INFRASTRUCTURE SERVICES COMMITTEE

Thursday, October 19, 2017
SCRD Boardroom, 1975 Field Road, Sechelt, B.C.

AGENDA

CALL TO ORDER: 9:30 a.m.

AGENDA

1. Adoption of Agenda

PETITIONS AND DELEGATIONS

2. Groundwater Investigation — Presentation
Delegation - Darren David, Waterline Resources Inc.

REPORTS

3. Manager, Utility Services – Special Projects — Annex A
Groundwater Investigation to Supplement Chapman Creek Water Supply — pp 1 – 79
(Voting – A, B, D, E, F, Sechelt)

4. 2017-Q3 Quarterly Report – Infrastructure — Annex B
(Voting – All) — pp 80 – 90

COMMUNICATIONS

NEW BUSINESS

IN CAMERA

ADJOURNMENT

**The Great British Columbia Shake Out is taking place at 10:19 a.m. The SCRD Board and Staff will be participating.*

SUNSHINE COAST REGIONAL DISTRICT STAFF REPORT

TO: Infrastructure Services Committee – October 19, 2017

AUTHOR: Dave Crosby, Manager Utility Services – Special Projects

SUBJECT: **GROUNDWATER INVESTIGATION TO SUPPLEMENT CHAPMAN CREEK WATER SUPPLY**

RECOMMENDATION(S)

THAT the report titled Groundwater Investigation to Supplement Chapman Creek Water Supply be received;

AND THAT recommendations from the Groundwater Investigation to Supplement Chapman Creek Water Supply Report be brought forward to the 2018 Budget process.

BACKGROUND

The Groundwater Investigation project was included in the 2013 Comprehensive Regional Water Plan in order to identify possible groundwater sites that could supplement the Chapman Creek water supply. The following recommendation was put forth at the July 8, 2016 Corporate and Administrative Services Committee Meeting:

> ***Recommendation No. 4*** *Stage 1 Groundwater Investigation Scope of Work*
>
> *The Corporate and Administrative Services committee recommended that staff report to the September 2016 Infrastructure Services Committee meeting regarding the draft scope of work for the Stage 1 Groundwater Investigation project Request for Proposals.*

The following resolution was adopted at the Regular Board meeting of September 22, 2016:

381/16

> ***Recommendation No. 3*** *Groundwater Investigation Scope of Work*
>
> *THAT the report titled "Regional Water Groundwater Investigation Scope of Work" be received for information.*

On December 15, 2016 the Regional District awarded Contract No. 16 272 to Waterline Resources Inc. to provide hydrogeological services and subsequent report pertaining to the Groundwater Investigation study. Staff have provided regular updates to the Committee through the Budget Project Status Report and Department Quarterly Reports.

DISCUSSION

Stage 1 of the Groundwater Investigation study consisted of a hydrogeological desktop study to identify aquifers contained within the Chapman Creek Water Service area. The desktop study was supplemented by site inspections. The purpose of the Stage 1 investigation was to identify the most promising aquifer(s) to pursue with test drilling in Stage 2 of the investigation.

A Stage 1 decision matrix was developed to provide rankings for each site identified as having possible groundwater potential. The matrix is based on the following criteria:

- hydrogeological feasibility
- community need
- infrastructure requirements and costs
- land tenure
- water quality
- stakeholder concerns
- environmental impacts; and
- regulatory requirements.

Twelve potential well locations were examined. The final site rankings identified four focus areas and indicates at least one preferred drilling site in each area as follows:

- Elphinstone (West of Town of Gibsons boundary): Site 1d on Mahan Road;
- Chapman/Sechelt: Site 2b located adjacent to the District of Sechelt Operations Yard on Dusty Road;
- Gray Creek: Site 3 located on Sechelt Inlet Road near the parking area south of the Gray Creek Bridge; and,
- Soames/Granthams: Site 4; next to the Soames Point Reservoir.

Waterline Resources Inc. will be presenting their findings to the Infrastructure Services Committee at the October 19, 2017 meeting. SCRD Staff have provided this report as information to the appropriate staff at the other Sunshine Coast local governments.

Aligned with this project, Staff have and will continue to coordinate internally with other departments to identify opportunities for groundwater to serve SCRD services such as recreation facilities and parks.

Financial Implications

The estimated cost to move forward with Stage 2 of the Groundwater Investigation study, which includes drilling and well installation at four sites, hydrogeological support during the field work, 48 hour pump testing, water quality testing and a technical report is $325,000.

STRATEGIC PLAN AND RELATED POLICIES

The Groundwater Investigation to Supplement Chapman Creek Water Supply directly links to the set of values identified in the Strategic Plan.

More specifically, the Groundwater Investigation aligns with the following Strategic Priorities:

> Strategic Priority: Enhance Collaboration with shíshálh and Skwxwu7mesh Nations by respecting their review/comment process and their rights.
>
> Strategic Priority: Embed Environmental Leadership through the responsible management of the regions' water supply.

The Comprehensive Regional Water Plan recommends to undertake a groundwater investigation (CRWP, p. 8-12).

CONCLUSION

The Groundwater Investigation study has identified 12 locations to be examined for potential groundwater production, of which four sites have been recommended by the Consultant based on the decision matrix that will require test drilling, water quality and yield testing and final assessment.

Staff will prepare a Budget Proposal for consideration to the 2018 Budget as described in the Groundwater Investigation Study.

Attachment: Report on Groundwater Investigation to Supplement Chapman Creek Water Supply Project No. 16-272 (Waterline)

Reviewed by:			
Manager	X- D. Crosby	Finance	
GM	X- M. Day	Legislative	
CAO	X- J. Loveys	Other	

REPORT ON GROUNDWATER INVESTIGATION TO SUPPLEMENT CHAPMAN CREEK WATER SUPPLY (SCRD Project N0.16-272)

Submitted to:

Sunshine Coast Regional District
1975 Field Road
Sechelt, British Columbia
V0N 3A1

Submitted by:

Waterline Resources Inc.
Nanaimo, British Columbia
October 10, 2017
2746-16-001

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1.0 INTRODUCTION AND BACKGROUND

The Chapman regional water distribution network relies primarily on surface water from Chapman Creek to service its residents. Waterline Resources Ltd. (Waterline) understands that the Chapman Creek water treatment plant is equipped to process 24.5 million liters a day, while the Selma No. 2 reservoir has the capacity of just over 15 million liters. There are 11 storage reservoirs in use by the SCRD, located in Electoral areas B, D, E, F, and the District of Sechelt (Figure 1). Chapman Creek provides approximately 98% of the water which is consumed by residents throughout the Chapman Creek System. The system is reliant on sufficient precipitation during the spring, summer and fall months to maintain usable water levels in Chapman Creek. Recent inconsistent amounts of precipitation have caused the SCRD to investigate the feasibility of supplementing the Chapman Creek water supply with a reliable source of groundwater.

In order to secure a reliable long-term source of safe groundwater, the SCRD is seeking to identify the location(s) and relevant parameters of any aquifers in the vicinity of the Chapman Water System. The suitability of aquifers for use as drinking water supply is dependent on location relative to the service area infrastructure, anticipated yield, water quality, infrastructure costs and maintenance/operations costs, and environmental impacts of groundwater extraction, including potential impacts on nearby surface water. A Phase 1 desk-top study was commissioned by the SCRD in December 2016. Waterline was selected to complete the work.

1.1 Objectives

The objective of the desktop-based study is to identify the most promising aquifer(s) with in the SCRD to pursue as drilling targets in Stage 2 of the overall SCRD project. For an aquifer to be deemed suitable for use as a long-term water supply, it must have a high enough yield and be of good water quality. In consultation with Vancouver Coastal Health Authority (VCHA), the water quality will determine whether treatment prior to consumption is required.

1.2 Scope of Work

Waterline developed a scope of work to meet the SCRD objectives. The following tasks were completed during the study:

- Project kick-off meeting;
- Public data review and integration with site specific data provided by SCRD;
- Conceptual hydrogeological model development of SCRD aquifers;
- Progress report and selection of up to 12 preliminary aquifer target areas;
- Assessment of environmental impact and regulatory implications;
- Field reconnaissance visit of preliminary aquifer targets;
- Assessment of Class 3 drilling and testing cost;
- Development of decision matrix and selection of 4 highest ranking aquifer targets; and,
- Draft/final report.

The project was awarded to Waterline in early December 2016 and work commenced at the end of January 2017. The project milestone completion dates are provided in Table 1.

Table 1: Summary of Project Milestones and Completion Dates

Project Milestone	Completion Date
Project Awarded to Waterline	December, 2016
WebEx kick off meeting	January 27th
Progress memo on conceptual hydrogeological model and site selections	February 20th
Field visit of preliminary 3 selected aquifers (10 drill sites)	March 27th
Issue 2nd progress memo with final site selection decision matrix	April 20th
Review well head protection plan Chaster; Soames, and Granthams Wells	May 10th
WebEx to present decision matrix and select 3 final aquifer areas	May 24th
Waterline provides a high level Phase 2 drilling cost for review by SCRD	May 29th
SCRD collecting test data for Chaster, Soames, and Granthams wells	June-August
SCRD provides test data for Chaster, Soames, and Granthams wells	August 30th
SCRD provides water quality data on Sechelt gravel pit wells	September 11th
Waterline issues draft report	September 20th
SCRD Provides comments and edits	October 5th
Final Report	October 10th

2.0 METHODOLOGY

2.1 Project Kick-off Meeting

The SCRD and Waterline completed the project kick-off meeting on January 27, 2017. The key project team members included:

- Trevor Rutley, SCRD, Engineering Technician – primary contact for Waterline
- Dave Crosby, SCRD, Manager of Utility Services, Special Projects
- Lynda Fyfe, SCRD, Environmental Technician
- Darren David, Waterline, Principal Hydrogeologist
- Dalton Pajak, Waterline, Intermediate Hydrogeologist

The meeting was conducted over WebEx. Waterline completed a preliminary review of the publically available groundwater information in order to clearly identify SCRD's study area of interest, establish a list of SCRD data required by Waterline, and discuss the project schedule.

2.2 Data Compilation and Conceptual Aquifer Model

Waterline completed a review of publically available data including geological reports, water well records, physiography data, and lithology reports. In addition, the following site-specific data was incorporated into our geodatabase:

- Comprehensive Regional Water Plan (OPUS Dayton Knight, 2013),
- Technical Memorandum No. 4 (Section 8.2.3). (Dayton & Knight, 2007), and
- Wellhead Protection Plans (Associated Environment, 2017).

The following GIS shapefiles were provided to Waterline by SCRD:

1. Land Parcel Data;
2. Easements, right-of-way's;
3. Water infrastructure data layers, including: water mains, intakes, dams/reservoirs, chlorination stations, pump stations, hydrants, service connections, pipelines;
4. High resolution Digital Elevation Data (DEM); and
5. Water monitoring sites (surface water, soil, or groundwater) and associated water quality data.

The site specific data used to build the conceptual aquifer model included available well logs, historical pumping test results, aquifer mapping and capture zones, well head protection information, long-term groundwater level monitoring, water quality data, and groundwater-surface water interactions.

2.3 Preliminary Site Selection for Groundwater Supply Development

Waterline's goal was to process the relevant information, identify the development potential of target aquifers within the SCRD and provide suitable drilling locations in consultation with the SCRD team. The preliminary site selection for groundwater supply was predominantly based on aquifer mapping data and a technical feasibility assessment focused on water quantity (aquifer capacity) and quality. This exercise resulted in a "shortlist" of four focus areas and 12 possible drilling sites.

2.4 Field Reconnaissance of Proposed Stage 2 Drilling Locations

Following desktop assessment, Waterline conducted a field visit with SCRD staff to confirm preliminary aquifer target locations. The intent of the field reconnaissance visit was to assess drilling locations in terms if site accessibility and local infrastructure.

2.5 Assessment of Environmental Impacts and New Regulatory Requirements

As part of the project, Waterline also considered potential environmental impacts and regulatory approval requirements related to the drilling, installation and operation of a well in each target aquifer. For example, shallow sand and gravel aquifers in the coastal environment tend to be unconfined and thus may have limited protection from surface activities such as potential contaminants discharges (i.e., spills) that may adversely affect water quality. Aquifers located near the coast may also be vulnerable to salt water intrusion and climate change affects related sea level rise which must be considered in the analysis (Government of Canada, 2008; Ferguson and Gleeson, 2012).

As of February 29, 2016, British Columbia's new Water Sustainability Act (WSA) requires that Municipal groundwater users licence water supply wells. The Groundwater Licence Application requirements include information regarding water works infrastructure and hydrogeological setting, such as; aquifer description, well details, estimated yield, etc. Waterline considered application requirements for submission to the BC Ministry of Forests, Lands and Natural Resource Operations (FLNRO) as part of the current project. Some regulatory risks exist depending on the volume of groundwater extracted, proximity to other wells, and hydraulic communication to surface. These factors were considered in the final selection of the preferred sites.

2.6 Development of Decision Matrix for Site Selection

Following our site visit, Waterline developed an evaluation matrix to compare and rank the 12 preliminary target aquifer locations and select four drilling/testing sites. The following site selection criteria were considered in the evaluation:

- **Hydrogeological Feasibility:** Existence of an aquifer and likelihood of drilling a successful test well. For the purposes of this study, a successful test well is defined as a well that can produce more than 545 cubic metres per day (m^3/d), equivalent to approximately 100 US gallons per minute (US gpm);
- **Community Need:** The number of potential connections that could be replaced to lessen the stress on the Chapman water system;
- **Infrastructure Requirements and Costs:** Well drilling and testing, water main tie-in, and water treatment requirements;
- **Land Tenure:** SCRD owned, crown land, or private land;
- **Water Quality:** Deep groundwater, bedrock fed, hydraulic connection to surface, presence of arsenic, salt water intrusion;
- **Stakeholder Concerns:** Proximity to other water wells (E.g.: Town of Gibsons, First Nations);
- **Environmental Impacts and Regulatory Requirements:** Regulatory constraints (e.g.: Environmental Assessment Act (EAA) trigger for a "reviewable project" involving diversions of >75 L/s, and possible Environmental Assessment requirement), Groundwater Licence Application requirements, environmental impacts, and VCHA requirements.

Although community needs were considered in the initial evaluation, it was determined that any water added to the Chapman system reduced the overall stress to all communities. Therefore this criteria was not considered in the final evaluation. As all preferred sites were located on crown or SCRD lands, the land tenure criteria became less important and was also not considered in the final evaluation.

Data collected by the SCRD from water supply wells at Chaster Creek, Soames, Granthams and Langdale was used to assess the potential additional capacity of the aquifer in those respective areas. As the intent of the present study was to identify new aquifer exploration targets rather than determining if existing supply wells could provide more capacity, the SCRD wells were not included in the final ranking.

Many groundwater supply options were identified, however; some were eliminated quickly based on technical feasibility, distance to existing SCRD infrastructure, or water quality issues. For instance, bedrock aquifers were eliminated in the current study due to the generally lower productivity and poor water quality related to the presence of arsenic.

Qualitative screening of aquifer options was completed in consultation with the SCRD by ranking each parameter according to its relative importance to the project and assigning a numeric value or score. The final ranking of the various groundwater supply options was determined based on the final cumulative score by multiplying individual scores for each of the selection criteria to provide a final score. This semi-quantitative ranking assessment helped the project team further narrow down the 12 preliminary drilling targets to select the four most promising drilling locations.

2.7 High-Level Infrastructure Costs

In terms of estimating costs, a Class 3 cost estimate was developed by Waterline for drilling and testing of four preferred target locations. Waterline did not provide a detailed cost assessment to tie-in to the SCRD Chapman water system because any costs relating to pump infrastructure, water treatment requirements, life-cycle operations and maintenance will entirely depend on the well capacity and groundwater quality. As this cannot be determine before a water well is drilled and tested, there was no point in attempting to develop “hypothetical” costs at this early stage.

As all target locations are relatively close to an existing distribution line, we have assumed that the capital costs for tie-in to the SCRD Chapman water system and chlorination will be equal at all sites. Given our knowledge of the groundwater in the area we believe that groundwater sources exist that may not require any treatment beyond secondary disinfection. This will require approval by VCHA.

2.8 Reporting

Reporting on this project has been completed at various stages/milestones which are detailed in Table 1. This includes a progress memo and WebEx meeting to present major project components including our conceptual hydrogeological model, selection of preliminary groundwater exploration sites, decision matrix, a draft report, and the enclosed final report. In addition, Waterline will complete a Power Point Presentation at the SCRD office in Sechelt on October 19, 2017.

3.0 RESULTS AND DISCUSSION

3.1 Study Area

Figure 1 shows the Chapman water distribution network. A small portion (approximately 2%) of the water servicing the SCRD is obtained from groundwater. The majority of groundwater development is along the Sunshine Coast Highway extending from Langdale to Secret Cove. Based on discussions with SCRD staff, the area between Secret Cove and Langdale was defined as the regional study area (RSA) for the groundwater exploration project (Figure 1).

3.2 Conceptual Hydrogeological Model

3.2.1 Overview of Watersheds and Aquifers

Review of the hydrogeological information and development of a conceptual hydrogeological model for the entire SCRD was a highly complex task. There are over 60 watersheds in the southern part of the SCRD, 14 mapped bedrock aquifers, 9 mapped overburden aquifers, and 1385 water wells within the entire SCRD boundary (BC MOE, 2017 BC MOE, 2017). As the majority of land development is along the coast, much of the available information regarding groundwater and surface water is also found near the coast.

3.2.2 Quaternary Geology and Mapped Aquifers

The landscape and landforms observed across the Sunshine Coast are the result of glacial and interglacial processes operating during the last 50,000 years. The latest and largest glaciation ia known as the Fraser Glaciation which started approximately 29,000 years before present (BP) due to a deteriorating (colder) climate. In southwestern BC, mountain glaciers formed between 19,000 and 30,000 BP before they advanced, coalesced, and thickened to create the maximum extent of the ice sheet that covered Georgia Strait nearly 15,000 BP. At this time, the ice surface was at about 2,300 metres above sea level (mASL) and towered over 1,000 m above the present-day peak of Mt. Elphinstone near the Town of Gibsons. After about 14,500 BP, the regional climate began to warm, causing ice to melt and glaciers to retreat over the next 5,000 years (Clague, 1977).

Quaternary sediments up to 300 m thick underlay the lowlands bordering the Strait of Georgia. Throughout this region, sediments were deposited during the glacial advance and retreat during older glacial and intervening interglacial cycles. Loading and unloading of the ice sheet caused significant land rebound and sea level fluctuations. Along the Strait of Georgia, sea level rose to almost 200 m above present-day sea level, leaving behind various marine deposits (eg: Capilano Sediments) across the Sunshine Coast at elevations up to 180 mASL (McCammon, 1977).

Figure 2 shows the mapped overburden (Quaternary) aquifers within the RSA. Water wells contained in the BC Water Well database are also plotted and sorted by aquifer material at the well screen. The yellow dots are wells completed in unconsolidated sands and gravels and pink dots shows wells completed in bedrock. Where aquifers were not previously mapped, Waterline

was able to supplement the data using the BC Terrain Mapping data (Clague et al., 1977) and geology/hydrogeology data provided in water well records as shown on Figure 3. Water wells were sorted and plotted by groundwater yield at the time of drilling. As can be seen on Figure 3, there are several areas across the SCRD with high yielding wells (red dots). Well records indicate all of the high yielding wells are completed in deep sand and gravel aquifers that are the primary groundwater supply targets for this study.

3.2.3 Bedrock Geology and Mapped Aquifers

Figure 4 shows the bedrock geology mapped by the BC Geological Survey (Cui et.al. 2015) across the SCRD. Water wells are also shown sorted by aquifer material occurring at the well screen. Granitic intrusions of quartz-diorite and granodiorite underlie most of the study area. The granite bedrock extends to the northeastern most part of the Town of Gibsons where it forms a sharp contact with Bowen Island Group bedrock. The Bowen Island Group is an assemblage metamorphic sedimentary and meta-volcanic rocks described as strongly foliated, fine-grained, and interbedded with green chlorite schist (Monger and Journeay, 1994; Friedman et al., 1990). Local bedrock exposures appear as pale gray, white and green fine-grained schistose meta-volcanic rock. Bedrock assemblages transition from volcanic-rich in the southeast near Bowen and Gambier Islands, to sedimentary-dominated towards the northwest near the Town of Gibsons.

Figure 5 shows the bedrock aquifers mapped between Langdale and Secret Cove (BC MOE, 2017a) along with water wells sorted by aquifer material at the screen. These bedrock aquifers are primarily developed in areas where overburden sediments were not sufficiently permeable for groundwater supply development.

Due to the generally lower permeability of bedrock and poor water quality resulting from the presence of arsenic, it was decided that bedrock aquifers would not be considered further for this project.

3.3 Preliminary Assessment of Aquifer Sites

Several areas were quickly eliminated based on groundwater potential, water quality concerns, and engineering factors. These areas are summarized below in Table 2.

Table 2: Preliminary Assessment - Areas Eliminated from Further Investigation

Area	Hydrogeological Summary	SCRD Input	Preliminary Conclusions
Langdale (**Figures 2 & 5**)	o Unconsolidated sand and gravel aquifer (BC Aquifer 552) o High producing, moderate demand and moderate vulnerability o Relatively small mapped aquifer area bounded to north and south by till and bedrock o Static groundwater levels close to surface (lots of available head)	o Low to moderate demand for water. Reduced water usage by 50% in 2010 due to replacement of the Langdale reservoir. o No water quality or quantity issues in the past.	o Aquifer may have additional capacity beyond current use. o May be considered for future development
Roberts Creek, Wakefield Creek, Sargeant Bay, Halfmoon Bay (**Figures 2 & 5**)	o Fractured bedrock (granite) aquifers (BC aquifers 555, 562, 972 and 558) o Low to moderate productivity o Localized water quality issues related to arsenic	o Would like to avoid bedrock aquifers due to elevated arsenic and other metals	o No further assessment required
	o Unconsolidated sand and gravel aquifers (BC aquifers 557 and 563) o Moderate productivity	o May be considered for future development	o No further assessment required

The Langdale area aquifer (mapped Aquifer 552, Figure 2) appears to have some additional capacity for development. However, due to the apparently smaller size of the aquifer, a decision was made to focus on other potentially larger unexplored aquifers. Bedrock aquifers mapped at Roberts Creek, Wakefield Creek, Sargeant Bay, and Halfmoon Bay (Figure 5) were all eliminated at this time for further investigation due to the generally lower expected yield and possible water quality issues related to arsenic. Unconsolidated sand and gravel aquifers in these area (BC aquifers 557 and 563, Figure 2) were also eliminated at this time based on low to moderate well yield but could be reconsidered in the future (Figure 3).

Based on the available hydrogeological information and SCRD's current requirements, four primary areas of interest emerged from Waterline's preliminary assessment:

1. Electoral Area E: Seven possible exploration drilling sites were identified west of the Town boundary and are shown on Figure 6 (Labelled 1a to 1f);
2. Chapman Creek/Sechelt – Three possible exploration drilling site were identified and are shown on Figure 7 (Labelled 2 a to 2c);
3. Gray Creek – One drilling site was selected and is shown on Figure 8; and
4. Soames/Granthams - One drilling site was selected and is shown on Figure 9.

The results of Waterline's evaluation are summarized in Table 3.

Table 3: Areas of Interest - Require Further Evaluation

Area	Hydrogeological Summary	SCRD Input	Preliminary Conclusions
Electoral Area E (Chaster and Mahan Road) (**Figure 6**)	o Extensive mapping information available including long-term monitoring data o Gibsons aquifer consists of a deep, unconsolidated sand which is confined by low permeable till o Moderate to high productivity, low vulnerability o Static groundwater levels are deep in upland area (less available head) and flowing artesian conditions exists in Lower Gibsons.	o Chaster well is only used in the summer o No water quality or quantity issues in the past o SCRD Frank West Firehall property is a potential drilling location o Mahan Road is another potential area for drilling	o Aquifer has capacity for additional well(s) o Need to coordinate efforts with Town of Gibsons o SCRD Chaster well may have additional capacity for year around pumping o Based on Gibsons Aquifer mapping data collected by Waterline, the Firehall property is located in an area of the aquifer that is thin or non-existent (Waterline 2013, Doyle 2013)) o Several targets along Mahan Road have been identified as high priority targets based on aquifer mapping data (1a to1d)
Chapman Creek / Sechelt (**Figure 7**)	o Large Chapman Creek watershed o High producing well at the gravel pit o No mapped aquifers and limited well data	o Unlined landfill located on the edge of Chapman Creek watershed, potentially upgradient of well locations	o Limited available information; point source geophysics and/or test well drilling is an option at select locations o Three potential target locations have been identified and further evaluation is needed to select one preferred location. o Groundwater monitoring data at landfill indicates flow is north and away from Chapman Creek Watershed. More data would be required to confirm.
Gray Creek (**Figure 8**)	o Large watershed for recharge o Several high producing wells (tested at 2700 m^3/d [500 GPM]) owned by Aquarius Sea Farms completed in a sand and gravel aquifer o Lower elevation, proximate to coastline, need to be aware of potential for salt water intrusion	o SCRD water mains run along Sechelt Inlet road at this location o SCRD would support groundwater supply in this area	o The sand and gravel aquifer is highly productive at the existing well locations o The Gray Creek aquifer(unmapped) is considered a potential target
Soames /Granthams (**Figure 9**)	o Unconsolidated aquifer mapped in this area o Artesian conditions	o Concerned with age and construction of Soames and Granthams wells	o A new replacement well may be required in the productive sand and gravel aquifer

Following the desktop assessment a field reconnaissance was required to verify the information and confirm site access for the stage 2 drilling program. A summary of the field work is provided below.

3.4 Field Visit of Proposed Focus Areas

The four focus areas and 12 proposed drilling sites were visited by Waterline and SCRD staff during the field reconnaissance visit on March 27th, 2017. Each site was evaluated to determine site characteristics, accessibility for drilling and testing, and proximity to existing SCRD water infrastructure. The location of possible drilling sites are plotted on Figures 6 through 9, inclusive. The following photos taken by Waterline during our field visit are provided in Appendix A.

Photo 1: Test Drilling Site 1a on Mahan Road
Photo 2: Test Drilling Site 1b on Mahan Road
Photo 3: Test Drilling Site 1e on Reed Road
Photo 4: Looking North at Test Drilling Site 1d on Mahan Road
Photo 5: SCRD Chaster Road Well
Photo 6: Frank West Firehall Rear Parking lot (Test Drilling Site 1f)
Photo 7: Chapman Creek Treatment Plant Site
Photo 8: Chapman Creek Booster Pump Station (Test Drilling Site 2a)
Photo 9: District of Sechelt Operations Yard (Test Drilling Site 2b)
Photo 10: Old Chapman Cr Reservoir (Test Drilling Site 2c)
Photo 11: Gray Creek Test Drilling Site #3 (Looking North)
Photo 12: Gray Creek Test Drilling Site #3 (Looking South)
Photo 13: Gray Creek Bridge with SCRD water line
Photo 14: Gray Creek flow (March 27, 2017)
Photo 15: Soames Reservoir (Test Drilling Site #4 Location)
Photo 16: Soames Well at the centre of the road access
Photo 17: Granthams Well Access Road
Photo 18: Granthams Wellhead in Soames Creek Valley
Photo 19: Granthams Well - Artesian Flow By-Pass

3.5 Capacity Assessment of Chaster Road, Soames, and Granthams Wells

As part of the analysis, Waterline reviewed historic water level and flow data provided by the SCRD. In addition, in June 2017 SCRD staff conducted additional tests in these wells to assess current well performance. Table 4 summarizes the well test data provided by the SCRD and Waterline's evaluation of the data.

Table 4: Summary of Well Performance Data – Chaster, Soames, and Granthams Supply Wells

Supply Well (screen depth in m)	Test Date Range	Static Water Level Range (mbtoc)	Estimated Diversion Rate (m^3/day)	Final Pumping Water Level Range (mbtoc)	Waterline Comments
Chaster (99.1-108.2)	1999-2003	69.98-71.27	1,104-1,406	86.04- 89.09	Data indicate consistent water production from 1999-2003 but some drop off in well efficiency in 2010 and 2017 (i.e.: lower pumping rate produced more drawdown in the well). Pumping water levels appear to be maintained approximately 6 m above the well screen and mean sea level (Table 5). The well is either losing efficiency and may need to be rehabilitated or the aquifer water levels are in decline which affects future capacity.
	2010	70.40	1,104	92.82	
	2011	72.03	NM	94.41	
	2017	70.00	912	85.85	
Soames (?-36.9)	2001	9.10	NM	14.81	Data indicate consistent water production from 2008 to 2014. Slight drop in static level in 2014 (maybe due to winter 2013 drought). Similar performance in 2017 although no flow rate measured. Pumping level maintained approximately 65 mASL (Table 5). Well appears to have continued to perform efficiently over the last 18 years and also appears to have additional capacity.
	2008-2014	9.44-10.62	1,296-1,440	15.96-16.32	
	2017	10.31	NM	15.73	
Langdale (35.4-44.5)	2009-2011	0.78-3.14	1,392-1,488	20.49-21.77	Data indicate consistent water production from 2009 to 2017. Pumping level maintained at approximately 15m above top of screen and at approximately the same elevation as sea level (Table 5). Although the aquifer may have additional capacity, significant drawdown of groundwater levels in the well indicates hydraulic inefficiencies due to poor well design or insufficient development.
	2015	2.92	1,440	19.59	
	2017	2.07	1,296	18.28	

Notes: mbtoc means meters below top of casing, NM means not measured

As indicated previously, the main purpose of the present study was to identify new aquifer exploration targets rather than determining if existing supply wells could provide more capacity. Therefore, existing SCRD wells were not included in the final ranking.

3.6 Decision Matrix and Final Site Selection

Further screening of exploration drilling options was completed in consultation with the SCRD using the key selection criteria previously described. In the analysis, each parameter was weighted equally; however, technical considerations or feasibility is most important as it gauges the likelihood of drilling a successful supply well to meet the SCRD water requirements.

The final ranking of the various exploration drilling options was determined based on a total score obtained by multiplying individual scores for each of the selection criteria. This semi-quantitative ranking assessment helped to further narrow down the 12 preliminary locations identified by Waterline during the preliminary assessment. The highest rank represents the likely “preferred” site for each exploration area. It should be cautioned however, that numerical ranking of options gives the appearance of a fully quantitative assessment but some of the criteria are very subjective and can therefore be misleading. The SCRD should exercise great care and consideration in reviewing the final options as it is possible that other factors can affect the final site selection that have not been considered in the assessment.

Numerical ranks ranged from 1 indicating a low or unfavorable rank, moderate rank=2, and high or favorable rank=3. The detailed assessment table is provided in Appendix B and summarized in Table 5 below.

Table 5: Results of Final Ranking

Location	Approximate Coordinates		Elevation	ID and Figures		Final Rank
	Latitude	Longitude	(masl)	Well ID	Figure	
Mahan Road	49.39789	-123.52412	112	1c	6	**108**
Mahan Road	49.40022	-123.52421	118	1d	6	**108**
Bridge at Gray Creek	49.53783	-123.75484	35	3	8	**108**
Soames Point	49.41606	-123.49402	101	4	9	**108**
District of Sechelt Operations Yard	49.49156	-123.74245	45	2b	7	**81**
Old Chapman Creek Reservoir	49.47344	-123.7348	115	2c	7	**72**
Mahan Road	49.39211	-123.52389	89	1a	6	**36**
Mahan Road	49.39397	-123.52389	103	1b	6	**36**
Frank West Firehall	49.39242	-123.53763	112	1f	6	**36**
Chapman Creek Booster Pump Stn	49.47959	-123.71793	156	2a	7	**36**
Reed Road Pump Station	49.41418	-123.52786	162	1e	6	**12**

Notes: Final rank calculated by multiplying individual selection criteria ranks or scores (see Appendix B)

The results of the final site rankings indicates at least one preferred drilling site in each of the focus areas as follows:

- Electoral Area E: Site 1C and/or 1D on Mahan Road (1D preferred due to better access and closer to the center of the Gibsons Aquifer);
- Gray Creek: Site 3 located near the parking are south of the bridge;
- Soames/Granthams: Site 4; Drill a new well at higher elevation next to the storage reservoir, and
- Chapman/Sechelt: Site 2b located at the District of Sechelt Operations Yard.

It should be noted that there is some value in further assessing the condition and long-term capacity of existing SCRD wells located at Chaster Road, Soames Point, and Granthams Landing. It may be possible to rehabilitate or retrofit some or all of these wells which could be less costly than drilling new wells. However, if a new well was drilled in each of these areas then the existing wells could be retired or serve as backup or be rehabilitated in order to add more capacity to the SCRD system.

3.7 Cost Evaluation

Although the SCRD proposal request called for a “high level” cost assessment of the infrastructure that may be needed for commissioning of a new groundwater supply well, this task could not be entirely completed until test wells are drilled and fully evaluated. All locations are very close to existing water mains, perhaps with the exception of the District of Sechelt lands north of the gravel pit (Site 2b) which would likely result in additional costs to tie-in.

Waterline developed a Class 3 cost estimate (-20- to +30%) for drilling and testing of four exploration wells at the preferred site locations selected. The cost estimate was based on recent work completed by Waterline on similar projects. Cost tables provided in Appendix D shows the detailed estimate and assumptions. The total estimated cost for completing a four well exploration program is approximately $325,000.00, excluding taxes. This includes drilling and well installation of four test wells, supply and install pumping equipment and conducting a 48 hour pumping test in each well, water quality testing, and hydrogeological support during the field work, and delivery of a short technical report summarizing results and recommendations for each location.

4.0 CONCLUSIONS AND RECOMMENDATIONS

Following Waterline's groundwater investigation of potential aquifer development targets within the SCRD, the following conclusions and recommendations have been reached:

Electoral Area E Area:

In Electoral Area E, Site 1c and 1d located along Mahan Road ranked the highest (most favorable) in our evaluation. However, Site 1d was selected as the preferred drilling location due to more favorable site access and its anticipated location near the center axis of the Gibsons Aquifer. The Frank West Firehall site (Site 1F) was determined to have low potential based on Waterline's re-evaluation of geophysical and geological data collected as part of the Gibsons Aquifer Mapping Project (Waterline 2013). The bedrock in this area shallows significantly in the vicinity of the Firehall site, resulting in thinning of the Gibsons Aquifer and likely restricting flow due to this aquifer boundary. Waterline is recommending that a Stage 2 drilling and testing program be initiated at Mahan Road Site 1d.

Sechelt Area:

In the Sechelt area, Waterline has concluded that the preferred location for stage 2 drilling and testing is adjacent to the District of Sechelt Operations Yard on Dusty Road (Site 2B). Hydrogeology data reviewed and compiled by Waterline suggests that a thick aquifer may exist in this area.

Gray Creek Area:

A thick and relatively extensive glacio-fluvial fan has been mapped by Waterline deep beneath the Gray Creek Valley. Existing supply wells at the Sturgeon Aquaculture facility closer to the Sechelt Inlet suggest that this aquifer is highly productive. A Stage 2 test drilling program is recommended on Sechelt Inlet Road located close to the Gray Creek Bridge (Site 3). Some uncertainty exists with respect to possible hydraulic communication with Gray Creek which could require a detailed "Groundwater at Risk of Containing Pathogens" (GARP) assessment.

Soames/Granthams Area: Based on work completed by Associated Environment (2017) both the Soames and Granthams wells may be located in higher risk areas for contamination. The Granthams Well is located in the deeply incised Soames Creek Valley and could be at risk of

flooding and surface water entering the well. The Soames Well is located in a roadway which is vulnerable to vehicular traffic and related activities (runoff, spills, physical damage). The SCRD conducted tests in June 2017 to determine well productivity and both wells appear to be functioning efficiently. The Granthams Well is relatively shallow (15.8 m below ground) and the artesian flow from the well when the pump is turned off is reported to be 45 US gpm (Associated Environment, 2017). Recent measurements of artesian discharge by SCRD (2017) indicate that artesian overflow from the two pipes (pipe 1 and 2, Appendix C) under pumping conditions was approximately 46 US gpm and under non-pumping conditions was approximately 71 US gpm. Flowing artesian conditions confirms that the well and aquifer are under continuous artesian pressure with upward flow gradients and the well casing seal is intact. Based on the above information, the opportunity for water from Soames Creek to enter the well under present conditions, although possible, appears to be low. However, given the potential consequences the SCRD should implement a robust monitoring program to fully quantify the risk under varying conditions including appropriate storm flow return periods.

Waterline recommends that the SCRD consult with the local Health Authority to confirm requirements for both the Soames and Granthams wells. It may be possible to rehabilitate or retrofit one or more of these wells which could be less costly than drilling new wells. However, if a new well is being contemplated by the SCRD as recommended by Associated Environment (2017) then Site 4 located next to the Soames Point Reservoir is preferred. If a new well proves successful, then the existing wells could be abandoned, or used for backup or observation and groundwater monitoring subject to the outcome of the recommended inspection.

5.0 CLOSURE

Waterline is pleased to provide the enclosed report on the groundwater investigation to supplement the Chapman Creek water supply during summer peak. We trust that the enclosed report provides sufficient information to the SCRD to move forward with the Stage 2 drilling and testing program.

Respectfully submitted,

Waterline Resources Inc.

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VP of Operations and Principal Hydrogeologist

Reviewed by:

Jolene Hermanson, M.Sc., P.Geo.
Hydrogeologist

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FIGURES

Figure 1: SCRD Project RSA (Defined by Distribution System from Langdale to Secret Cove)

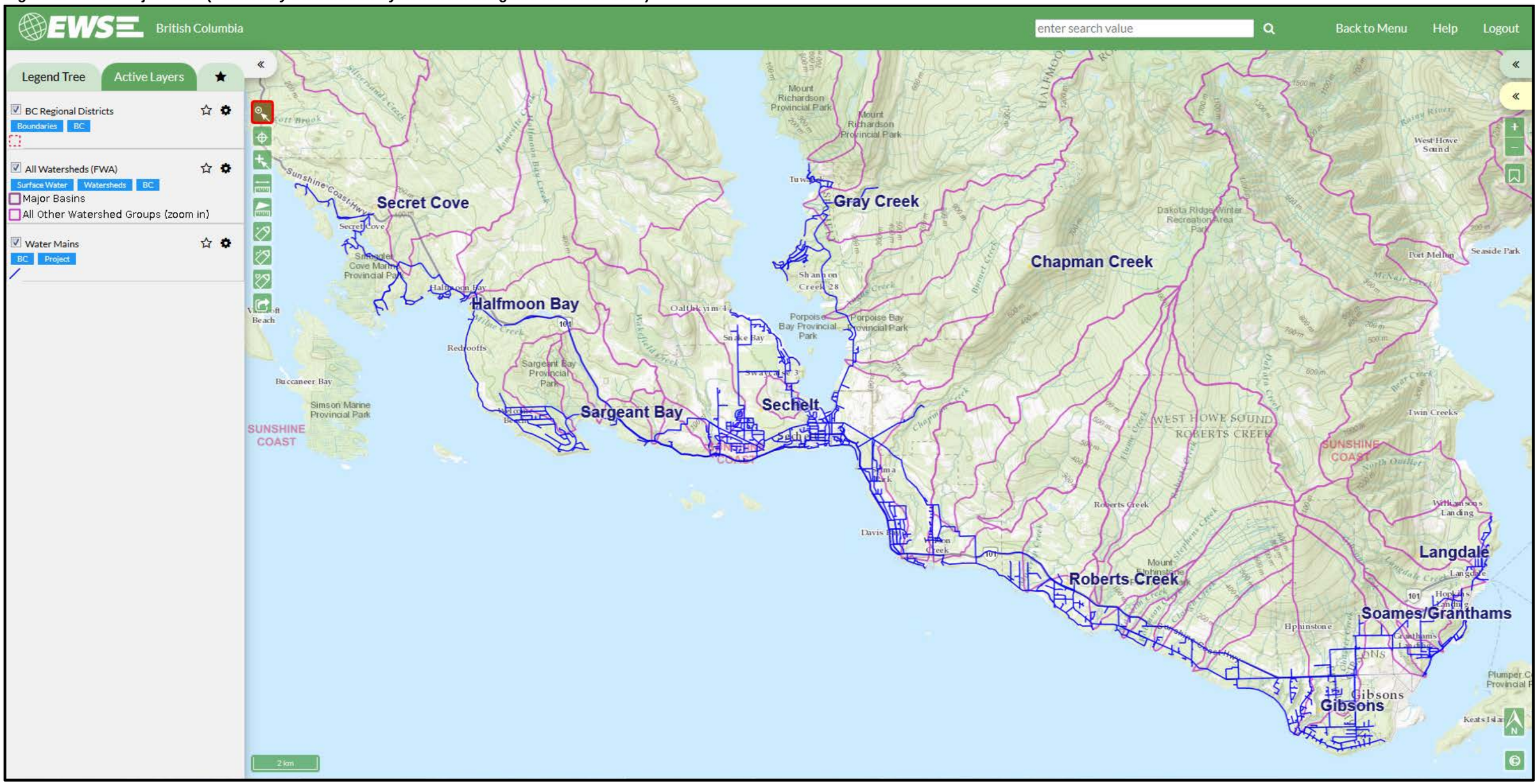


Figure 2: Mapped Overburden Aquifer and Water Wells Sorted by Aquifer Material

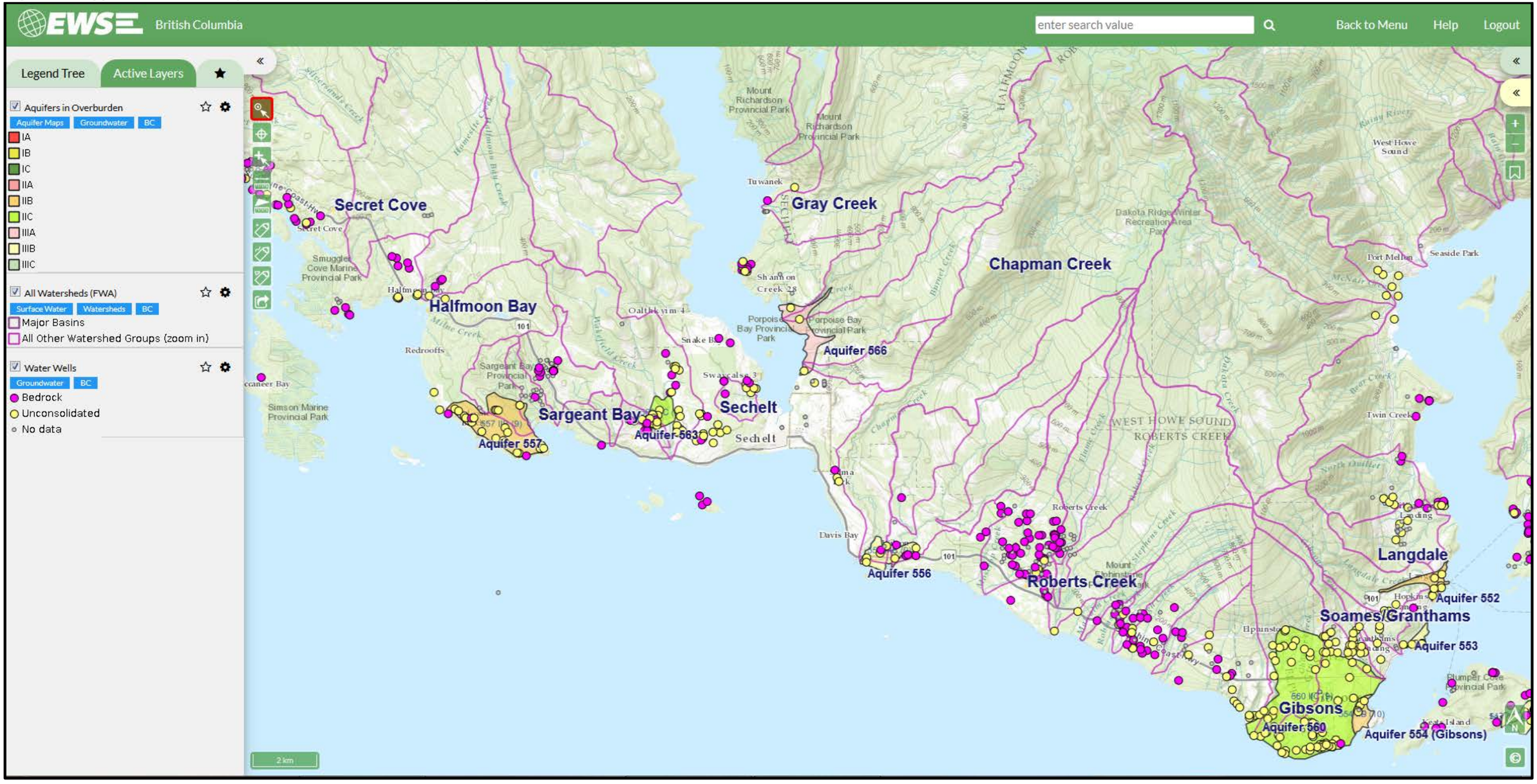


Figure 3: Surficial Geology/Terrain Mapping and Water Wells Sorted by Well Yield

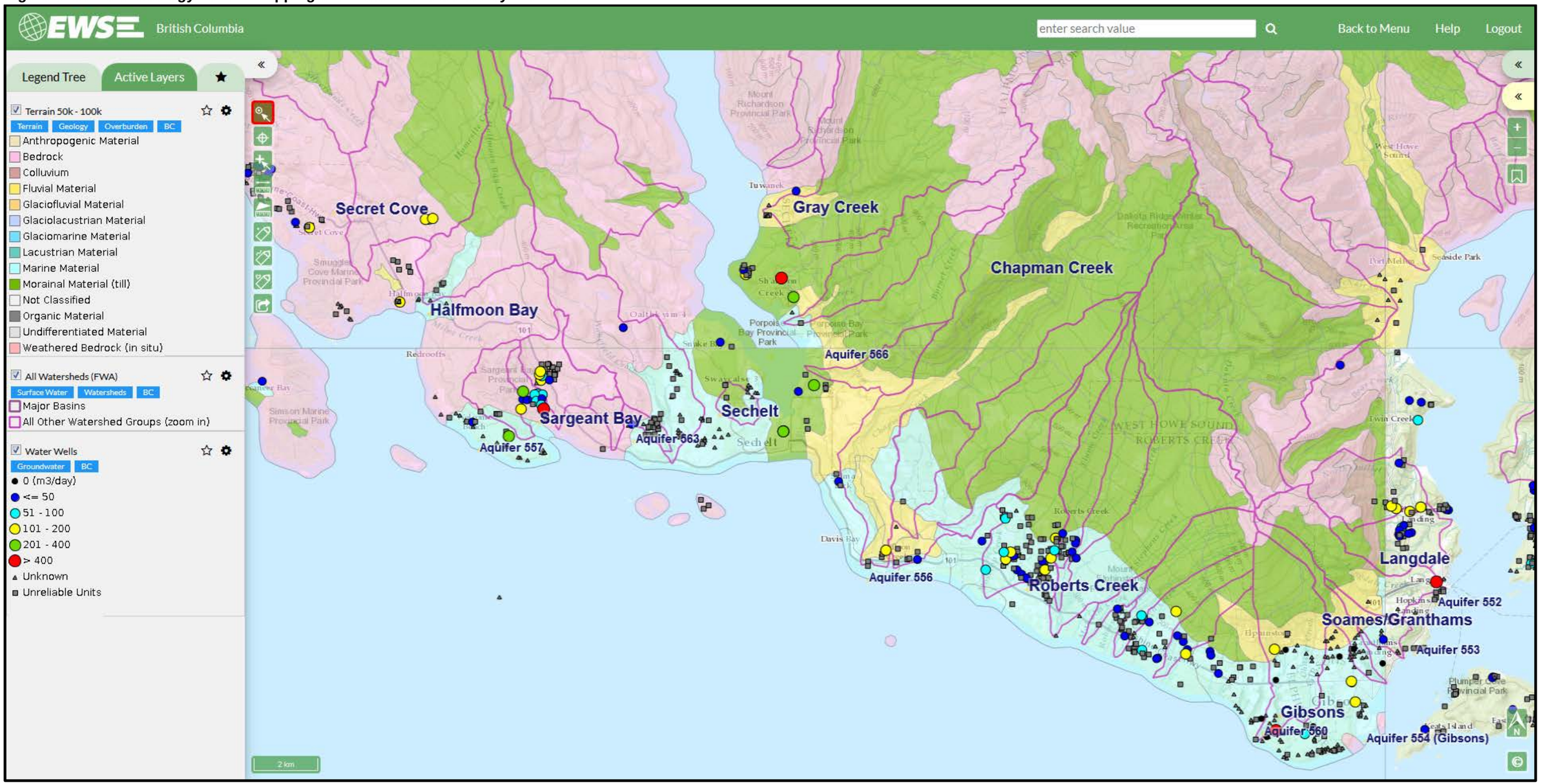


Figure 4: Bedrock Geology and Water Wells Sorted by Aquifer Material

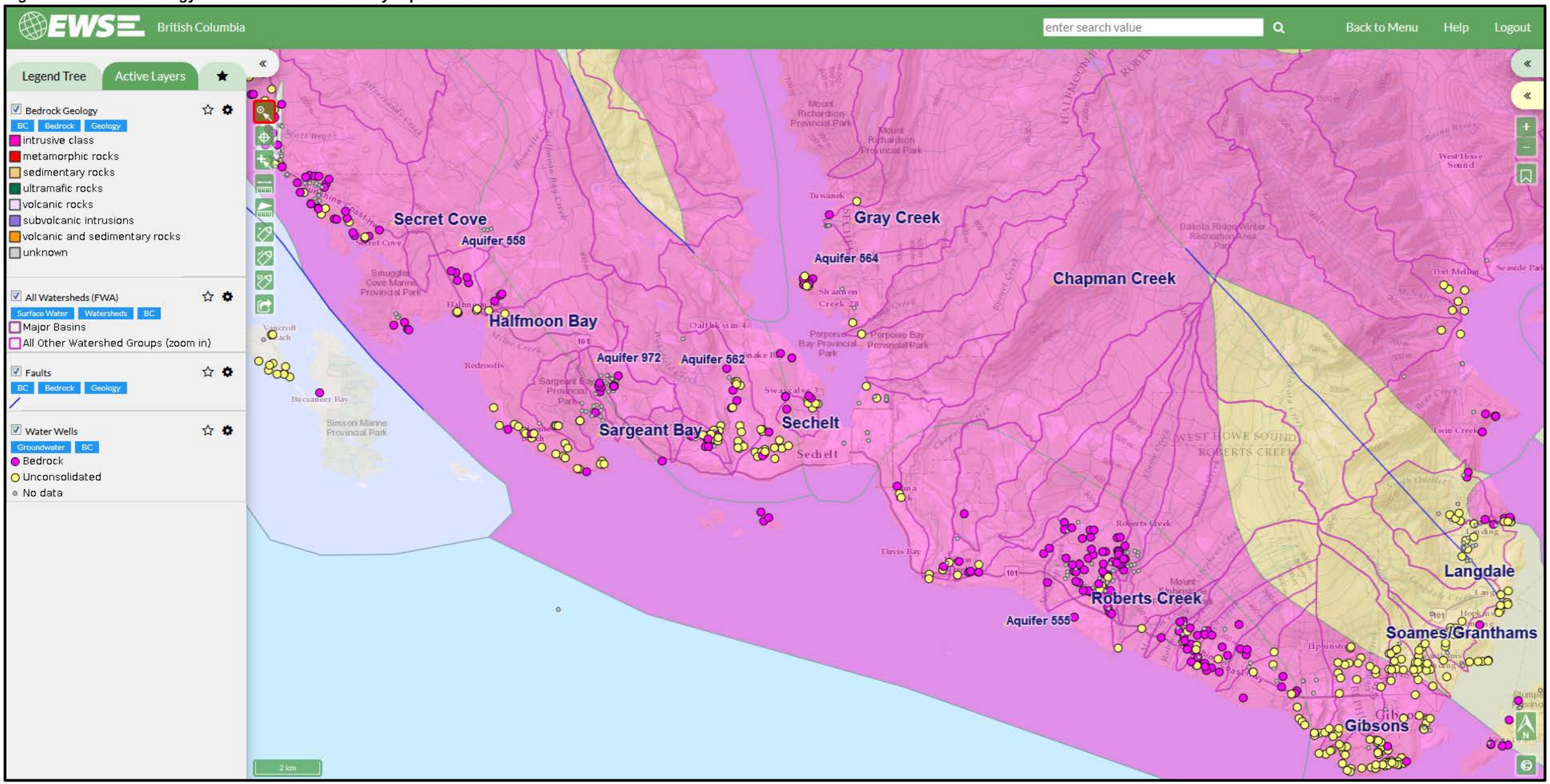


Figure 5: Mapped Bedrock Aquifers and Water Wells Sorted by Aquifer Material

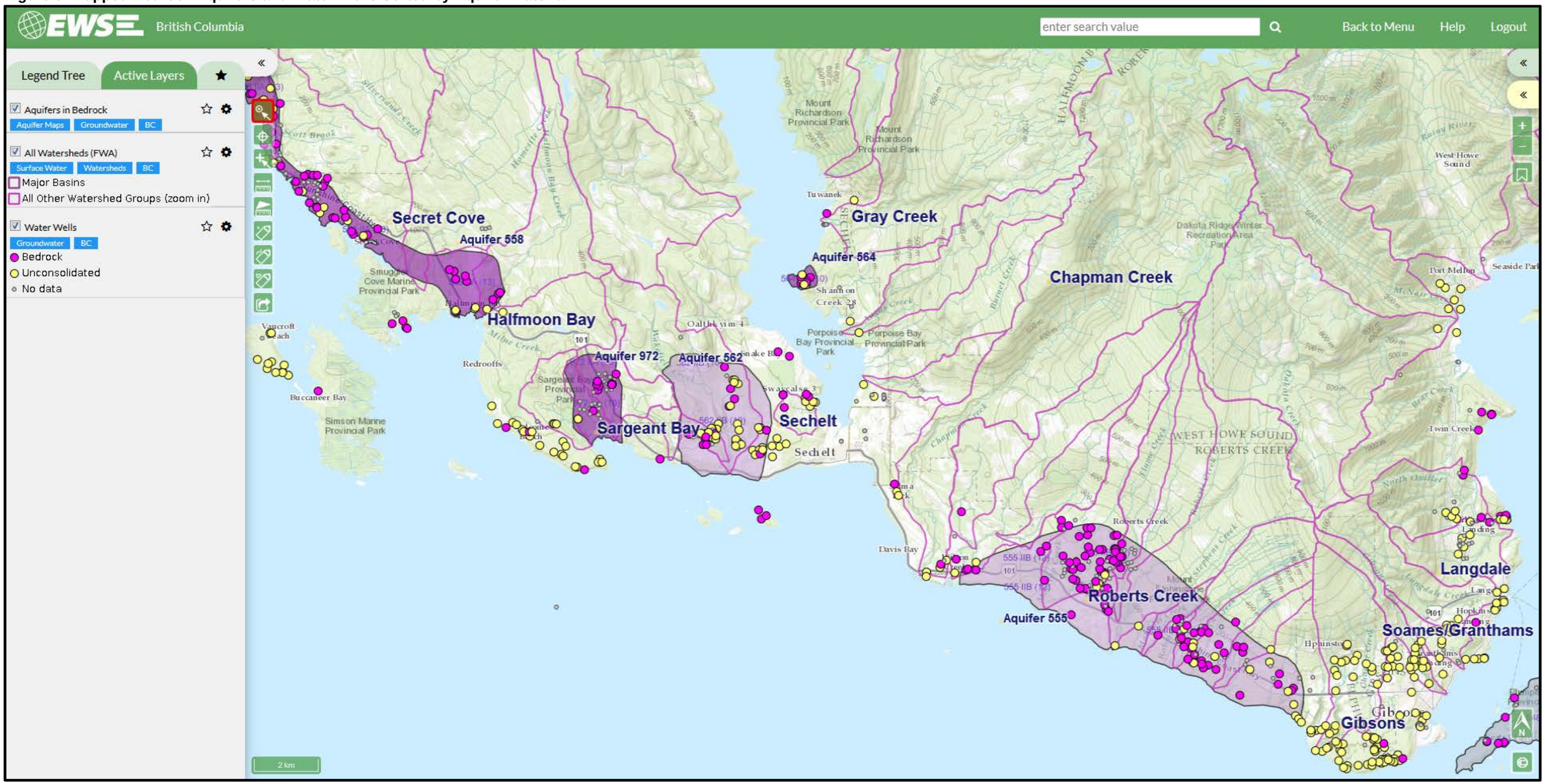
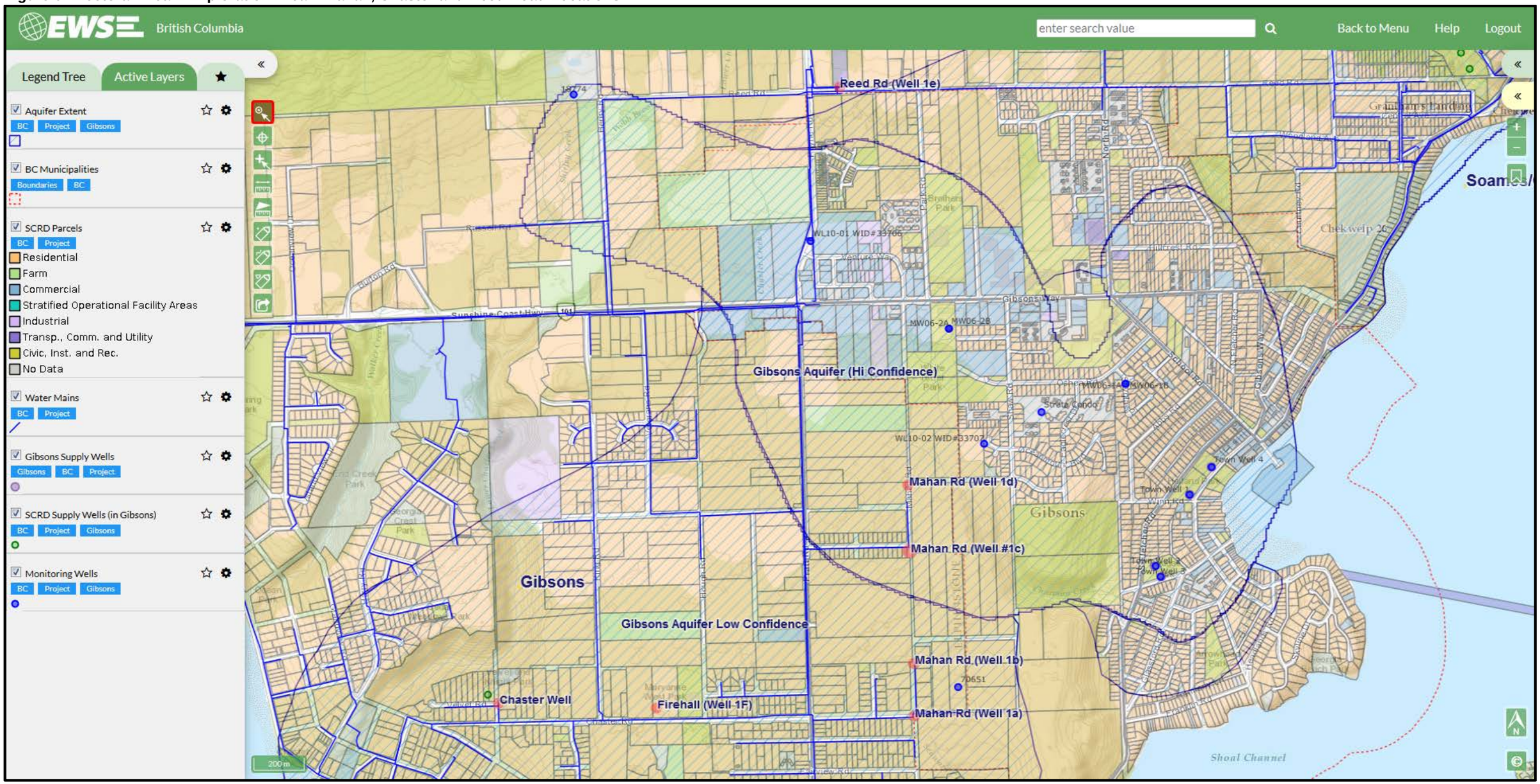
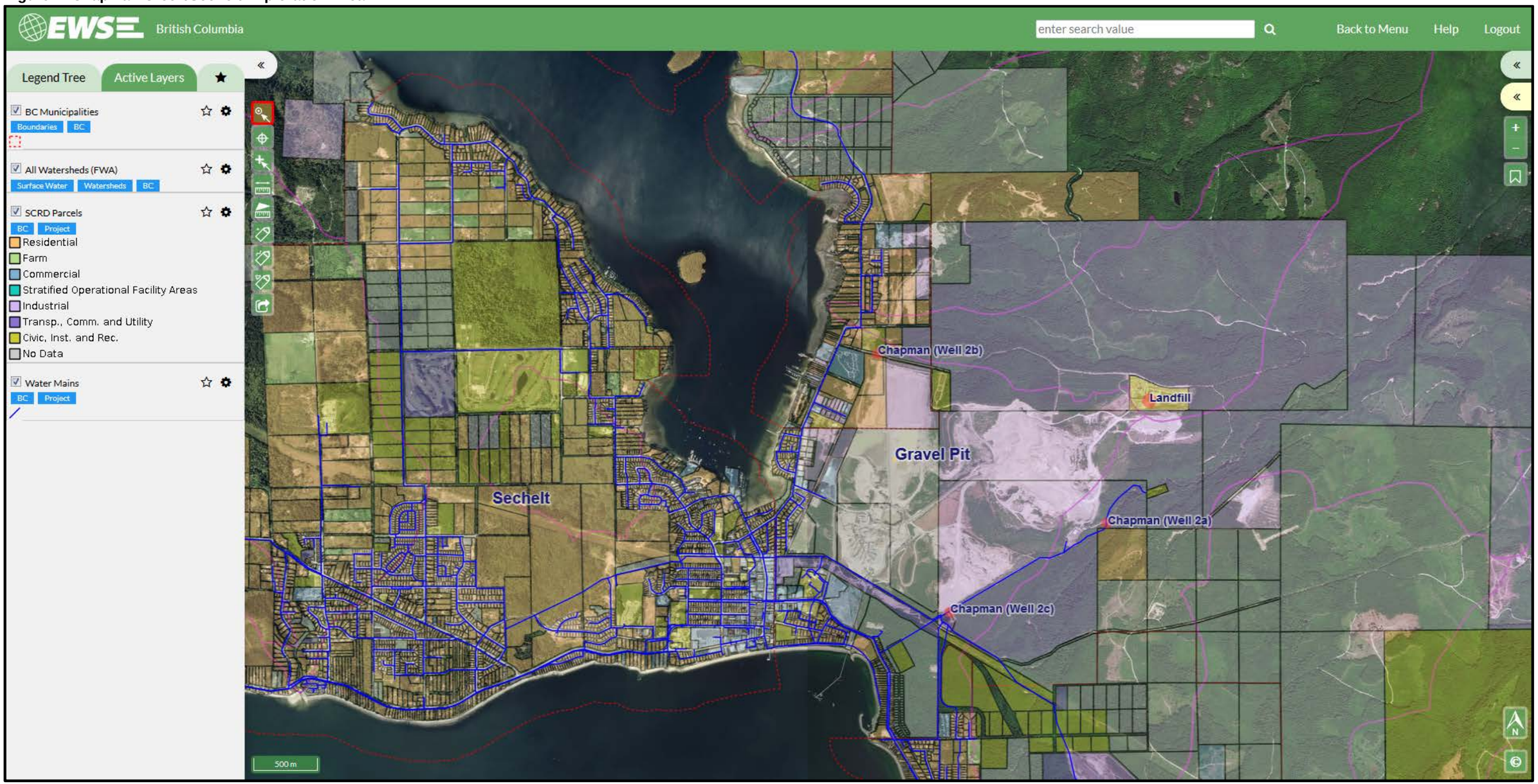


Figure 6: Electoral Area E Exploration Area – Mahan, Chaster and Reed Road Locations



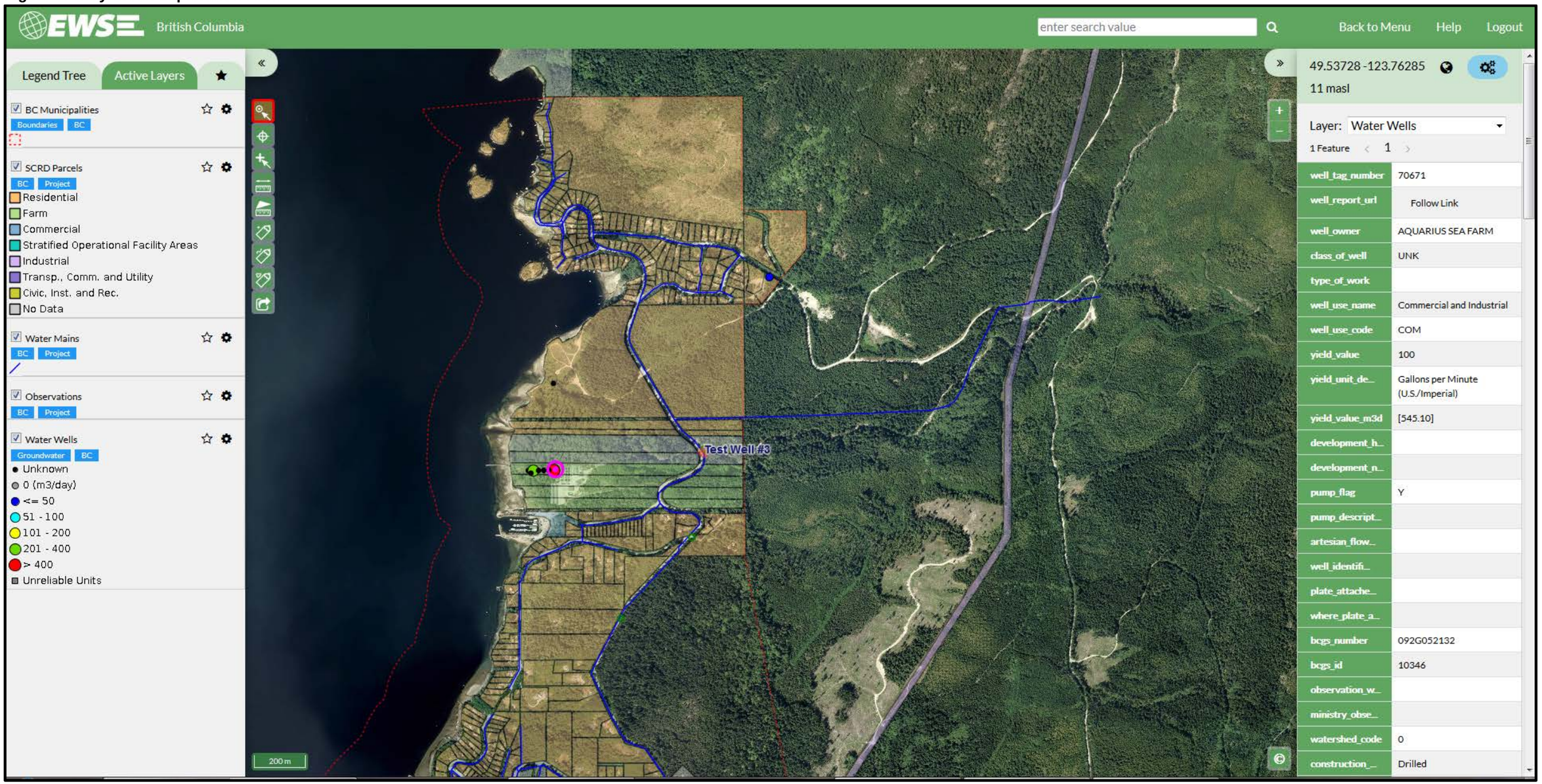
Notes: Mahan Road is a high priority target located in the Gibsons Aquifer high confidence zone in Electoral Area E. Highly productive SCRD Chaster well may have capacity for increased usage.

Figure 7: Chapman Creek/Sechelt Exploration Area



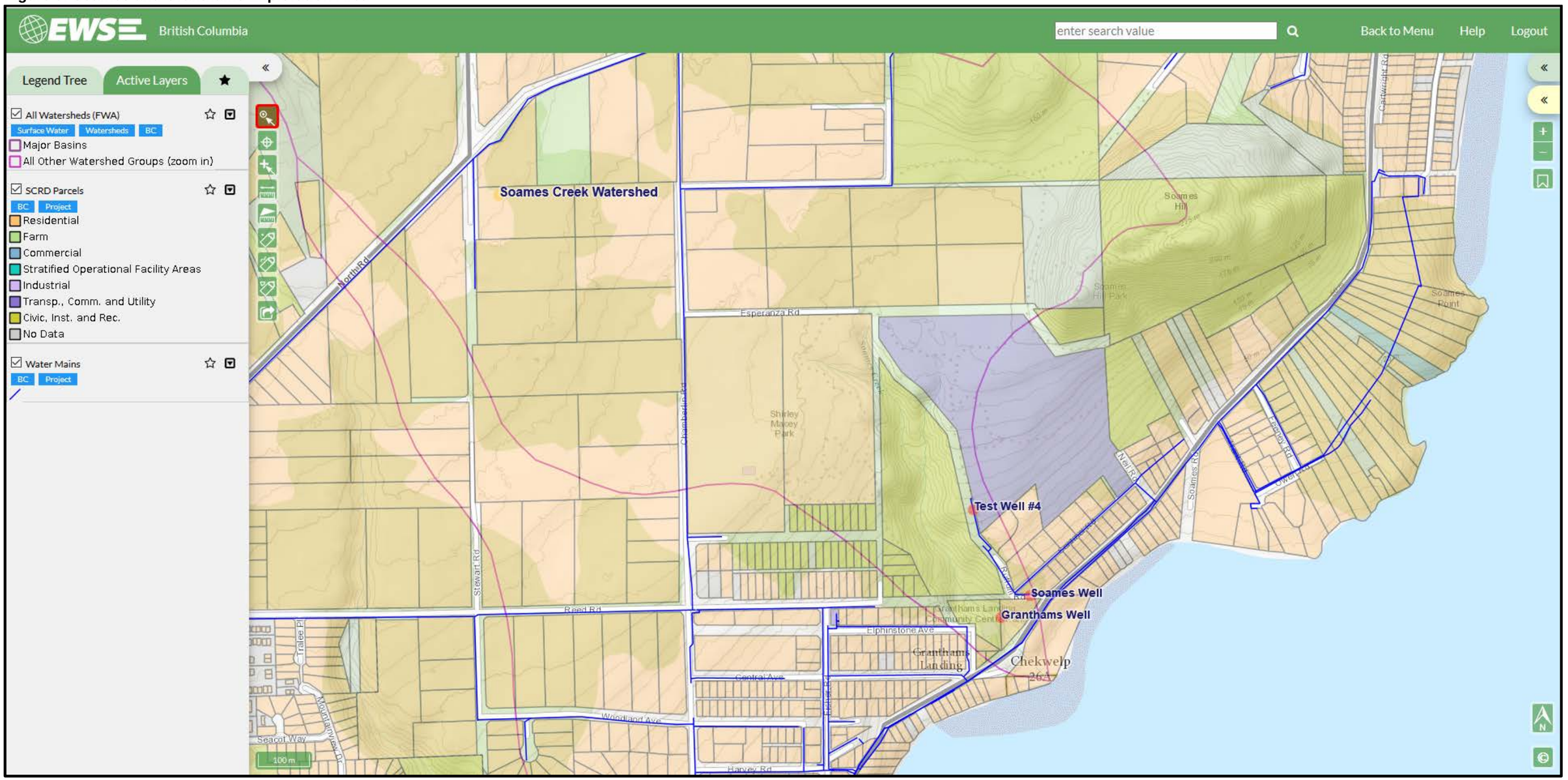
Notes: There are three potential test drilling locations in the Chapman Creek area. Limited subsurface information is available. The upgradient landfill is a concern.

Figure 8: Gray Creek Exploration Area



Notes: Unconsolidated sand and gravel aquifer in Gray Creek lowland has several good producing wells owned by Aquarius Sea Farms. SCRD water main runs along Sechelt Inlet Road and the right-of-way is a potential drilling target.

Figure 9: Soames and Granthams Exploration Area



Notes: Test Well #4 has been identified as a potential location for a replacement well for existing Soames and Granthams wells.

Appendix A

Field Visit Site Photos

Photo 1: Test Drilling Site 1a on Mahan Road

Photo 2: Test Drilling Site 1b on Mahan Road

Photo 3: Test Drilling Site 1e on Reed Road

Photo 4: Mahan Road looking north towards Site 1D from Site 1C

Photo 5: SCRD Chaster Road Well

Photo 6: Frank West Firehall Rear Parking lot (Test Drilling Site 1f)

Photo 7: Chapman Creek Treatment Plant Site

Photo 8: Chapman Creek Booster Pump Station (Test Drilling Site 2a)

Photo 9: District of Sechelt Operations Yard (Test Drilling Site 2b)

Photo 10: Old Chapman Cr Reservoir (Test Drilling Site 2c)

Photo 11: Gray Creek Test Drilling Site #3 (Looking North)

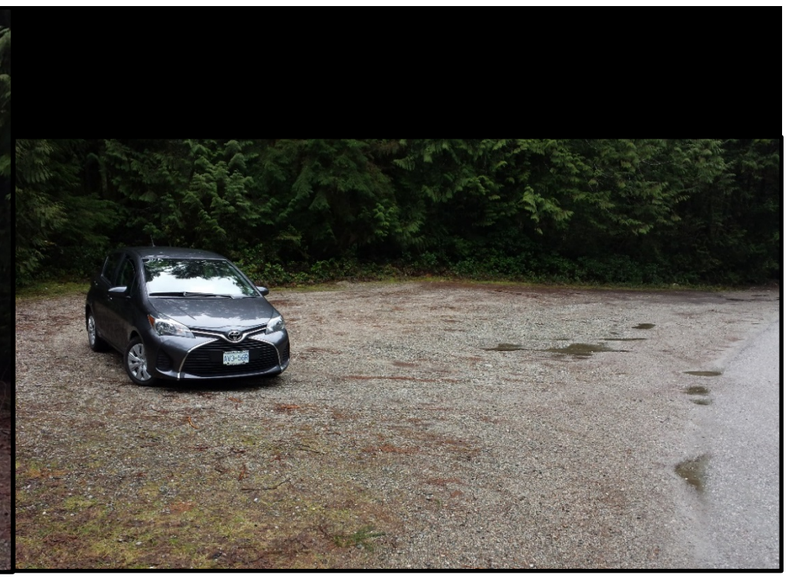


Photo 12: Gray Creek Test Drilling Site #3 (Looking South)

Photo 13: Gray Creek Bridge with SCRD Water Line

Photo 14: Gray Creek flow (March 27, 2017)

Photo 15: Soames Reservoir (Test Drilling Site #4 Location)

Photo 16: Soames Well at the centre of the road access

Photo 17: Granthams Well Access Road

Photo 18: Granthams Wellhead in Soames Creek Valley

Photo 19: Granthams Well - Artesian Flow By-Pass

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APPENDIX B
EVALUATION MATRIX AND SITE RANKING

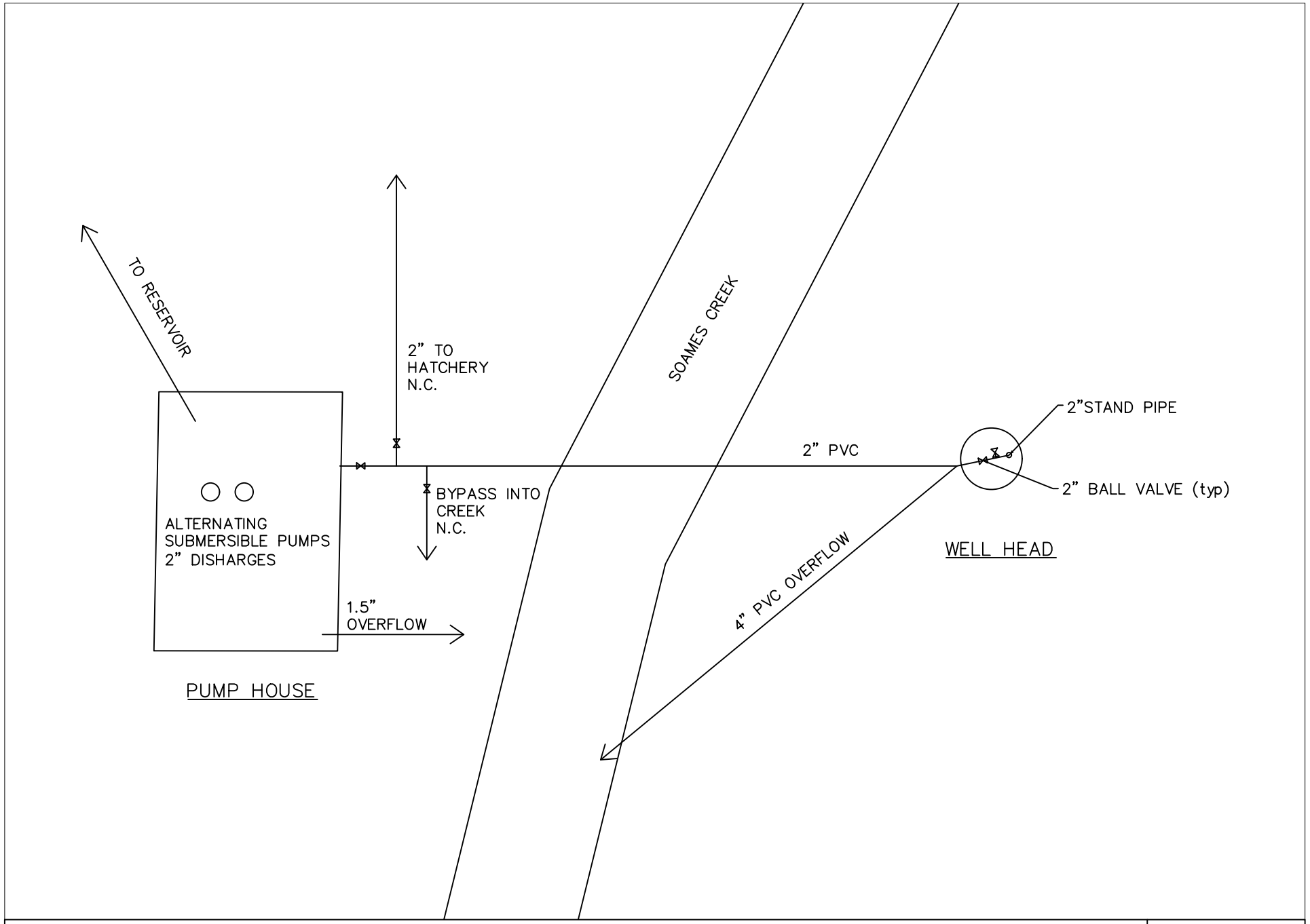
Preliminary Ranking of Groundwater Exploration Sites - SCRD Water Source Enhancement Study

	Coordinates			Location Description				Hydrogeological Feasibility		Infrastructure Requirements		Water Quality		Stakeholder concerns		Regulatory Requirements		TOTAL RANK
Location	**Latitude**	**Longitude**	**Approx. Elevation (masl)**	**Well ID**	**Field Obs ID**	**Photo #**	**Figure**	**Aquifer Transmissivity/water deliverability**	**Rank**	**Drill and test well, Pipeline and treatment**	**Rank**	**Comment**	**Rank**	**Adjacent users, first nations traditional use**	**Rank**	**Connection to surface water, impact assessment if interference with existing users**	**Rank**	
Mahan Road	49.39789	-123.52412	112	1c	none, did not field visit	none did not field visit	6	Within the Gibsons Aquifer High Confidence mapping area	3	Drill well, <5 m tie-in, need chorination stn.	2	High Quality Gibsons Aquifer Water source	3	Town of Gibsons and Eaglecrest Condo are existing users	2		3	**108**
Mahan Road	49.40022	-123.52421	118	1d	none, did not field visit	none did not field visit	6	Within the Gibsons Aquifer High Confidence mapping area	3	Drill well, 70 m tie-in, need chorination stn.	2	High Quality Gibsons Aquifer Water source	3	Town of Gibsons and Eaglecrest Condo are existing users	2		3	**108**
Bridge Crossing at Gray Creek	49.53783	-123.75484	35	3	OBS 3	11 to 14	8	Several high producing wells (tested at 500 GPM) owned by Aquarius Sea Farms completed in a sand and gravel aquifer. Large watershed	3	Drill well, <5 m tie-in, need chorination stn.	3	unknown, suspected good but may be GARP	2	Low, few users in the area	3	Surface water connection?	2	**108**
Soames Point	49.41606	-123.49402	101	4		15 to 19	9	Higher elevation, some uncertainty of aquifer extends to selected location.	2	Drill well, <5 m tie-in, need chorination stn.	3	unknown, but suspected good	2	Low, no users in the area	3	Closest wells belong to SCRD	3	**108**
District of Sechelt Operations Yard	49.49156	-123.74245	45	2b	OBS 4	9	7	High producing well at the gravel pit	3	Drill well, >300 m tie-in, need chorination stn. need to secure land/lease	1	suspected good based on gravel pit groundwater quality data from supply wells	3	Low, few users in the area	3		3	**81**
Old Chapman Creek Reservoir	49.47344	-123.7348	115	2c	OBS 7	10	7	No mapped aquifers and limited well data	2	Drill well, <5 m tie-in, need chorination stn.	2	unknown, but suspected good	2	Low, no users in the area	3		3	**72**
Mahan Road	49.39211	-123.52389	89	1a	OBS10	1	6	Within the Gibsons Aquifer Low Confidence mapping area	1	Drill well, <5 m tie-in, need chorination stn.	2	High Quality Gibsons Aquifer Water source	3	Town of Gibsons and Eaglecrest Condo are existing users	2	WSA Requirements, more complicated when assessming existing users (may need additional observation wells)	3	**36**
Mahan Road	49.39397	-123.52389	103	1b	OBS 11	2	6	Within the Gibsons Aquifer Low Confidence mapping area	1	Drill well, <5 m tie-in, need chorination stn.	2	High Quality Gibsons Aquifer Water source	3	Town of Gibsons and Eaglecrest Condo are existing users	2		3	**36**
Frank West Firehall	49.39242	-123.53763	112	1f	OBS 8	6	6	This area is though to be near the edge of the Gibsons aquifer where bedrock is shallow and the aquifer may be non-existent or less productive.	1	Drill well, <5 m tie-in, need chorination stn.	2	Similar to Chaster Well	3	Believed to be hydrualically isolated from Gibson Town Wells	3	Well-well interference low, nearest user is SCRD	2	**36**
Chapman Creek Booster Pump Stn	49.47959	-123.71793	156	2a	OBS 6	8	7	Large Chapman Creek watershed, possible Gibsons Style Aquifer, no well data	2	Drill well, <5 m tie-in, need chorination stn.	2	Unlined landfill located on the edge of Chapman Creek watershed, potentially upgradient of well locations	1	Low, no users in the area	3		3	**36**
Reed Road Pump Station	49.41418	-123.52786	162	1e	OBS12	3	6	Reed rd pump station. Scrd land parcel. Good access for rig but high up in water shed and likely very deep static water levels (maybe dry?)	1	Drill well, <5 m tie-in, need chorination stn.n.	2	Deep static water levels. May be affected by bedrock (see Gibson Aquifer Study Report)	1	Town of Gibsons and Eaglecrest Condo are existing users	2		3	**12**

Notes: Rank: 1=poor, 2=Moderate, 3=high

APPENDIX C

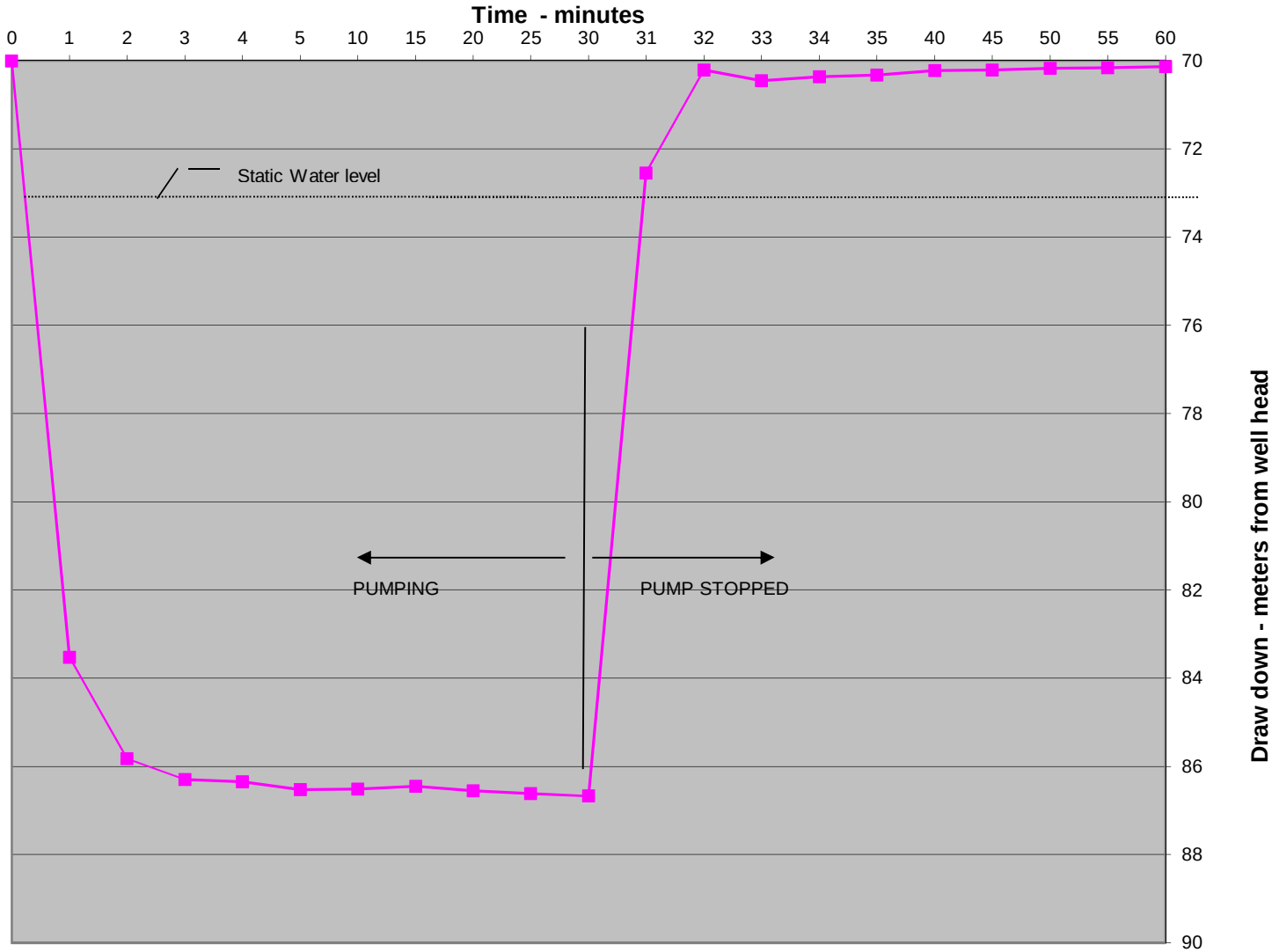
SCRD 2017 PUMPING TEST DATA FOR CHASTER, SOAMES, GRANTHAMS AND LANGDALE WELLS



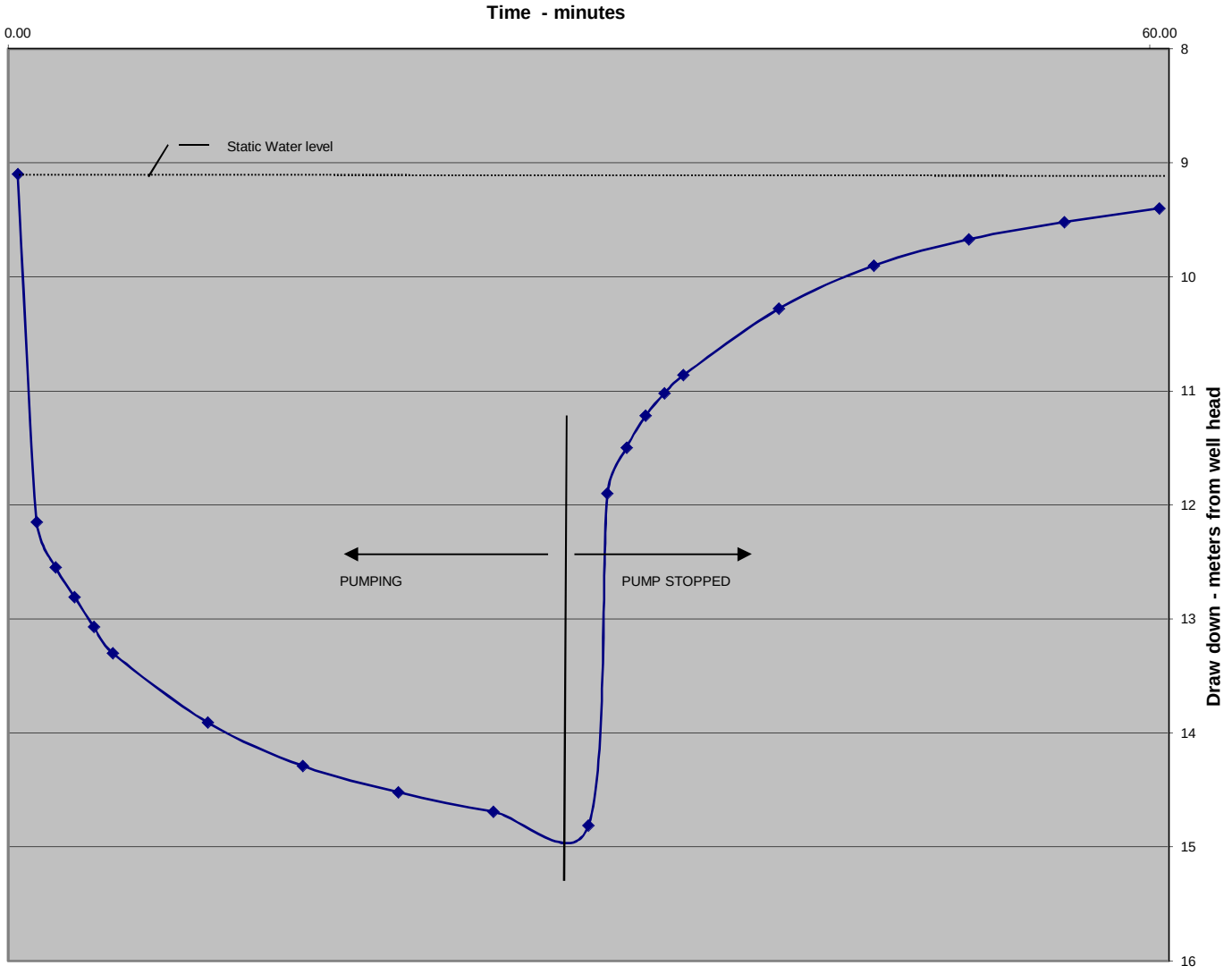
GRANTHAMS LANDING WELL AND PUMP HOUSE LAYOUT

DRAWN BY: TR
SKETCH BY: RH
2017.06.29

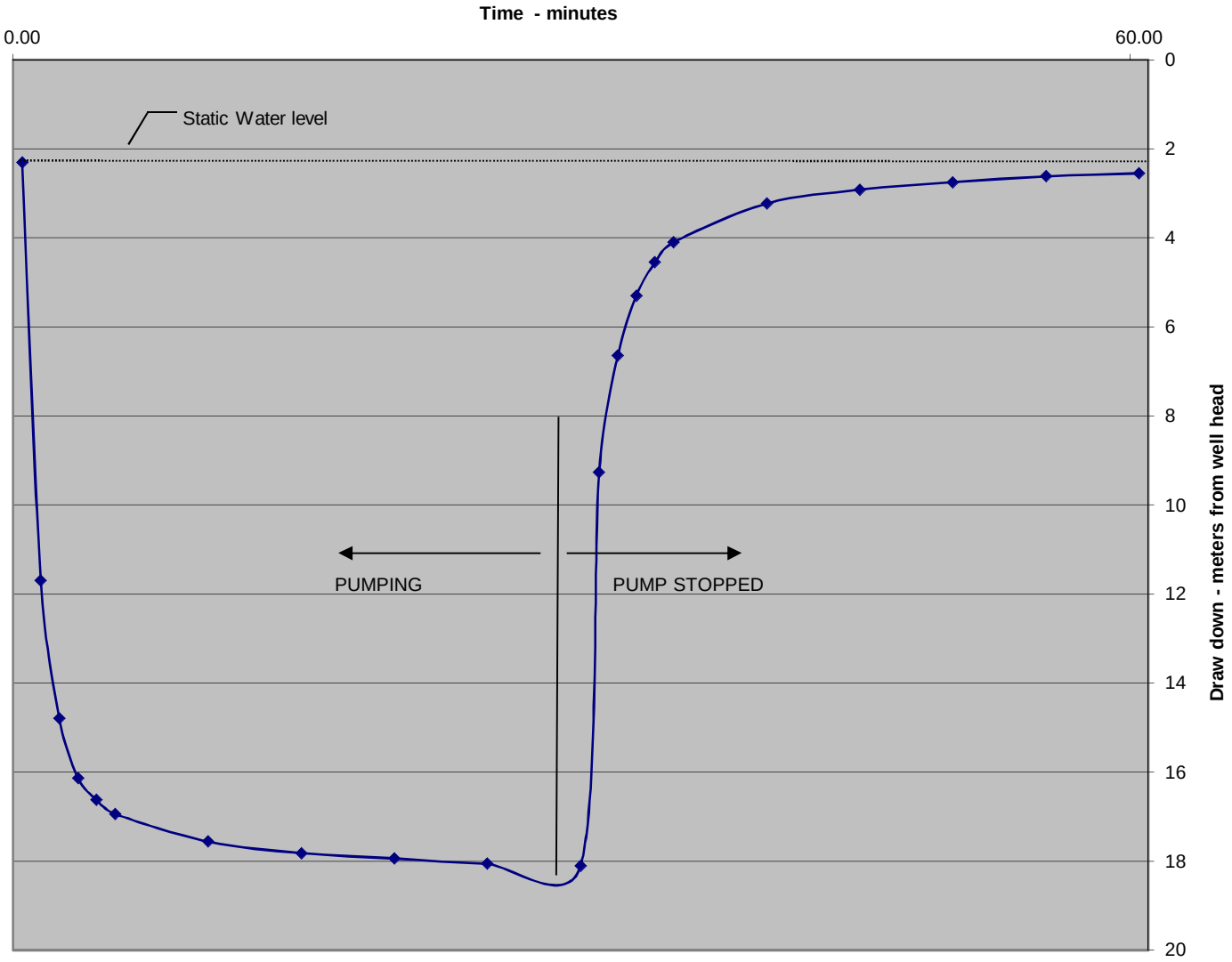
Soames Well Draw Down - Nov / 2001



Soames Well Draw Down - Nov / 2001



Langdale Well Draw Down - Nov / 2001



Sunshine Coast Regional District

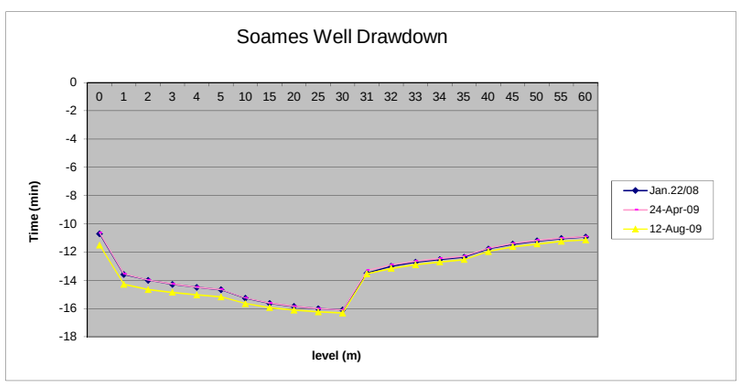
Soames Well

Measurments in meters from bottom of manhole ring

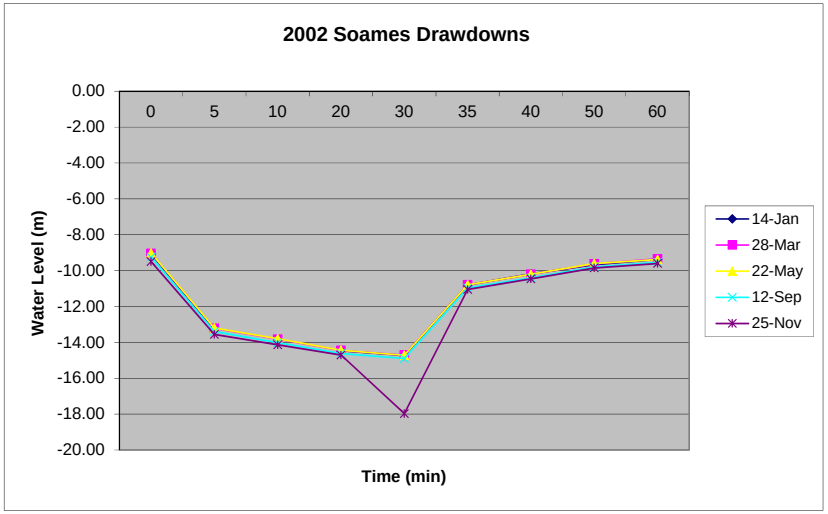
	2008 Jan.22/08	2009 24-Apr-09	2009 12-Aug-09	2010 11-Feb-10	2010 28-Apr-10	2014 21-Aug-15	2017 23-Jun-17
measurment to manhole ring:	10.72	10.64	11.52				
Static Level:	9.52	9.44	10.32	-10.59	-10.62	10.56	10.31
Drawdown: (minutes)							
1	13.60	13.56	14.29	-13.46	-13.58	13.45	13.26
2	14.00	13.99	14.67	-13.90	-13.97	13.86	13.65
3	14.29	14.27	14.86	-14.17	-14.25	14.12	13.92
4	14.50	14.49	15.04	-14.36	-14.45	14.34	14.14
5	14.68	14.66	15.18	-14.53	-14.62	14.51	14.31
10	15.28	15.26	15.66	-15.13	-15.20	15.10	14.91
15	15.64	15.62	15.94	-15.49	-15.54	15.50	15.27
20	15.86	15.85	16.12	-15.72	-15.78	15.69	15.49
25	16.01	16.01	16.24	-15.86	-15.92	15.85	15.64
30	16.11	16.11	16.32	-15.96	-16.02	16.00	15.73
Recovery: (minutes)							
31	13.50	13.31	13.55	-13.24	-13.24	13.18	13.10
32	13.02	12.91	13.16	-12.83	-12.88	12.78	12.68
33	12.72	12.65	12.90	-12.57	-12.61	12.55	12.37
34	12.53	12.46	12.71	-12.37	-12.42	12.36	12.18
35	12.36	12.29	12.54	-12.21	-12.25	12.19	12.02
40	11.79	11.73	11.97	-11.655	-11.7	11.63	11.43
45	11.44	11.39	11.63	-11.31	-11.37	11.33	11.08
50	11.21	11.17	11.44	-11.11	-11.16	11.09	10.86
55	11.05	11.02	11.25	-10.96	-11.02	10.94	10.70
60	10.94	10.91	11.15	-10.86	-10.91	10.84	10.59
pump hours @ start	**194.3**	**320.5**	**766.2**	**1242.6**	**1409.3**	**5907.3**	**6941.30**
water meter @ start	**382601**	**452062**	**478138**	**505983**	**515717**	**774054**	**804116.0**
pump hours @ stop	**194.8**	**321**	**766.7**	**1243.1**	**1409.8**	**5907.8**	**6941.8**
water meter @ stop	**382630**	**452092**	**478167**	**506012**	**515747**	**774081**	**804125.0**
pump hours during drawdown	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**
water moved (m^3)	**29**	**30**	**29**	**29**	**30**	**27**	**NA**
Esperanza test point							
Comments	SF, SV, EL	EL/SK	EL/BD		MH/SK	SK/TM	

Raw data for Graphs:

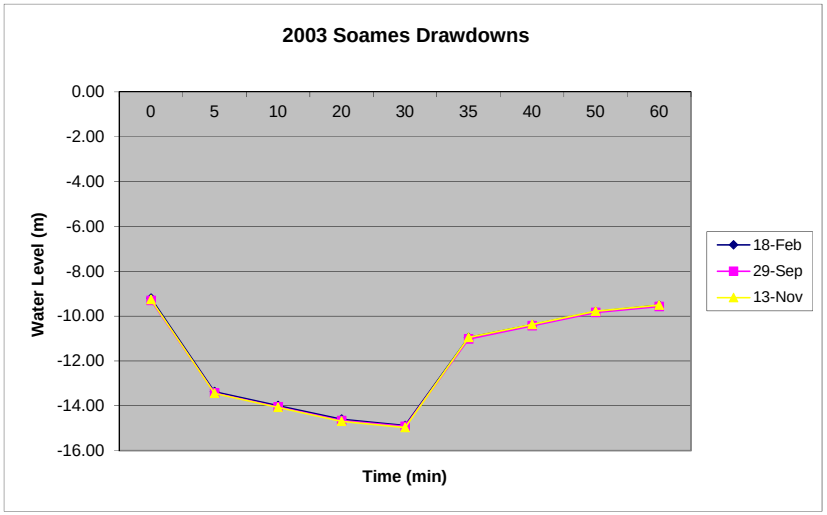
Time (min)	Jan.22/08 Level (m)	24-Apr-09 Level (m)	12-Aug-09 Level (m)
0	-10.72	-10.64	-11.52
1	-13.60	-13.56	-14.29
2	-14.00	-13.99	-14.67
3	-14.29	-14.27	-14.86
4	-14.50	-14.49	-15.04
5	-14.68	-14.66	-15.18
10	-15.28	-15.26	-15.66
15	-15.64	-15.62	-15.94
20	-15.86	-15.85	-16.12
25	-16.01	-16.01	-16.24
30	-16.11	-16.11	-16.32
31	-13.50	-13.31	-13.55
32	-13.02	-12.91	-13.16
33	-12.72	-12.65	-12.9
34	-12.53	-12.46	-12.71
35	-12.36	-12.29	-12.54
40	-11.79	-11.73	-11.97
45	-11.44	-11.39	-11.63
50	-11.21	-11.17	-11.44
55	-11.05	-11.02	-11.25
60	-10.94	-10.91	-11.15



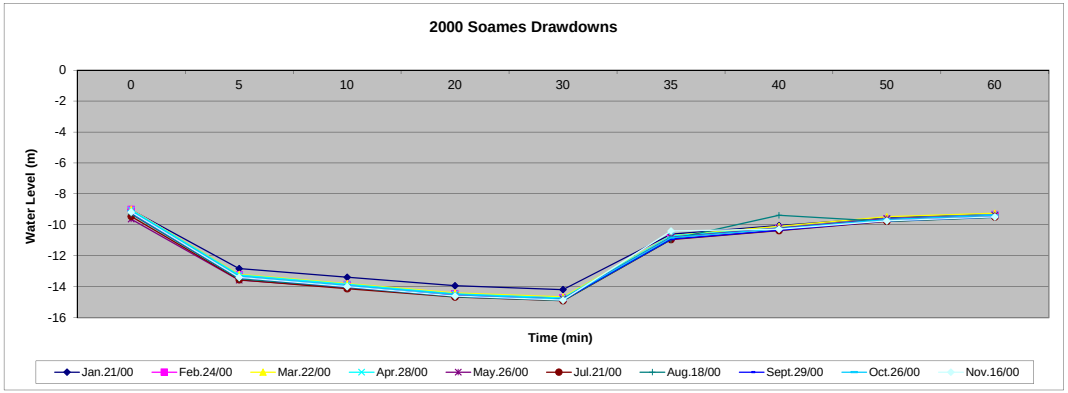
	2002 14-Jan	28-Mar	22-May	12-Sep	25-Nov
0	-9.07	-9.04	-9.02	-9.26	-9.50
5	-13.25	-13.22	-13.20	-13.40	-13.56
10		-13.82	-13.80	-14.02	-14.14
20	-14.47	-14.45	-14.44	-14.63	-14.71
30	-14.73	-14.71	-14.72	-14.90	-17.97
35	-10.80	-10.79	-10.79	-10.97	-11.05
40	-10.18	-10.20	-10.20	-10.41	-10.46
50	-9.67	-9.62	-9.60	-9.80	-9.85
60	-9.37	-9.35	-9.38	-9.54	-9.60



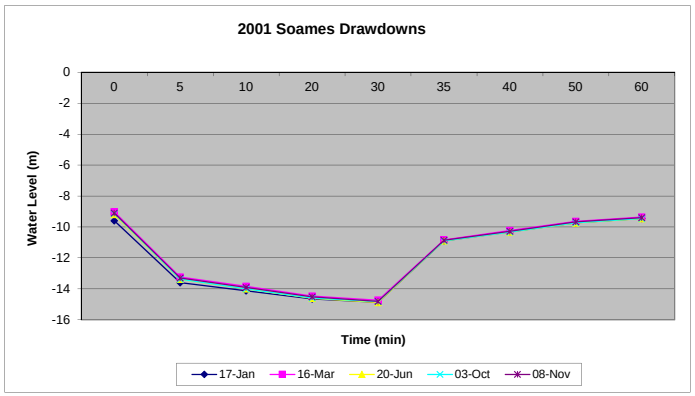
	18-Feb	29-Sep	13-Nov
0	-9.20	-9.30	-9.26
5	-13.37	-13.43	-13.44
10	-13.99	-14.05	-14.07
20	-14.60	-14.66	-14.69
30	-14.88	-14.92	-14.97
35	-10.96	-11.02	-10.95
40	-10.39	-10.43	-10.37
50	-9.80	-9.84	-9.78
60	-9.52	-9.57	-9.51



	2000									
	Jan.21/00	Feb.24/00	Mar.22/00	Apr.28/00	May.26/00	Jul.21/00	Aug.18/00	Sept.29/00	Oct.26/00	Nov.16/00
0	-9.04	-9.00	-9.01	-9.04	-9.63	-9.46	-9.31	-9.21	-9.10	-9.18
5	-12.83	-13.24	-13.20	-13.25	-13.58	-13.56	-13.49	-13.40	-13.32	-13.40
10	-13.39	-13.86	-13.80	-13.85	-14.07	-14.14	-14.04	-14.00	-13.93	-14.00
20	-13.94	-14.48	-14.40	-14.47	-14.59	-14.67	-14.65	-14.60	-14.50	-14.61
30	-14.19	-14.74	-14.66	-14.73	-14.79	-14.91	-14.90	-14.85	-14.80	-14.87
35	-10.61	-10.80	-10.71	-10.72	-10.80	-10.96	-10.95	-10.93	-10.83	-10.40
40	-10.05	-10.22	-10.10	-10.20	-10.21	-10.38	-9.39	-10.36	-10.25	-10.29
50	-9.54	-9.62	-9.48	-9.60	-9.60	-9.78	-9.79	-9.75	-9.65	-9.75
60	-9.30	-9.34	-9.25	-9.34	-9.38	-9.50	-9.52	-9.49	-9.39	-9.49



	2001				
	17-Jan	16-Mar	20-Jun	03-Oct	08-Nov
0	-9.60	-9.02	-9.20	-9.13	-9.10
5	-13.60	-13.24	-13.38	-13.37	-13.30
10	-14.13	-13.84	-14.00	-14.00	-13.91
20	-14.66	-14.47	-14.61	-14.59	-14.52
30	-14.87	-14.73	-14.88	-14.83	-14.81
35	-10.90	-10.84	-10.90	-10.90	-10.86
40	-10.32	-10.23	-10.33	-10.33	-10.28
50	-9.73	-9.64	-9.74	-9.73	-9.67
60	-9.45	-9.36	-9.46	-9.45	-9.40



Sunshine Coast Regional District

Soames

Measurments in meters from well head
note: measure to edge of manhole and subtract 1.20 meters

	1999			2000										2001							2002							2003			
	Aug.12/99		Dec.10/99	Jan.21/00	Feb.24/00	Mar.22/00	Apr.28/00	May.26/00	Jul.21/00	Aug.18/00	Sept.29/00	Oct.26/00	Nov.16/00	17-Jan	16-Mar	20-Jun	30-Jul	03-Oct	08-Nov		14-Jan	28-Mar	22-May	11-Aug	12-Sep	25-Nov	18-Feb		29-Sep	13-Nov
Static Level	-9.32		-9.23	-9.04	-9.00	-9.01	-9.04	-9.63	-9.46	-9.31	-9.21	-9.10	-9.18	-9.60	-9.02	-9.20 ***		-9.13	-9.10		-9.07	-9.04	-9.02 **		-9.26	-9.50	-9.20		-9.30	-9.26
Drawdown:																														
5 minutes	-13.12			-12.83	-13.24	-13.20	-13.25	-13.58	-13.56	-13.49	-13.40	-13.32	-13.40	-13.60	-13.24	-13.38	-14.11	-13.37	-13.30		-13.25	-13.22	-13.20	-14.76	-13.40	-13.56	-13.37		-13.43	-13.44
10 minutes	-13.69		-13.54	-13.39	-13.86	-13.80	-13.85	-14.07	-14.14	-14.04	-14.00	-13.93	-14.00	-14.13	-13.84	-14.00	-14.44	-14.00	-13.91		N/A	-13.82	-13.80		-14.02	-14.14	-13.99		-14.05	-14.07
20 minutes			-14.10	-13.94	-14.48	-14.40	-14.47	-14.59	-14.67	-14.65	-14.60	-14.50	-14.61	-14.66	-14.47	-14.61	off in auto	-14.59	-14.52		-14.47	-14.45	-14.44		-14.63	-14.71	-14.60		-14.66	-14.69
30 minutes			-14.35	-14.19	-14.74	-14.66	-14.73	-14.79	-14.91	-14.90	-14.85	-14.80	-14.87	-14.87	-14.73	-14.88		-14.83	-14.81		-14.73	-14.71	-14.72		-14.90	-17.97	-14.88		-14.92	-14.97
Recovery:																														
5 minutes	-10.65		-10.71	-10.61	-10.80	-10.71	-10.72	-10.80	-10.96	-10.95	-10.93	-10.83	-10.40	-10.90	-10.84	-10.90	-10.67	-10.90	-10.86		-10.80	-10.79	-10.79	-10.86	-10.97	-11.05	-10.96		-11.02	-10.95
10 minutes	-10.20		-10.19	-10.05	-10.22	-10.10	-10.20	-10.21	-10.38	-9.30	-10.36	-10.25	-10.29	-10.32	-10.23	-10.33	-10.15	-10.33	-10.28		-10.18	-10.20	-10.20	-10.33	-10.41	-10.46	-10.39		-10.43	-10.37
20 minutes			-9.67	-9.54	-9.62	-9.48	-9.60	-9.60	-9.78	-9.79	-9.75	-9.65	-9.75	-9.73	-9.64	-9.74	-9.63	-9.73	-9.67		-9.67	-9.62	-9.60	-9.78	-9.80	-9.85	-9.80		-9.84	-9.78
30 minutes			-9.43	-9.30	-9.34	-9.25	-9.34	-9.38	-9.50	-9.52	-9.49	-9.39	-9.49	-9.45	-9.36	-9.46	-9.39	-9.45	-9.40		-9.37	-9.35	-9.38	-9.55	-9.54	-9.60	-9.52		-9.57	-9.51
														*** pump running upon arrival																
water meter before						4155.2										75862	84545	95384	98564		104151	110281	115887	132554	140611	148950	157272			
meter after						4186.8										75892	84556	95414	98594		104182	110311	115916	132558	140641	148980	157302			
total water pumped						31.6										30	11	30	30		31	30	29	4	30	30	30			
hour meter before				6199.5		6323.8										7494.4	7636.8	7819	7871.2		7962.6	8060.6	8150.3	8424.7	8556.9	8694.3	8831.9			
hour meter after				6200		6324.3										7494.9	7637	7819.5	7871.7		7963.1	8061.1	8150.8	8424.7	8557.4	8694.8	8832.4			
total pump hours				0.5		0.5										0.5	0.2	0.5	0.5		0.5	0.5	0.5	0	0.5	0.5	0.5			
Esperanza Road test point	Aug.12/99	Sept.22/99	Nov. 17/99	Jan-21	Feb-23	mar. 22						Oct-19		Jan-17	15-Mar	20-Jun	30-Jul	09-Oct	08-Nov	15-Nov	14-Jan	02-Apr	23-May	11-Aug	12-Sep	25-Nov	14-Feb	26-May	29-Sep	13-Nov
meters to top of well casing	-94.50	-93.85	-93.78	-93.70	-93.69	-93.57						-93.40		-93.57	-93.60	-93.63	-93.60	-96.67	-93.63	-93.47	-93.71	-93.77	-93.80	-93.86	-93.80	-93.92	-93.98	-94.01	-94.09	-94.04

2000

	Jan.21/00	Feb.24/00	Mar.22/00	Apr.28/00	May.26/00	Jul.21/00	Aug.18/00	Sept.29/00	Oct.26/00	Nov.16/00
0	-9.04	-9.00	-9.01	-9.04	-9.63	-9.46	-9.31	-9.21	-9.10	-9.18
5	-12.83	-13.24	-13.20	-13.25	-13.58	-13.56	-13.49	-13.40	-13.32	-13.40
10	-13.39	-13.86	-13.80	-13.85	-14.07	-14.14	-14.04	-14.00	-13.93	-14.00
20	-13.94	-14.48	-14.40	-14.47	-14.59	-14.67	-14.65	-14.60	-14.50	-14.61
30	-14.19	-14.74	-14.66	-14.73	-14.79	-14.91	-14.90	-14.85	-14.80	-14.87
35	-10.61	-10.80	-10.71	-10.72	-10.80	-10.96	-10.95	-10.93	-10.83	-10.40
40	-10.05	-10.22	-10.10	-10.20	-10.21	-10.38	-9.30	-10.36	-10.25	-10.29
50	-9.54	-9.62	-9.48	-9.60	-9.60	-9.78	-9.79	-9.75	-9.65	-9.75
60	-9.30	-9.34	-9.25	-9.34	-9.38	-9.50	-9.52	-9.49	-9.39	-9.49

2001

	17-Jan	16-Mar	20-Jun	03-Oct	08-Nov
0	-9.60	-9.02	-9.20	-9.13	-9.10
5	-13.60	-13.24	-13.38	-13.37	-13.30
10	-14.13	-13.84	-14.00	-14.00	-13.91
20	-14.66	-14.47	-14.61	-14.59	-14.52
30	-14.87	-14.73	-14.88	-14.83	-14.81
35	-10.90	-10.84	-10.90	-10.90	-10.86
40	-10.32	-10.23	-10.33	-10.33	-10.28
50	-9.73	-9.64	-9.74	-9.73	-9.67
60	-9.45	-9.36	-9.46	-9.45	-9.40

2002

	14-Jan	28-Mar	22-May	12-Sep	25-Nov
0	-9.07	-9.04	-9.02	-9.26	-9.50
5	-13.25	-13.22	-13.20	-13.40	-13.56
10		-13.82	-13.80	-14.02	-14.14
20	-14.47	-14.45	-14.44	-14.63	-14.71
30	-14.73	-14.71	-14.72	-14.90	-17.97
35	-10.80	-10.79	-10.79	-10.97	-11.05
40	-10.18	-10.20	-10.20	-10.41	-10.46
50	-9.67	-9.62	-9.60	-9.80	-9.85
60	-9.37	-9.35	-9.38	-9.54	-9.60

Somes well is located at 871 Ruffum Road in Gibsons, BC

9.49m is the average static level at Soames well.

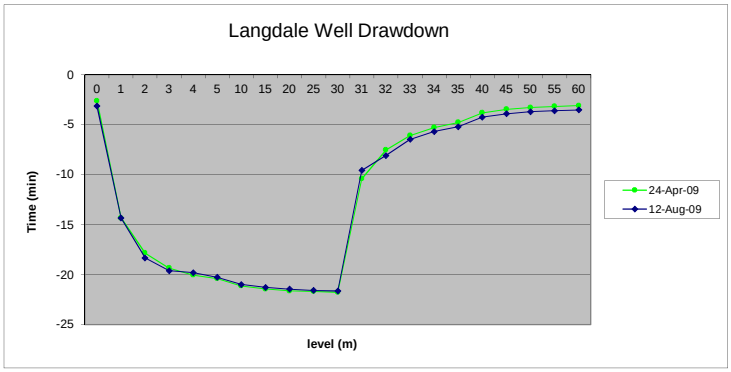
Sunshine Coast Regional District
Langdale Well

Measurments in meters from top of well head

	24-Apr-09	12-Aug-09	11-Feb-10	28-Apr-10	09-May-11	19-Aug-15	23-Jun-17
Static Level:	-2.63	-3.14	-3.00	-0.78	2.82	2.92	2.07
Drawdown: (minutes)							
1	-14.34	-14.35	-14.58	-13.09	13.34	12.72	12.22
2	-17.83	-18.33	-17.66	-17.58	16.86	16.02	15.00
3	-19.34	-19.61		-19.01	18.30	17.40	16.26
4	-20.04	-19.80	-19.64	-19.70	18.93	18.10	16.76
5	-20.40	-20.26	-19.99	-20.03	19.30	18.36	17.07
10	-21.13	-20.98	-20.66	-20.73	19.98	19.03	17.67
15	-21.43	-21.27	-20.92	-21.02	20.21	19.27	17.92
20	-21.62	-21.45	-21.80	-21.18	20.33	19.40	18.10
25	-21.68	-21.57	-21.17	-21.34	20.42	19.50	18.20
30	-21.77	-21.64	-21.28	-21.37	20.49	19.59	18.28
Recovery: (minutes)							
31	-10.42	-9.58	-10.32	-10.54	-9.60	8.59	9.10
32	-7.53	-8.10	-7.68	-7.60	-7.05	6.27	6.61
33	-6.10	-6.48	-6.18	-6.06	-5.78	5.40	5.26
34	-5.30	-5.70	-5.32	-5.31	-5.02	4.87	4.52
35	-4.79	-5.21	-4.88	-4.83	-4.56	4.5	4.06
40	-3.82	-4.25	-3.91	-3.89	-3.62	3.78	3.17
45	-3.48	-3.92	-3.59	-3.56	-3.27	3.5	2.87
50	-3.30	-3.72	-3.4	-3.39	-3.06	3.31	2.69
55	-3.18	-3.62	-3.27	-3.28	-2.92	3.2	2.58
60	-3.10	-3.53	-3.18	-3.2	-2.82	3.12	2.51
pump hours @ start	**74056.7**	**75248.4**	**77307.6**	**78188.1**	**81171.3**	**91084.9**	**94080.9**
water meter @ start	**135109**	**208366**	**333274**	**386428**	**564755**	**139668**	**307214.0**
pump hours @ stop	**74057.2**	**75248.9**	**77308.1**	**78188.7**		**91085.2**	**94081.4**
water meter @ stop	**135138**	**208395**	**333305**	**386459**		**139688**	**307241**
pump hours during drawdown	**0.5**	**0.5**	**0.5**	**0.6**		**0.3**	
water moved (m^3)	**29**	**29**	**31**	**31**		**20**	**27**
Comments	SK/EL	EL/BD	**EL/SG**	**MH/SK**	EL/JG	SK/TM	

Raw data for Graphs:

Time (min)	**24-Apr-09** level (m)	**12-Aug-09** level (m)
0	-2.63	-3.14
1	-14.34	-14.35
2	-17.83	-18.33
3	-19.34	-19.61
4	-20.04	-19.80
5	-20.40	-20.26
10	-21.13	-20.98
15	-21.43	-21.27
20	-21.62	-21.45
25	-21.68	-21.57
30	-21.77	-21.64
31	-10.42	-9.58
32	-7.53	-8.10
33	-6.10	-6.48
34	-5.30	-5.70
35	-4.79	-5.21
40	-3.82	-4.25
45	-3.48	-3.92
50	-3.30	-3.72
55	-3.18	-3.62
60	-3.10	-3.53



Sunshine Coast Regional District

Langdale Well Draw Down Results

Measurments in meters from well head

	1999					2000									
	25-Mar-99	10-Aug-99	22-Sep-99	19-Nov-99	10-Dec-99	21-Jan-00	24-Feb-00	23-Mar-00	28-Apr-00	26-May-00	21-Jul-00	18-Aug-00	29-Sep-00	19-Oct-00	16-Nov-00
Static Level	-2.47	-3.38	-2.70	-2.04		-1.76	-2.03		-2.04	-2.16	-3.11	-2.66			-2.57
Drawdown:															
5 minutes	-17.11	-18.40	-17.94	-17.00		-16.77	-16.93		-17.06	-16.99	-17.87	-17.54			-17.32
10 minutes	-18.00	-18.96	-18.62	-17.73		-17.44	-17.59		-17.72	-17.63	-18.45	-18.16			-17.95
20 minutes		-19.29	-18.80	-18.03		-17.83	-18.01		-18.07	-18.02	-18.85	-18.60			-18.33
30 minutes		-19.41		-18.18		-18.03	-18.20		-18.28	-18.20	-19.02	-18.81			-18.49
Recovery:															
5 minutes	-4.11	-4.96	-4.40	-3.93	-3.95	-3.70	-4.03	-4.03	-4.00	-4.00	-4.78	-4.55	-4.89	-4.41	-4.37
10 minutes	-2.63	-4.12	-3.56	-3.03	-3.06	-2.79	-3.17	-3.11	-3.17	-3.21	-3.93	-3.72	-4.03	-3.62	-3.52
20 minutes		-3.62	-3.12	-2.54	-2.54	-2.31	-2.67	-2.60	-2.67	-2.76	-3.43	-3.25	-3.50	-3.12	-3.05
30 minutes				-2.34	-2.31	-2.10	-2.46	-2.38	-2.48	-2.58	-3.25	-3.07	-3.29	-2.90	-2.86

Pumping Level								-19.34							
pressure well on															
pressure well off															

water meter before						32421000									
meter after						32424800									
total pumped						3800									

pump hour meter before						48341.1									
hour meter after						48341.5									
total pump hours						0.4									

Sunshine Coast Regional District

Langdale Well Draw Down Results

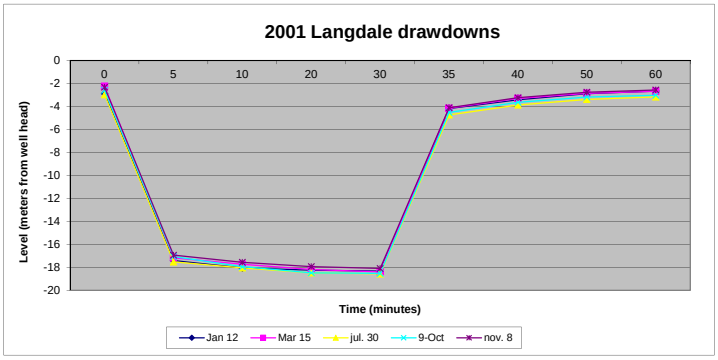
Measurments in meters from well head

	2001						2002							2003			
	Jan.12/01	Mar.15/01	Jun.19/01	Jul.30/01	oct. 9/01	Nov.8/01	Jan.14/02	Mar.26/02	May.22/02	Jul.28/02	Sep.12/02	Oct.9/02	Nov.28/02	Feb.14/03	May 29/03	Sep 29/03	13-Nov
Static Level	-2.87	-2.23 **		-2.97	-2.58	-2.31	-1.89	-2.00 **		-3.10 **		-2.58	-2.26	**	-2.95	-2.71	-2.53
Drawdown:															*		
5 minutes	-17.41	-17.17	-18.86	-17.53	-17.36	-16.94	-16.70	-16.70	-18.42	-17.84		-17.36	-17.16		-17.69	-17.45	
10 minutes	-18.06	-17.74	-18.88	-18.05	-17.95	-17.56	-17.30	-17.18	-18.47	-18.42		-17.95	-17.77		-18.27	-18.00	-17.89
20 minutes	-18.25	-18.19	-18.90	-18.48	-18.48	-17.94	-17.73	-17.65	-18.53	-18.83		-18.48	-18.23		-18.63	-18.36	-18.32
30 minutes	-18.33	-18.40 off in auto		-18.57	-18.53	-18.10	-17.86	-17.92	-18.56	-18.96		-18.53	-18.36		-18.78	-18.56	-18.51
Recovery:																	
5 minutes	-4.17	-4.15	-4.77	-4.73	-4.50	-4.10	-3.74	-3.84	-4.51	-4.83	-4.95	-4.50	-4.00	-4.42	-4.47	-4.53	-4.46
10 minutes	-3.40	-3.29	-3.90	-3.86	-3.63	-3.23	-2.88	-2.94	-3.67	-3.95	-4.03	-3.63	-3.23	-3.54	-3.67	-3.70	
20 minutes	-2.87	-2.85	-3.36	-3.38	-3.17	-2.75	-2.40	-2.48	-3.12	-3.46	-3.49	-3.17	-2.75	-3.00	-3.15	-3.25	-3.10
30 minutes	-2.65	-2.66	-3.12	-3.16	-3.01	-2.55	-2.17	-2.28	-2.88	-3.26	-3.26	-3.01	-2.56	-2.76	-2.90	-3.06	-2.90
Pumping Level									-18.6		-19.09						
pressure well on																	
pressure well off																	
water meter before	62960300		74400500	78694600	84891900	86824000	91079900	95879100	68000	7037800			161917	188465	227608		309862
meter after	62965800		74403200	78700100	84897500	86829600		95884700	75300	7043400			161937	188465	227633		309889
total pumped	5500		2700	5500	5600	5600		5600	7300	5600			20	0	25		27
pump hour meter before	51131.9		52164.9	52563.1	53126.2	53301.1	53684.5	54115.2	54493.8	55139.1			56071.7	56593.5	57363.8		58986.8
hour meter after	51132.4		52165.2	52563.7	53126.7	53301.6		54115.7	54494.5	55139.6			56072.1	56593.5	57364.3		58987.3
total pump hours	0.5		0.3	0.6	0.5	0.5		0.5	0.7	0.5			0.4	0	0.5		0.5

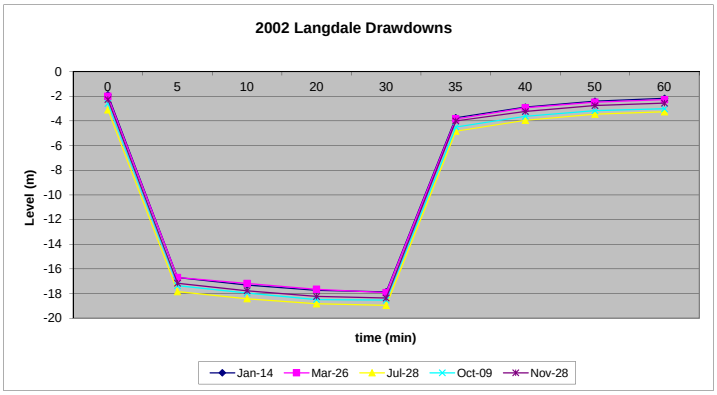
* Level still rising upon arrival

** pump running upon arrival

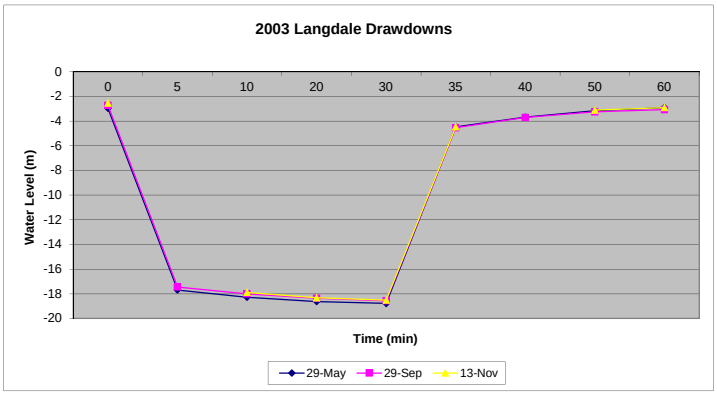
	2001				
	Jan-12	Mar-15	Jul-30	Oct-09	Nov-08
0	-2.87	-2.23	-2.97	-2.58	-2.31
5	-17.41	-17.17	-17.53	-17.06	-16.94
10	-18.06	-17.74	-18.05	-17.95	-17.56
20	-18.25	-18.19	-18.48	-18.48	-17.94
30	-18.33	-18.40	-18.57	-18.53	-18.10
35	-4.17	-4.15	-4.73	-4.50	-4.10
40	-3.40	-3.29	-3.86	-3.63	-3.23
50	-2.87	-2.85	-3.38	-3.17	-2.75
60	-2.65	-2.66	-3.16	-3.01	-2.55

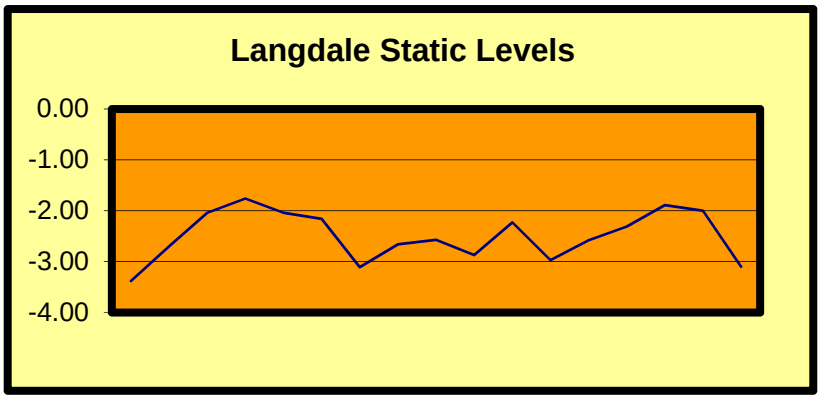


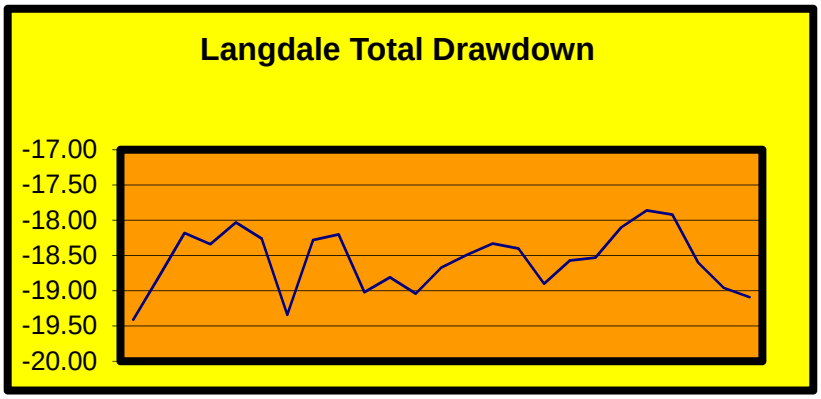
	2002				
	Jan-14	Mar-26	Jul-28	Oct-09	Nov-28
0	-1.89	-2.00	-3.10	-2.58	-2.26
5	-16.70	-16.70	-17.84	-17.36	-17.16
10	-17.30	-17.18	-18.42	-17.95	-17.77
20	-17.73	-17.65	-18.83	-18.48	-18.23
30	-17.86	-17.92	-18.96	-18.53	-18.36
35	-3.74	-3.84	-4.83	-4.50	-4.00
40	-2.88	-2.94	-3.95	-3.63	-3.23
50	-2.40	-2.48	-3.46	-3.17	-2.75
60	-2.17	-2.28	-3.26	-3.01	-2.56

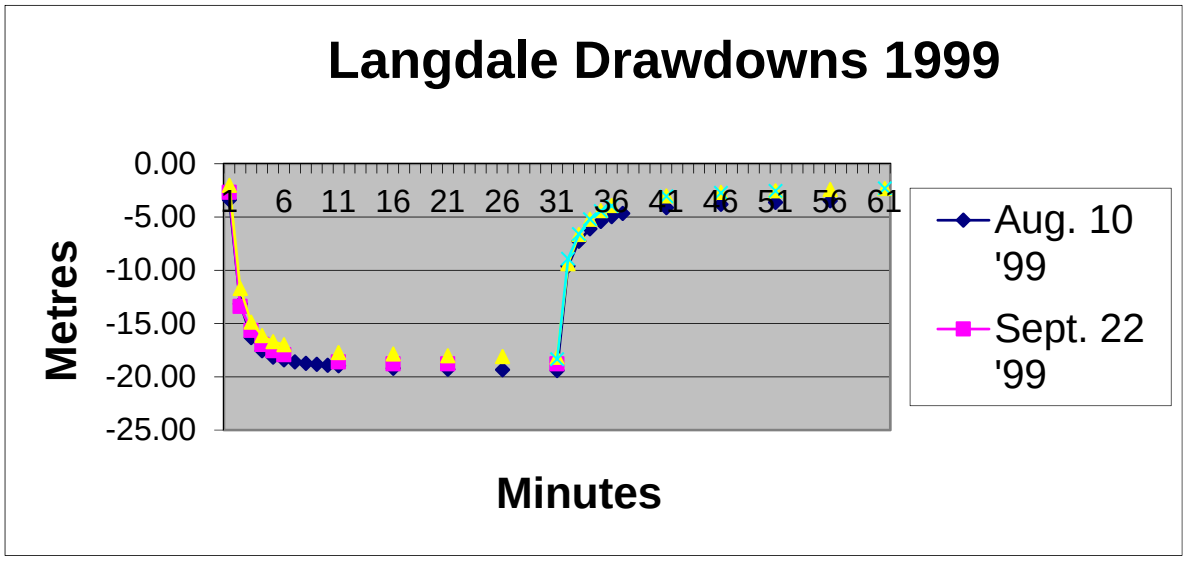


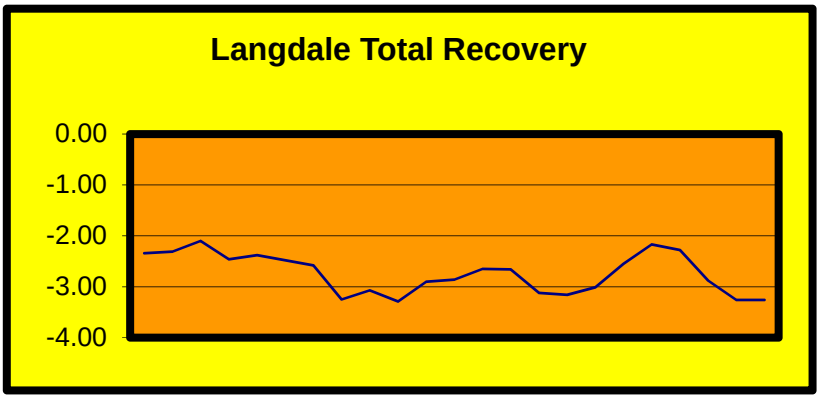
	2003		
	29-May	29-Sep	13-Nov
0	-2.95	-2.71	-2.53
5	-17.69	-17.45	
10	-18.27	-18.00	-17.89
20	-18.63	-18.36	-18.32
30	-18.78	-18.56	-18.51
35	-4.47	-4.53	-4.46
40	-3.67	-3.70	
50	-3.15	-3.25	-3.10
60	-2.90	-3.06	-2.90




Langdale Static Levels
0.00
-1.00
-2.00
-3.00
-4.00


Langdale Total Drawdown
-17.00
-17.50
-18.00
-18.50
-19.00
-19.50
-20.00


Langdale Drawdowns 1999
Metres
0.00
-5.00
-10.00
-15.00
-20.00
-25.00
1
6
11
16
21
26
31
36
41
46
51
56
61
Minutes
Aug. 10 '99
Sept. 22 '99


Langdale Total Recovery
0.00
-1.00
-2.00
-3.00
-4.00

Langdale Well Drawdowns

	Aug. 10 '99	Sept. 22 '99	Nov. 19 '99	Dec. 10 '99	Jan. 21 '00	Feb. 24 '00	Mar. 23 '00
Static	-3.38	-2.70	-2.04		-1.76		
1	-13.15	-13.41	-11.72		-12.18		
2	-16.32	-15.65	-14.88		-14.62		
3	-17.55	-16.98	-16.13		-15.85		
4	-18.15	-17.57	-16.71		-16.45		
5	-18.40	-17.94	-17.00		-16.77		
6	-18.60						
7	-18.73						
8	-18.82						
9	-18.91						
10	-18.96	-18.62	-17.73		-17.44		
11							
12							
13							
14							
15	-19.20	-18.80	-17.87		-17.70		
16							
17							
18							
19							
20	-19.29	-18.80	-18.03		-17.83		
21							
22							
23							
24							
25	-19.34		-18.11		-17.96		
26							
27							
28							
29							
30	-19.41	-18.80	-18.18	-18.34	-18.03	-18.26	-19.34
Rec. 31	-9.60		-9.40	-8.91	-8.00		-9.26
32	-7.27		-6.65	-6.60	-6.36	-6.00	-6.62
33	-6.10		-5.22	-5.20	-4.98	-5.20	-5.26
34	-5.42		-4.41	-4.44	-4.18	-4.48	-4.50
35	-4.96		-3.93	-3.95	-3.70	-4.03	-4.03
36	-4.66						
37							
38							
39							
40	-4.12		-3.03	-3.06	-2.79	-3.17	-3.11
41							
42							
43							
44							
45	-3.80		-2.70	-2.72	-2.46	-2.84	-2.79
46							
47							
48							
49							
50	-3.62		-2.54	-2.54	-2.31	-2.67	-2.60
51							
52							
53							
54							
55	-3.48		-2.42		-2.18	-2.54	-2.47
56							
57							
58							
59							
60			-2.34	-2.31	-2.10	-2.46	-2.38

Langdale Well Drawdowns

Apr. 28 '00	May 26 '00	Jul. 21 '00	Aug. 18 '00	Sept. 29 '00	Oct. 19 '00	Nov. 16 '00	Jan. 12 '01
-2.04	-2.16	-3.11	-2.66			-2.57	-2.87
-11.94	-13.08	-13.00	-12.38			-12.30	-12.88
-15.30	-14.08	-15.92	-15.50			-15.22	-15.42
-16.15	-16.07	-17.05	-16.70			-16.45	-16.62
-16.71	-16.68	-17.60	-17.24			-16.97	-17.14
-17.06	-16.99	-17.87	-17.54			-17.32	-17.41
-17.27							
-17.42							
-17.53							
-17.62							
-17.72	-17.63	-18.45	-18.16			-17.95	
-17.78							-18.06
-17.83							
-17.88							
-17.91							
-17.94	-17.86	-18.72	-18.42			-18.18	-18.18
-17.97							
-17.98							
-18.02							
-18.04							
-18.07	-18.02	-18.85	-18.76			-18.33	-18.25
-18.11							
-18.14							
-18.16							
-18.18							
-18.19	-18.11	-18.94	-18.75			-18.44	-18.36
-18.20							
-18.22							
-18.24							
-18.26							
-18.28	-18.20	-19.02	-18.81	-19.04	-18.67	-18.49	-18.33
-10.28	-8.30	-9.50	-9.44	-9.65	-8.41	-9.21	-9.20
-7.13	-6.20	-7.10	-6.95	-7.25	-6.70	-6.77	-6.71
-5.57	-5.08	-5.90	-5.69	-6.00	-5.40	-5.52	-5.38
-4.65	-4.44	-5.18	-4.98	-5.32	-4.80	-4.80	-4.65
-4.00	-4.00	-4.78	-4.55	-4.89	-4.41	-4.37	-4.17
-3.80							
-3.56							
-3.40							
-3.28							
-3.17	-3.21	-3.93	-3.72	-4.03	-3.62	-3.52	-3.40
-3.08							
-3.00							
-2.95							
-2.89							
-2.85	-2.92	-3.63	-3.42	-3.70	-3.31	-3.22	-3.05
-2.80							
-2.76							
-2.73							
-2.70							
-2.67	-2.76	-3.43	-3.25	-3.50	-3.12	-3.05	-2.87
-2.64							
-2.62							
-2.60							
-2.58							
-2.56	-2.66	-3.35	-3.15	-3.38	-3.00	-2.94	-2.74
-2.54							
-2.52							
-2.50							
-2.49							
-2.48	-2.58	-3.25	-3.07	-3.29	-2.90	-2.86	-2.65

Langdale Well Drawdowns

Mar. 15 '01	Jun. 19 '01	Jul. 31 '01	Oct. 9 '01	Nov. 08 '01	Jan. 14 '02	Mar. 26 '02	May 22 '02
-2.23		-2.97	-2.58	-2.31	-1.89	-2.00	
-11.85		-12.60	-12.28	-11.70	-11.53	-11.62	
-15.00		-15.60	-15.28	-14.79	-14.57	-14.66	
-16.30		-16.80	-16.45	-16.13	-15.83	-15.85	
-16.86		-17.31	-17.06	-16.62	-16.37	-16.41	
-17.17		-17.53	-17.36	-16.94	-16.70	-16.70	
-17.74		-18.05	-17.95	-17.56	-17.30	-17.18	
-18.11		-18.30	-18.34	-17.82	-17.57	-17.41	
-18.19		-18.48	-18.48	-17.94	-17.73	-17.65	
-18.28		-18.48	-18.47	-18.06	-17.78	-17.81	
-18.40	-18.90	-18.57	-18.53	-18.10	-17.86	-17.92	-18.60
-8.95	-9.73	-9.76	-9.74	-9.27	-8.88	-9.05	
-6.46	-7.22	-7.20	-7.08	-6.65	-6.25	-6.40	-6.70
-5.23	-5.95	-5.89	-5.71	-5.30	-4.87	-5.05	-5.65
-4.57	-5.24	-5.15	-4.95	-4.55	-4.18	-4.30	-4.97
-4.15	-4.77	-4.73	-4.50	-4.10	-3.74	-3.84	-4.51
							-4.21
							-4.03
							-3.88
							-3.76
-3.29	-3.90	-3.86	-3.63	-3.23	-2.88	-2.94	-3.67
							-3.59
							-3.50
							-3.43
							-3.38
-3.00	-3.57	-3.55	-3.34	-2.92	-2.57	-2.67	-3.32
							-3.27
							-3.23
							-3.20
							-3.17
-2.85	-3.36	-3.38	-3.17	-2.75	-2.40	-2.48	-3.12
							-3.10
							-3.06
							-3.02
							-3.00
-2.72	-3.22	-3.26	-3.07	-2.62	-2.28	-2.36	-2.99
							-2.97
							-2.94
							-2.92
							-2.90
-2.66	-3.12	-3.16	-3.01	-2.55	-2.17	-2.28	-2.88

Langdale Well Drawdowns

Jul. 28 '02	Sep. 12 '02
-3.10	
-12.85	
-15.87	
-16.98	
-17.54	
-17.84	
-18.42	
-18.56	
-18.83	
-18.87	
-18.96	-19.09
-9.92	-10.10
-7.33	-7.50
-6.02	-6.13
-5.27	-5.40
-4.83	-4.95
	-4.66
	-4.42
	-4.27
	-4.13
-3.95	-4.03
	-3.98
	-3.88
	-3.81
	-3.75
-3.64	-3.70
	-3.65
	-3.59
	-3.57
	-3.52
-3.46	-3.49
	-3.46
	-3.43
	-3.40
	-3.38
-3.35	-3.35
	-3.33
	-3.31
	-3.30
	-3.27
-3.26	-3.26

Langdale well is located at 1410 Sunshine Coast Highway

estimated drill date 1971

The well pump has a capacity 300 GPM @ 510' TDH

The pumping column is 5" pipe x 1" shaft (open lineshaft) 95' deep

Chaster Well Flow Tests

Date	Operators	Time	Pump Status	Valve position	well Level (mm)	Flow (L/Sec)	Pressure (psi)	Turbidity (NTU)	Other comments
20-Mar-14	EL	9:30	off	2" wide open	2995				
		9:35	on	2" wide open	407	17	34		
		9:50	on	2" wide open	342	17	32	3.42	
	EL/KJ	10:30	on	throttled 2"	583	17	62		
		10:30	on	throttled more	860	15	90	2.09	
		10:44	on	2" wide open	311	17	30	2.43	Collected coliform sample
		11:00	off	2"wide open	2949				conductivity = 167us/cm

Sunshine Coast Regional District

Chaster Well

Measurments in meters from top of well head

	19-Apr-10	08-Jun-11	28-Jun-17	
Static Level:	-70.40	72.03	70.00	
Drawdown: (minutes)				
1	-85.32	87.69	83.00	
2	-90.61	92.40	85.05	
3	-92.09	93.61	85.41	
4	-92.46	94.06	85.64	
5	-92.62	94.23	85.70	
10	-92.71	94.50	85.74	
15	-92.73	94.52	85.78	
20	-92.73	94.42	85.81	
25	-92.79	94.41	85.84	
30	-92.82	94.41	85.85	
Recovery: (minutes)				
31	-76.86	79.26	72.65	
32	-72.73	73.80	70.90	
33	-70.96	72.64	70.45	
34	-70.76	72.40	70.34	
35	-70.69	72.33	70.29	
40	-70.58	72.33	70.2	
45	-70.54	72.33	70.17	
50	-70.52	72.33	70.14	
55	-70.50	72.33	70.13	
60	-70.49	72.33	70.12	
pump hours @ start			**7132.2**	
water meter @ start	**705656**		**206707**	
pump hours @ stop			**7132.7**	
water meter @ stop	**705679**		**206726**	

pump hours during drawdown			**0.5**	
water moved (m^3)	**23**		**19**	

Comments	EI/SG	SK/JG		

Sunshine Coast Regional District

Chaster Well

Measurments in meters from top of well head

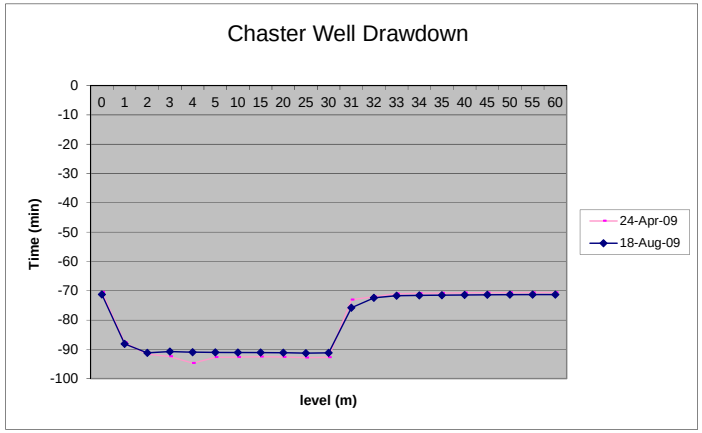
	24-Apr-09	18-Aug-09		
Static Level:	-70.46	-71.32		
Drawdown: (minutes)				
1	-87.71	-88.15		
2	-91.64	-91.24		
3	-92.46	-90.81		
4	-94.72	-91.03		
5	-92.73	-91.05		
10	-92.70	-91.13		
15	-92.55	-91.15		
20	-92.65	-91.16		
25	-92.85	-91.34		
30	-92.76	-91.25		
Recovery: (minutes)				
31	-73.10	-75.83		
32	-72.05	-72.45		
33	-71.04	-71.74		
34	-70.91	-71.60		
35	-70.83	-71.56		
40	-70.72	-71.45		
45	-70.69	-71.41		
50	-70.65	-71.38		
55	-70.63	-71.35		
60	-70.63	-71.35		
pump hours @ start				
water meter @ start	**597114**	**670622**		
pump hours @ stop				
water meter @ stop	**597138**	**670643**		

pump hours during drawdown				
water moved (m^3)	**24**	**21**		

Comments	SK/EL	EL/BD		

Raw data for Graphs:

Time (min)	**24-Apr-09** level (m)	**18-Aug-09** level (m)
0	-70.46	-71.32
1	-87.71	-88.15
2	-91.64	-91.24
3	-92.46	-90.81
4	-94.72	-91.03
5	-92.73	-91.05
10	-92.70	-91.13
15	-92.55	-91.15
20	-92.65	-91.16
25	-92.85	-91.34
30	-92.76	-91.25
31	-73.10	-75.83
32	-72.05	-72.45
33	-71.04	-71.74
34	-70.91	-71.60
35	-70.83	-71.56
40	-70.72	-71.45
45	-70.69	-71.41
50	-70.65	-71.38
55	-70.63	-71.35
60	-70.63	-71.35



Chaster Well is located at 256 Knight road in Gibsons, BC

The well has a 4" pump column surrounded by 3 pump casings (8", 10" and 12")

The estimated year of drilling is 1975.

The well is currently only used in high water demand situations (summer flows) to aid the Chapman water system

Samples of the well water are sent to an independent lab annually and tested for nutrients, drinking water parame

While in use, regular samples are collected from the well and tested for total and fecal coliforms.

Well ID tag #: T-2402X1

Sunshine Coast Regional District

Chaster Well

Measurments in meters from well head

Note: measure to edge of manhole and subtract 1.35M

	1999					2000										2001							2002							2003		
	Mar. 25/99	Aug.11/99	Sept.22/99	Nov.18/99	Dec.10/99	Jan.20/00	Feb.23/00	Mar.22/00	Apr.28/00	May.25/00	Jul.21/00	Aug.17/00	Sept.29/00	Oct.25/00	Nov.15/00	Jan.17/01	Mar.16/01	Jun.18/01	Jul.28/01	Oct.3/01	Nov.25/01		Jan.14/02	Apr. 2/02	May.23/02	Aug.10/02	Sep.12/02	Oct.3/02	Nov.25/02	14-Feb	26-May	13-Nov
Static Level	-70.16	-71.27	-70.38	-70.23	-70.20	-70.08	-70.05	-70.00	-70.01	-69.98	-71.07	-71.13	-70.27	-70.05	-70.07	-70.11	-69.98		-70.50	-70.16	-70.01		-70.10	-70.09	-70.08		-70.20	-70.16	-70.27	-70.10	-70.08 ***	
Drawdown:																	***								***							
5 minutes		-89.72	-86.74	-87.12	-86.12	-86.83	-87.00	-86.27	-85.96	-86.55	-88.90	-88.81	-87.21	-89.96	-86.68	-86.28	-86.27	-88.38	-87.53	-86.74	-86.53		-85.55				-87.60	-86.74				
10 minutes	-85	-89.79	-86.88	-87.21	-86.34	-86.82	-87.10	-86.36	-85.92	-86.65	-89.05	-88.85	-87.41	-87.11	-86.96	-86.43	-86.41	-88.36	-87.55	-86.77	-86.51		-85.45				-87.65	-86.77				
20 minutes	-85.89	-89.72	-87.05	-87.25	-86.38	-86.98	-87.03	-86.44	-86.11	-86.70	-89.07	-88.90	-87.28	-87.29	-86.90	-86.45	-86.33	-88.40	-87.67	-86.83	-86.55		-85.60				-87.75	-86.83				
30 minutes	-86.02	-89.76		-87.22		-87.01	-89.72	-86.45	-86.04	-86.68	-89.09	-88.95	-87.37	-87.06	-87.15	-86.44	-86.45	-88.42	-87.68	-86.90	-86.67		-85.61			-88.48	-87.78	-86.90				
Recovery:																																
5 minutes	-70.56	-71.56	-70.65	-70.51	-70.46	-70.40	-70.34	-70.30	-70.30	-70.03	-71.35	-71.40	-70.59	-70.36	-70.40	-70.41	-70.29	-70.88	-70.80	-70.48	-70.33		-70.38			-71.17	-70.52	-70.48				-72.46
10 minutes	-70.51	-71.43	-70.55	-70.42	-70.37	-70.30	-70.25	-70.21	-70.21	-70.20	-71.23	-71.27	-70.49	-70.27	-70.30	-70.31	-70.21	-70.77	-70.70	-70.38	-70.23		-70.29			-71.06	-70.43	-70.38				-72.39
20 minutes		-71.35	-70.50	-70.36	-70.32	-80.24	-70.19	-70.14	-70.15	-70.15	-71.12	-71.16		-70.20	-70.24	-70.24	-70.16	-70.68	-70.63	-70.32	-70.17		-70.22			-70.99	-70.37	-70.32				-72.34
30 minutes		-71.27				-70.21	-70.16	-70.11		-70.11	-71.07	-71.13		-70.18	-70.23	-70.22	-70.13	-70.63	-70.60	-70.29	-70.14		-70.20			-70.93	-70.36	-70.29				-72.30
																*** pump running upon arrival							*** pump running upon arrival							*** pump running upon arrival		
Pumping Level		-89.85									-90.79	-90.21																				
pressure well on						170psi				170psi				168psi	170psi					165 psi			173 psi									
pressure well off										100psi				110psi	110psi								108 psi									
water meter before						984125.5	985004.3	985033.6						45479				48097	76747.5	88113.2	88182		88206									
meter after						984150	985033.6	985057.4						45504.7				48121.3	76771.1	88136.8	88206		88229									
total pumped						24.5	29.3	23.8						25.7				24.3	23.6	23.6	24		23									
pump hour meter before						9585.2	9602.8	9603.4						10827.3				10879.8	11473.7	11709.3	11710.8		11711.3				12502.3					
hour meter after						9585.7	9603.4	9603.9						10827.8				10880.2	11474.2	11709.8	11711.3		11711.8				12502.8					
total pump hours						0.5	0.6	0.5						0.5				0.4	0.5	0.5	0.5		0.5				0.5					

Note: recorded on June 18th 2001 - 94 meters to top of pump and 94.33m to low level probe shut off

GRANDVIEW static level		-22.90	-22.87	-22.93		-22.83	-22.75	-22.55						-22.86		-23.00	-22.88	-22.90	-22.97	-23.05	-23.04	-22.94	-23.00	-22.70	-22.67	-22.83			-23.06	-23.12	-23.00	
		12-Aug	22-Sep	17-Nov		20-Jan	23-Feb	22-Mar						19-Oct		17-Jan	15-Mar	18-Jun	30-Jul	03-Oct	08-Nov	15-Nov	14-Jan	02-Apr	23-May	10-Aug			25-Nov	14-Feb	26-May	

Sunshine Coast Regional District

Langdale, Soames,Chaster,Granthams Wells

Measurments in meters from top of well head

	Chaster	Soames	Langdale
	28-Jun-17	**23-Jun-17**	**23-Jun-17**
Static Level:	70.00	10.31	2.07
Drawdown: (minutes)			
1	83.00	13.26	12.22
2	85.05	13.65	15.00
3	85.41	13.92	16.26
4	85.64	14.14	16.76
5	85.70	14.31	17.07
10	85.74	14.91	17.67
15	85.78	15.27	17.92
20	85.81	15.49	18.10
25	85.84	15.64	18.20
30	85.85	15.73	18.28
Recovery: (minutes)			
31	72.65	13.10	9.10
32	70.90	12.68	6.61
33	70.45	12.37	5.26
34	70.34	12.18	4.52
35	70.29	12.02	4.06
40	70.2	11.43	3.17
45	70.17	11.08	2.87
50	70.14	10.86	2.69
55	70.13	10.70	2.58
60	70.12	10.59	2.51
pump hours @ start	**7132.2**	**6941.30**	**94080.9**
water meter @ start	**206707**	**804116.0**	**307214.0**
pump hours @ stop	**7132.7**	**6941.8**	**94081.4**
water meter @ stop	**206726**	**804125.0**	**307241**
pump hours during drawdown	**0.5**	**0.5**	
water moved (m^3)	**19**	**NA**	**27**
Comments			

Granthams

28-Jun-17		
	Amount of Overflow (sec/10L)	
Well On	Pipe 1	Pipe 2
1.00	3.79	36.00
2.00	3.60	36.63
3.00	3.99	36.56
4.00	3.86	35.85
5.00	3.67	35.84
Average	3.78	36.18
Well Off		
1.00	3.93	5.75
2.00	3.85	5.50
3.00	3.73	4.97
4.00	3.93	5.04
5.00	3.80	4.71
Average	3.85	5.19

Note: Granthams well is an artesian well and therefore we measure the amount of overflow from pipe 1 and pipe 2 with the well running at the max 2.75 L/S @ 122 psi. The measurement is amount of secs required to get 10L.

Report To	MAT KAVANAGH, LEHIGH HEIDELBERG CEMENT GROUP 5784 Sechelt Inlet Road Sechelt, BC V0N 3A3	**Date Received** **Report Date** **Report Revision** **Version**	23-Aug-2017 07:00 24-Aug-2017 17:24 1 FINAL
Client Phone	604-312-0848		

Certificate of Analysis

Lab Work Order #	L1979208
Project P.O. #	4500655861
Job Reference	SECHELT
Legal Site Description	
C of C Numbers	15-569472

Case Narrative/Comments

Heather McKenzie
Account Manager

Sample Summary L1979208

Job Reference	SECHELT
Report To	MAT KAVANAGH, LEHIGH HEIDELBERG CEMENT GROUP
Date Received	23-Aug-2017 7:00
Report Date	24-Aug-2017 17:24
Report Version	1

Sample Details

ALS Sample ID	Client Sample ID	Matrix	Date Sampled	Time Sampled	Qualifier
L1979208-1	SP17-1	Water	22-Aug-17	12:00	
L1979208-2	SP17-2	Water	22-Aug-17	12:00	
L1979208-3	SP17-3	Water	22-Aug-17	12:00	

Results Summary L1979208

Job Reference	SECHELT
Report To	MAT KAVANAGH, LEHIGH HEIDELBERG CEMENT C
Date Received	23-Aug-2017 7:00
Report Date	24-Aug-2017 17:24
Report Version	1

Client Sample ID	SP17-3
Date Sampled	22-Aug-2017
Time Sampled	12:00
ALS Sample ID	L1979208-3

Parameter	Lowest Detection Limit	Units	Water
Anions and Nutrients (Water)			
Chloride (Cl)	0.50	mg/L	10.9
Total Metals (Water)			
Sodium (Na)-Total	0.050	mg/L	8.10

Results of Analysis L1979208

Job Reference SECHELT
Report To MAT KAVANAGH, LEHIGH HEIDELBERG CEMENT GROUP
Date Received 23-Aug-2017 7:00
Report Date 24-Aug-2017 17:24
Report Version 1

Parameter	ALS ID	Client Sample ID	ALS Test Code	Results	Detection Limit	Units	Qual	Date Sampled	Time Sampled	Prep Date	Analysis Date	QC Lot	QC Eval	Hold Time Eval	Matrix	Class
Anions and Nutrients (Water)																
Chloride (Cl)	L1979208-3	SP17-3	CL-IC-N-VA	10.9	0.50	mg/L		22-Aug-17	12:00		24-Aug-17	720344	✓	✓	Water	Anions and Nutrients
Total Metals (Water)																
Sodium (Na)-Total	L1979208-3	SP17-3	MET-T-CCMS-VA	8.10	0.050	mg/L		22-Aug-17	12:00		24-Aug-17	719679	✓	✓	Water	Total Metals

Evaluation Legend
✓ QC Lot met ALS Data Quality Objectives or Test result met ALS Hold Time Recommendations

Quality Control L1979208

Job Reference SECHELT
Report To MAT KAVANAGH, LEHIGH HEIDELBERG CEMENT GROUP
Date Received 23-Aug-2017 7:00
Report Date 24-Aug-2017 17:24
Report Version 1

QC Type	Analyte	QC Lot #	ALS QC ID	Result	Target	Units	%	Limit	Units	Qual	Eval	Matrix	Class
Anions and Nutrients (Water)													
LCS	Chloride (Cl)	720344	WG2599689-8	102	100	mg/L	102.2	90-110	%		✓	Water	Anions and Nutrients
Total Metals (Water)													
LCS	Sodium (Na)-Total	719679	WG2599828-2	50.7	50	mg/L	101.4	80-120	%		✓	Water	Total Metals
Anions and Nutrients (Water)													
MB	Chloride (Cl)	720344	WG2599689-6	<0.50		mg/L	-	<0.50	mg/L		✓	Water	Anions and Nutrients
Total Metals (Water)													
MB	Sodium (Na)-Total	719679	WG2599828-1	<0.050		mg/L	-	<0.050	mg/L		✓	Water	Total Metals
MS	Sodium (Na)-Total	719679	SP17-3	10.1	10.1	mg/L	N/A	-	%	MS-B		Water	Total Metals

Qualifier Legend

MS-B Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Evaluation Legend

✓ QC Lot met ALS Data Quality Objectives

Methodology L1979208

Job Reference	SECHELT
Report To	MAT KAVANAGH, LEHIGH HEIDELBERG CEMENT GROUP
Date Received	23-Aug-2017 7:00
Report Date	24-Aug-2017 17:24
Report Version	1

ALS Test Code	ALS Test Description	Lab Location	Matrix	Method Reference	Methodology Description
Anions and Nutrients (Water)					
CL-IC-N-VA	Chloride in Water by IC	Vancouver	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Total Metals (Water)					
MET-T-CCMS-VA	Total Metals in Water by CRC ICPMS	Vancouver	Water	EPA 200.2/6020A (mod)	Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

Detection Limits L1979208

Job Reference	SECHELT
Report To	MAT KAVANAGH, LEHIGH HEIDELBEI
Date Received	23-Aug-2017 7:00
Report Date	24-Aug-2017 17:24
Report Version	1

Client Sample ID		SP17-3
Date Sampled		22-Aug-2017
Time Sampled		12:00
ALS Sample ID		L1979208-3
Parameter	Units	Water
Anions and Nutrients (Water)		
Chloride (Cl)	mg/L	0.50
Total Metals (Water)		
Sodium (Na)-Total	mg/L	0.050

APPENDIX D

CLASS 3 COST ESTIMATE – DRILLING AND TESTING

Class 3 Cost Estimate - Test Well Drilling and Installation (4 Well Program)

Waterline Resources Inc
2430 Jingle Pot Road
Nanaimo, BC,

Attention: SCRD

Estimate: Construction of four 6" test wells assume each to 500' with standard 10" surface seal and 8' screen.

Item	Description	Units	Unit	$/unit	Totals
1	Mobilize and de-mobilization	lump sum	1	$10,000.00	$10,000.00
2	Install Sanitary Surface seal Bentonite to 18 ft.	each	4	$700.00	$2,800.00
3	Drill and case 6" diameter	feet	2000	$43.00	$86,000.00
4	Supply and weld 6" casing drive shoe	each	4	$350.00	$1,400.00
5	Supply 6" telescopic, SS well screen	4' sections	8	$850.00	$6,800.00
	Supply bottom, riser, k-pack		4	$275.00	$1,100.00
6	Drill open hole through rock	feet		$25.00	
7	Supply 4" CSA potable PVC plastic liner (if req)	feet		$5.25	
8	Standby for delays caused by others	hours	10	$200.00	$2,000.00
9	Hourly for screen installation, development, airlifting, moving or other non-drilling work	hours	44	$ 375.00	$16,500.00
10	Room and board (3 crew)	man day	48	$200.00	$9,600.00
Prices do not include GST.		**TOTAL ESTIMATED COST**			**$ 136,200.00**

Quantities listed are Class 3 estimates -20% to +30%.
Actual cost will be determined by quantities required, multiplied by the cost per unit as above.

The following unknowns can significantly affect the cost of a drilling and completing a test well:

- Well depth: Based on surrounding information well depths are all expected to be in the 150m (500 ft) range. Assuming this is correct and consistent ground conditions are present at all sites it is expected that drilling and completion would require 4 days per site to install;
- Well diameter: Test well sizes are assumed to be 6” with short well screens (8 ft), as longer screens take more time to develop and are therefore more costly. Development time is estimated to be 1 hour per foot of well screen but longer development times are possible if an aggressive screen design (i.e., larger open area within screen) is selected. The screen design can only be determined once aquifer samples are collected and analyzed.
- Pumping test: Aquifer testing of test wells is typically 48 hours pumping and 48 hours recovery, but may vary depending on aquifer properties and groundwater level response during pumping.

Class 3 cost estimate for running four 48 hr pumping tests @ 500 GPM

Item	Description	Unit	Quantity	Unit Price ($)	Total ($)
1	Mobilize and demobilize test pump with power unit and all necessary accessories to and from the site.	Lump Sum	1	4,000.00	4,000.00
2	Set and pull pump	Hourly	16	$175.00	$2,800.00
3	Supply Discharge pipe	Lin. Meter	65	$3.35	$217.75
4	Step pumping & recovery tests	Hourly	8	$175.00	$1,400.00
5	Carry out constant rate pumping	Hourly	48	$175.00	$8,400.00
6	Monitoring water level recovery	Hourly	6	$175.00	$1,050.00
7	Standby rate for pump and Crew	Hourly	8	$175.00	$1,400.00
8	Subsistence	Per Day	5	$200.00	$1,000.00
9	Silent run gen. set rental	Lump	1	$2,800.00	$2,800.00
Subtotal for testing 4 wells (not including Mob/Demob)			4	$19,067.75	$76,271.00
Total (not including taxes)					**$80,271.00**

Note: Quantites may vary, unit pricing will remain constant

Cost Estimate - Hydrogeological Support for Phase 2 Groundwater Exploration (4 well Program)

PROFESSIONAL FEES									
TASK	DESCRIPTION	Waterline Personnel Allocation							Cost
		Title	Principal Hydrogeo	Senior Hydrogeo / Engineer	Intermed. Hydrogeo	GIS Analyst	Project Scientist	Admin	
		Hour Rate	$210	$170	$120	$120	$100	$80	
		Hours							$
TASK 1 Project Management	Project management; client and contractor liason; interim project update meeting; budget control		4		16			2	$2,920.00
	Health and safety program, develop ERP and work permits.				4				$480.00
TASK 2 Drilling and Testing - 6" Test Well West of Gibsons	Pre-mobilization equipment preparation.				2			2	$400.00
	Provide on-site hydrogeological support during drilling and well completion. Allow 4 days @ 12 hours/day				48				$5,760.00
	Provide on-site hydrogeological support during aquifer testing. Assume 48-hr pumping test. Allow 3 days at 12 hours/day			2	36				$4,660.00
	Data compilation, analysis, and reporting. Meeting to discuss recommendations.		4		36	8	8		$6,920.00
TASK 3 Drilling and Testing - 6" Test Well Chapman Creek / Sechelt	Pre-mobilization equipment preparation.				2			2	$400.00
	Provide on-site hydrogeological support during drilling and well completion. Allow 4 days @ 12 hours/day			2	48				$6,100.00
	Provide on-site hydrogeological support during aquifer testing. Assume 48-hr pumping test. Allow 3 days at 12 hours/day				36				$4,320.00
	Data compilation, analysis, and reporting. Meeting to discuss recommendations.		4		36	8	8		$6,920.00
TASK 4 Drilling and Testing - 6" Test Well Gray Creek	Pre-mobilization equipment preparation.				2			2	$320.00
	Provide on-site hydrogeological support during drilling and well completion. Allow 4 days @ 12 hours/day			2	48				$5,760.00
	Provide on-site hydrogeological support during aquifer testing. Assume 48-hr pumping test. Allow 3 days at 12 hours/day				36				$4,320.00
	Data compilation, analysis, and reporting. Meeting to discuss recommendations.		4		36	8	8		$5,560.00
TASK 5 Drilling and Testing - 6" Test Well Soames Point	Pre-mobilization equipment preparation.				2			2	$400.00
	Provide on-site hydrogeological support during drilling and well completion. Allow 4 days @ 12 hours/day			2	48				$6,100.00
	Provide on-site hydrogeological support during aquifer testing. Assume 48-hr pumping test. Allow 3 days at 12 hours/day				36				$4,320.00
	Data compilation, analysis, and reporting. Meeting to discuss recommendations.		4		36	8	8		$6,920.00
TOTAL PROFESSIONAL FEES		Hours	20	8	508	32	32	10	610
		Cost	$4,200.00	$1,360.00	$60,960.00	$3,840.00	$3,200.00	$800.00	**$74,360.00**

Cost Estimate - Hydrogeological Support for Phase 2 Groundwater Exploration (4 well Program)

EXPENSES					
TASK	**DESCRIPTION**	**Unit**	**# of Units**	**$/Unit**	**Cost**
Mob/demob	Flights - round trip	lump	4	$300.00	$1,200.00
Crew truck	Daily travel less than 200 km	day	28	$220.00	$6,160.00
Accommodation	Hotel on Sunshine Coast	day	28	$150.00	$4,200.00
Subsistence	Daily subsistence	day	28	$70.00	$1,960.00
Field equipment	Water level tape, pH/EC meter, 4-Gas monitor, laptop, GPS, digital camera, consumables, etc.	day	28	$150.00	$4,200.00
	RENTAL of 2-dataloggers, 1-direct read cable, 1-barologger	week	3	$800.00	$2,400.00
	Sieve Kit for well screen design	week	3	$200.00	$600.00
Laboratory analytical costs Estimated	Extensive Potability Package (assume 2 samples per well location)	lump	8	$500.00	$4,000.00
Shipping	Courier equipment and samples	lump	4	$200.00	$800.00
Third party mark-up	10% mark-up on third party invoices (lab analysis)	%	0.1	$4,000.00	$400.00
Misc. Expenses 8% of Fees	Miscellaneous expenses (GIS systems, phone, reproduction, courier, etc.) (8% of fees).	%	0.08	$74,360.00	$5,948.80
TOTAL EXPENSES					**$31,868.80**
TOTAL PROFESSIONAL FESS AND EXPENSES (GST not included)					**$106,228.80**

NOTES:	
1	The Client will be responsible for coordinating the utility locates.
2	The Client will be responsible for site prep and access.
3	Waterline assumes the Client will directly contract the drilling contractor. Waterline will provide assistance in coordinating the contractor and developing a cost estimate.
4	Waterline charges a 10% mark-up handling fee for third party costs unless billed directly to the Client.
5	The aquifer test contractor will be responsible for supplying and installing a pump and the required equipment for testing (back-up flow meter, discharge lines, flow control valve)

SUNSHINE COAST REGIONAL DISTRICT STAFF REPORT

TO: Infrastructure Services Committee – October 19, 2017

AUTHOR: Michael Day, GM Infrastructure Services / Regional Engineer

SUBJECT: **INFRASTRUCTURE SERVICES DEPARTMENT – 2017 Q3 REPORT**

RECOMMENDATION(S)

THAT the report titled Infrastructure Services Department – 2017 Q3 Report be received.

BACKGROUND

The purpose of this report is to provide an update on activities in the Infrastructures Services Department for the Third Quarter (Q3) of 2017: July 1 to September 30.

The report provides information from the following divisions: Water, Waste Water, Solid Waste, Recycling, Green Waste, Transit and Fleet.

Utilities Division [365, 366, 370]

PROJECTS - CAPITAL WORKS

- **Water main replacement program**
  - Mason Road
    - Scheduled for October construction.
  - Nor-West Bay Road
    - Installation complete. Testing and tie-in to existing water system yet to be completed.
  - Reed Road
    - Design completed.
  - South Pender Harbour
    - Design completed and construction RFP out for tender.
  - North Pender Harbour
    - Design completed and construction RFP out for tender.
  - Soames Point Chlorine Project
    - Design completed for chlorination station and permits approved.
  - Eastbourne
    - An RFP for construction and maintenance of the water system is under development.
- **Water Projects**
  - Chlorine Upgrade Study
    - Contract was awarded to Opus International Consultants. The kick off meeting was held on October 4.

- **Wastewater**

  - YMCA/Langdale
    - Community communication regarding best practices for using sewer systems took place in July. Staff continue to assess data acquired from the trial integration of both systems.

  - Square Bay
    - Contract awarded to EcoFluids on June 26, kickoff meeting with staff held June 27, 2017.
    - Staff continue to work with Ecofluids regarding design and construction requirements.

  - Canoe Road
    - Survey of site completed
    - RFP developed and under review by senior management.

  - Merrill Crescent
    - Survey of site completed
    - RFP developed and under review by senior management.

Universal Metering Phase 2 Electoral Areas:

Rural Metering Project – Installation Progress Summary, Sept 29						
Area	**Egmont/ Cove Cay**	**Halfmoon Bay**	**Roberts Creek**	**Elphinstone**	**West Howe Sound**	**Total**
Completed Installs	86	1383	1080	1257	734	**4540**
Total to Complete	2	12	50	94	65	**223**
Percentage Complete	98%	99%	96%	93%	92%	**95%**

Phase 3 – Sechelt – Staff applied for a funding grant for the Sechelt Metering Project in May 2017 and are awaiting a decision from the Gas Tax Strategic Priorities fund which is expected by the end of November.

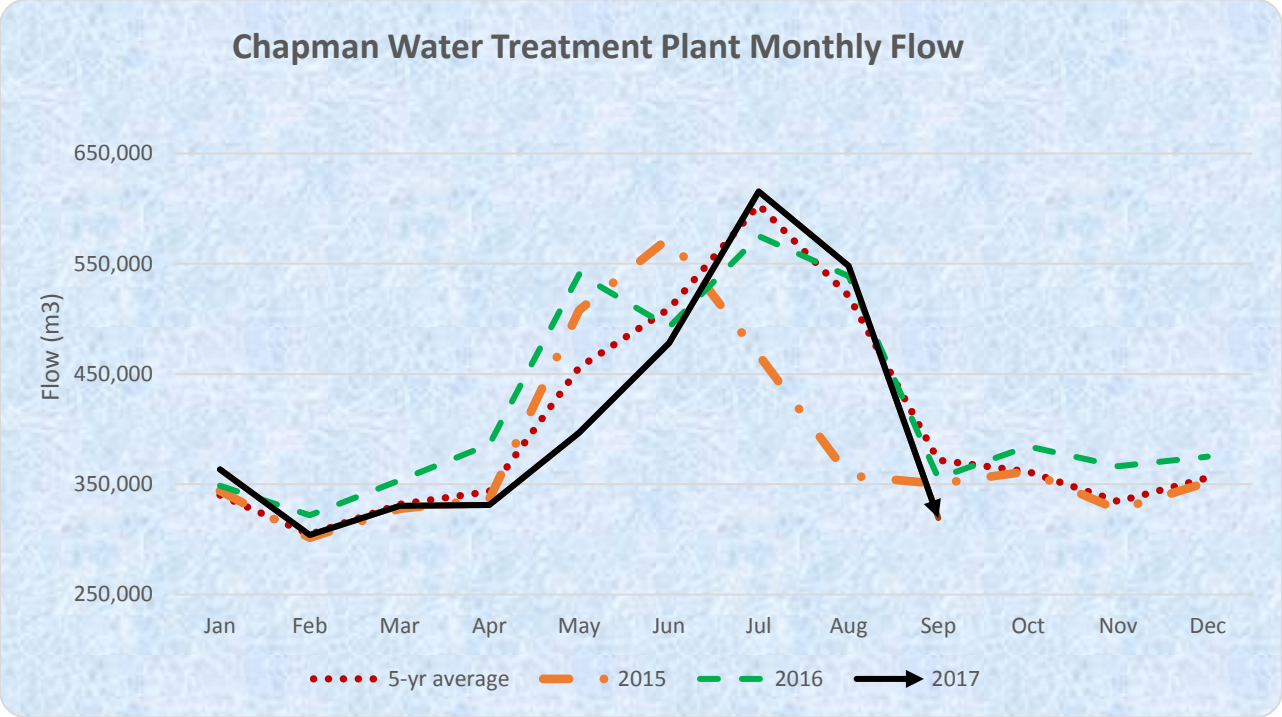
OPERATIONS

Statistics - Water

WATER DISTRIBUTION SYSTEM

CHAPMAN WATER TREATMENT PLANT

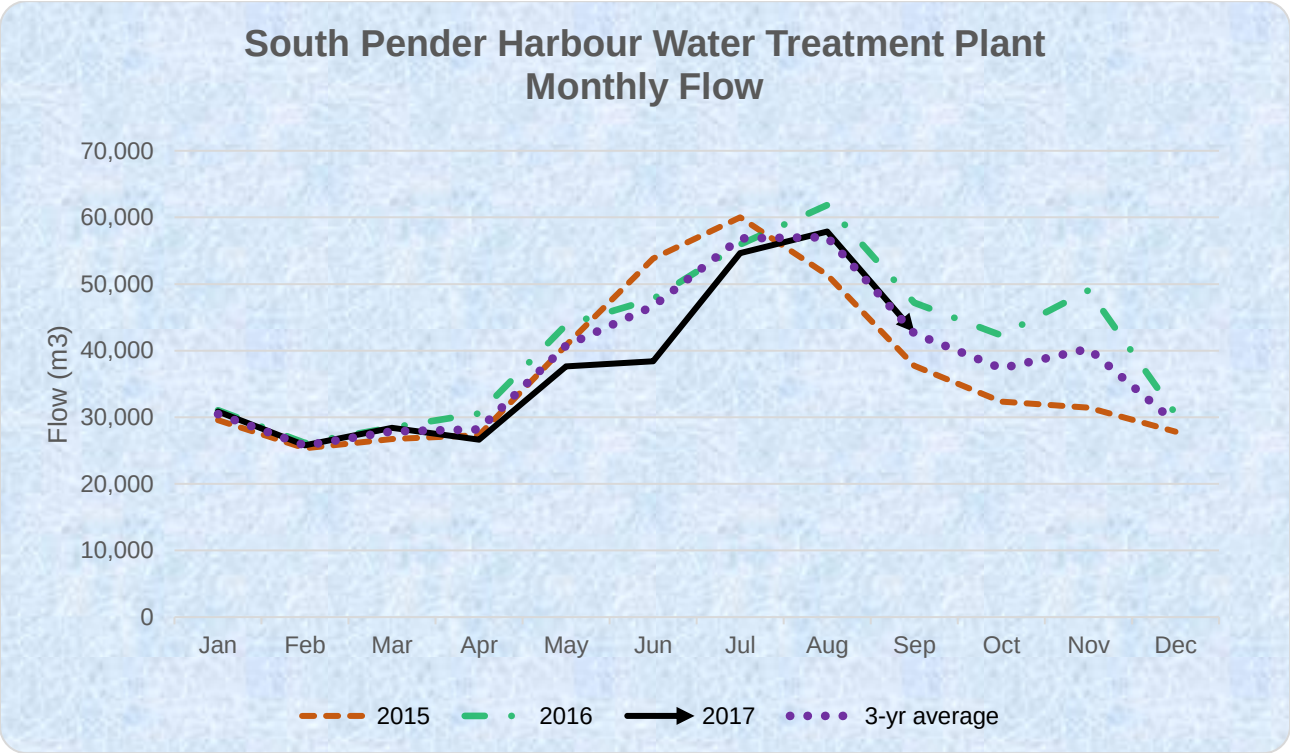
In the third quarter, the Chapman Creek Water Treatment Plant produced and supplied 1,482,744m^3, a 1% decrease over the five year average.



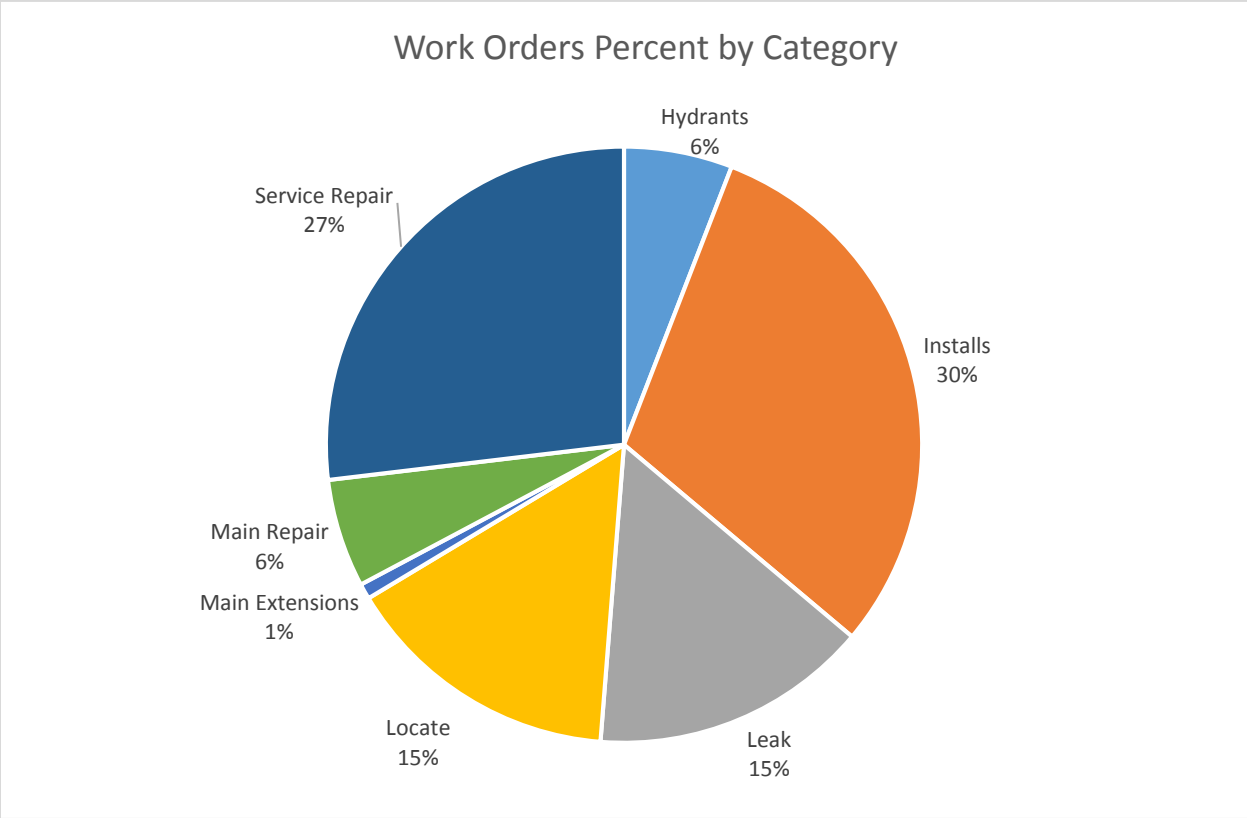
The sharp decline in production in the month of August aligns with the completion of repairs at many properties with significant leaks combined with the typical reduction in irrigation that came with lower temperatures mid-August. September consumption was the lowest in five years which can be attributed to community response to the declaration of Stage 3 water restrictions again combined with lower temperatures, rain showers and ongoing leak repairs.

SOUTH PENDER WATER TREATMENT PLANT

In the third quarter, the South Pender Water Treatment Plant produced and supplied 155,257 m^3, a 6.3% decrease from last year. A multi-year comparison will be provided once three full years of data become available.



Utility Services
Work Orders Issued in Q3 2017



Transportation and Facilities [310, 312, 345, 350]

PROJECTS

Transit

Expansion Preparation
Preparation for transit expansion is now complete. Preparation has included driver and service person re-orientation, the review and updating of daily bus preparation procedures, and changes to bus assignment procedures and driver pre-trip inspections. New schedules were confirmed and the Rider's Guide was developed and distributed online, at fare product outlets and at other public locations. PDF copies of the new schedule were made available well in advance. Updated uniforms were received and issued to all drivers.

Staffing
Additional drivers were hired and trained in preparation for expansion, however with the combination of expansion, two retirements and shift changes, additional hiring has continued. Dispatch support staffing is complete. A Transit Superintendent has been selected and will to start on October 31st.

Promotional Activities
Promotional activities completed over the summer included participation in both the Canada Day Parade and the Sea Cavalcade Parade, accompanied by "Double Your Daypass" promotion for those two events, as well as an information table at Sunnycrest Mall for Seniors Day.

Fleet Maintenance

Expansion Preparation
All Vicinity buses are now on site and have been prepared for expanded transit service beginning October 10th. Yard grading is complete and parking arrangements were adjusted to accommodate the six additional buses. All mechanics have received a thorough orientation on maintenance and repair of the new buses, with an in-depth "train the trainer" week set to occur in November. Some minor reliability and power issues stemming from the newness of the design are being worked on in collaboration with BC Transit.

Refurbishment
Two full-sized buses have returned from the refurbishment process with new colours and interior materials, while the next two buses have been sent out; the fleet is on its way to consistent colouring and state of repair. The refurbishment of the fleet heavy hoist has been completed, with some cost savings as a result of work being done internally.

OPERATIONS

Statistics – Transit

While the Q1 and Q2 invoices have now been submitted to BC Transit, the corresponding statistical information is still based on accruals; actual costs are not yet available. Ridership data however is obtained separately from cost data. Preliminary BC Transit ridership figures show an increase of 4.5% over last year at this time.

Solid Waste [350, 351, 352, 353, 355]
PROJECTS

2017 Islands Clean Up
The 2017 Islands Clean Up service is now complete. Six events were held on:

- Saturday, August 12
  - 1 event: Gambier Island and Anvil Island flag stops
- Saturday, August 26
  - 4 events: Gambier on land at New Brighton, Keats on land at Keats Landing and Eastbourne, and Keats Island flag stops
- Sunday, September 10 (rescheduled from Saturday, September 9)
  - 1 event: Thormanby and Trail Islands flag stops

Mercury Transport Inc. provided barge services for all events with one SCRD staff member overseeing each event.

The total tonnage of materials collected is outlined below.

- Garbage, durable goods and glass: 20.5 tonnes
- Fridges/Freezers: 47 units
- Mattresses: 62 units

2017 Backroad Trash Bash
The SCRD's 6th Annual Backroad Trash Bash was held on Saturday, September 16, 2017.

In total, 82 community volunteers cleaned up 7.83 tonnes of household garbage, scrap metal, furniture and construction and demolition material from 18 illegal dump sites from Port Mellon to Elphinstone, as well as off the B&K forest service road in Roberts Creek.

This is the highest number of event volunteers to date since the program launched in 2012.

The 2018 Backroad Trash Bash will be taking place in Pender Harbour/Egmont.

Pender Harbour Trash Bash
In addition, the Pender Harbour Advisory Council hosted their own community Trash Bash on Saturday, September 23, 2017. A total of 40 community volunteers collected 2.3 tonnes of illegally dumped materials in the Pender Harbour area. The SCRD paid approximately $1,000 for the tipping fees associated with this clean up through the Good Samaritan Program.

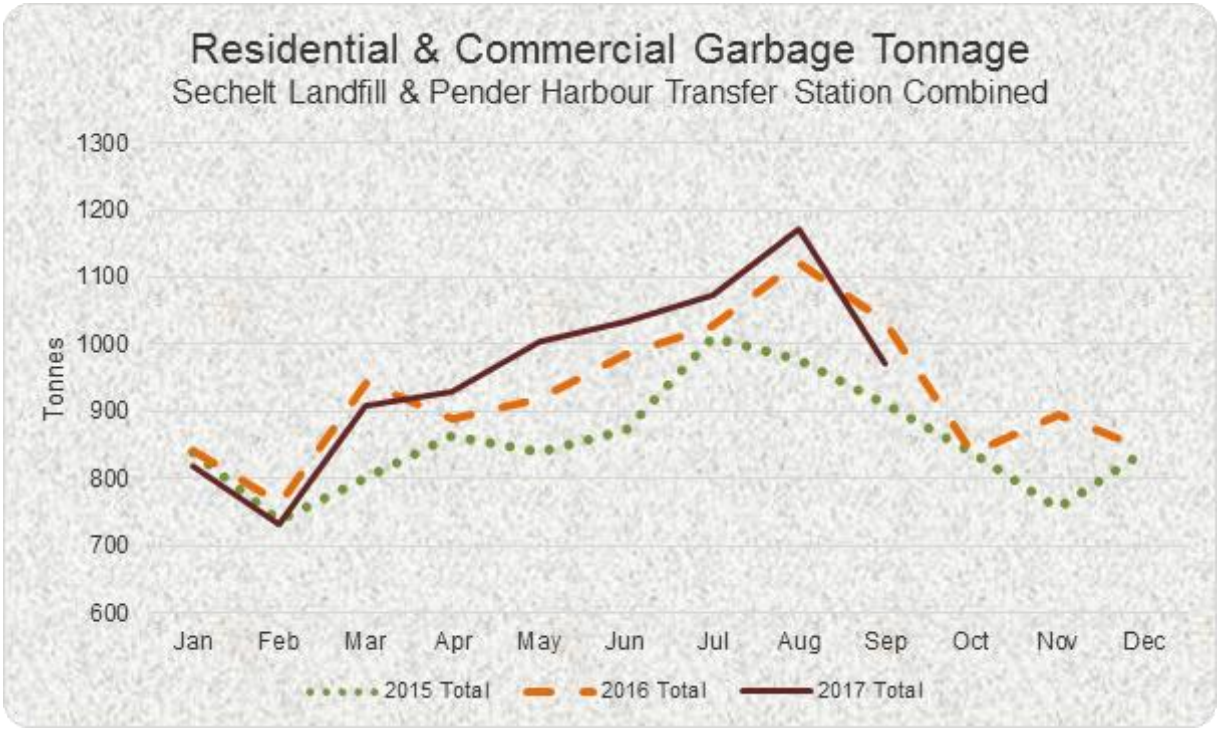
Waste Reduction Initiatives Program
The 2017 Waste Reduction Initiatives Program (WRIP) call for project proposals opened on Friday, August 25, 2017.

In 2017, a total of $5000 is available to help give community groups, non-profit organizations, registered charities and school groups the ability to develop and implement their own ideas that support waste reduction and diversion on the Sunshine Coast.

The deadline to submit a WRIP application is Friday, October 20, 2017. Applications will be evaluated against set criteria and successful projects awarded in Q4 2017.

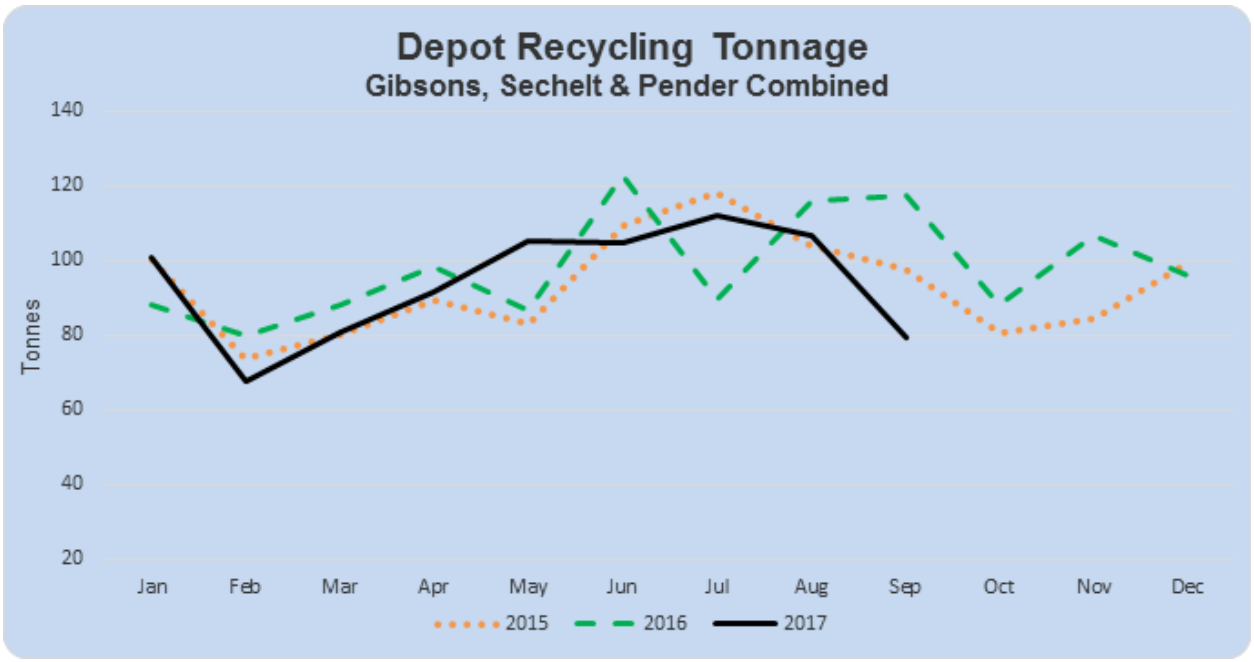
OPERATIONS

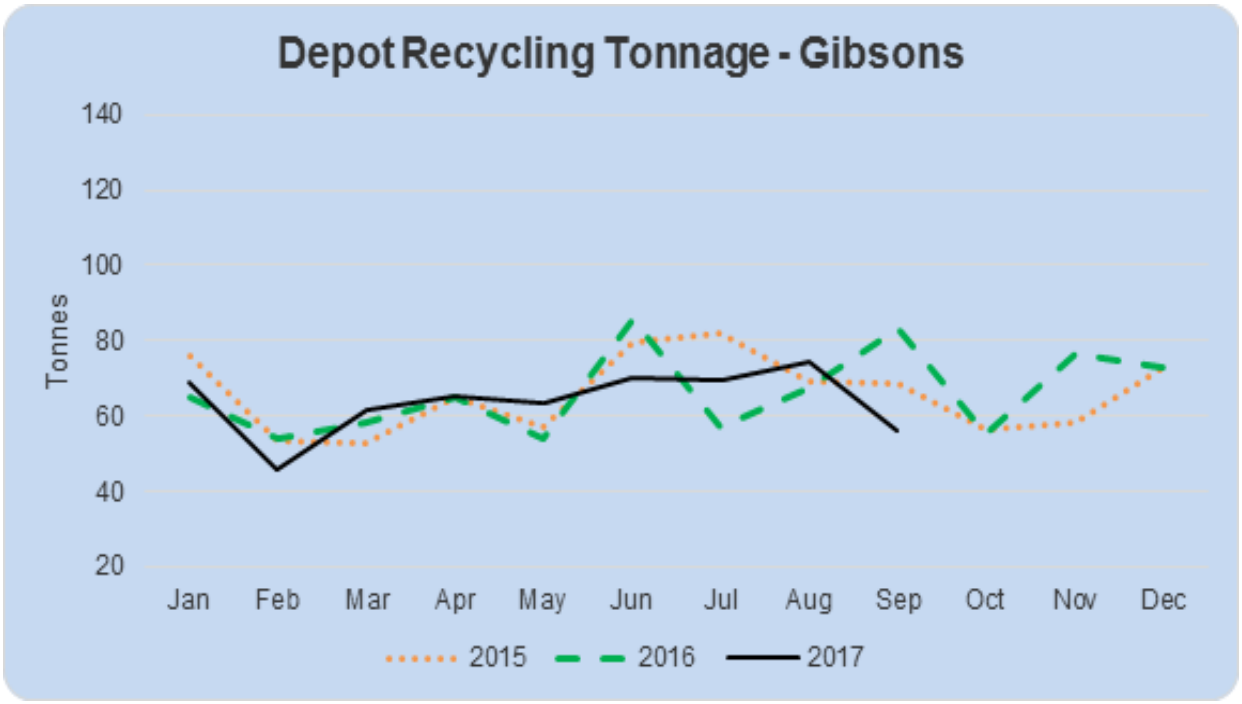
Statistics - Landfill



**Does not include other landfilled items such as construction waste, asbestos or furniture.*

Statistics - Recycling




Depot Recycling Tonnage - Gibsons
Tonnes
140
120
100
80
60
40
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Oct
Nov
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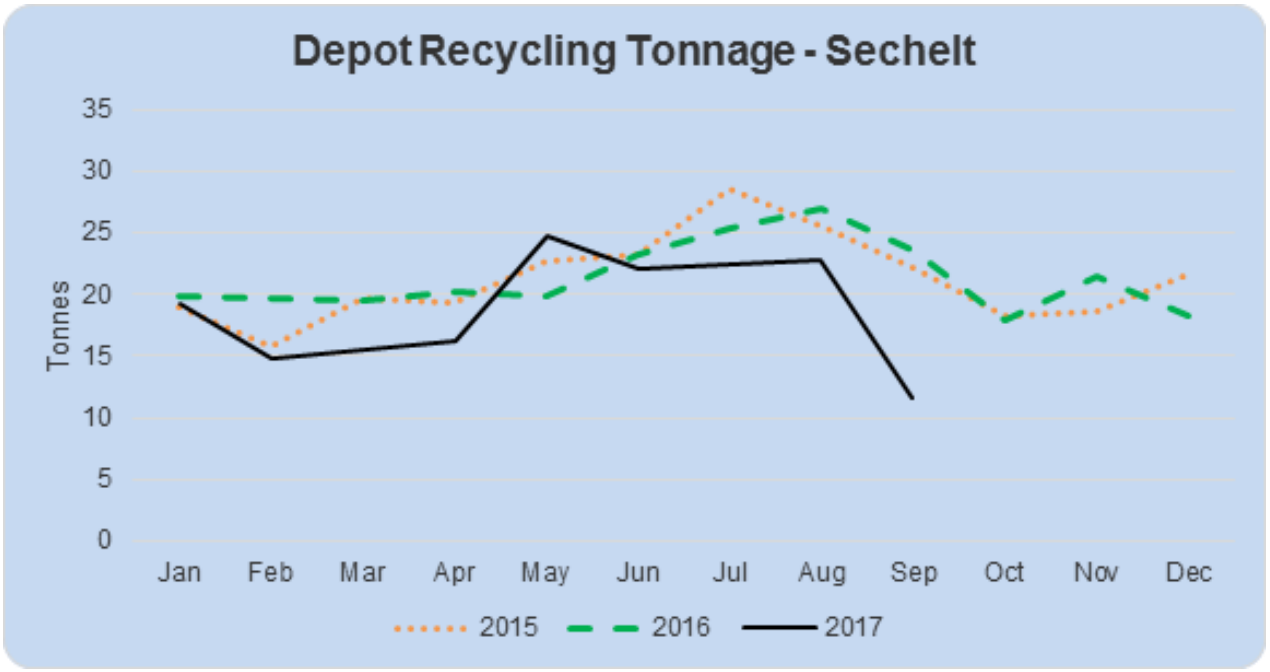
2015
2016
2017


Depot Recycling Tonnage - Sechelt
Tonnes
35
30
25
20
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0
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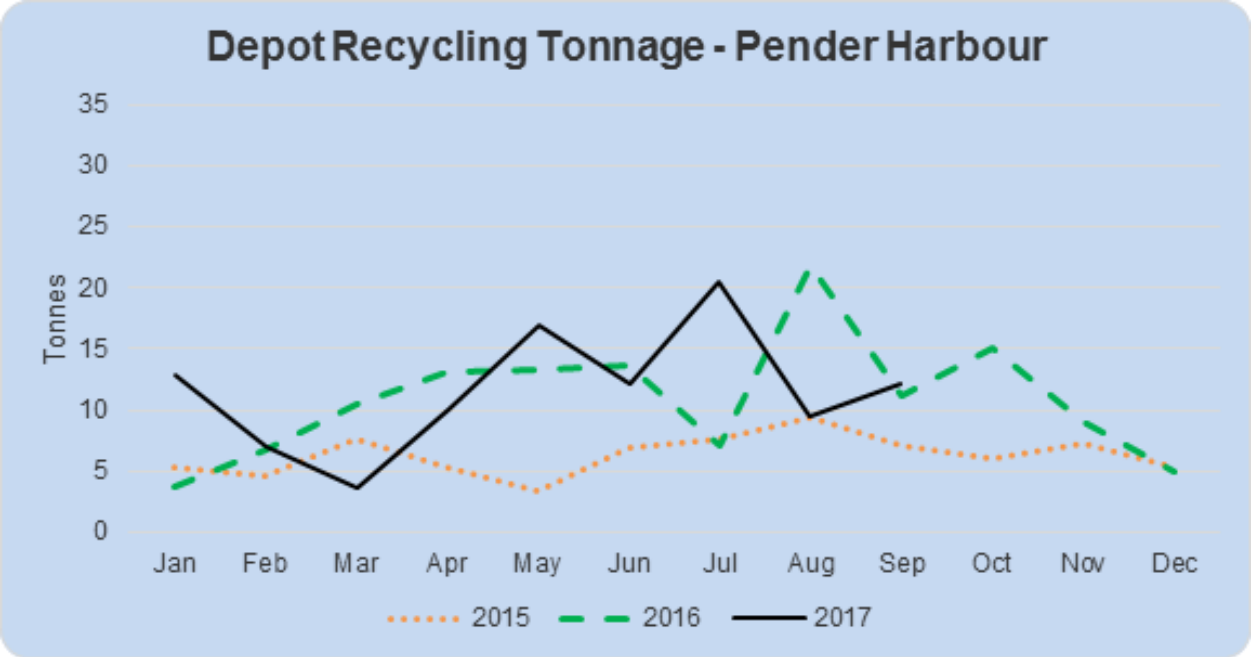
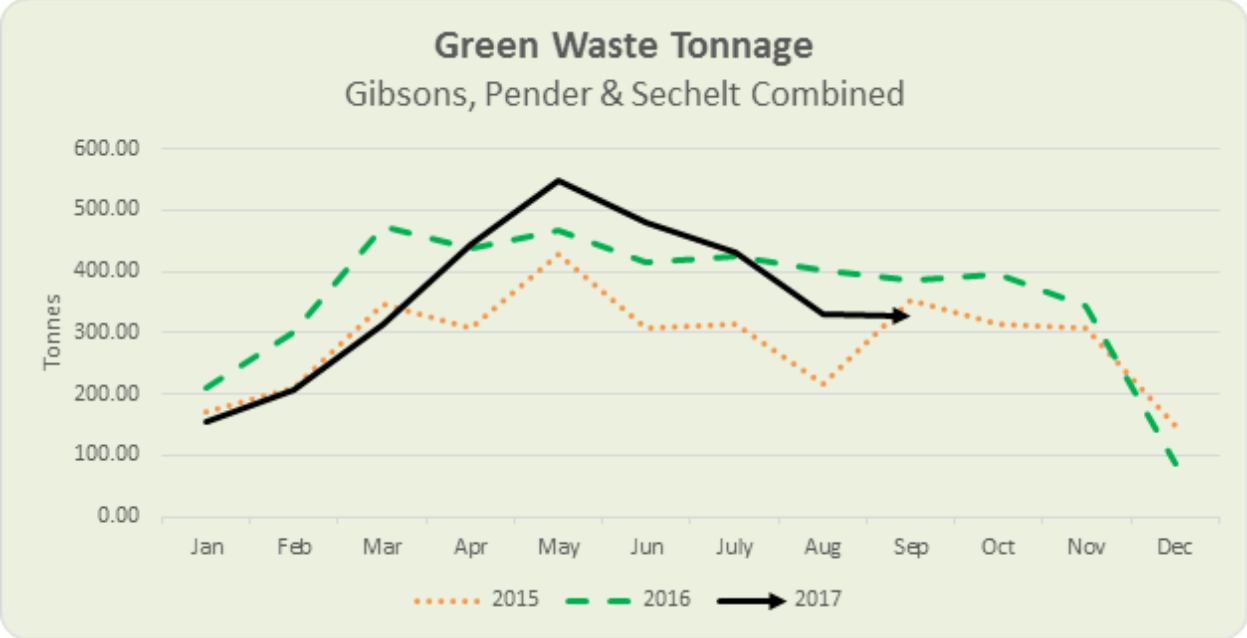


** Data provided by RecycleBC (formerly called MMBC) and is updated as data is received.*

Statistics - Green Waste



**Combined totals for Sechelt Landfill, Pender Harbour Transfer Station, Town of Gibsons Green Waste Facility and residential self-haul at Salish Soils.*

Infrastructure Community Events/Outreach

Date	Community Event	Topic
July 1, 2017	Canada Day Parade Participation	Transit
July 29, 2017	Sea Cavalcade Parade Participation	Transit
September 28, 2017	Sechelt Landfill Tour for students from SD46's SPIDER Elementary Program	Waste Reduction
Ongoing	Rural Metering Program continuous community outreach	Water

Date	Professional Development
September 12, 2017	GM Day is a Board Member of the BC Water and Waste Association (BCWWA) Board Meeting. The Board meets quarterly.

Reviewed by:			
Manager	X – S. Walkey X – G. Dykstra X – R. Cooper X – D. Crosby	Finance	
GM	X – M. Day	Legislative	
CAO	X – J. Loveys	Other	