peak Dry Weather Sewage Flow, (m^3/d)	17.5		43.5		165.1		286.7		286.7
Average Wet Weather Sewage Flow, (m^3/d)	53.9		62.6		103.1		143.7		143.7
Peak Wet Weather Sewage Flow, (m^3/d)	65.6		91.6		213.2		334.8		334.8

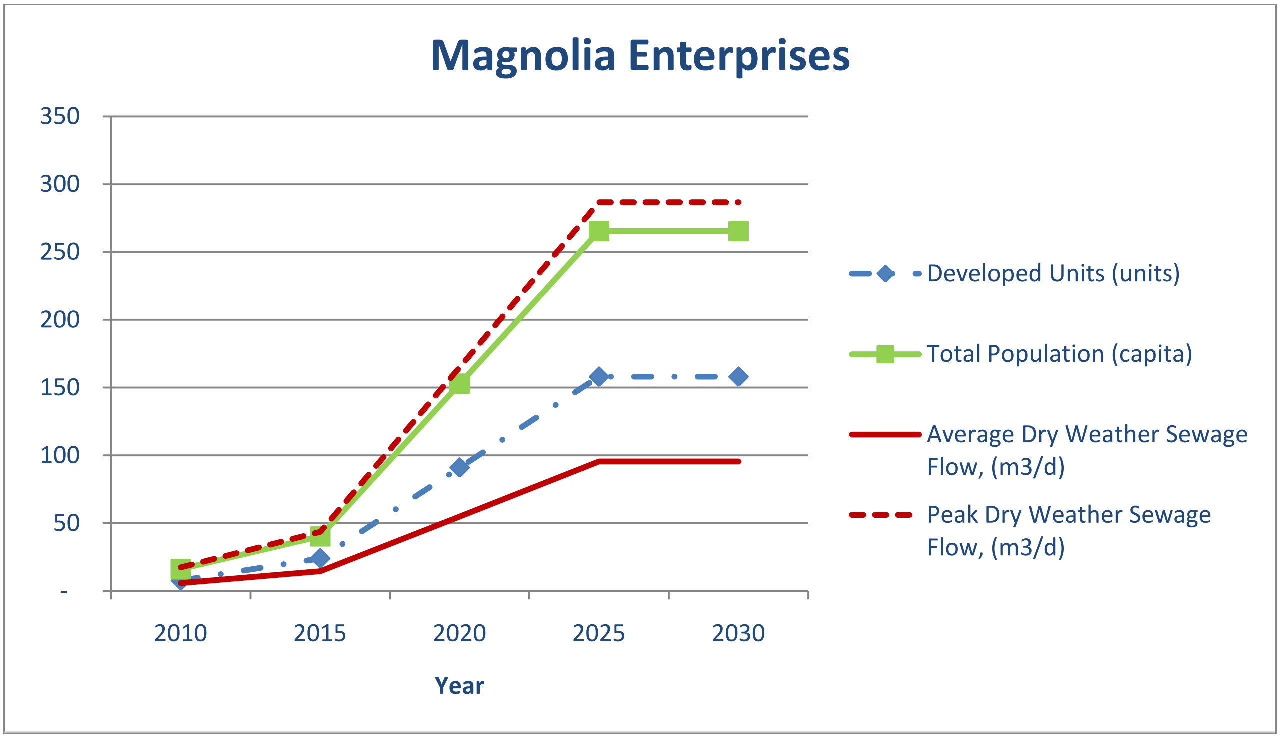

Figure 8: Projections – Magnolia Enterprises

2.4.5 Projections – AG Project Management

Table 22: Projection Criteria – AG Project Management

AG Project Management		
Total Area, (ha)	1.90	
Developable Area, (ha) - 20% for setbacks, roads and services	1.52	
Current (2010) Unit Density (units/ha) - according to OCP	1.60	
Land Use - according to OCP	30% Commercial Mix Use	70% High Density Residential
Unit Density, (units/ha) - according to OCP	35	45
Maximum Units, (units) - based on OCP criteria	64	
Population Density, (Capita/unit) - according to OCP	2.1	
Population Diversity Factor, (%) - according to OCP	50% for Commercial Mix use, and Civic and Cultural land uses.	
Maximum Population, (capita) - based on OCP criteria	114	
Average Dry Weather Sewage Rate, (l/capita/d)	360	
Sewage Peak Factor	3	
Infiltration rate, (m^3/ha/d) - according to RDN Bylaw 500	10	
Infiltration rate, (m^3/d)	19	

Table 23: Projections – AG Project Management

Year	2010		2015		2020		2025		2030
Developed Units (units)	3		20		25		45		64
Average Units Added Annually (units/year)		3.4		1.0		4.0		3.8	
Total Population (capita)	6.4		35.7		44.6		80.3		114.2
Average Dry Weather Sewage Flow, (m^3/d)	2.3		12.9		16.1		28.9		41.1
Peak Dry Weather Sewage Flow, (m^3/d)	6.9		38.6		48.2		86.8		123.4
Average Wet Weather Sewage Flow, (m^3/d)	21.3		31.9		35.1		47.9		60.1
Peak Wet Weather Sewage Flow, (m^3/d)	25.9		57.6		67.2		105.8		142.4

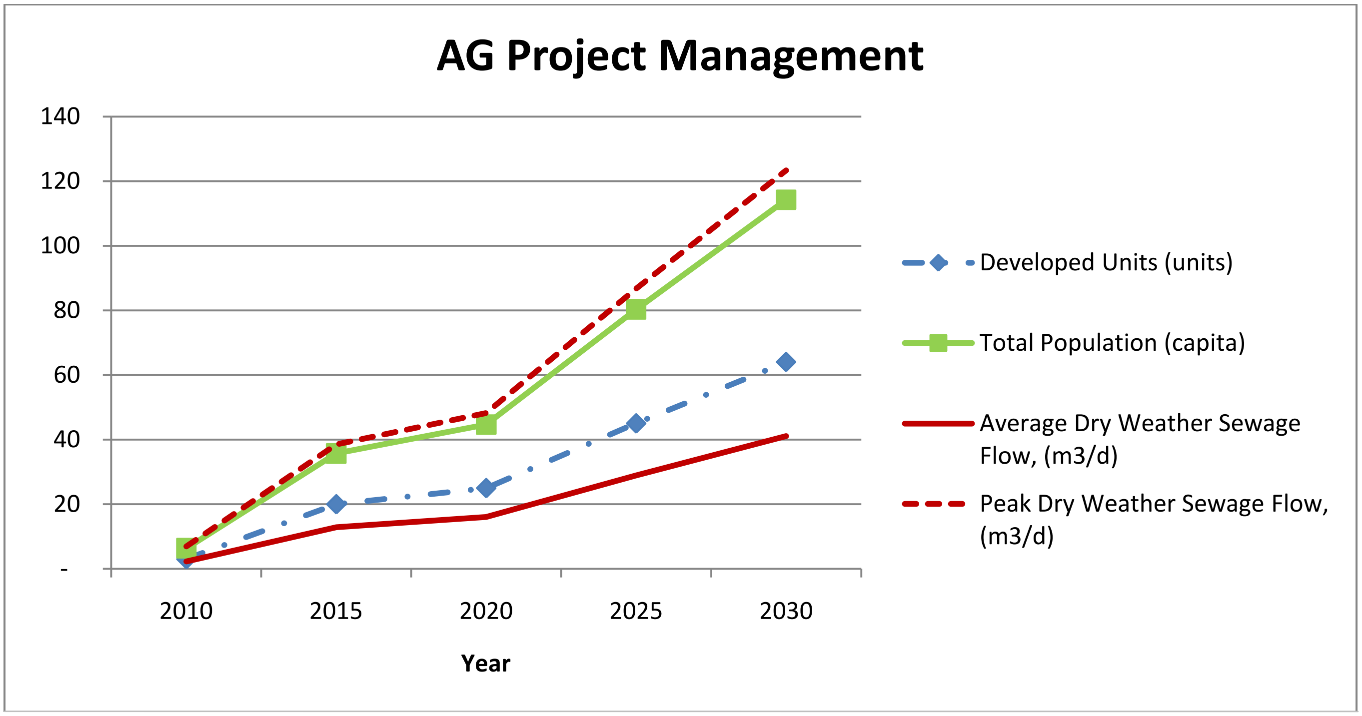

Figure 9: Projections – AG Project Management

2.4.6 Projections – Tomm's Food Market

Table 24: Projection Criteria – Tomm's Food Market

Tomm's Food Market		
Total Area, (ha)	3.38	
Developable Area, (ha) - 20% for setbacks, roads and services	2.70	
Current (2010) Unit Density (units/ha) - according to OCP	1.60	
Land Use - according to OCP	75% Commercial Mix Use	25% High Density Residential
Unit Density, (units/ha) - according to OCP	35	45
Maximum Units, (units) - based on OCP criteria	101	
Population Density, (Capita/unit) - according to OCP	2.1	
Population Diversity Factor, (%) - according to OCP	50% for Commercial Mix use, and Civic and Cultural land uses.	
Maximum Population, (capita) - based on OCP criteria	133	
Average Dry Weather Sewage Rate, (l/capita/d)	360	
Sewage Peak Factor	3	
Infiltration rate, (m^3/ha/d) - according to RDN Bylaw 500	10	
Infiltration rate, (m^3/d)	33.8	

Table 25: Projections – Tomm's Food Market

Year	**2010**		**2015**		**2020**		**2025**		**2030**
Developed Units (units)	5		20		35		50		65
Average Units Added Annually (units/year)		2.9		3.0		3.0		3.0	
Total Population (capita)	11.4		26.3		45.9		65.6		85.3
Average Dry Weather Sewage Flow, (m^3/d)	4.1		9.5		16.5		23.6		30.7
Peak Dry Weather Sewage Flow, (m^3/d)	12.3		28.4		49.6		70.9		92.1
Average Wet Weather Sewage Flow, (m^3/d)	37.9		43.3		50.3		57.4		64.5
Peak Wet Weather Sewage Flow, (m^3/d)	46.1		62.2		83.4		104.7		125.9

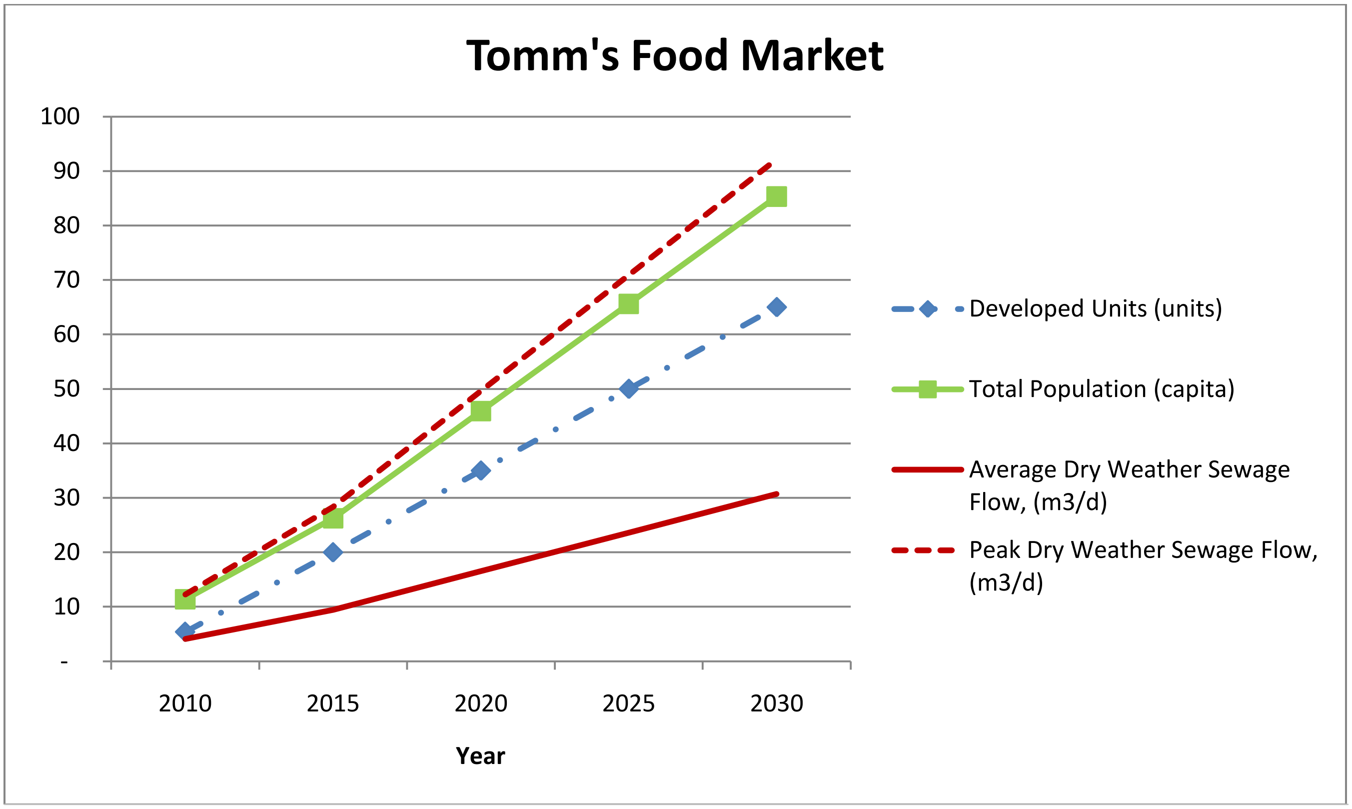

Figure 10: Projections – Tomm's Food Market

2.4.7 Projections – Green Thumb Nursery

Table 26: Projections Criteria – Green Thumb Nursery

Green Thumb Nursery			
Total Area, (ha)	4.81		
Developable Area, (ha) - 20% for setbacks, roads and services	3.85		
Current (2010) Unit Density (units/ha) - according to OCP	1.60		
Land Use - according to OCP	40% Medium Density Residential	56% High Density Residential	4% Parks and Open Space
Unit Density, (units/ha) - according to OCP	35	45	0
Maximum Units, (units) - based on OCP criteria	151		
Population Density, (Capita/unit) - according to OCP	2.1		
Population Diversity Factor, (%) - according to OCP	50% for Commercial Mix use, and Civic and Cultural land uses.		
Maximum Population, (capita) - based on OCP criteria	317		
Average Dry Weather Sewage Rate, (l/capita/d)	360		
Sewage Peak Factor	3		
Infiltration rate, (m^3/ha/d) - according to RDN Bylaw 500	10		
Infiltration rate, (m^3/d)	48.1		

Table 27: Projections – Green Thumb Nursery

Year	2010		2015		2020		2025		2030
Developed Units (units)	8		44		80		115		151
Average Units Added Annually (units/year)		7.3		7.2		7.0		7.2	
Total Population (capita)	16.2		92.4		168.0		241.5		317.1
Average Dry Weather Sewage Flow, (m^3/d)	5.8		33.3		60.5		86.9		114.2
Peak Dry Weather Sewage Flow, (m^3/d)	17.5		99.8		181.4		260.8		342.5
Average Wet Weather Sewage Flow, (m^3/d)	53.9		81.4		108.6		135.0		162.3
Peak Wet Weather Sewage Flow, (m^3/d)	65.6		147.9		229.5		308.9		390.6

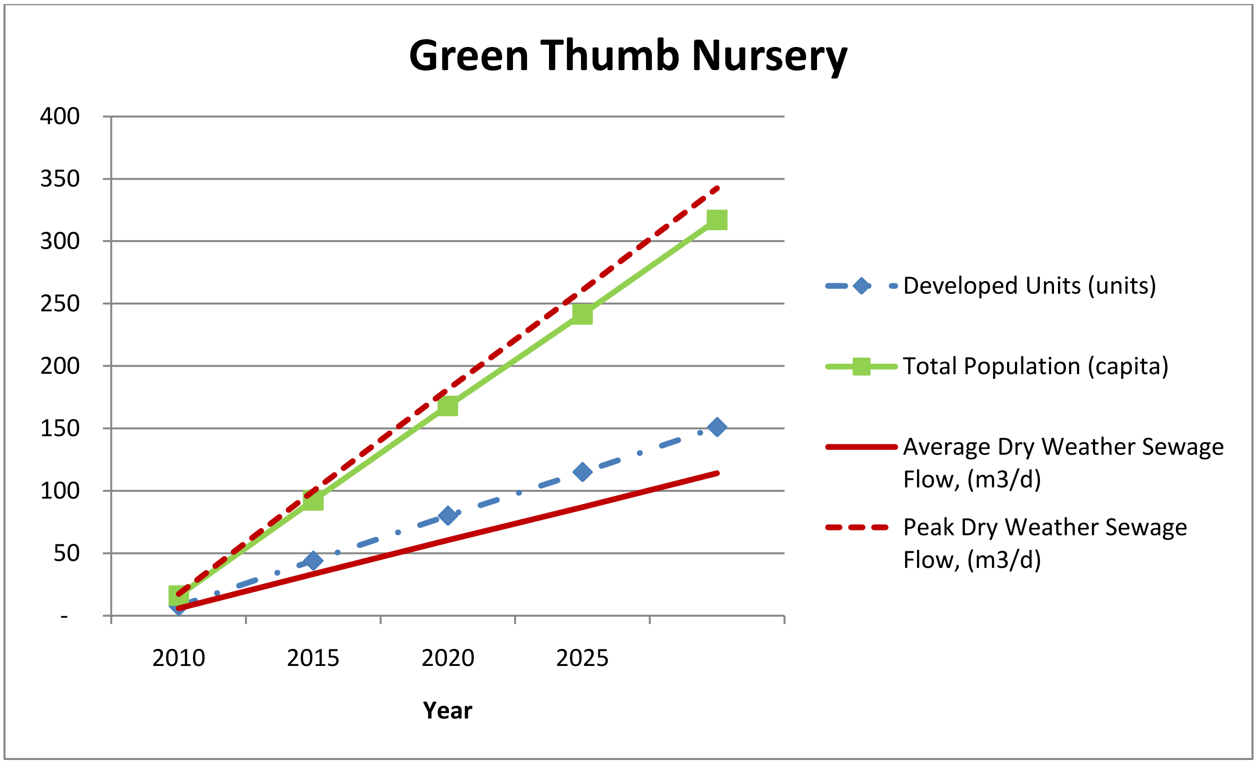

Figure 11: Projections – Green Thumb Nursery

2.4.8 Projections – Total: Bowser Community Stakeholders

Table 28: Projection Criteria – Total: Bowser Community Stakeholders

Total					
Total Area, (ha)	18.52				
Developable Area, (ha) - 20% for setbacks, roads and services	14.82				
Current (2010) Unit Density (units/ha) - according to OCP	1.60				
Land Use - according to OCP	39.1% Commercial Mix Use	7.6% Civic and Cultural	10.4% Medium Density Residential	41.8% High Density Residential	1% Parks and Open Space
Sub-Area, (ha)	5.80	1.12	1.54	6.20	0.15
Unit Density, (units/ha) - according to OCP	35	35	35	45	0
Maximum Units, (units) - based on OCP criteria	575				
Population Density, (Capita/unit) - according to OCP	2.1				
Population Diversity Factor, (%) - according to OCP	50% for Commercial Mix use, and Civic and Cultural land uses.				
Maximum Population, (capita) - based on OCP criteria	954				
Average Dry Weather Sewage Rate, (l/capita/d)	360				
Sewage Peak Factor	3				
Infiltration rate, (m^3/d)	185				

Table 29: Projections – Total: Bowser Community Stakeholders

Year	2010		2015		2020		2025		2030
Developed Units (units)	30		173		306		453		540
Average Units Added Annually (units/year)		28.7		26.6		29.4		17.4	
Total Population (capita)	62		263		490		742		889
Average Dry Weather Sewage Flow, (m^3/d)	22.4		94.7		176.5		267.2		320.1
Peak Dry Weather Sewage Flow, (m^3/d)	67.2		284.0		529.4		801.5		960.3
Average Wet Weather Sewage Flow, (m^3/d)	207.6		279.9		361.7		452.4		505.3
Peak Wet Weather Sewage Flow, (m^3/d)	252.4		469.2		714.6		986.7		1,145.5

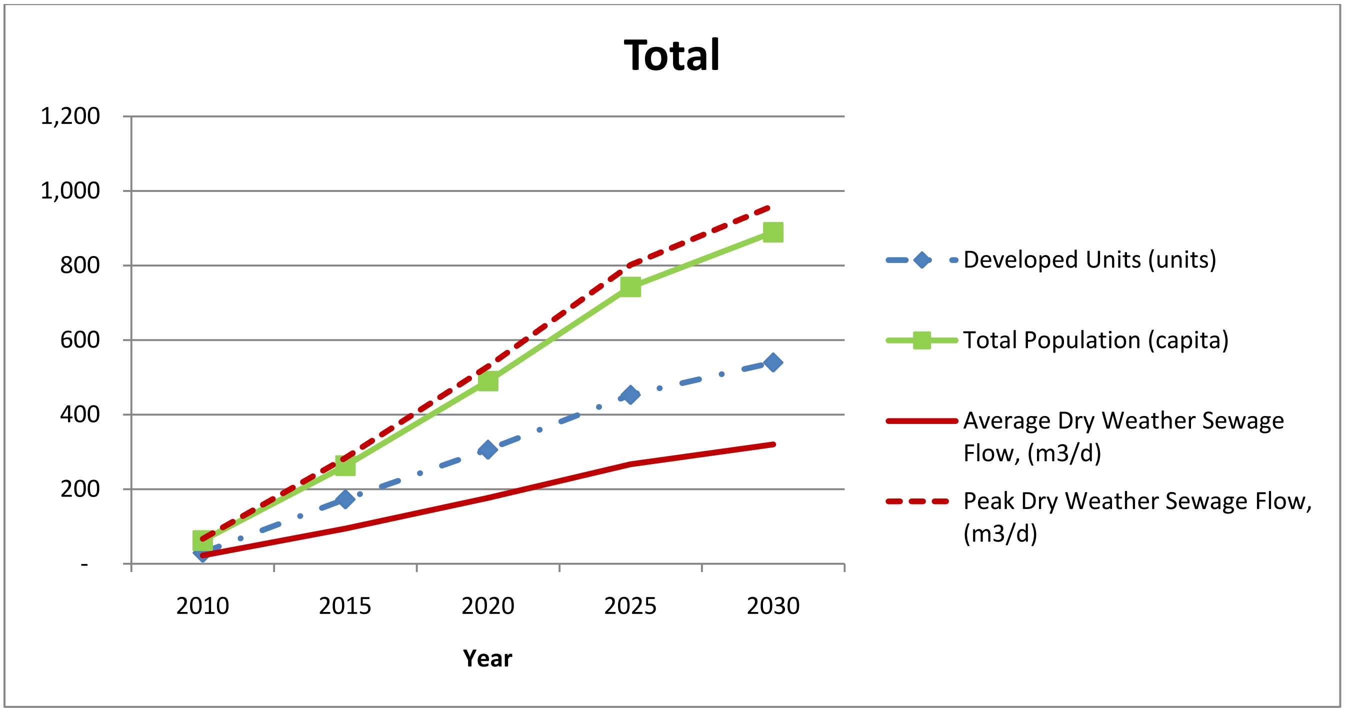

Figure 12: Projections – Total: Bowser Community Stakeholders

The tables and graphs above show that stakeholders have diverse development plans and different rates of development. However, the overall development of the BCS group shows a linear development rate at an average of 26 units/year with a peak of 540 units, 889 people and thus a 320m^3/d ADWF of sewage.

Furthermore, the percentage distribution of sewage generated from each stakeholder is show in Figure 13.

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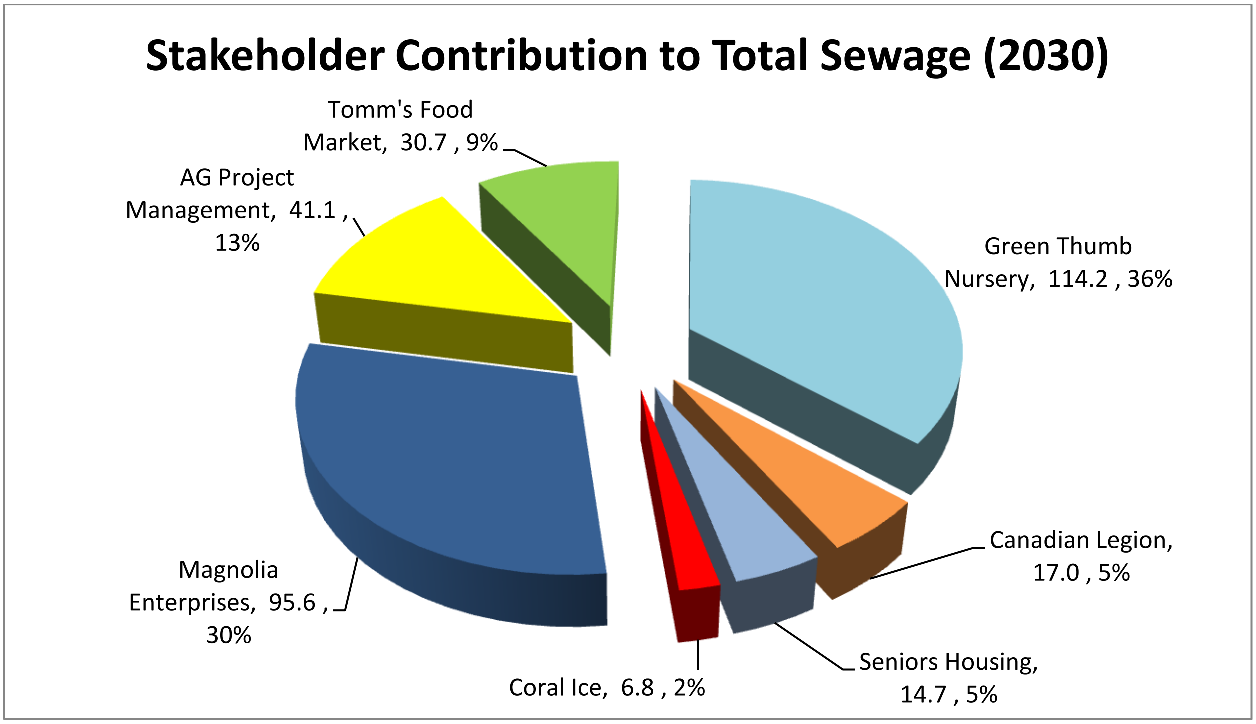

Figure 13: Stakeholder Contribution to Total Sewage

Moreover, if the entire Bowser Village community were to develop their lots following the OCP planning and unit density criteria, then the total 91.5ha of land in Bowser would be able to support a population of 4,750 people which is anticipated to generate 1,800m^3/d of AWDF, approximately.

3.0 Sewage Collection System (SCS)

Two types of sewage collection systems were considered to service the development plans of BCS, these are:

1. Gravity Collection System
2. Low-Pressure Collection System

3.1 Gravity Collection System

The gravity collection system to service the BCS group is proposed to follow natural topographical terrain as much as possible to minimize excavation costs and to avoid pumping and lift stations as much as possible. This would ideally reduce construction capital costs as well as operations and maintenance costs for running and operating the pumps in the lift stations. However, due to the proposed location of the treatment plant on a site with higher elevations, the incorporation of two lift stations was inevitable, refer to Figure 1073-SKC-CS-1.

Moreover, the lift stations are strategically located to allow for network expansion in the future, especially the lift station located close to the intersection of Highway 19A and the E&N railway. This lift station is central and acts as the core of the collection system where all the sewage from the BCS group drains and is then pumped to the treatment plant. The location of this lift station can also allow for future connections of the lots East and Southeast of the Bowser village centre.

Cost savings can be achieved with the proposed pipe alignment by using a common trench for both the gravity sewer pipes and the forcemain. In addition, inverts of manholes and lift stations, pipe sizes and pump capacities can be designed and constructed to accommodate for the expansion of Bowser Village in case the rest of the village decides to connect to the communal system in the future.

The detailed design of the system would follow the Land Use and Subdivision Bylaw 500 of 1987 by the RDN, which was reissued in August 2009. Other regulations and bylaws that are applicable to Bowser Village should also be considered.

Some of the advantages and disadvantages of the conventional gravity collection system are listed in Table 30.

Table 30: Gravity Collection System – Advantages and Disadvantages

Gravity Collection System	
Advantages	**Disadvantages**
• Low Operations and Maintenance (O&M) requirements. • Minimal electrical power requirements; only to operate pumps at lift stations. • Pipe sizes can be designed at an early stage to accommodate future growth and development plans.	• Significant vertical excavation is required to satisfy depth requirements. • Wider horizontal excavation is required to open trench, install pipes and manholes. • Higher capital cost. • Potential infiltration of stormwater surface runoff and sub-ground water into the system which results in bigger pipe sizes and larger volumes of sewage at the treatment facility. Additional measures would be necessary to avoid this.

The Class-D cost estimate for the gravity collection system for BCS as illustrated Figure 1073-SKC-CS1 is as shown in Table 31.

NOTES

PRELIMINARY
NOT FOR CONSTRUCTION

PROFESSIONAL ENGINEER'S SEAL

NO.	DATE	REVISION	DWN	CHK

LEGEND

- FORCEMAIN
- CLEAN OUT — SCO
- AIR RELEASE VALVE
- STAKEHOLDER PLOT
- CONTOUR LINES
- TREATMENT PLANT — TP
- LOW PRESSURE PUMPS
- WATER WELL

CLIENT: REGIONAL DISTRICT OF NANAIMO

PROJECT: BOWSER SEWER SERVICING FEASIBILITY STUDY

LOCATION: BOWSER VILLAGE

TITLE: PROPOSED SANITARY COLLECTION SYSTEM OPTION 1 – GRAVITY

DATE 2011/02/08	SHEET 1073-SKC-CS1	REV. –	
DESIGNED D. SHEARER			
DRAWN A. SMIDI	CHECKED Z. AZAIZEH		
H. SCALE 1:1000	V. SCALE N/A		
SUB ----	ENG ----	DP ----	BP ----

CHATWIN ENGINEERING LIMITED
1614 MOREY ROAD, NANAIMO, B.C., V9S 1J7
T. 250-753-9171 F. 250-754-4459 WWW.CHATWINENGINEERING.COM

Table 31: Gravity Collection System Capital Cost Estimate

Component	Class D Cost Estimate
Gravity PVC Pipes (1,200 m Long)	$ 224,500
Forcemain PVC Pipes (1,500m Long)	$ 186,000
Manholes (10 Nos.)	$ 30,000
Inspection Chambers /Connections to Systems (12 Nos.)	$ 14,400
Lift Stations with pumps (2 Nos.)	$ 240,000
Gate, Air Release and Clean-out Valves with chambers	$ 8,174
Road and Railway Crossings	$ 52,200
Decommissioning existing Septic Tanks (7Nos.)	$ 7,490
Sub-Total Construction Cost	**$ 762,764**
Contingency and Engineering (30% of construction cost)	$ 228,829
Total	**$ 991,593**

Table 32: Gravity Collection System Annual O&M Cost Estimate

Component	Annual Cost Estimate
Inspections (1 visit per month)	$ 3,600
Utilities and Consumables	$ 2,400
Equipments and Parts Replacement	$ 10,000
Total (Annually)	**$ 16,000**

3.2 Low-Pressure Collection System

Low-pressure collection is a system where each lot or development has one or more grinder pumps in a chamber which is connected by pipes to a common (main) pressure forcemain which eventually delivers sewage to a treatment facility.

The relatively smaller pressure pipes can follow the terrain of the ground and can convey sewage uphill by pressure; this gives the system more flexibility.

Figure 1073-SKC-CS2 in is a schematic of the low-pressure collection system alignment proposed for the BCS. The network can be designed at an early stage to be flexible enough to accommodate additional sewage flows and allow for the rest of Bowser Village to connect to the communal collection system.

Some of the advantages and disadvantages of this system are listed in Table 33.
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NOTES

PRELIMINARY
NOT FOR CONSTRUCTION

PROFESSIONAL ENGINEER'S SEAL

NO.	DATE	REVISION	DWN	CHK

LEGEND

- FORCEMAIN
- CLEAN OUT — SCO
- AIR RELEASE VALVE
- STAKEHOLDER PLOT
- CONTOUR LINES
- TREATMENT PLANT — TP
- LOW PRESSURE PUMPS
- WATER WELL — W

CLIENT: REGIONAL DISTRICT OF NANAIMO

PROJECT: BOWSER SEWER SERVICING FEASIBILITY STUDY

LOCATION: BOWSER VILLAGE

TITLE: PROPOSED SANITARY COLLECTION SYSTEM OPTION 2 – LOW PRESSURE

DATE 2011/02/10	SHEET 1073-SKC-CS2	REV. –	
DESIGNED D. SHEARER			
DRAWN A. SMIDI		CHECKED Z. AZAIZEH	
H. SCALE 1:1000		V. SCALE N/A	
SUB ----	ENG ----	DP ----	BP ----

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Table 33: Low-Pressure System – Advantages and Disadvantages

Low-Pressure Collection System	
Advantages	**Disadvantages**
• Less vertical and horizontal excavation required. • Smaller pipes. • Infiltration into the pipes is considerably reduced. • Lower overall treatment costs through grinding sewage at the pump.	• Requires electrical power to keep the system operational. • May require stand-by power supply if power outages were frequent. • Higher Operations and Maintenance costs.

The Class-D cost estimate for the low-pressure collection system for BCS as illustrated in Figure 1073-SKC-CS2 is as shown in Table 34.

Table 34: Low-Pressure Collection System Capital Cost Estimate

Component	Class D Cost Estimate
Forcemain PVC Pipes (1,500m Long)	$ 268,000
Grinder Pumps (7 Nos)	$ 238,000
Wiring and Communication Cables (1,500m Long)	$ 30,000
Gate, Air Release and Clean-out Valves with chambers	$ 28,185
Road and Railway Crossings	$ 52,200
Decommissioning existing Septic Tanks (7Nos.)	$ 7,490
Sub-Total Construction Cost	**$ 623,875**
Contingency and Engineering (30% of construction cost)	$ 187,163
Total	**$ 811,038**

Table 35: Low-Pressure Collection System Annual O&M Cost Estimate

Component	Annual Cost Estimate
Inspections (3 visits per week)	$ 10,000
Utilities and Consumables	$ 6,000
Equipments and Parts Replacement	$ 7,000
Emergency Disposal (2 power outages per year)	$ 2,000
Total (Annually)	**$ 25,000**

3.3 Collection Systems Cost Comparison

The life cycle cost analysis between the two alternative collection systems is tabulated in Table 36. It is based on a 5% interest rate for a period of 20 years.

Table 36: Collection Systems Cost Comparison

Cost	Gravity System	Low-Pressure System
Capital Cost	$ 991,593	$ 811,038
O&M Annual Costs	$ 16,000	$ 25,000
Present Worth	**$ 1,190,989**	**$ 1,122,593**

4.0 Sewage Treatment

4.1 Treatment Plant Location

The proposed location for the treatment plant is in the South end of plan VIP2076 (Crown Lot 1 and 2), Area-1 as shown Figure 14. This area is within Bowser Village and is designated for civic use, including utilities and services according to the OCP.

4.2 Treatment Levels:

Two treatment levels were considered for the communal sewer system and these are to achieve Class-A treated effluent or Class-B as defined by Municipal Sewer Regulations. These two levels would allow for the safe disposal of the treated effluent. However, the level of treatment is directly linked to the disposal option chosen (discussed later in the report).

Class-A treated effluent is of higher quality and would be suitable for marine disposal due to the sensitivity of the aquatic ecosystem surrounding Bowser.

Class-B treated effluent is of high quality, but not as high as Class-A with regards to coliform concentrations. Class-B treated effluent can allow for the disposal to ground provided that appropriate setbacks from surface water or water wells are maintained according to MSR.

The treated effluent classifications are as shown in Table 37.

Table 37: MSR Effluent Classification

Parameter	Class-A	Class-B
Biochemical Oxygen Demand (BOD_5)	10mg/l	10mg/l
Total Suspended Solids (TSS)	10mg/l	10mg/l
Fecal Coliform count, median; "limit"	2.2/100ml; "14/100ml"	400/100ml

The costs and treatment plant areas associated with each of the two treated effluent classes are shown in Table 38.

Table 38: Treatment Plant Capital Cost Estimate

Component	Class-D Capital Cost Estimate	
	Class-A	Class-B
Area	150m^2	120m^2
Treatment Plant Cost (Phase-1 = 160m^3/d)	\$ 700,000	\$ 400,000
Treatment Plant Cost (Phase-2 = 320m^3/d)	\$ 300,000	\$ 200,000
Sub-Total Cost of Treatment Plant	**\$ 1,000,000**	**\$ 600,000**
Engineering and Contingency (30% of Plant Cost)	\$ 300,000	\$ 180,000
Total	**\$ 1,300,000**	**\$ 780,000**

Table 39: Treatment Plant Annual O&M Cost Estimate

Component	Annual O&M	
	Class-A	Class-B
Inspections and Sludge Disposal (3 visits per week)	\$120,000	\$ 96,000
Utilities and Consumables	\$ 12,000	\$ 12,000
Equipments and Parts Replacement	\$ 5,000	\$ 5,000
Total (Annually)	**\$ 137,000**	**\$ 113,000**

The costs above were based on the Upflow Sludge Blanket Filtration (USBF) process, which is the process used at Nanoose First Nations (FN) treatment facility. The Nanoose FN plant has been constructed in a similar highly sensitive marine environment and has operated very successfully for over 5 years with effluent quality records confirming that effluent has consistently met the Class-A MSR standards.

4.3 Treatment Class Cost Comparison

The life cycle cost analysis between the two alternatives of treated effluent class is listed in Table 40. It is based on a 5% interest rate for a period of 20 years.

Table 40: Treatment Class Cost Comparison

Cost	Class A	Class B
Capital Cost	$ 1,300,000	$ 780,000
O&M Annual Costs	$ 137,000	$ 113,000
Present Worth	**$ 3,007,323**	**$ 2,188,230**

4.4 Environmental Review

Area 1 is identified as a recently cleared lot located off of the Old Island Highway within the community of Bowser and immediately behind the Lighthouse Village Market at 6948 Island Highway West. The subject lot within Area 1 is rectangular in shape and approximately 4 Ha in size. The lot has been grubbed of all vegetation and supports a stormwater detention pond and a cut-off ditched that is aligned along the cleared boundary of the lot in order to redirect drainage flows during wet weather. Lots to the immediate north, south and west of the lot are forested. Area 1 is proposed for the location of a community Sewerage Treatment Plant and for a small in-ground sewerage dispersal field (treat daily flows of <22.7m3) that would service new development within the Lighthouse Market Village Centre.

The site is located within the Coastal Douglas Fir Moist Maritime Subzone (CDFmm). The CDF mm occurs between the ocean to an elevation of approximately 150m along southeast Vancouver Island from Bowser to Victoria. Climatic conditions are influenced by the rainshadow of the Vancouver Island and Olympic mountains resulting in warm, dry summers and wet winters. CDFmm zonal sites are dominated by salal, dull Oregon grape, ocean spray and Oregon Beaked moss, while less prominent species include baldhip rose, snowberry, western trumpet honey suckle and vanilla leaf.

Vegetation species within the treed lot immediately to the north as observed to be dominated by Western redcedar, douglas-fir, Western hemlock, and understory vegetation consisting of Sword fern, salal, dull-Oregon grape, red huckleberry and salmonberry. Canopy cover was dense and greater than 50%, while down and dead wood debris on the forest floor was estimated at 15%. The immature forest stand was estimated range from 40 to 60 years. The exposed soil profile along the cut-off ditch located along the northern boundary of the cleared lot was characterized by a thin A-Horizon between 20-40 cm in thickness, overlying a thicker B Horizon (> 1.0m) dominated by consolidated marine tills. At the time of the site inspection the region had experienced significant rainfall over a 24hr period. Extensive subsurface drainage was visible along the length of the exposed ditch between the A and B horizons.

The surrounding forested lots are expected to support various cavity nesting and canopy rearing birds, including various small raptors and owls. Further investigations at the site during the preliminary design phase of the project will require an inventory of nesting birds (with emphasis on eagle and blue heron nests). Mammals expected to frequent the lots include black-tailed deer, black bear, raccoons, American mink and various, rodents, and Myotis bats.

While no permanent streams were noted, the site influence by seasonally high water table conditions is expected to support several forested swamps and vernal pools which likely support various amphibian species, including provincially threatened (blue-listed) red legged frogs. A more detailed assessment of streams and wetlands within the lots will be required if development within the site is determined to be suitable. Site information will require presentation in an Environmental Impact Study as required under the Environmental Management Act following Municipal Sewerage Regulations.

5.0 Treated Effluent Disposal

Effluent disposal aims at discharging treated sewage in an environmentally friendly and cost effective way to a receiving body.
The disposal alternatives covered in this study and are the following:

- Ground Disposal (GD)
- Marine Disposal (MD)
- Effluent Reuse

5.1 Ground Disposal (GD)

Ground Disposal is the process of disposing treated sewage effluent in a safe manner to a receiving ground area where the soil allows for natural infiltration and further natural treatment of the effluent within the soil layers. Some of the advantages and disadvantages of this alternative are summarized in Table 41.

Table 41: Ground Disposal – Advantages and Disadvantages

Ground Disposal	
Advantages	**Disadvantages**
• Aids in ground water recharge. • Disposal fields replenish soils with water in dry seasons and can act as an irrigation process. • Disposal fields may be designed to act like community forests or trails for recreational purposes. • Contributes to irrigation if in forested areas. • Makes use of the soils natural infiltration properties. • Aside from regulations on land acquisitions, Ground Disposal in comparison to Marine disposal involves less regulatory restrictions with regards to approvals. • Publicly more acceptable and favored over Marine disposal.	• May require land acquisition, which could be from crown land, private owners, or other. • Additional cost for land acquisitions by purchasing or leasing or other possible arrangements. • Constrained in terms of expansion. Development and growth will require acquiring additional land. • Forcemain route and cost for accessibility. • Further environmental studies to determine sensitive ecosystems. • Double the area is required according to MSR to make provision during maintenance works and in the event of failure. • Higher ground elevation and longer proximity; requires pumping. • Aligning infiltration basins to suit ground conditions, slopes etc in order to maximize infiltration efficiency may lead to requiring a larger footprint of land area.

The proposed ground disposal is compromised of subsurface infiltration basins by drip disposal.

A scoping geotechnical assessment and site visits were performed by Trax Development Ltd® on several ground disposal sites for suitability and potential for ground disposal. The complete report is attached in Appendix 1.

The three main locations considered for ground disposal are as illustrated in Figure 14 and listed below:

- The crown land within Bowser Village; Area-1. This is Crown Land within Electoral Area-H of RDN, Lots 1 and 2, VIP2076, located to the South of Highway 19A.

- The area around BC Hydro’s Right of Way (ROW).

- A site adjacent to the Inland Island Highway; Area-2. This is Crown Land within Electoral Area-H of RDN, Lot 65, VIP2018, located to the South of Thames Creek.

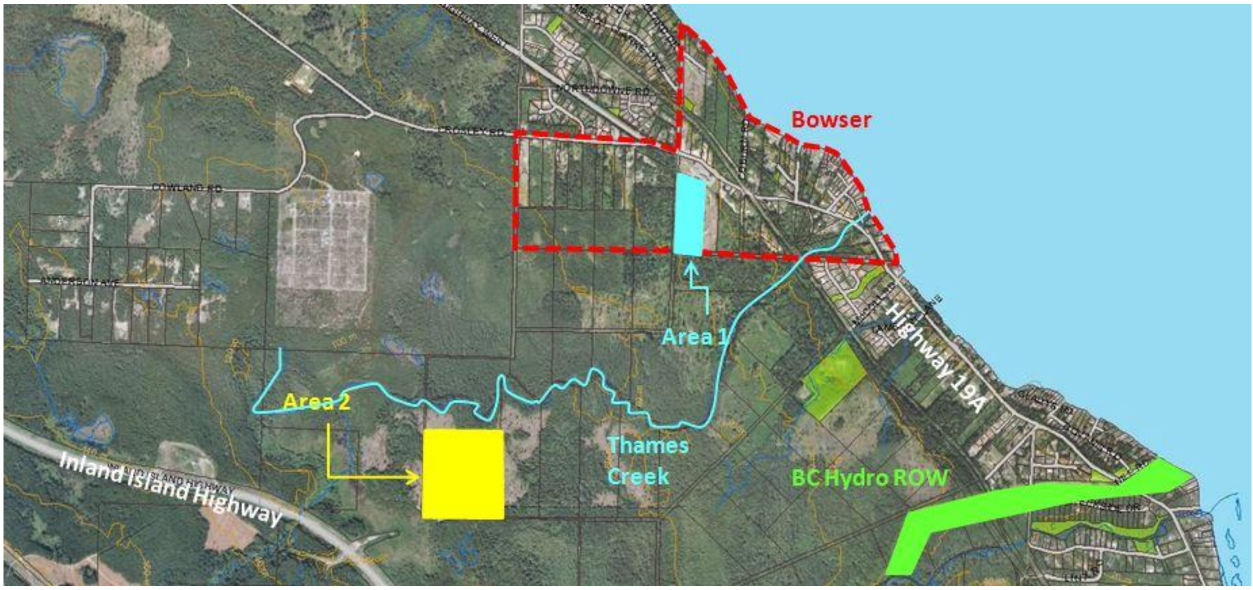

Figure 14: Ground Disposal Alternative Locations

Area-1 (blue) was considered as it lies within Bowser Village and is designated for Civic use, including services and utilities. Area-2 (yellow) and the area around BC Hydro's ROW (green) were considered because they showed potentially suitable soils as shown by the soil mapping for BC identified as yellow-colored areas in Figure 15.

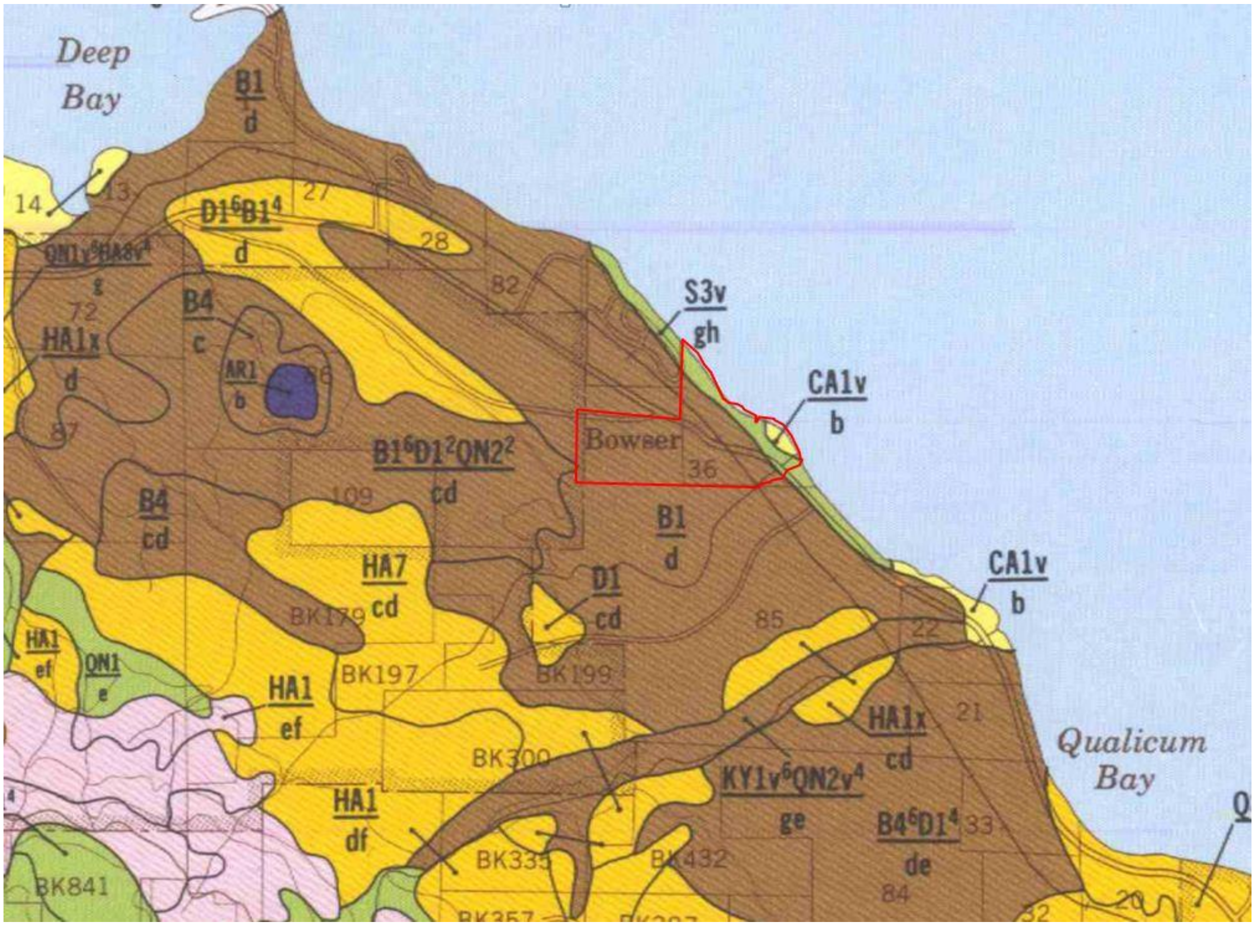

Figure 15: Soils Map. ***Source: Soils of Southern Vancouver Island. BC Ministry of Environment.***

The suitability of ground disposal depends on several criteria, some of which are:

- Soil type and infiltration capacity: the soil type plays a major role in facilitating the infiltration of treated effluent through its layers.
- Water table and saturation level: high water table and soil saturation levels would reduce the infiltration capacity of the soil.
- Proximity to water wells and ecologically sensitive areas, such as surface waters and protected areas, etc: setbacks from water wells, rivers, streams, etc as mandated by the Ministry of Environment (MOE) and other regulatory authorities that may be affected need to be addressed. The regulations are outlined in the Municipal Sewage Regulations (MSR) in Table-1 (Effluent Class Definition) of Schedule-4 (Standards for Discharge into Ground) and in Table-H (Minimum Setback Requirements) of

Schedule-7 (Design Standards for Sewage Facilities) Section 5 (Discharges into Ground), subsection 3(h). In summary, ground disposal requires a minimum setback of 300m for Class-B treated effluent and 30m for Class-A treated effluent.

- Proximity to Bowser village: in order to reduce the length of piping required to convey the treated effluent to the ground disposal site and reduce pumping requirements.

- Land area available, ownership and acquisition: the effective disposal area of basins is governed by the soil type, gradient of ground, water table, the class of treated effluent, and the length to width ratio of the basins. Moreover, MOE regulations require a reserve basin area equal in size to the disposal fields as a backup during basin failure or maintenance works. In addition, the alignment of basins is affected by the ground conditions and therefore more land area is required to accommodate the basins with all the equipment and piping associated with them.

The geotechnical assessment concluded that:

Crown Land within Bowser Village (Area-1):

The soil conditions of this site were only suitable for disposal under Sewerage System Regulations (SSR) outlined in the Standard Practice Manual (SPM) Version-2 published in Sept 2007, i.e. a maximum of 22.7m^3/d. Moreover, the area has a high water table, the depth of soil suitable for infiltration is shallow and there layer of impermeable soil is relatively shallow. Hence, the lot area was insufficient for larger sewage flows, refer to photos in Appendix 2 In addition, active water wells exist close to this area; therefore the aforementioned setbacks reduce the area of land available for ground disposal. Water well locations are shown in Figure 1073-SKC-CS-1 and 1073-SKC-CS-2.A summary of the area required and costs associated with disposal in this area is outlined in Table 42.

Table 42: Infiltration Basin under SSR

Area -1 (within Bowser Village)	
Maximum Sewage Capacity	22.7m^3/d
Approximate Area of Infiltration basins	1,200-1,800m^2; (6m wide x 200-300m Long)
Estimated Cost of Infiltration Basins	$75,000 – 150,000

Site around BC Hydro's ROW:

This area had slightly better soil type than the Area-1 but was not suitable due to presence of adjacent development, BC Hydro's ROW, close proximity to Nile Creek and insufficient area to discharge the $320m^3/d$ ADWF of sewage from BCS group.

Site adjacent to the Inland Island Highway (Area-2):

This site has good potential for ground disposal and can handle the projected sewage flows of the stakeholder group. This site is about 2.5Km from the treatment plant and is approximately 40m higher in elevation than the treatment plant site. The shortest possible forcemain runs in a zigzag pattern towards this disposal site through forested areas and in between parcels of land, mostly undeveloped, refer to Figure 1073-SKC-GD. Land clearing, grubbing and construction of logging road are expected along the route. Based on the broad assessment, the estimated land area required for disposing $320m^3/d$ average dry-weather flows is 3.2ha; this includes 10 active and 10 reserve infiltration basins and additional areas to align the basins and accommodate equipment and accessibility. Moreover, the site is constrained by Thames Creek from the North, thus appropriate setbacks needs to be established based on the level of sewage treatment.

The preliminary cost of this ground disposal area is as shown in Table 43. This includes 10 sets of infiltration basins (each set is made up of one active and one reserve infiltration basin), land acquisition, 2,700m long forcemain and 30% contingency and engineering.

Land acquisition price is based on $7,000/ha. This was derived from the land value assessment listed on RDN's GIS Mapping website for Block 199 which is adjacent to the site of Area-2. This land is 237.58 Acres (96ha) and is valued at $668,000, i.e. $7,000/ha). Depending on the true market value of, the cost of acquiring Area-2 can greatly influence the total cost of the ground disposal option. However, since it is Crown Land within Electoral Area-H, then the price might not vary too much from the estimated $7,000/ha. Further investigation would be beneficial to determine the true market value of the land or other agreements such as a long term lease option.

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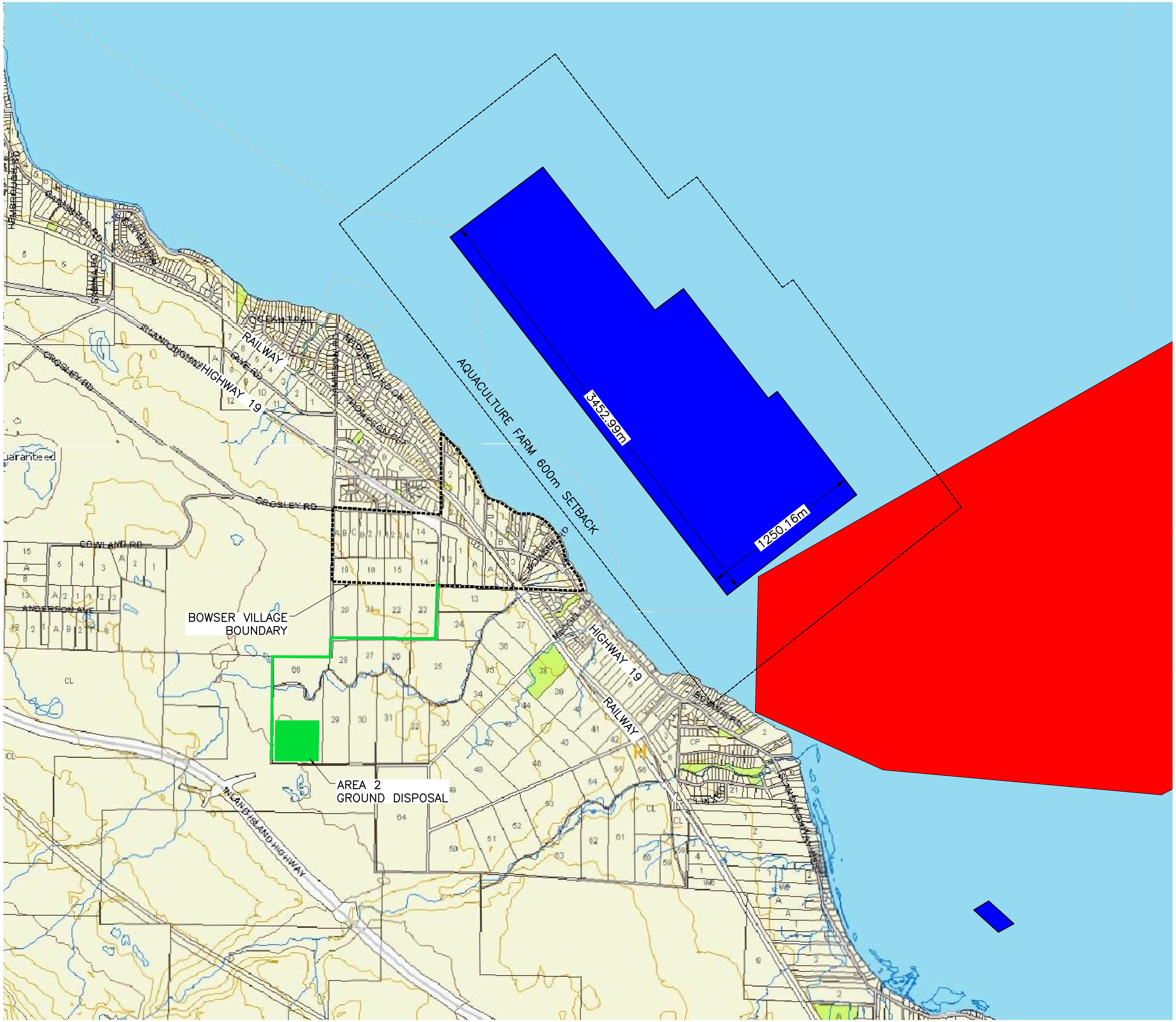

NOTES

PRELIMINARY
NOT FOR CONSTRUCTION

PROFESSIONAL ENGINEER'S SEAL

NO.	DATE	REVISION	DWN

LEGEND

- GROUND DISPOSAL OPTION
- GROUND DISPOSAL AREA
- AQUACULTURE FARM
- B.C. HYDRO R.O.W.

CLIENT	REGIONAL DISTRICT OF NANAIMO
PROJECT	BOWSER SEWER SERVICING FEASIBILITY STUDY
LOCATION	BOWSER VILLAGE
TITLE	GROUND DISPOSAL OPTION
DATE	2011/02/09
SHEET	1073-SKC-GD
REV.	–
DESIGNED	D. SHEARER
DRAWN	A. SMIDI
CHECKED	Z. AZAIZEH
H. SCALE	1:7500
V. SCALE	N/A
SUB	----
ENG	----
DP	----
BP	----

CHATWIN ENGINEERING LIMITED
1614 MOREY ROAD, NANAIMO, B.C., V9S 1J7
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Table 43: Ground Disposal Capital Cost Estimate

Component	Class D Cost Estimate
Infiltration Basins (10 sets)	$ 1,080,000
Land Acquisition (3.2ha)	$ 22,400
Forcemain PVC Pipes (2,700m Long)	$ 432,000
Thames Creek Crossing	$ 10,000
Access Road and Power Supply	$ 35,000
Sub-Total Construction Cost	**$ 1,579,400**
Contingency and Engineering (30% of construction cost)	$ 473,820
Total	**$ 2,053,220**

Table 44: Ground Disposal O&M Cost Estimate

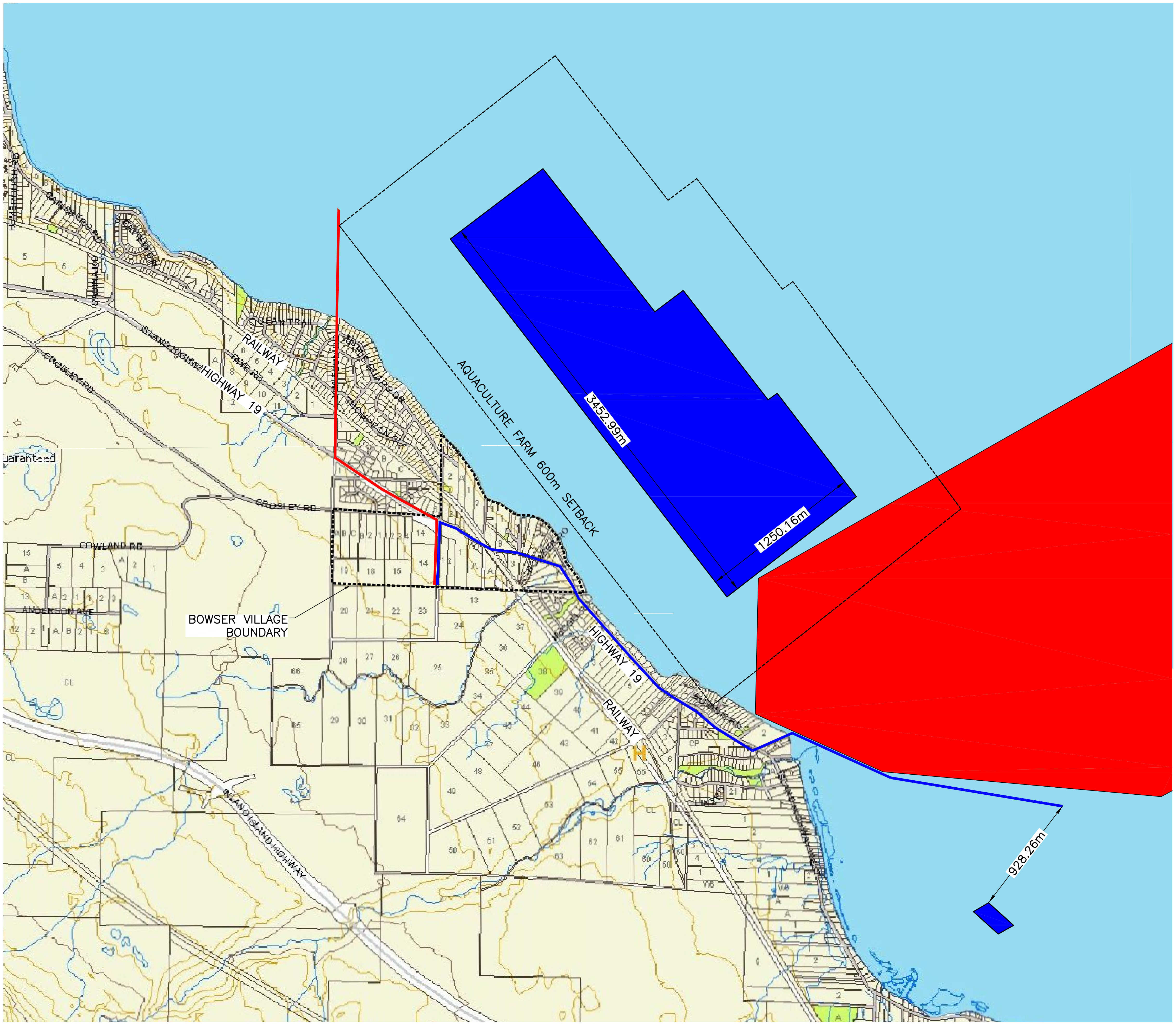
Component	Annual Cost Estimate
Inspections (3 visits per week)	$ 25,000
Utilities and Consumables	$ 6,000
Equipments and Parts Replacement	$ 2,000
Total (Annually)	**$ 33,000**

In the event of developing the entire Bowser Village where the ADWF is approximately 1,800m^3/d, Area-2 would not be sufficient to handle this capacity. The geotechnical assessment report in Appendix 1, showed that an additional area is required along side Area-2 to accommodate for the sewage beyond 320m^3/d ADWF; Area-3. This area shows suitable soil types and infiltration conditions, however other constraints and costs are associated with it such as the cost and route of an additional forcemain to pump the treated sewage further to Area-3, increasing the pumping capacity at the treatment plant to get enough pressure to reach the disposal area, additional infiltration basins, the land in Area-3 partly belongs to a private owner which makes the land acquisition process more complicated and potentially more expensive.

The total estimated construction cost of adding 15 more infiltration basins, acquiring 16ha of land at $7,000/ha and extending the forcemain by 1,400m as outlined in the geotechnical assessment report, to utilize Area-3 for disposal is approximately $2,135,900 including 30% for engineering and contingency.

5.1.1 Environmental Review

Area 2 is located within Crown land (Lot 65), west of Thames Creek and east of the Inland Island Highway. The site encompasses an area of 10 to 13 ha and is accessed by McColl Road (municipal designated road right-of-way). The lot slopes gently to the east (towards the Inland Island Highway) and is presently characterized by a second growth immature forest supporting pole sapling and a 20 to 30 year forest tree stand. Tree



NOTES

PRELIMINARY
NOT FOR CONSTRUCTION

PROFESSIONAL ENGINEER'S SEAL

NO.	DATE	REVISION	DWN	CHK

LEGEND

- MARINE DISPOSAL OPTION 1
- MARINE DISPOSAL OPTION 2
- AQUACULTURE FARM
- B.C. HYDRO R.O.W.

CLIENT: REGIONAL DISTRICT OF NANAIMO

PROJECT: BOWSER SEWER SERVICING FEASIBILITY STUDY

LOCATION: BOWSER VILLAGE

TITLE: MARINE DISPOSAL OPTIONS

DATE 2011/02/09	SHEET 1073-SKC-MD		REV. –
DESIGNED D. SHEARER			
DRAWN A. SMIDI		CHECKED Z. AZAIZEH	
H. SCALE 1:7500		V. SCALE N/A	
SUB ----	ENG ----	DP ----	BP ----

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T. 250-753-9171 F. 250-754-4459 WWW.CHATWINENGINEERING.COM

cover on the site predominantly consists of Western red cedar, Douglas Fir, and red alder. Western white pine was observed in low numbers. Pioneering vegetation consisted of salal, sword fern, salmonberry, red huckleberry, and scotch broom.

Surface soil depth (A Horizon) are much thicker in Area 2 than in Area 1 exceeding thicknesses of 2-3m, as observed along several exposed embankments. The soil matrix consists primarily of gravelly loam and fine sand resulting in seasonal perched water. Thames Creek is the dominant watercourse within the area located east of Area 2. However, several small drainages and forested wetlands swamps are also found throughout the area and likely connected to Thames Creek as surface flow. A review of the provincial fisheries resource data base identifies Thames Creek as supporting a least four species of salmonids including coho salmon, resident cutthroat trout, anadromous cutthroat trout and steelhead salmon. The use of the site for inground sewerage disposal will require a detailed review on potential impact to downstream fish habitat.

Use of Area 2 for sewerage disposal will also require studies to identify wildlife use, including nesting habitat for eagles and herons, provincially identified species at risk and the potential for negative impacts on amphibians and their habitats. Site information will require presentation in an Environmental Impact Study as required under the Environmental Management Act following Municipal Sewerage Regulations.

Area 2 is located within Crown land (Lot 65), west of Thames Creek and east of the Inland Island Highway. The site encompasses an area of 10 to 13ha and is accessed by McColl Road (municipally designated road right-of-way). The lot slopes gently to the east (towards the Inland Island Highway) and is presently characterized by a second growth immature forest supporting pole sapling and a 20 to 30 year forest tree stand. Tree cover on the site predominantly consists of Western red cedar, Douglas Fir, and red alder. Western white pine was observed in low numbers. Pioneering vegetation consisted of salal, sword fern, salmonberry, red huckleberry, and scotch broom.

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5.2 Marine Disposal

Marine Disposal is the process of disposing treated sewage effluent in a safe manner to a receiving water body where the effluent mixes with the receiving water and gets diluted without imposing any impacts on the aquatic ecosystem. Some of the advantages and disadvantages of this alternative are summarized in Table 45.

Table 45: Marine Disposal – Advantages and Disadvantages

Marine Disposal	
Advantages	Disadvantages
• Ability to accommodate larger effluent capacities. • Relatively lower Operations and Maintenance Costs. • RDN has good experience with marine outfall management.	• Higher treated effluent levels are required. • Relatively longer forcemain route. • Existence of aquaculture farms and tenure. • Relatively less accepted by the public and shellfish growers associations.

The receiving water for effluent is the ocean in the Strait of Georgia. Although Thames Creek runs through Bowser Village, it is not a viable disposal option because of the relatively low flow during the summer which makes the creek incapable of meeting the dilution levels mandated by MSR. Moreover, MSR’s regulations for disposal to surface water are more stringent than to sea.

An aquaculture farm (tenure) for growing scallops and shellfish exists off the shore of Bowser. The tenure is a leased offshore area that belongs to Island Scallops Ltd. The tenure is approximately 375ha in area and extends about 3.2Km parallel to the coast of Bowser; refer to Figure 1073-SKC-MD. The tenure extends to the South towards the BC Hydro marine ROW. Another smaller tenure exist further South to Bowser and adjacent to the shore of Qualicum Bay.

Two outfall locations were considered in the course of the study. One is in the North direction towards Deep Bay and along Jamieson Road and the other is in the South direction towards Qualicum Bay and along Crane Road. The first alignment was eliminated because the marine ecosystem is much more sensitive in that area with denser areas of shellfish tenures, such as the Scallop fishery (red shaded area) shown in figure from Marine Water Quality Monitoring in Appendix 3.

The proposed route of the forcemain from the treatment plant to the outfall pipe is located parallel to Highway 19A and in the Southeast direction and into Crane Road. The forcemain alignment entails crossing under E&N railway, where directional (trenchless) drilling would be required, and also entails crossing Thames Creek. The outfall pipe route is proposed to extend about 2,000m off the coast, into the ocean adjacent to BC Hydro's ROW and to an approximate depth of 25m, as shown by the blue colored alignment in Figure 1073-SKC-MD.

The outfall pipe alignment is proposed to maintain adequate setbacks from the aquaculture farms and the depth requirements of the MSR, see section 5.2.1 . It is also aligned to avoid crossing through BC Hydro's ROW. In addition, the alignment is set in such a way that the outfall pipe can be further extended into the ocean in case there were regulatory changes in the future with regards to increasing setbacks or in case of pressure from the public or shellfish growers associations demanding larger setbacks.

The pipe size can be designed to accommodate larger effluent flows and that is to contain any additional effluent if the remaining Bowser Village were to connect to the communal system. This would enable the disposal of larger quantities of treated effluent.

Table 46: Marine Disposal Capital Cost Estimate

Marine Disposal Capital Cost Estimate (Class D)	
Component	**Class D Cost Estimate**
Forcemain PVC Pipes (3,880 m Long)	$ 760,000
Outfall Pipe (2,000m Long)	$ 800,000
Air Release and Clean-out Valves with Chambers	$ 18,500
Shoreline Reinstating	$ 20,000
Railway and Creek Crossings (Thames, Wildwood and offshore Nile)	$ 71,200
Sub-Total Construction Cost	**$ 1,669,700**
Contingency and Engineering (30% of construction cost)	$ 500,910
Total	**$ 2,170,610**

Table 47: Marine Disposal O&M Cost Estimate

Component	Annual Cost Estimate
Outfall Inspections (1 per year)	$ 2,000
Utilities and Consumables	$ 1,500
Equipments and Parts Replacement	$ 3,000
Total (Annually)	**$ 6,500**

5.2.1 Environmental Review

Sewage disposal options for the Bowser Village project have included the feasibility of constructing an outfall to the marine environment. An ocean outfall would allow for full project build out and the disposal of liquid waste that could be generated with the maximum design flow of 1,800m^3/day. Treated liquid waste would be directed to the ocean via a 200mm PVC sanitary forcemain and then to an ocean outfall located at an approximate ocean depth of 25m. Constraints with the alignment route and access to the ocean included foreshore access beyond private lands (residential, commercial, crown), costs associated with length of sanitary forcemain required, physical crossing of sensitive areas (i.e. creek crossings) and alignment constraints within / near sensitive area (shell fish tenures, commercial and agricultural water intakes, recreational areas).

The location of the sewerage disposal outfall to the ocean would be located next to the BC Hydro transformer station located immediately north of Nile Creek. The sewerage forcemain would be aligned along the Old Island Highway starting from the location of the proposed sewerage treatment plant (Area A) and then follow the road edge over a distance of 3800 m. Once aligned along the old island highway, the forcemain would be required to cross a series of watercourses (including Thames Creek) and to be trenched in place along the intertidal beach area located at the end of Crane Road located immediately north of the Nile Creek Old Island Highway crossing. The forcemain would be aligned out to sea over an estimated distance of 2.0km to reach the 25m depth following the southern edge of BC Hydro’s right-of-way for its submarine power cables that stretches across the Strait of Georgia.

The Bayne Sound and Qualicum Bay area support several licensed shellfish tenures including aquaculture scallop farms, tidal clam grow-outs, commercial harvesting zones for goeduck, as well, saltwater intakes supporting shellfish processing operations. The installation of a sewerage outfall within the area will require review and approval by both federal and provincial environment agencies (Department of Environment Canada and BC Ministry of Environment) and will need to meet regulatory protection measures to ensure minimal effects to water quality.

Under the provincial Municipal Sewerage Regulation (MSR) the construction of marine outfalls must abide by the following regulatory requirements:

- Embayed marine waters, and/or,

  a) Marine waters located on the shore side of up to 6km long drawn between two points on a continuous coastline, or located so that the maximum width of sea access by any route is less than 1.5 km wide, or
  b) Marine waters in which flushing action is considered to be adequate by a director.

- Open marine waters, and/or,

  a) Ocean water other than embayed marine waters or water for which, in the opinion of a director, the flushing action is considered adequate.

- For discharge to shellfish bearing waters, the number of fecal coliform organisms at the edge of the initial dilution zone must be less than 14/100ml ("the median number of fecal coliform organisms in a water sample does not exceed 14/100 ml, with not more than 10% of the samples exceeding 43/100 ml, from "Canadian Shellfish Sanitation Program, Manual of Operations".

- Completion of an Environmental Impact Study (EIS) as required under the Environmental Management Act following Municipal Sewerage Regulations.

EIS requirements under the MSR for marine discharge include:

- An assessment of currents and seasonal or other stratification, including current meter and drogue study results, wind analysis and conductivity/depth/ temperature profiles;

- Characterization of bathymetry in the marine environment;

- Effluent plume modeling and dilution calculations;

- The number, location and size of other discharges to the water body;

- Minimum discharge depth below mean low water for any outfall is located in marine waters is 10m;

- Ensure that the outside boundary of the discharge's Initial Dilution Zone (IDZ) must not be within 300m of a commercial shellfish lease or known native or recreational shellfish harvesting area. *The IDZ is the 3 dimensional zone around the point of discharge where mixing of the effluent and the receiving waters occur;

- The IDZ must also be located at least 300m away from sensitive areas such as recreations areas, domestic and agricultural water intakes, or other sensitive areas requiring protection as identified by the director; and,

- A diffuser section that will provide a minimum 10:1 dilution within the IDZ.

The installation of a marine outfall and its forcemain will also require a review by the Federal Department of Fisheries and Oceans and include the documentation of marine fish and fish habitat within the forcemain alignment area and measures to protect the environment during construction.

5.3 Effluent Reuse

Effluent reuse may not be regarded as a disposal option but rather as a solution to a shortage in treated water supply for non-potable uses (i.e. landscape irrigation, stream augmentation). Furthermore, MSR requires that there should be a back-up (redundant) disposal system for all projects proposing re-use of treated effluent. As a result the cost of infrastructure set for providing reuse will be an additional cost to developing a primary disposal system.

Moreover, reuse for agricultural purposes such as forest irrigation, follows seasonal trends. Demand for irrigation is best suited on Vancouver Island during hot dry summer months when ground water levels are at their lowest. Soil conditions along eastern Vancouver Island during winter are typically saturated and not suitable to any irrigation enhancement.

6.0 Sewage System Options Analysis

Based on the feasibility and cost analysis of each component of the sewer servicing system, two options were considered viable, these are as show in Table 48.

Table 48: System Options

System Component	Option-1	Option -2
Collection:	Low-Pressure System	Low-Pressure System
Treatment:	Class B Effluent	Class A Effluent
Disposal:	Ground Disposal	Marine Disposal

Low-pressure collection system is favoured over gravity system in both options because it has lower capital costs. Although, it has higher annual operations and maintenance costs than gravity collection system, it still has lower life cycle cost.
The low pressure collection system is also recommended because it offers more flexibility in terms of pipe alignments at bends and curves which is due to the fact that the pipe sizes are smaller than those used in the gravity system. This is achieved by installing more manholes in the gravity system, thus higher costs and more space requirement.

The treated effluent quality was recommended based on the disposal option. Class B effluent is acceptable when using infiltration basins for ground disposal as long as the soil conditions and surrounding environment allow for that. Based on the broad geotechnical assessment, the soil types in the proposed site seem to possess good infiltration capacities. The site is bordered by Thames Creek from the North, however an adequate setback distance seems to be available.

On the other hand, it is recommended to achieve highest treatment levels for marine disposal. Moreover, due to the sensitivity of the area and the existence of aquaculture tenures around Bowser, Class-A effluent would be the preferred treatment alternative for marine disposal as outlined in Option-2.

The cost analysis for these options is listed in Table 49 and Table 50.

Table 49: Cost Analysis for Option-1

Option-1			
	Construction Cost (plus 30% engineering and contingency)	Annual Operations and Maintenance Costs	Present Worth
Low-Pressure System	$ 811,038	$ 25,000	$ 1,122,593
Class B Effluent	$ 780,000	$ 113,000	$ 2,188,230
Ground Disposal	$ 2,053,220	$ 33,000	$ 2,464,473
Total	**$ 3,644,258**	**$ 171,000**	**$ 5,775,296**

Table 50: Cost Analysis for Option-2

Option-2			
	Construction Cost (plus 30% engineering and contingency)	Annual Operations and Maintenance Costs	Present Worth
Low-Pressure System	$ 811,038	$ 25,000	$ 1,122,593
Class A Effluent	$ 1,300,000	$ 137,000	$ 3,007,323
Marine Disposal	$ 2,170,610	$ 6,500	$ 2,251,614
Total	**$ 4,281,648**	**$ 168,500**	**$ 6,381,530**

7.0 Conclusion

The analysis shows that construction cost for Option-1, with ground disposal, is 15% less costly than Option-2, whereas the former's annual O&M costs are about 1.5% higher. The Present Worth of Option-1 is 10.5% less than Option-2.

Ground disposal is a less costly solution for the BCS group and the disposal fields may be designed to include recreational uses such as trails and community forests. On the other hand, it may pose limitations to expansion if the entire Bowser community decides to connect to the communal system because additional land would be required for further expansion and there may be risks associated with the possibility of acquiring those lands in the future. Furthermore, the cost of $7,000/ha used in the cost calculations for land acquisition may not reflect the true current market value. Moreover, the value of land will probably rise in the future and the expansion is further restricted by the availability of Crown land adjacent to the proposed site. Thus, private land may require procurement which could be priced at much higher rates. Given that, the total construction cost associated with expanding the ground disposal site to accommodate the entire Bowser village is estimated at an additional $2,135,900, including 30% contingency and engineering costs.

Marine disposal option is slightly more costly than the ground disposal for the subject BCS group and it also has its challenges regarding receiving water quality, public acceptance and the existence of the aquaculture farms. However, those challenges can be overcome and the costs associated with the solutions can return higher benefits and unlimited access to a disposal option that can serve larger capacities and support the growth and development of Bowser without incurring additional costs.

The option for a marine outfall is likely a more viable solution to meet the development plans for Bowser Village and its capacity for future expansion. Although this option will entail more detailed studies to ensure compliance with all regulatory requirements, it has the advantage to meet the development plans for Bowser Village and its future expansion and to avoid additional construction costs in the long term.

7.1 Interim scenario

The cost comparison is based upon full development of the BCS group properties. A cost saving interim approach to lower initial capital costs is possible by phasing the construction of the treatment plant.

The treatment plant construction can be phased according to sewage capacity; Phase-1 can be build to treat 160m^3/d. Based on the development plans of BCS group, this capacity is reached approximately in the year 2019. The costs associated with phasing the treatment plant are as shown in Table 51. This would defer a portion of the capital cost until the development reaches levels where further upgrading is required, as listed in Table 52 and Table 53.

Table 51: Treatment Plant Costs (Interim)

Cost (Interim)	Class A	Class B
Capital Cost	$ 910,000	$ 520,000
O&M Annual Costs	$ 107,000	$ 89,000

Table 52: Cost Analysis for Option-1 (Interim)

Option-1 (Interim)		
	Construction Cost (plus 30% engineering and contingency)	Annual Operations and Maintenance Costs
Low-Pressure System	$ 811,038	$ 25,000
Class B Effluent	$ 520,000	$ 89,000
Ground Disposal	$ 2,053,220	$ 33,000
Total	**$ 3,384,258**	**$ 147,000**

Table 53: Cost Analysis for Option-2 (Interim)

Option-2 (Interim)		
	Construction Cost (plus 30% engineering and contingency)	Annual Operations and Maintenance Costs
Low-Pressure System	$ 811,038	$ 25,000
Class A Effluent	$ 910,000	$ 107,000
Marine Disposal	$ 2,170,610	$ 6,500
Total	**$ 3,891,648**	**$ 138,500**

8.0 Next Steps

The next steps required to move the project forward in order to provide the sanitary sewer servicing infrastructure to support Bowser's development plans is to start the preliminary design and regulatory review process then detailed design and eventually construction.

Preliminary Design

Preliminary design tasks include the following site assessment work:

- Topographic survey.
- Geotechnical assessment.
- Hydro-geological assessment.
- Coastal engineering studies
- Environmental and water courses assessment.
- Receiving environment assessment.
- Plume dispersal modeling.

Preliminary engineering work would be undertaken in order to provide engineered drawings, specifications and calculations in support of submissions to regulatory agencies to commence the approval and permitting process.

Regulatory Approval Process

The following permits/approvals will be required:

- MOT: To obtain permits on the route of gravity and/or forcemain pipes and ROW's.
- BC Hydro: coordination would be required regarding pipe alignment since the forcemain and outfall pipe are adjacent to the substation and marine cables ROW. (marine disposal option only)
- MOE: Two types of permits from MOE. One is regarding disposal of treated effluent under MSR and the other is regarding environmental assessment and habitat protection.

- DFO (Department of Fisheries and Oceans): for an Environmental Review Process (ERP)
- EC (Environment Canada)
- BC Lands and Water: to obtain lease on offshore land where the outfall pipe is located (marine disposal option) and for Crown land acquisition (ground disposal option).
- Transport Canada: permits are required from the Navigable Waters Protection Act for the outfall alignment. (marine disposal option only)
- Railway agency: coordination and permit is required to cross the railway.

Stakeholder Consultation

- Stakeholder consultation is recommended with the following key stakeholders:
- Stakeholders to review the feasible options.
- Other Bowser Village community members to participate in the communal sewer system.
- Consultation and discussions with BC Shellfish Growers Association.
- Consultation with First Nations of Qualicum Indian Reserve.

Appendix 1

Bowser Village – Ground Discharge Reconnaissance Memo
Trax Development Ltd
February 01, 2011

TRAX Developments Ltd.

Box 9-6, Thetis Island, BC, V0R2Y0. T 250-597-3155 Fx 866-424-8569
onsite@traxdev.com

Memo: Bowser village ground discharge: Initial site reconnaissance.

Project: Bowser

Client: Chatwin Engineering

Table of Contents

1 Summary report

1.1 Introduction

Stakeholders in the Bowser village and the Regional District of Nanaimo (RDN) have retained Chatwin Engineering to undertake a study on potential community sewer options for the village center area.

Chatwin Engineering has approached TRAX Developments Ltd (TRAX) with a request for assistance with identification of possible onsite ground discharge options.

TRAX has retained Michael Payne PEng PGeo of Payne Engineering Geology as senior advisor.

TRAX has reviewed background information including soil survey reports and maps, air photography and RDN mapping. TRAX has also made a very brief exploratory reconnaissance of the area and met with one of the stakeholders on site.

This memo presents the results of this initial study and makes recommendation for potential options together with recommended steps for further assessment of these options.

The reader is cautioned that this reconnaissance and report is preliminary in nature, and options presented require further investigation before feasibility can be determined. Further, system sizing and cost estimates are conceptual only. Reliable cost estimates for decision making can only be prepared after further site evaluation and analysis.

See page 5, Section 1.4.1—Key Conclusion.

1.2 Basic design assumptions and source documents

1.2.1 Design assumptions:

Construction of a Sewerage system to address potential development in the village core area, in three phases:

- Phase 1 with each (or some of) stakeholder lot discharging up to 22.7 m^3/day, on or off site options per lot under the *Sewerage System Regulation* (SSR).
- Phase 2 with full build out of the village core lots, with average design flow of 320 m^3/day and daily design flow for hydraulic loading rate (HLR) calculation 640 m^3/day per Chatwin analysis based on zoning and density.
  - Note that infiltration is not accounted for based on assumption of STEP collection system.
  - We recommend considering this phase in two sub phases, 2A and 2B.
- Phase 3 with connection of other parts of the Bowser village, with average design flow of 2000 m^3/day and maximum daily design flow 4000 m^3/day (for HLR) and 6000 m^3/day (with infiltration) per Chatwin analysis.
- Effluent type, Class C or B pre-treatment (SSR classification Type 2 or Type 3). Class A only if required for well setback or other nutrient reduction considerations.

- Discharge in phases 2 and 3 to be under the *Environmental Management Act—Municipal Sewerage Regulation* (MSR).

1.2.2 Base information and key reference documents:

- Climate data Comox Airport (1021830), Environment Canada. Farmwest ET calculation.
- Jungen, J.R. *Soils of Southern Vancouver Island*. BC Ministry of Environment. Surveys and Mapping Branch. MOE Technical Report 17. Report No. 44. BC Soil Survey. Trafford Publishing. Victoria, BC. 1985.
- RDN mapping and air photographs.
- BCGS mapping of aquifers and wells, and Ministry of Environment well database.
- *Municipal Sewerage Regulation*, BC. and guidance documents prepared by the BC Ministry of Environment.
- *Sewerage System Regulation, BC.*
- Sewerage System Standard Practice Manual V2 (SPM).

1.2.2.1 CLIMATE

- Average annual rainfall 1173mm, sd 187. Peak 1559mm.
- Average 6mo winter rainfall 922mm, sd 182. Peak 1365mm.
- Preliminary moisture deficit estimate. Design effective precipitation 632mm, ET 726mm. Design moisture deficit 94mm (1995). Average annual moisture deficit 532mm.

1.3 Objectives

- Identify areas in or near the village core with potential for ground discharge for each of the phases.
- For each phase:
  - Identify potential ground discharge areas.
  - Estimate size of area needed.
  - Provide a typical budget range for discharge system for the area.
- Make recommendations on sites suitable for further investigation.
- Make recommendations on steps for further investigation and a feasibility study.

1.4 Conclusions

1.4.1 Key conclusion

We recommend that if ground discharge is to be considered, the stakeholders and RDN undertake the feasibility study outlined in Section 1.4.7 as soon as possible, since the study is necessary in order to support decisions on ground discharge options.

This initial report indicates only that ground discharge appears to be an option worthy of further investigation, the illustrative material included here should NOT be used to support decisions about type or location of ground discharge.

The reader is cautioned that any statements on site capability, system cost or system design are for illustration only and the feasibility of *and* cost for ground discharge solutions can only be determined after proper site evaluation and preliminary design.

1.4.2 Phase 1

Based upon conceptual evaluation of Area 1 (see attached sketch plan) onsite or near site dispersal under the SSR would be suitable for this phase. Onsite systems might be per building lot, or small communal systems serving a development on a larger lot. The SSR allows for relatively rapid system design and construction, and design costs are typically lower than under the MSR.

A typical budget range of $75,000 to $150,000 for a small, onsite, communal system with 22.7 m^3/day daily design flow, including design, treatment and dispersal (but not collection) is suggested for a typical lot of approximately 4Ha in overall site area.

System planning should include design for re-use or re-purposing of system components as a community sewage system is developed.

The use of a pressure collection system (STEP or similar) for the community system would address re-use of on-site components for flow equalization and is likely to be more economical than gravity sewer solutions as well as reducing infiltration risk.

1.4.3 Phases 2 and 3

Based on conceptual evaluation of Areas 2, 3 and 5 (see attached sketch plan) these areas all show potential for use as ground discharge sites (either primary or reserve) for these phases and warrant further investigation.

A crown land lot near the village, shown as Area 2 on the sketch plan, may be suitable for ground discharge in phase 2, or at least in an initial sub phase of phase 2. Area 2 covers 10 to 13 Ha.

Parts of two privately held lots shown as Area 3 and Area 5 on the sketch plan may be suitable for ground discharge in phase 3, and could also be utilized for phase 2 ground discharge. These areas are likely to have more favourable soils than Area 2.

Lands in the village center area are not expected to be suitable for large ground discharge systems (phase 2 and 3).

System planning for phase 2 should include design for re-use or incorporation of phase 2 works into a future expanded solution.

1.4.3.1 PHASE 2 SUB PHASING

Based on our initial conceptual overview, it may be preferable to divide phase 2 into two sub phases, phase 2A and phase 2B. Phase 2A discharge may be more readily supportable on Area 2. We have therefore indicated this in our summary table.

1.4.4 Treatment

Dispersal system design will be mainly constrained by natural discharge capacity, which is related to drainage and system length, rather than by area.

For this reason Class B effluent may not be necessary from an economic point of view and initial design scoping should consider Class C effluent. Class A effluent may confer some hydraulic advantages in design, but cost benefit would need to be assessed.

Decision on effluent quality may be taken after the initial feasibility study, and at that point it will be possible to assess the advantages of higher levels of treatment.

1.4.5 Land areas

1.4.5.1 SIZE OF AREA NEEDED

We have made estimates of approximate land area needed for each phase, based on assumptions about soil and site capability.

There are two types of "size" to be considered:

- The area needed for dispersal/infiltration and for associated works (example a rapid infiltration basin plus berms).
- The length and alignment needed to ensure water applied will move away from the discharge area, the natural discharge capacity.

In the case of the sites reviewed, the natural discharge capacity is more likely to be limiting and is likely to lead to the need for a larger overall land area—although the actual dispersal system would only use a small part of the area in terms of coverage.

To give the reader an idea of system size requirements we have assumed system types (example, rapid infiltration basins). After full site and soil evaluation a suitable system type should be chosen, this may not be the same type as we use for illustration purposes.

Other options for dispersal should be explored during the feasibility study, and cost estimates prepared at that time to support decision making.

The table below summarizes our conceptual **estimates** of soils and potential discharge area for each area. See Section 2 for discussion. Areas and lengths are presented for **illustrative purposes only**.

For Phase 1 SSR systems, the area shown is assumed to be contained within a lot of adequate size (the lot used for conceptual consideration had a usable area of approximately 4Ha). This is important to permit separation to drainage and other features, other uses of the lot.

	Area 1	Area 2	Area 3	Area 5
Land area (Ha)	Lot area ~ 4	10 to 13	30 to 40	37
Landowner	Stakeholder	Crown (Lot 65)	Private (part of Lots A and B)	Private (part of Lot B)
Forcemain (m)	NA	2400	1400 additional	1300 additional
Elevation increase (m)	NA	50	80	100
Main soil type	Sandy Loam to Loamy fine Sand	Gravelly Loamy fine Sand to Gravelly medium Sand	Gravelly Loamy Sand to V Gravelly medium Sand	Gravelly Loamy Sand to V Gravelly medium Sand
Potential soil depth to SHWT (m)	0.5 to 1.0	4 to 5	5 to 6	5 to 6
Suitable for phase	1, onsite option	2, and as part of 3	2 and 3	2 and 3
Area for HLR 22.7 m^3/day (phase 1)	1200 to 1800 sqm (including treatment) (within larger lot)			
Length (m)	200 to 300			
Treatment and dispersal cost range ($)	75,000 to 150,000 including design			
Area for HLR 320 m^3/day (phase 2A)	Not suitable	2.2 to 2.75 Ha		
Length (m)	NA	1400 to 1875 (with drainage separation)		
Discharge area cost range ($)	NA	300,000 to 900,000		
Area for HLR 640 m^3/day (phase 2B)	Not suitable	4.4 to 6.6 Ha		
Length (m)	NA	3750 , Area 2 may not be adequate for 2B total flow due to length constraint and inadequate area for drainage separation		
Discharge area cost range ($)	NA	500,000 to 1,500,000 (includes full phase, 2A and 2B)		
Area for HLR 4000 m^3/day (phase 3)	Not suitable	NA	24 to 30 Ha	
Length (m)	NA	NA	5000 to 7500 with drainage separation	
Discharge area cost range ($)	NA		900,000 to 1,950,000	

Notes: Lot designations are for reference to sketch plan, see below for lot legal/PID. Area for discharge is area for dispersal system only, based on Class C effluent. Lot area needed will be larger. Length for discharge may be achieved by separation to separate drainage areas or separation by artificial drainage. Phase 3 figures for system length assume phase 2 already constructed.

1.4.6 Acquisition of land

Acquisition of land for Areas 2, 3 and 5 should be explored hand in hand with further site investigation to support decision on the most economical and practical alternative. Area 4 should also be considered, based on indications as a feasibility study goes forward.

Purchase may not be necessary in order to use land for discharge.

Some regulatory issues may need to be resolved in order to be able to use land for discharge (example re-zoning).

Crown land obtained by the RDN may have low cost, the private lands making up Areas 3 and 5 are currently assessed at slightly less than $7000/Ha.

It is recommended that the RDN and stakeholders consult a specialist in land purchase/acquisition for advice.

It is **strongly recommended** that suitable land be obtained for use during early planning stages, in order to ensure the full future potential of the system can be realized at a later date. It would be unfortunate and potentially costly if suitable land areas were lost.

1.4.6.1 OTHER USES OF LAND

The land used for discharge is not necessarily entirely alienated from other uses. The actual dispersal structures would only occupy a small percentage of the total land area.

Depending on design of the discharge system these uses could include forestry, recreation and park reserve.

1.4.7 Further investigation, feasibility study

We recommend that as a key and immediate part of the next planning steps a feasibility study be undertaken to establish the feasibility of ground discharge in the identified areas for phases 2 (sub phases 2A and 2B) and 3.

This study should take an integrated planning approach. The study may be undertaken in stages, with opportunity for redirection by the stakeholders/RDN at interim report points.

The study should include site and soil evaluation in each of the areas and should result in recommendations for system planning, with detailed recommendations for phase 2, including conceptual design, system and process recommendations and system budget estimates.

The study should also address conceptual design of collection systems for the phase 2 and phase 3 sewage systems, in order to improve integration of planning.

Forcemain alignments should be selected during the study.

The study should identify potential impacts of discharge, including water wells and receiving waters, and establish preliminary estimates of setbacks needed to these as well as any impacts on system design/system and process selection.

Similar process should be followed for onsite options per lot in phase 1, and conceptual design should take into account integration to the overall communal system design concept. If possible this process would be undertaken simultaneously for any of the stakeholder lots which are likely to need systems in phase 1.

We consider it advisable to take this integrated approach to planning, even though phase 2 and 3 may not be implemented for some time. Key reasons for this include:

- Potential for loss of suitable discharge sites.
- Improved efficiency of conversion of infrastructure from phase to phase.
- Improved support to community planning decisions.
- Lower overall cost.

See Section 3 for an outline of the process for registration and construction of a sewage system under the MSR.

For smaller systems in phase 1, under the SSR, site and soil evaluation and design follow similar process to that described in Section 3. However, an Environmental Impact Study is not required, and the process of filing the system design is considerably faster.

2 Site information

2.1 Soils and sites

Ground reconnaissance confirmed soils to be typically as described by Jungen, see attached excerpt of soil map and soil associations. The site visit was made at a time after very wet weather.

2.1.1 Areas identified on sketch plan

Based on soil types and site capabilities four areas for potential discharge have been identified. See attached sketch plan. These are:

- Area 1, this is an example of a stakeholder lot in the village center area.
- Area 2, this is a Crown land lot near to the village.
- Area 3, a larger private resource land area near to the village.
- Area 4 A, 4B and 4C three further small private resource land areas near to the village, separated by a creek and the inland island highway.
- Area 5, a second part of a private resource land lot to the south of the inland island highway.

2.1.2 Soil and site suitability for discharge

Below we present the results of review of the soil survey information and site reconnaissance of the soils. Where an area is indicated to be unsuitable for large ground discharge systems, the area may contain suitable soils for small dispersal systems, but these areas are not likely to be large enough or sufficiently contiguous to be feasible for a larger system. Equally, the soils in an area may be suitable for small dispersal systems but do not have the natural discharge capacity required to support larger systems.

2.1.2.1 HAWARTH 7 (HA7) - AREA 3 AND AREA 5, AREA 4

The most suitable soil association for discharge in the area near the village is the HA7/cd (yellow on map). This soil was viewed in cutbanks and borrow pits near the inland island highway. Air photographs (analysis of vegetation patterns) appear to confirm that this soil association extends over an area similar to that described by Jungen.

A part of this soil association area is defined as Area 3 (see attached plan). Area 5 is also expected to be of this soil type.

Areas 4 A, B and C are expected to contain some areas of this soil type; however a part of Area 4A viewed in the field appeared to show higher SHWT. Area 4 is also less attractive for use due to its fragmented nature and impact from highway construction and the old McColl Road logging road.

- Site slope was variable, rolling, with considerable areas of relatively low slope.
- Vegetation Douglas Fir with Western White Pine, low Salal understory. Cleared areas with sparse, low growing, grasses.

- These soils are deep and highly permeable.
- No restrictive horizon was seen to 5m in a borrow pit bank.
- No sign of seasonal high water table (SHWT) was seen to this depth.
- Soil texture for surficial soils Gravelly Loamy Sand to Medium Sand.
- Soil texture for deeper soils Very Gravelly Medium Sand.

Soils in this area may be suitable for large ground discharge systems, and similar soil areas on the other side of the inland island highway are also likely to be suitable.

2.1.2.2 DASHWOOD 1 (D1) - AREA 2

The second most suitable soil area near the village is an area shown on the soil map as D1/cd, although the soil survey indicates that this association may be expected to have a strongly cemented duric layer at 75 to 100 cm depth, this did not seem to be evident in several cutbanks viewed in the field. It is possible that the soils in this area are more D7 and show areas characteristic of HA7 (although with somewhat finer surficial soils).

Much of this area falls within a Crown land lot, and is defined as Area 2.

- Site slope was variable, rolling.
- Vegetation Douglas Fir with some (planted?) Western White Pine, Salal understory. Cleared areas with growing, grasses and broom, some Red Alder. Vegetation appears more vigorous/dense than the HA7 area which is assumed to be due to higher field capacity in surficial soils and possibly higher water table.
- These soils are deep and highly permeable.
- No restrictive horizon was seen to 5m in a borrow pit bank and a second cutbank area.
- No sign of seasonal high water table (SHWT) was seen to this depth at one cutbank, but some sign was seen in one borrow pit at about 4m depth.
- Soil texture for surficial soils Gravelly Loamy fine Sand to Sandy Loam
- Soil texture for deeper soils Gravelly and Very Gravelly Loamy Medium Sand and Medium Sand.

Soils in this area may be suitable for large ground discharge systems, however as our brief reconnaissance is at odds with the conclusions of the soil survey extra caution is indicated. This area is expected to have a lower capacity than the HA7 area.

Note that this is **not** an indication that other areas shown as D1 on the soil map will show similar areas with no well-developed flow restrictive horizon.

2.1.2.3 KYE/QUINSAM

An area under and near the Vancouver Island Hydro transmission lines (south of the village) shown on the soil map as KY1v^{5}QN2y^4/ge and HA1x/cd was viewed in the field. The soil map indications of restricted drainage and seepage were confirmed, and the description of soil associations indicating shallow restrictive layers was also confirmed in the area viewed.

This area is unlikely to be suitable for large ground discharge systems.

2.1.2.4 BOWSER - AREA 1

The village center area is shown on the soil map as B1/d, and soils evidence viewed in the field visit confirmed the soils to be of this type.

Area 1 and the proposed sewage treatment facility lot fall in this soil area.

- Site slope was low.
- Vegetation Douglas Fir, Red Cedar, Red Alder, Big Leaf Maple with understory of Oregon Grape, (in better drained areas), Salal, Swordfern. Significant areas of Salmonberry were seen in less well drained areas.
- These soils are shallow and moderately permeable, with imperfect drainage.
- Restrictive horizons were seen at 50 to 100 cm depth in a long exposed trench on the West and South sides of Area 1 and in nearby excavations (including the pond to the NE of Area 1).
- Seasonal high water table (SHWT) was seen at this depth, and extending into the soil up to 15cm above the restrictive horizons. Some surface water flow was seen in lower lying areas. The drainage ditch was flowing strongly, it is reported that the ditch flow dries to almost zero in the summer.
- Soil texture for surficial soils Loamy fine Sand and some Sandy Loam.
- Soil texture for deeper soils Loamy fine Sand and some areas of medium Sand.
- Estimate of saturated permeability 1500 mm/dy to 3000 mm/dy, 2000 mm/dy assumed for purposes of site size guidance.

These soils are not suitable for large ground discharge systems.

2.1.2.5 OTHER AREAS

Three other areas were viewed:

- One to the East of the inland island highway in an area shown as B4 on the soil map, which showed Sandy Loam soils with shallow flow restrictive horizons and high SHWT,
- One in the subdivision to the north of Area 3 in an area shown on the soil map as $B1^6D1^6QN^2$ which showed variable soils with relatively shallow flow restrictive horizons,
- And one in the area shown on the soil map as $D1^6B1^4$ to the north of the village on the old island highway, which again showed shallow flow restrictive horizons and higher SHWT levels.

None of these areas appeared suitable for large ground discharge systems, and similar soil areas on the soil map are expected to be unsuitable.

2.1.3 Aquifer

The five identified areas all overlay mapped aquifers (Thames River and Mapleguard Point, and Nile Creek to Thomas Creek) classified as having an overall moderate intrinsic vulnerability to contamination.

2.2 Ground discharge

In order to illustrate potential for ground discharge we examined each of the phases identified.

The reader is cautioned that any statements on site capability, system cost or system design are for illustration only and the feasibility of and cost for ground discharge solutions can only be determined after proper site investigation and preliminary design.

To give the reader an idea of system size requirements we have assumed system types (example, rapid infiltration basins). After full site and soil evaluation a suitable system type should be chosen based upon suitability and cost, this may not be the same type as we use for illustration purposes here.

2.2.1 Phase 1

2.2.1.1 GROUND DISCHARGE SOLUTIONS

For this phase it is considered to be appropriate to find options for ground discharge of secondary or tertiary treated effluent on the site of development or on a similar site nearby. Area 1 is chosen to represent a typical site in the village center area, a lot with usable area of approximately 4Ha.

For a daily design flow of up to 22.7 cum/dy the lot forming Area 1 is likely to be capable of an onsite dispersal option with Type 2 10/10 effluent. Some imported sand may be necessary to adjust the natural discharge capacity of the site, and drainage will certainly be necessary. Onsite dispersal will have an advantage in terms of recharge of shallow groundwater and on site recycling of water.

For the particular site and use proposed for Area 1, to address site constraints and development objectives a dispersal system that can be implemented in green spaces and landscaped areas between clustered building units may be preferred, and if this is the case we suggest consideration of subsurface drip dispersal. This system has other advantages for the site, including a potential for later repurposing as irrigation when a communal system is installed. Solutions for other sites and plans should be established based on site and use specific analysis.

As a typical village center lot will eventually be converted to higher density development, implementation of the sewerage system should include planning for re use of components of the system as a part of a communal system. For example, tank components could be re used as part of a flow equalization and STEP (Septic Tank Effluent Pump) collection system. Treatment facilities may best be made modular and possibly moveable. Dispersal areas could be re used for irrigation of landscaping if suitably designed.

2.2.1.2 DISCHARGE AREA SIZE

(a) Area

For a small onsite communal system with daily design flow of 22,700 L/dy. Assuming the use of Type 2 effluent and a hydraulic loading rate of 25 to 37 mm/dy to a drip dispersal system in native soils or shallow fill, a discharge area of approximately 600 to 900 sqm would be required.

Treatment, collection and ancillary systems would require more area. A 1:1 allowance could be made for land area, resulting in an area of 1200 to 1800 sqm, less area could be used at higher cost.

This area would need to be within a lot of approximately 2 to 4 Ha to allow for other uses, drainage system separations and for economical layout. This should be taken into account when considering this option.

(b) Length for natural discharge

For a daily design flow of 22,700 L/dy and assuming the use of native soil, a system length of 200 to 300 m would be necessary. This length might be arranged to suit other lot use objectives. The use of interception and relief drainage is likely to be necessary.

2.2.1.3 COST FOR GROUND DISCHARGE

Typical costs (including design and construction) for a treatment and dispersal system of this sort are in the range of $75,000 to $150,000 plus any collection system needed. Collection system costs are highly variable. Of this figure anywhere from 25% to 75% (depending upon the level of care in design) could be re used as part of a communal system. If dispersal areas are repurposed at that time then up to 90% of the overall cost would be included in future solutions. 100% of any collection system would be re used in a communal system.

The smaller the lot and the more other uses to be accommodated, the higher the cost.

2.2.1.4 COMMUNAL SYSTEM

If a number of lots are in process of development, earlier implementation of part of Phase 2 would be justified.

2.2.1.5 FURTHER INVESTIGATION

Prior to system design a proper site and soils evaluation would need to be conducted, and system design would be based upon information from this evaluation.

2.2.2 Phase 2

2.2.2.1 GROUND DISCHARGE SOLUTIONS

For this phase it will be necessary to obtain and utilize an area for ground discharge at some distance from the village center. Treatment, control and headworks facilities could be located at the village center (perhaps at the crown land lot next to Area 1).

For the higher flows in this phase discharge would need to be on a more favourable land area outside of the village center. This is also considered to be a more appropriate land use planning decision, as it removes the discharge area from high density development zones and places it in rural or resource areas.

As Area 2 is closest to the village, and is largely on crown land, Area 2 is chosen to illustrate the first part of a communal system in Phase 2. Phase 2 could also utilize the more favourable Area 3/Area 5 site, if this was available.

2.2.2.2 DISCHARGE AREA SIZE

(a) Area

For maximum Phase 2 daily design flow for HLR of 640,000 L/dy.

Assuming the use of Class A or B effluent and a hydraulic loading rate of 80mm/dy to a Rapid Infiltration Basin, a discharge area of approximately 8,000 sqm would be required, with a similar reserve basin for a total of 16,000 sqm (1.6 Ha).

Assuming the use of Class C effluent and a hydraulic loading rate of 59 mm/dy to a Rapid Infiltration Basin, a discharge area of approximately 11,000 sqm would be required, with a similar reserve basin for a total of 22,000 sqm (2.2 Ha).

Basin arrays would require more land area for berms and ancillary structures. A 1:1 to 1.5:1 minimum allowance should be made for land area, resulting in an area of 4.4 to 6.6 Ha for Class C effluent.

However, due to the need to align the basin arrays for drainage, a considerably larger overall area will be needed.

(b) Length for natural discharge

For Phase 2 average flow of 320000 L/dy (at 50% of daily design flow), and assuming a soil depth of 5 m with an initial water table depth of 1 m ten basin areas at 375 m length would need to be separated to separate drainages or (if using Area 2) separated by drainage systems, with secondary (reserve) basin areas in line with each primary.

This length cannot be achieved in Area 2, so full build out for phase 2 may require use of part of Area 3 or Area 5. This decision will only be possible after site and soil evaluation and analysis of natural drainage capacity together with conceptual system design.

Note that this estimate is for illustration only, groundwater flow modelling based upon a full site and soil evaluation and hydraulic testing should be used to establish system alignment. At that time a considerably shorter or a longer alignment may be necessary, and this will vary over the site.

(c) Overall size, class C effluent

For conceptual purposes, therefore, ten double basin arrays (ten primary, ten reserve basins) with infiltrative surfaces 3m wide by 375m long (an array of smaller basins totalling that length) may be considered. For class B effluent the basins would be narrower.

2.2.2.3 AREA CAPACITY

Assuming soils are favourable; Area 2 may or may not be capable of supporting maximum Phase 2 flows. It is likely that for maximum phase 2 build out part of Area 3 or Area 5 would also be needed.

Without proper site and soil evaluation it is not possible to determine this. We would not recommend relying entirely upon Area 2 at this planning stage.

2.2.2.4 SUB PHASING

It is our understanding that full development of phase 2 flows will not occur in the medium term, so it might be possible to undertake phase 2 works in two sub phases, with Area 2 supporting the initial part of the discharge.

In our summary table we have split phase 2 into 2A and 2B, with 2A at 50% of the final phase 2 design flow.

2.2.2.5 FORCEMAIN

Two optional concepts for forcemain location are presented on the sketch plan. Forcemain 1 follows road allowances to Area 2 from the village center area. Length is 2.4 km. Forcemain 2 follows a walking trail and then a road allowance (approximately aligned on an existing logging road) and is approximately 3.8 km to Area 2.

At phase 2 forcemains adequate to support extension in phase 3 should be installed.

2.2.2.6 COST FOR GROUND DISCHARGE

Typical construction costs for a ground discharge system (without treatment or forcemains) of this sort are in the range of $50,000 to $150,000 per each of the ten basin clusters (with ancillary works, assuming primary and reserve basins are paired), for a total of $500,000 to $1,500,000. With the use of class B effluent some cost savings could be realized, at the expense of higher treatment facility costs and higher operating costs.

Other options for dispersal should also be explored after site and soil evaluation, and cost estimates prepared at that time to support decision making.

2.2.2.7 THE LAND

Area 2 occupies much of a crown land lot shown as Lot 65 (Lot 65, District Lot 85, Newcastle District, Plan 2018 (PID 6670075)) on the sketch plan. The lot is currently zoned Rural 1. No assessment information is available.

(a) Obtaining land

The land may be purchased, leased or an agreement for non-exclusive use might be negotiated. As the land will continue to be usable for other purposes than discharge the total cost of the land should not be assigned to the ground discharge system.

Assuming Area 2 is found to contain sufficient parts with usable soils and suitable alignments for all or part of phase 2 discharge, the crown land Lot 65 should be secured for use.

It is our understanding that the RDN will be able to obtain crown land, either in fee simple or in some other form, for use as a discharge area and be able to alter zoning (if necessary) and provide any necessary development permits.

This may favour the choice of Area 2 with sub phasing of Phase 2.

(b) Sensitive ecosystems

Thames creek flows on the north boundary of the lot, however the creek and riparian area is well outside of the area potentially usable for discharge.

The creek may be found to be the receiving area for part of the water flowing from a discharge area; the Environmental Impact Study (EIS) will need to consider nutrient impact on receiving waters.

2.2.2.8 OTHER USES OF THE LAND

The land used for discharge is not necessarily entirely alienated from other uses. The actual dispersal structures would only occupy a small percentage of the total land area.

Depending on design of the discharge system these uses could include forestry, recreation and park reserve.

2.2.3 Phase 3

2.2.3.1 GROUND DISCHARGE SOLUTIONS

As with phase 2, it will be necessary to obtain and utilize an area for ground discharge at some distance from the village center. Treatment, control and headworks facilities could continue to be located at the village center (perhaps at the crown land lot next to Area 1).

Area 3 and Area 5 is chosen to illustrate this further expansion of the communal system.

Note that phase 2B is likely to utilize part of Area 3 or Area 5. Area 2, if already being used for phase 2 flows would, of course, contribute to phase 3 total capacity.

Area 4 is not considered for phase 3 as it involves further lots (Lots C and D on the sketch plan) and is relatively small in size, and because of concerns about the extent of favourable soils within the area. However, it may be suitable as a reserve area.

The actual usable discharge area will depend on the effluent class (A-D), on the method of discharge (basins vs. trenches), on system design based upon full site and soil evaluation and upon the results of the EIS.

2.2.3.2 DISCHARGE AREA SIZE

(a) Area

For maximum Phase 3 daily design flow of 4,000,000, L/dy for consideration of HLR and mass loading.

Assuming the use of Class A or B effluent and a hydraulic loading rate of 100 mm/dy to a Rapid Infiltration Basin, a discharge area of approximately 40,000 sqm (4 Ha) would be required, with a similar reserve basin for a total of 80,000 sqm (8 Ha).

Assuming the use of Class C effluent and a hydraulic loading rate of 68 mm/dy to a Rapid Infiltration Basin, a discharge area of approximately 60,000 sqm (6 Ha) would be required, with a similar reserve basin for a total of 120,000 sqm (12 Ha).

Basin arrays would require more land area for berms and ancillary structures. . A 1:1 to 1.5:1 minimum allowance should be made for land area, resulting in an area of 24 to 30 Ha for Class C effluent.

However due to the need to align the basin arrays for drainage a considerably larger overall area will be needed.

(b) Length for natural discharge

For Phase 3 average flow of 2,000,000 L/dy (at average design flow). Assuming Area 2 is already in use and accounting for an average flow of 320,000 L/dy resulting in total 1,680,000 L/dy average flow.

Assuming a soil depth of 7 m with an initial water table depth of 2 m fifteen basin areas at 300 m length would need to be separated to separate drainages or separated by drainage systems, with secondary (reserve) basin areas in line with each primary.

Note that this estimate is for illustration only, groundwater flow modelling based upon a full site and soil evaluation and hydraulic testing should be used to establish system alignment. At that time a considerably shorter or a longer alignment may be necessary, and this will vary over the site.

(c) Overall size, Class C effluent

For conceptual purposes, therefore, fifteen basin arrays (15 primary and 15 reserve) at 13m wide by 300 m long (an array of smaller basins totalling that length) may be considered. Total length needed (allowing for drainage separation where basins in line in same watershed) 5000 m.

2.2.3.3 WATER WELLS

Area 3 curtailed at the north side by setbacks to water wells in the subdivision to the north of the Area (Anderson Avenue), see sketch plan. The MSR requires Class A effluent for Rapid Infiltration Basins if within 300 m of a source of water.

The site evaluation will need to determine the location and use of all water wells within 400m of the proposed discharge area(s), and the EIS will establish appropriate setbacks and other provisions for system design.

2.2.3.4 AREA CAPACITY

Assuming soils are favourable; Areas 3 and 5 may be capable of supporting maximum Phase 3 flows. However, without proper site and soil evaluation it is not possible to determine this. It is possible that further areas of favourable soils may be needed.

2.2.3.5 FORCEMAIN

Assuming phase 2 was implemented in Area 2, the worst case forcemain length for extension to the center of Area 3 would be 1.4 km length based on a conceptual location shown as Forcemain 3 on the sketch plan.

2.2.3.6 COST FOR GROUND DISCHARGE

Typical costs for a ground discharge system (without treatment or forcemains) of this sort are in the range of $60,000 to $130,000 per each of the fifteen basin arrays (with ancillary works, assuming primary and reserve basins paired), for a total of $900,000 to $1,950,000. With the use of class B effluent cost savings could be realized, at the expense of higher treatment facility costs and higher operating costs.

Other options for dispersal should also be explored after site and soil evaluation, and cost estimates prepared at that time to support decision making.

2.2.3.7 THE LAND

Area 3 occupies part of two private lots referenced on the sketch plan as Lot A (Block 179, Newcastle District, Containing 880.5 Acres More Or Less Except Part Outlined In Red On Plan 513 Rw, Except Part In Plan Vip65067 (PID 10787011)) and Lot B (Block 197, Newcastle District, Containing 360 Acres More Or Less Except Part Outlined In Red On Plan 513rw And Plan Vip65045 (PID 10787054)).

These lots are currently zoned Resource Management 1, and appear to be subject to development permit requirements for certain activities/use of certain areas.

Area 5 is within that part of Lot B north of Thames creek and south of the inland island highway, see sketch plan.

Lot A has no assessment information, Lot B is assessed at $912,000 for 356.54 Acres (144.3 Ha) or $6320/Ha.

Area 4 A is an extension of Area 3 over the lot shown as Lot C on the sketch plan. This may have some potentially usable area, but is not considered to be as favourable.

Lot C is Block 199, Newcastle District, Containing 259.5 Acres More Or Less Except Part In Plan VIP65045, PID 10787089. Lot C is currently assessed at $668,000 for 237.58 Acres (96.14 Ha) or $6948 per Ha.

Areas 4B and 4C comprise parts of Lots B, C and D. Again, these are not considered as favourable but may be necessary.

Lot D is Block 300, Newcastle District, Except That Part In Plans 513 Rw, Plan VIP60163 And VIP65045, PID 12633771. Area is 445 Acres and current assessment is $1,178,000.

Lots B,C and D are shown as fully exempt from taxation and are assumed to be in the forest land reserve; however this has not been confirmed.

(a) Obtaining land

The land may be purchased, leased or an agreement for non-exclusive use might be negotiated. As the land will continue to be usable for other purposes than discharge the total cost of the land should not be assigned to the ground discharge system.

Assuming that Areas 2, 3 and 5 are found to be suitable for phase 3 ground discharge after site and soil evaluation it would be necessary (in addition to obtaining Lot 65) to obtain and be able to use the part of Lot B north of the inland island highway and the part of Lot A north of the highway and east of Chef creek. Assuming Area 3 to be defined as shown and extended to natural boundaries or lot lines total area is approximately 62 Ha.

Area 5 would also need to be obtained. Again, assuming the use of property lines and natural boundaries a this would mean obtaining a further 44 Ha of Lot B (that part north of Thames creek and south of the inland island highway).

Overall total land area would thus be 106 Ha for Areas 3 and 5.

If further land is necessary parts of Lot C and D would need to be obtained.

Zoning and other restrictions

It is assumed that the RDN would be able to alter zoning (if necessary) and provide necessary development permits.

Any potential conflict with the forest land reserve would need to be explored, however the land would still be usable for forestry and clearly considerable areas have already been used for highway and borrow pit purposes, so it is assumed that this will be amenable to solution.

(b) Sensitive ecosystems

Lot A contains a wetland area that is the headwaters of Chef creek, and also a tributary of Thames creek. Lot B contains Thames creek (north and south of the inland island highway).

The wetland area and creek areas may be found to be the receiving areas for part of the water flowing from a discharge area. The EIS will need to consider nutrient impact on receiving waters.

(c) Water wells

The subdivision to the north of Area 3 contains a number of water supply wells for individual lots. Separation to these wells will need to be established prior to system design, and the feasibility study should include assessment of probable setback requirements for chosen discharge options.

2.2.3.8 OTHER USES OF THE LAND

The land used for discharge is not necessarily entirely alienated from other uses. The actual dispersal structures would only occupy a small percentage of the total land area.

Depending on design of the discharge system these uses could include forestry, recreation and park reserve.

3 Summary of MSR process

3.1 Feasibility study and preliminary site and soil evaluation, conceptual design

- Preliminary site evaluation, including test pits, soil logs, measuring the water table, permeability tests, surveying.
- Locate boundaries and establish preliminary setback distances, especially to water wells.
- Evaluate the overall suitability of the proposed site and soils.
- Estimate the drainfield area required versus the potential area available.
- Identify site capability, site constraints, and potential solutions for site constraints.
- Check site and soil conditions versus requirements of the Regulation.
- Develop conceptual design(s) for dispersal systems and information for related system process choices.
- System cost comparisons.

Typical time required for this study is 3 to 12 weeks, depending on the need to measure the wintertime water table.

This is the recommended next step as noted in our conclusions. In the case of the Bowser sewer system, this step would also consider collection and forcemain system location and conceptual design.

3.2 Preliminary design

Based upon choice of options from the feasibility and conceptual design stage:

- Conceptual layout drawings for the collection, treatment and dispersal systems.
- Pre-registration meeting with the Ministry.

3.2.1 Environmental Impact Study (EIS), Design Drawings, Operating Plan and other submissions

An applicant must submit the following information 90 days before the first sewage discharge:

- Registration form.
- Environmental Impact Study (EIS) for the discharge.
- EIS for the construction and operation of the treatment system, especially the treatment plant.
- Preliminary drawings for the collection, treatment, and discharge systems.
- Operating Plan, prepared by a qualified professional.

- Proof of Security or an Assurance Plan (only if privately owned and serving a residential development).
- Proof of a Capital Replacement Fund (CRF) (only if privately owned and serving a residential development).
- Any written requests for the Manager's approval (for example, approval for a raised mound drainfield, changes to required setback distances).

The EIS for a ground discharge system normally includes:

- Site evaluation with seasonal water levels and hydraulic testing
- Hydrogeology assessment
- Installation and sampling of ground water monitoring wells (pre-discharge monitoring)
- Evaluation of the effects of the sewage on health and environment
- Design drawings for the discharge works
- Confirmation that the site conditions and design meet the Regulation
- A detailed report

Typical time for the EIS: 3 to 12 months (depending on timing of seasonal monitoring). Note that part of the initial site and soil evaluation is normally used for this study.

3.2.2 Registration

- The owner registers the project with the Ministry using a standard form. This officially starts the process. Construction cannot start within 90 days (3 months) of registration.
- Within 30 days of the registration date, the owner may submit any changes to the information submitted.
- At least 30 days before construction, the owner must submit proof of Security (typically a bond), and a Capital Replacement Fund, or submit an Assurance Plan for approval (if these are required).

3.2.3 Construction

- The designers prepare final design drawings and specifications.
- The owner retains a qualified contractor to build the sewage system. For larger systems, there may be separate contractors for the collection, treatment, and discharge systems.
- The Regulation requires field reviews and quality control by the designers.
- The owner must retain the EOCP (Environmental Operators Certification Program) to classify the sewage treatment plant.

3.2.4 Commissioning and Operation

The owner must hire a certified operator. The operator, with assistance from the designers, must:

- Start the sewage system and monitor sewage flows daily.
- Start the effluent quality monitoring program, usually started 20 to 30 days after startup.
- Commission the system. The MSR allows for a commissioning period of 90 days.
- Continue the receiving environment monitoring program.
- Continue the operation, inspection, monitoring, maintenance, and repairs, as required to meet effluent quality requirements and to keep sewage flows below the maximum allowable.
- Maintain peak-day flows at less than 2.0 times average-day flows.
- Maintain records of all inspections, monitoring, schedules maintenance, and repairs.
- Submit monitoring reports to BC Environment.

Conduct periodic environmental compliance audits

Please do not hesitate to contact the undersigned for clarification.

Ian Ralston BSc PgDipAgEng ROWP (TRAX Developments Ltd.)

Attached:

Soil survey excerpts with annotated photographs

Soil map excerpt

Soil map overlay on RDN map/2007 photograph

Sketch plan (2 page)

Statement of General Conditions

Scope of this Report

This review report satisfies only those objectives stated in the introduction. TRAX Developments Ltd. (TRAX) has not conducted a Site Investigation, Hydrogeology Study or Environmental Impact Assessment.

Use of this Report

This TRAX Developments Ltd. (TRAX) report pertains only to a specific project. If the project is modified, then our client will allow us to confirm that the report is still valid. We prepared this report only for the benefit of our Client and those agencies authorized by law to regulate our Client's activities. No others may use any part of this report without our written consent. To understand the content of this report, the reader must refer to the entire, signed report. We cannot be responsible for the consequences of anyone using only a part of the report, or referring only to a draft report. This report reflects our best judgement based on information available at the time. Any use of this report, or reliance on this report, by a third party is the responsibility of that third party. We accept no responsibility for damages, if any, suffered by a third party as a result of decisions made or actions taken based on this report.

Reliance on Provided Information

TRAX has relied on the accuracy and completeness of information provided by its client (Chatwin Engineering) and by other professionals. We are not responsible for any deficiency in this document that results from a deficiency in this information.

Logs of Test Holes and Subsurface Interpretations

Ground and ground water conditions always vary across a site and vary with time. Test hole and well logs show subsurface conditions only at the locations of the test hole or well.

Descriptions of Geological Materials and Water Wells

This report includes descriptions of natural geological materials, including soil, rock, and ground water. TRAX based these descriptions on observations at the time of the study. Unless otherwise noted, we based the report's conclusions and recommendations on these observed conditions. Construction activities on the site or adjacent sites may change or alter these geological materials.

Changed Conditions

Conditions encountered by others at this site may differ significantly from what we encountered, either due to natural variability of subsurface conditions or construction activities. Our client will inform us about any such changes, and will give us an opportunity to review our recommendations. Recognizing changed soil and rock conditions, or changed well conditions, requires experience. Therefore, during construction or remediation, a ROWP or qualified professional should be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

Recommendations

We recommend that our client engage TRAX to review all design drawings and constructed works that are based on our conclusions

Risks and Liability

TRAX carries commercial general liability insurance to an amount of $2M.

TRAX and Ian Ralston do not carry insurance for errors and omissions. In all cases the liability of TRAX and/or Ian Ralston is limited to the fees charged. By accepting and using this report the client accepts that TRAX and Ian Ralston's liability are limited in this way.

BOWSER Soil Association - B

Bowser soils occur in the coast Douglas-fir subzone of the Coastal Western Hemlock Forest Zone within the Nanaimo Lowland physiographic subdivision. They have developed in shallow, sandy marine or fluvial deposits overlying silty to clayey marine deposits. Slopes are normally level to gently sloping; elevations range from sea level to about 200 m.

Bowser soils are imperfectly drained. Sandy loam or loamy sand are the usual surface textures; these change to silt loam or silty clay loam at depth. Bowser soils are mostly free of coarse fragments with the exception of minor amounts of fine gravel and occasional cobble or stone-sized fragments. The upper horizons contain abundant spherical concretions. The podzolized solum is usually about 70 cm in thickness, yellowish red to reddish brown and strongly acid. Dense, compact subsoil layers restrict perviousness to slow. Distinct to prominent mottles and gleying occur at depths below 50 cm. Relatively unweathered parent material occurs within 1 m of the soil surface. A mull layer between 1 and 5 cm thick is present on the soil surface. The usual taxonomic classification is Gleyed Humo-Ferric Podzol.

Soil Assoc. Component	Most Common Soil Classification	Drainage	Less Common Soil Classification	Drainage	Comments
B1	Gleyed Humo-Ferric Podzol	imperfect	-	-	Consists dominantly of the usual or most common soil as described above.
B2	Gleyed Humo-Ferric Podzol	imperfect	Gleyed Dystric Brunisol	imperfect	Less common soil is only weakly podzolized due to its occurrence in climatically and/or edaphically drier locations.
B4	Gleyed Humo-Ferric Podzol	imperfect	Duric Humo-Ferric Podzol	imperfect	Less common soil contains a moderately to strongly cemented subsoil layer.
B7	Gleyed Humo-Ferric Podzol	imperfect	Orthic Humic Gleysol	poor	Less common soil is poorly drained. It is equivalent to the most common soil in the Parksville soil association.

Plate 14. An example of the alder dominated vegetation growing on Bowser and other imperfectly drained soils.

Area 1
Typical ditch section on W side of lot.

Area 1
Typical ditch section on W side of lot, in area of deeper soils. Note large old D Fir stump.

DASHWOOD Soil Association - D

Dashwood soils are common throughout the coast Douglas-fir subzone of the Coastal Western Hemlock Forest Zone. They occur mainly in the Nanaimo Lowland and to a minor extent in the Alberni Basin physiographic subdivisions. They have developed in shallow, sandy gravelly fluvial, fluvioglacial and/or marine deposits. Normally less than 1 m thick and underlain by compact sandy gravelly morainal deposits. Slopes are usually less than 20%; elevations range from sea level to about 200 m.

Dashwood soils are well drained. Very gravelly loamy sand to gravelly sandy loam is the usual texture in the upper horizons; subsoils consist of gravelly sandy loam. The coarse fragment content is generally at least 40% and usually exceeds 50% by volume. The podzolized surface and subsurface horizons are usually less than 75 cm in thickness; are strong brown to brown, and medium to strongly acid. A strongly cemented duric layer is generally present at depths between 75 and 100 cm (in the upper part of the morainal material); relatively unweathered parent material is encountered at depths between 100 and 120 cm. A mor or moder layer between 1 and 4 cm thick is present on the soil surface. The usual taxonomic classification is Duric Humo-Ferric Podzol.

Soil Assoc. Component	Most Common Soil Classification	Drainage	Less Common Soil Classification	Drainage	Comments
D1	Duric Humo-Ferric Podzol	well	-	-	Consists dominantly of the usual or most common soil as described above.
D2	Duric Humo-Ferric Podzol	well	Duric Dystric Brunisol	well	Less common soil is only weakly podzolized due to its occurrence in climatically and/or edaphically drier locations.
D4	Duric Humo-Ferric Podzol	well	Orstein Humo-Ferric Podzol	well	Less common soil contains orstein cementing in the upper B horizons.
D7	Orthic Humo-Ferric Podzol	well	Duric Humo-Ferric Podzol	well	Soils without strongly cemented layers form a major part of the soil component.


Area 2
Upper bank of borrow pit showing vgr mS soil
Soil Dashwoood 7 or Hawarth 7 (appears without the cemented layer typical in Dashwood soils).


Area 2
Cutbank area.
Dashwood 7 or Hawarth 7 soil, no clear evidence of cemented or firm layer,
Note heavier understory in this area and slightly different forest composition, which may have led to interpretation of this area as different from air photos.
Depth of about 5m, no sign of water table.
Soils gr and vgr mS with finer surficial layers.
Note white pine in foreground has been planted.

Plate 19. Shallow, sandy gravelly fluvial deposits overlying moraine (till) typifes the parent material of Dashwood and Dashwood Creek Soil Associations.

HAWARTH Soil Association - HA

Hawarth soils are common throughout the coast Douglas-fir subzone of the Coastal Western Hemlock Forest Zone. They occur mainly in the Nanaimo Lowland and Alberni Basin physiographic subdivisions and on the floor of low elevation valleys in the Vancouver Island Ranges. They have developed in deep, sandy gravelly fluvial, fluvioglacial and/or marine deposits. Slopes are usually less than 5%; elevations range from sea level to about 700 m.

Hawarth soils are rapidly drained. Very gravelly to gravelly loamy sand is the usual texture in the upper horizons; subsoils consist of very gravelly sand. The coarse fragment content is generally at least 35% and usually exceeds 50% by volume. The podzolized surface and subsurface horizons are usually less than 60 cm in thickness, reddish-brown to strong brown, and strongly acid. A strongly cemented duric layer is generally present at depths between 50 and 90 cm; relatively unweathered parent material is encountered at depths between 1.5 and 2 m. A mor layer between 2 and 5 cm thick is present on the soil surface. The usual taxonomic classification is Duric Humo-Ferric Podzol.

Soil Assoc. Component	Most Common Soil Classification	Most Common Soil Drainage	Less Common Soil Classification	Less Common Soil Drainage	Comments
HA1	Duric Humo-Ferric Podzol	rapid	-	-	Consists dominantly of the usual or most common soil as described above.
HA2	Duric Humo-Ferric Podzol	rapid	Duric Dystric Brunisol	rapid	Less common soil is only weakly podzolized due to its occurrence in climatically and/or edaphically drier locations. It is equivalent to the most common soil in the Qualicum soil association.
HA4	Duric Humo-Ferric Podzol	rapid	Ortstein Humo-Ferric Podzol	rapid	Less common soil contains a podzolized, reddish-brown cemented layer in the upper solum.
HA5	Duric Humo-Ferric Podzol	rapid	Duric Humo-Ferric Podzol: shallow lithic phase	rapid	Less common soil is between 50 and 100 cm thick over bedrock.
HA7	Orthic Humo-Ferric Podzol	rapid	Ortstein Humo-Ferric Podzol	rapid	Soils without strongly cemented horizons are most common.

HAWARTH Soil Association - HA (Continued)

Soil Assoc. Component	Most Common Soil Classification	Most Common Soil Drainage	Less Common Soil Classification	Less Common Soil Drainage	Comments
HA8	Orthic Humo-Ferric Podzol	rapid	Orthic Regosol	rapid	Strongly cemented horzions are not present. Less common soil is very weakly developed and usually occurs on recently deposited alluvium.

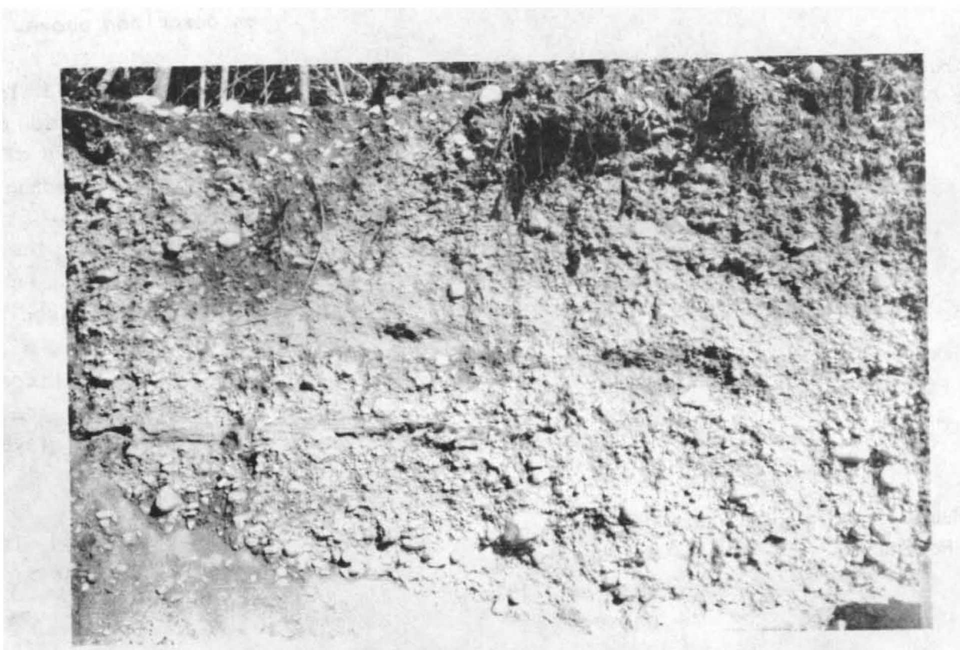
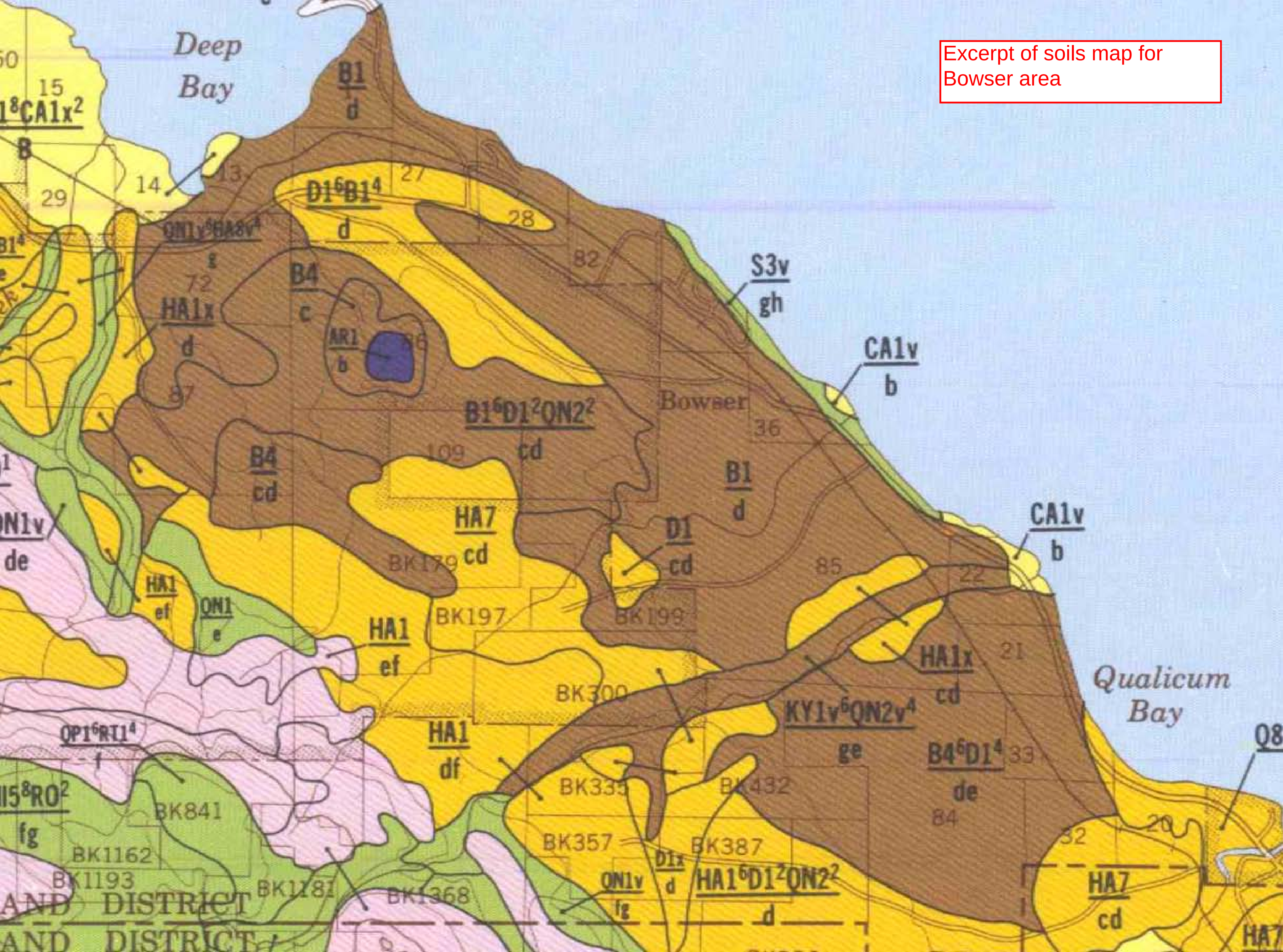


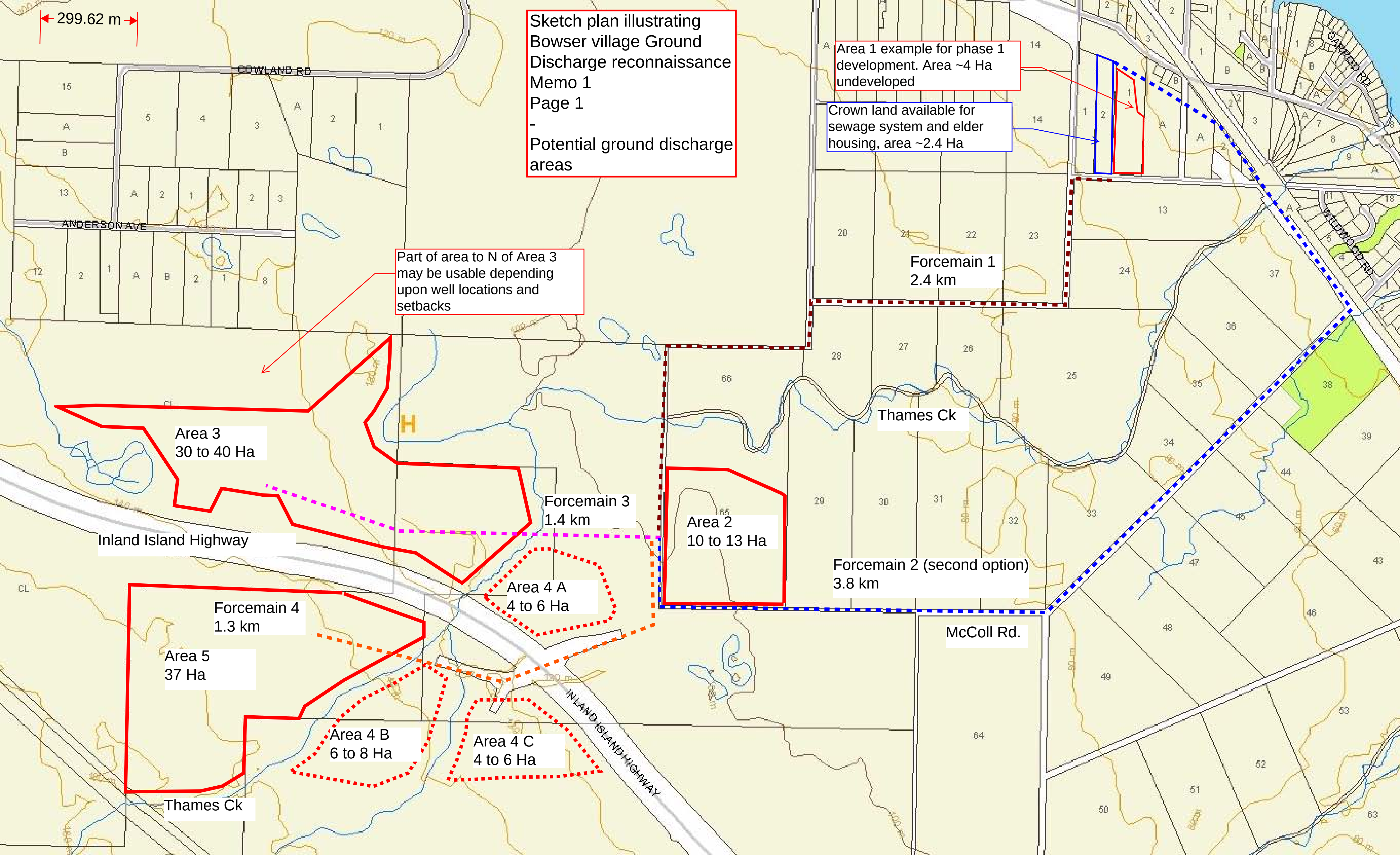
Plate 20. Hawarth, Honeymoon and Qualicum are common soil associations developed on deep, coarse textured fluvial, fluvioglacial or marine deposits.


Area 3
Borrow pit at inland highway.
Shows depth to seasonal water table of up to 5m.
No evidence of cemented horizons showing in banks.
Soil Hawarth 7

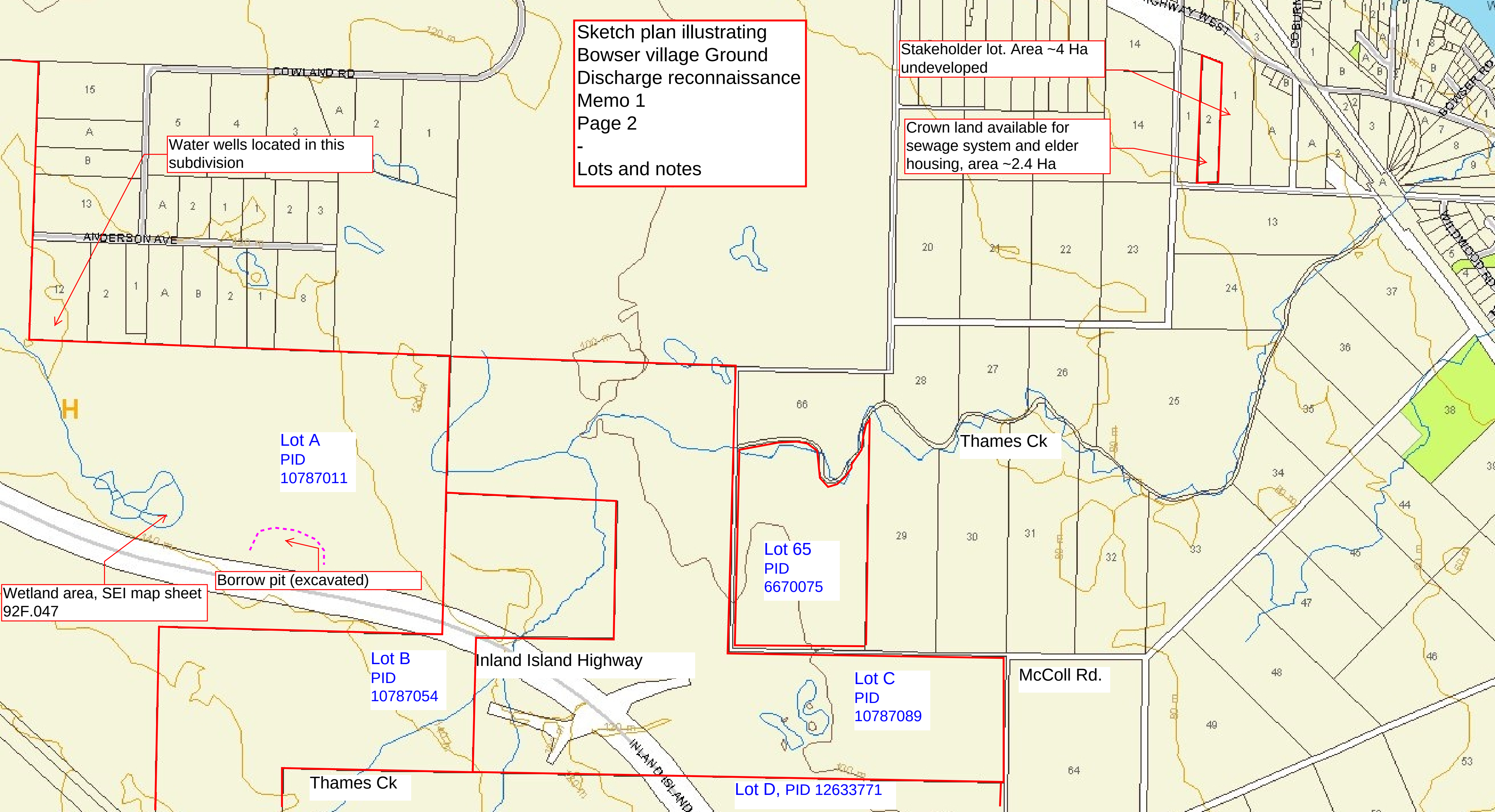


Excerpt of soils map for Bowser area

Soil map overlay on RDN map with 2007 orthophoto. Note that overlay is not accurately georeferenced.



299.62 m
Sketch plan illustrating Bowser village Ground Discharge reconnaissance Memo 1 Page 1 - Potential ground discharge areas
Area 1 example for phase 1 development. Area ~4 Ha undeveloped
Crown land available for sewage system and elder housing, area ~2.4 Ha
Part of area to N of Area 3 may be usable depending upon well locations and setbacks
COWLAND RD
ANDERSON AVE
Forcemain 1
2.4 km
Thames Ck
Area 3
30 to 40 Ha
Forcemain 3
1.4 km
Area 2
10 to 13 Ha
Inland Island Highway
Forcemain 2 (second option)
3.8 km
Area 4 A
4 to 6 Ha
Forcemain 4
1.3 km
McColl Rd.
Area 5
37 Ha
Area 4 B
6 to 8 Ha
Area 4 C
4 to 6 Ha
INLAND ISLAND HIGHWAY
Thames Ck



Sketch plan illustrating
Bowser village Ground
Discharge reconnaissance
Memo 1
Page 2
-
Lots and notes
Stakeholder lot. Area ~4 Ha
undeveloped
Crown land available for
sewage system and elder
housing, area ~2.4 Ha
Water wells located in this
subdivision
COWLAND RD
ANDERSON AVE
Lot A
PID
10787011
Borrow pit (excavated)
Wetland area, SEI map sheet
92F.047
Lot B
PID
10787054
Inland Island Highway
INLAND ISLAND
Lot 65
PID
6670075
Thames Ck
Lot C
PID
10787089
McColl Rd.
Thames Ck
Lot D, PID 12633771

Appendix 2

Photos from Site Visit taken by:
Chatwin Engineering Ltd
February 15, 2011

Nile Creek Bridge (Looking Southwards)

BC Hydro Substation and Power Cables (Looking Inland from Shoreline)

Ditch along proposed Treatment Plant site (Looking Southwards).
Treatment Plant site is to the right.

Gravel road along McColl road towards Ground Disposal Area-2
(heading West towards Inland Island Highway)

Thames Creek Crossing (Looking Northwards)

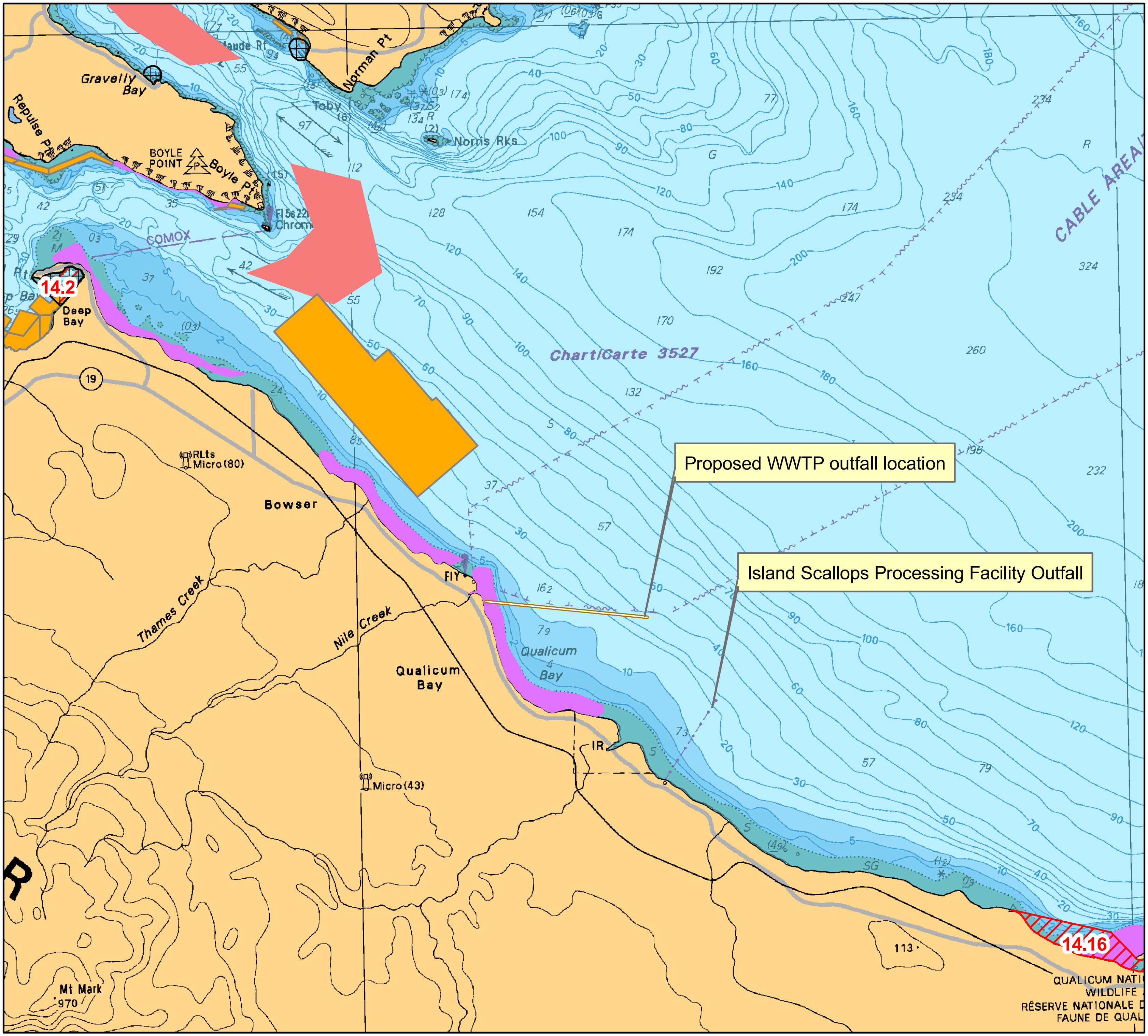
Thames Creek Crossing (Looking Southwards)

Shoreline adjacent to BC Hydro Stations (Looking Southwards)

BC Hydro Marine Cable ROW

Appendix 3

Marine Water Quality Monitoring Figure



Marine Water Quality Monitoring
Monitoring de la qualité des eaux marines

Proposed outfall location at Bowser Feb22, 2011

Legend

- Prohibited Areas
- Conditionally Approved
- Conditionally Restricted
- Restricted
- Shellfish Leases
- Clam Resources
- Oyster Resources
- Current Scallop Fishery

Projection: BC Albers Standard
Data Sources:
Basemap - © Canadian Hydrographic Service
Not For Navigation