Gambier Island Local Trust Committee
Regular Meeting Agenda

Date:	December 11, 2017
Time:	10:45 am
Location:	John Braithwaite Community Centre 145 West 1st Street North Vancouver, BC

Pages

1. CALL TO ORDER 10:45 AM - 10:45 AM

   "Please note, the order of agenda items may be modified during the meeting. Times are provided for convenience only and are subject to change."

2. APPROVAL OF AGENDA

3. TOWN HALL AND QUESTIONS 10:45 AM - 10:55 AM

4. COMMUNITY INFORMATION MEETING - None

5. PUBLIC HEARING - None

6. MINUTES 10:55 AM - 11:00 AM

   6.1 Local Trust Committee Meeting dated October 26, 2017 for adoption 3 - 15

   6.2 Section 26 Resolutions-Without-Meeting Report dated November 23, 2017 16 - 16

   6.3 Advisory Planning Commission Minutes - None

7. BUSINESS ARISING FROM MINUTES 11:00 AM - 11:10 AM

   7.1 Follow-up Action List dated November 23, 2017 17 - 18

8. DELEGATIONS - None

9. CORRESPONDENCE - None

   (Correspondence received concerning current applications or projects is posted to the LTC webpage)

10. LOCAL TRUST COMMITTEE PROJECTS - None

11. REPORTS 11:10 AM - 11:40 AM

11.1 Work Program Reports

11.1.1 Top Priorities Report dated November 23, 2017 19 - 19

11.1.2 Projects List Report dated November 23, 2017 20 - 20

11.2 Applications Report dated November 23, 2017 21 - 22

11.3 Trustee and Local Expense Report dated September, 2017

11.4 Adopted Policies and Standing Resolutions 23 - 24

11.5 Local Trust Committee Webpage

11.6 Chair's Report

11.7 Trustee Reports

11.8 Electoral Area Director's Report - None

11.9 Trust Fund Board Report - None

12. NEW BUSINESS 11:40 AM - 11:50 AM

12.1 Ministry of Forests, Lands, Natural Resource Operations and Rural Development Request for Comment on Proposed Amendments to the Coastal Douglas-fir Land Use Objectives Regulation Order, 2010 - for Discussion

12.2 Hunting on Gambier Island

--BREAK-- 11:50AM - 12:20PM

13. APPLICATIONS AND REFERRALS 12:20 PM - 1:50 PM

13.1 GM-RZ-2004.1 (District Lot 696, Keats Island) - Staff Report 25 - 112

14. UPCOMING MEETINGS

14.1 Next Regular Meeting Scheduled for Thursday, January 25, 2018 at 10:45 am at John Braithwaite Community Centre, Meeting Room 2, 145 West 1st Street, North Vancouver, BC

15. TOWN HALL 1:50 PM - 2:00 PM

16. CLOSED MEETING - None

17. ADJOURNMENT 2:00 PM - 2:00 PM

Gambier Island Local Trust Committee
Minutes of Regular Meeting

Date: October 26, 2017
Location: John Braithwaite Community Centre
145 West 1st Street
North Vancouver, BC

Members Present Susan Morrison, Chair
Dan Rogers, Local Trustee
Kate-Louise Stamford, Local Trustee

Staff Present Ann Kjerulf, Regional Planning Manager
Madeleine Koch, Planner 2
Sonja Zupanec, Island Planner (by telephone, 11:16-11:43 am)
Kate Emmings, Ecosystem Protection Specialist (by telephone, 1:51-2:07 pm)
Diane Corbett, Recorder

Others Present Members of the Public – 15

1. CALL TO ORDER

Chair Morrison called the meeting to order at 10:45 am. She acknowledged that the meeting was being held on Coast Salish territory, particularly Squamish First Nation. Chair Morrison introduced trustees and staff in attendance.

2. APPROVAL OF AGENDA

"Please note, the order of agenda items may be modified during the meeting. Times are provided for convenience only and are subject to change."

By general consent the agenda was approved as presented.

3. TOWN HALL AND QUESTIONS

A member of the public inquired if there was an update on the park proposal; Trustee Stamford indicated she would mention this as part of the trustee report.

Two members of the public requested the opportunity to speak during discussion of particular agenda items; the Chair accepted the requests.

4. COMMUNITY INFORMATION MEETING – None

5. PUBLIC HEARING – None

6. MINUTES

6.1 Local Trust Committee Meeting dated August 31, 2017

The following amendments to the minutes of August 31, 2017 were presented for consideration:

- Page 6, item 12.6, bullet 1, line 3: replace “Trust Council table” with “the Executive Committee”;
- Page 7, item 12.6, bullet at top of page: connect second sentence to the first by replacing the period at end of sentence 1 with a comma; insert “and they” before “are looking”; and replace “at doing” with “at getting”;

By general consent the minutes were adopted as amended.

6.2 Local Trust Committee Special Meeting dated September 20, 2017

The following amendments to the Special Meeting minutes of September 20, 2017 were presented for consideration:

- Page 3, second full paragraph, should read: “Trustee Rogers noted the two issues were sufficiency of the water supply to meet the needs of the proposed lots and the Camp, and the issue of the septic field in Area E by Campfire Rock; he had heard a fair amount of concern about these two issues.”;
- Page 3, bullet 3: replace “water” with “sewage outflow”;
- Page 3, bullet 4, last word: replace “sewer” with “septic field”;
- Page 4, bullet 5, last sentence before the comma should read: “Regarding information about the impacts of sea level rise”;
- Page 5, first line: insert “stated that it” after “The operator”;
- Page 6, middle of page: add “in the Frequently Asked Questions” after “included”.

By general consent the minutes were adopted as amended.

6.3 Section 26 Resolutions-Without-Meeting Report – None

6.4 Advisory Planning Commission Minutes – None

7. BUSINESS ARISING FROM MINUTES

7.1 Follow-up Action List dated October 19, 2017

The Regional Planning Manager reviewed the Follow-Up action list dated October 19, 2017.

8. DELEGATIONS

8.1 Gambier Island Sea Ranch

Peter Buckland, accompanied by Lynn Roxborough, of Gambier Island Sea Ranch, reviewed points mentioned in correspondence to Islands Trust, dated October 12, 2017,

and outlined the issues pertaining to the process of subdivision of lots of the Gambier Island Sea Ranch, requesting that Islands Trust "help as much as possible" to make the "simple 'non-invasive'" subdivision a reality. Mr. Buckland responded to inquiries from trustees.

Chair Morrison thanked Mr. Buckland and Ms. Roxborough for the presentation.

9. CORRESPONDENCE - None

(Correspondence received concerning current applications or projects is posted to the LTC webpage)

10. APPLICATIONS AND REFERRALS

10.1 Referral from Sunshine Coast Regional District Regarding Langdale Ferry Rezoning Application

Island Planner Zupanec gave a brief summary of the staff report on the Sunshine Coast Regional District (SCRD) referral of Zoning Amendment Bylaw No. 310.173, 2017 (BC Ferries), and responded to requests for clarification from trustees about the process.

GM-2017-063
It was MOVED and SECONDED
that the Gambier Island Local Trust Committee request staff to prepare a referral response to the Sunshine Coast Regional District Board to support the approval of SCRD Zoning Amendment Bylaw No. 310.173, 2017 (BC Ferries), and include a copy of the Islands Trust staff report dated October 26, 2017 and the following comments:

a) The subject marine area of Proposed Zoning Amendment Bylaw No. 310.173, 2017 is within the Gambier Island Local Trust Area of the Islands Trust but located outside the planning areas of the Gambier, Keats or Associated Islands Official Community Plans; and
b) Pursuant to Islands Trust Policy Manual 5.9ii (Planning, Regulation and Advocacy Initiatives: Outer Boundary of Islands Trust Area) the Gambier Island Local Trust Committee has reviewed the proposed zoning amendments and deems Bylaw No. 310.173, 2017 to be consistent with the Islands Trust object and policy statement.

CARRIED

GM-2017-064
It was MOVED and SECONDED
that the Gambier Island Local Trust Committee request that the Sunshine Coast Regional District encourage BC Ferries to make extra efforts to reach out to islanders through the island communication network during the consultation process for the Langdale terminal renovations.

CARRIED

10.2 GM-RZ-2004.1 (District Lot 696, Keats Island) - Status Update - Verbal Presentation

Applicant Kevin Healy, CREUS Engineering, thanked the Local Trustees and staff for allowing the time for an update. He noted that a bit more time was needed to finalize the review of a checklist of items from the last meeting for a revised report. He introduced Matthew Munn of exp Services, Inc. to provide an update.

Mr. Munn gave a report on activities since the September 20 meeting, at which he had agreed to review and revise the hydrogeological report. Points included:

- At that meeting information was received for the first time that water system flow meters referenced and utilized in the study could be off by 50%. Further testing was done. It was found that the meters were off by 42%.
- In the finalized report, statements of opinion regarding water availability and projection would not change; the assessment would look different, but not change. The sewage discussion would be fuller and more visual. Statements of opinion would remain unchanged.
- During this review period, it became evident that, in the Terms of Reference document, the report is referred to as stage one, in alignment with the preliminary status. But in reality, the Terms of Reference is strongly aligned with the Technical Assessment Report (TAR) for groundwater licensing in BC, which is under the mandate of the Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD). The TAR is something the applicant will need. It is a comprehensive process, not preliminary; coupled with that are two independent comprehensive hydrological reports, for sewage and for the water system, with Vancouver Coastal Health. The revised report will discuss the pending licensing approval process. This would be one report of a few hydrogeological reports.

Responding to an inquiry from Trustee Rogers as to whether the Terms of Reference agreed to by Islands Trust staff, the Province and the proponent had some items that should not be included, Mr. Healy explained that Mr. Munn had brought the draft Terms of Reference forward to FLNRORD (which is not of the flexibility to give advice in terms of what would be needed for Islands Trust approvals) for an opinion on the approach, and had received a letter of support. Islands Trust came back with a slightly revised Terms of Reference. The applicant had had some concerns, such as the use of the word “investigations”, which could be openly interpreted. Mr. Healy noted that technically the report meets the criteria; a review has been done based on desktop information. A more detailed review would be done later.

Previous Local Trustee Kim Benson of Keats Island requested that her comments on the history of the file be included in the public record. The submission was entitled “Process Regarding GM-RZ-2004.1 (District Lot 696, Keats Island) with Attachments July 20, 2007 to September 10, 2013 (6 years)”, and was read aloud as follows:

- July 20, 2007
  - Public Hearing for Bylaws 100 & 101 held on Keats Island.
  - Gambier LTC Minutes – Defer Consideration of Bylaws to next meeting, request Staff to provide a summary of issues arising from the public hearing at the next meeting.
- August 30, 2007

  - Gambier LTC Minutes – Bylaws 100 & 101 given Second and Third Readings
  - Bylaws forwarded to Islands Trust Executive Committee for approval consideration
- October 9, 2007
  - Islands Trust Executive Committee Minutes – Bylaws 100 & 101 approved unanimously
- November 20, 2008
  - Gambier LTC Resolution Without Meeting – Instructing staff to forward to the Applicant third letter outlining the remaining requirements and process for adoption of Bylaws 100 & 101
- November 24, 2008
  - Third IT Staff Letter to Applicant (since EC Approval in 2007) – Outlining five requirements for consideration of final adoption of Bylaws 100 & 101
  - Letter states "Upon receipt of required items… staff will prepare a report to the LTC for consideration of final reading and adoption of Bylaws 100 & 101."
  - Letter requests a status update of the rezoning from Applicant no later than December 31, 2008.
  - No information was received until 2013 (6 years after Public Hearing, Second and Third Reading, and EC approval of Bylaws 100 & 101)
- February 02, 2012
  - Vancouver Coastal Health letter to Subdivision Approving Officer – offering a recommendation of "conditional approval for the proposed wastewater disposal plan" for DL 696 provided by John Enevoldsen Engineering on November 3, 2010
- September 10, 2013
  - Islands Trust Staff Report GM-RZ-2004.1 – Background regarding the Applicant and confirming that:
    1. Bylaws 100 & 101 "were not adopted by the GMLTC because additional information requested of the applicant, including specific details on sewage disposal plans was not received. Activity was halted on the bylaw process";
    2. Staff explained that the rezoning application had been in a 'holding pattern' since the (2007) public hearing;
    3. In July 2013, activity began again [with the Applicant] to move towards subdivision.

Trustee Rogers expressed thanks to everyone who had filed submissions.

The Island Planner left the meeting at 11:43 am.

Chair Morrison recessed the meeting at 11:43 am., and reconvened the meeting at 11:48 am.

11. LOCAL TRUST COMMITTEE PROJECTS

11.1 Riparian Areas Regulation Implementation Project

Planner Koch reviewed the staff report on the Gambier Riparian Areas Regulation (RAR) update. It had been determined it would be necessary to amend the OCP bylaw for clarity regarding the RAR and non-RAR provisions.

Discussion ensued. Points included:

- Overview of the process to date.
- Contrast of Keats and Gambier RAR provisions.
- Lack of reference to non-RAR in the Gambier Island OCP. The way it is written in the OCP does not justify applying the blanket Development Permit Area to watercourses that are not applicable to the RAR.
- In light of extensive watersheds on Gambier, the approach of a blanket DPA No. 3 included protection of sensitive ecosystems, intending to give protection to streams and protect watersheds for biodiversity. DPA No. 3 is effective in terms of applying the RAR, but very strictly applies the RAR and does not mention non-RAR.
- Section 12.3.1 of OCP Amendment Bylaw No. 140, indicates a "Designated Area" but this is not in the Land Use Bylaw, which poses implementation challenges.
- Trustees advised staff that the map attached to the draft bylaw No. 140 was not what was intended. Private land is located within DPA 3 (RAR), while the public land is within DPA 1 and DPA 3 yet under FLNRORD's mandate. Expanding DPA No. 1 (for general environmental and watercourse protection) would fit better with the overall intent to protect biodiversity and watersheds on Gambier.

The Regional Planning Manager requested that the LTC give staff the ability to improve the DPA language to better meet the LTC's objectives.

GM-2017-065
It was MOVED and SECONDED
that the Gambier Island Local Trust Committee adopt a Standing Resolution which directs staff to administer Development Permit Area (DPA) No. 3: Riparian Areas in the interim before formal amendments are made to the DPA, as follows:

a. The "Designated Area" provisions of Section 12.3.1 of Gambier Island Official Community Plan No. 73 should be used to determine whether or not a proposed development is subject to DPA No. 3: Riparian Areas;
b. When development is proposed within the "Designated Area", applicants shall be required to have a Qualified Environmental Professional assess the water feature to determine whether or not it is subject to the Riparian Areas Regulation;
c. When development is proposed within the "Designated Area" of a water feature which is determined to be subject to the Riparian Areas Regulation, a DPA No. 3: Riparian Areas Development Permit shall be required;
d. When development is proposed within the "Designated Area" of a water feature which is determined not to be subject to the Riparian Areas Regulation, a DPA No. 3: Riparian Areas Development Permit shall not be required.

CARRIED

Planner Koch noted staff had been working with the SCRD; Islands Trust now has a Riparian declaration form in place at the Regional District. The declaration form is included with building permit application forms, and asks applicants to indicate if there are any water features on the subject property.

Trustee Stamford requested "what if" scenarios for the public education aspect regarding this process to help people understand whether they have a water feature.

GM-2017-066
It was MOVED and SECONDED
that the Gambier Island Local Trust Committee endorse the amended Project Charter.

CARRIED

11.2 Gambier Island Bylaw Nos. 146 and 147 (Bowyer and Anvil Streamside Protection)

The Regional Planning Manager reviewed the staff report on draft Bylaw Nos. 146 and 147, to amend the Bowyer and Passage Land Use Bylaw and Gambier Associated Islands Land Use Bylaws to include guidelines for proposed Gambier Associated Islands Official Community Plan Development Permit Area (DPA) 2: Streamside Protection (DP-2). Discussion ensued.

A Professional Biologist from Bowyer Island was invited to comment. While he believed that Orchid Creek was not RAR applicable, there were no plans for development near Orchid Creek and there were no issues with protecting the creek. He posed a number of questions. Why does the DPA apply only to Orchid Creek and not to a wetland on the island? What is a watercourse? What is a ditch? Is the drainage ditch created to keep moisture from under his cabin protected? Is a road a structure? In setting the DPA, is the boundary defined by 30 metres off every branch or the main channel? The latter would sterilize some lots.

Chair Morrison thanked the speaker for his comments.

GM-2017-067
It was MOVED and SECONDED
that the Gambier Island Local Trust Committee has reviewed the Islands Trust Policy Statement Directives Only Checklist and determined that Bylaw No. 147, cited as "Gambier Associated Islands Land Use Bylaw, 2013, Amendment No. 1, 2017", is not contrary to or at variance with the Islands Trust Policy Statement.

CARRIED

GM-2017-068
It was MOVED and SECONDED
that Gambier Island Local Trust Committee Bylaw No. 147 cited as "Gambier Associated Islands Land Use Bylaw, 2013, Amendment No. 1, 2017", be read a first time.

CARRIED

GM-2017-069
It was MOVED and SECONDED
that the Gambier Island Local Trust Committee request staff to refer Bylaw No. 147 to the following agencies and First Nations: Ministry of Forests, Lands, Natural Resource Operations and Rural Development (Resource Management Objectives Branch), Ministry of Municipal Affairs and Housing, Ministry of Transportation and Infrastructure, Sunshine Coast Regional District, Squamish First Nation, Tsleil Waututh First Nation, and Musqueam Nation.

CARRIED

GM-2017-070
It was MOVED and SECONDED
that the Gambier Island Local Trust Committee request staff to refer Bylaw No. 145, cited as "Gambier Associated Islands Official Community Plan, 2009, Amendment No. 1, 2017", to the following agencies: Ministry of Forests, Lands, Natural Resource Operations and Rural Development (Resource Management Objectives Branch), Ministry of Municipal Affairs and Housing, Ministry of Transportation and Infrastructure, and Sunshine Coast Regional District.

CARRIED

GM-2017-071
It was MOVED and SECONDED
that the Gambier Island Local Trust Committee request staff to amend draft Bylaw No. 146 to have similar language to Bylaw No. 147 and refer this to the Ministry of Forests, Lands, Natural Resource Operations and Rural Development for comment on its acceptability.

CARRIED

11.3 Gambier OCP and Shared Narrative of Place

Planner Koch gave an update on recent actions related to the Gambier OCP project that included: contact with First Nations; work on amendments of out of date legislative references; update of some introductory sections; and a look at adding/ strengthening tools such as Temporary Use Permits.

It was noted the Shared Narrative of Place initiative had been included as a top priority. Staff has begun to incorporate Squamish words in business communications as resolved by the LTC in July 2017. The Senior Intergovernmental Policy Advisor on First Nations and Marine Issues had made an application to the Squamish Nation to request names that Islands Trust currently has no names for, including several places on Gambier. Musqueum Nation recently asserted their interest in all of Howe Sound.

Trustee Rogers requested utilization of "at least" the name for Howe Sound in official communications, to enable the public to see the name.

There was discussion of background related to the woodlots on Gambier Island, which are within the timber supply of the Sunshine Coast Forest District. Part of the OCP review would be to look at the Recreation Wilderness zone, and see if there is a way of reconciling desires for that zone. The Suzuki Foundation had fielded the idea of a federal park, but there are other options to consider. It was noted there is no protocol agreement with FLNRORD now, nor a proactive communication with them.

Trustee Stamford thanked Planner Koch for the work being done.

Chair Morrison recessed the meeting at 1:05 pm, and re-convened the meeting at 1:25 pm.

11.4 Keats Shoreline Protection

The Regional Planning Manager announced that staff had not had the ability to advance Keats Shoreline Protection, one of the LTC's top priority projects, due to a lack of sufficient resources to start the project. Staff would come back with a draft terms of reference to have a consultant undertake at least the public consultation on it.

It was anticipated that, in the new year, Island Planner Zupanec would become the full-time Island Planner for the Gambier Island Local Trust Area. In addition to helping Planner Koch with the Gambier Island Official Community Plan review, the Island Planner would continue to work on the District Lot 696 rezoning application and the RAR implementation project.

12. REPORTS

12.1 Work Program Reports

12.1.1 Top Priorities Report dated October 19, 2017
Received.

12.1.2 Projects List Report dated October 19, 2017
Received.

12.2 Applications Report dated October 19, 2017

Received.

12.3 Trustee and Local Expense Report dated August, 2017

Received.

There was discussion of the need to adjust the meeting expenses allotment, as requested the previous term; it was noted this could be addressed at the next Financial Planning Committee meeting.

12.4 Adopted Policies and Standing Resolutions

Received.

12.5 Local Trust Committee Webpage

No additions to the Gambier Island Local Trust Committee webpage were requested.

12.6 Chair's Report

Chair Morrison reported:

- At its last meeting, the Executive Committee did not actually approve the draft engagement plan and made a motion to address service delivery and governance for Salt Spring Island.
- Getting ready for Trust Council in December in Victoria.
- Will attend Comox Valley and Denman-Hornby liaison.

12.7 Trustee Reports

Trustee Rogers sent his report to his contact lists prior to the meeting, and added the following to his report:

- Received reply from senior staff of Ministry of Environment who said they would not remove the derelict vessels within the park boundary off Keats because they did not think it was a danger. He would continue to consider this issue.
- Draft Principles of Cooperation for Howe Sound Community Forum were redrafted slightly. They will be forwarded to local governments for adoption, and would likely be coming to the LTC in November.

Trustee Stamford sent a report to her contact lists prior to the meeting, and gave further updates:

- BURNCO is having a second public comment period for its technical report starting October 28.
- Feasibility study for a national park – Any interest from the federal Environment Minister is long term. They will not be doing a feasibility study soon. They will look at priorities, and how different properties across the country fit into their goal of 17% of land protected by 2020. The person stewarding the feasibility study for the Suzuki foundation had a stroke. Trustee Stamford is working to have a different contact with the Foundation and is supporting the process in how it engages for Gambier, and will continue acting as a representative (any Islands Trust decisions related to this would go through Trust Council).
- Attended the Canada C3 stop at Fircom. It is a research and connectivity initiative from Canada 150. The ship started in Toronto harbour, and has gone around Canada, stopping at different communities. People from all across Canada were on the ship that stopped at Gambier for a day.

12.8 Electoral Area Director's Report – None

12.9 Trust Fund Board Report dated October, 2017

Received.

13. NEW BUSINESS

13.1 Regional Conservation Plan

Ecosystem Protection Specialist Kate Emmings gave an overview of the draft Islands Trust Fund Regional Conservation Plan 2018-2027.

13.2 Islands Trust Fund Five Year Plan

Ecosystem Protection Specialist Kate Emmings gave an overview of the Islands Trust Fund Five Year Plan.

GM-2017-072
It was MOVED and SECONDED
that the Gambier Island Local Trust Committee receive the draft Islands Trust Fund Plan for information.

CARRIED

13.3 Gambier/Metro Vancouver Meeting

The Regional Planning Manager inquired whether the LTC wanted staff to try to arrange a meeting with Metro Vancouver board and staff. Discussion ensued. Staff will follow up on this to see if there are any outstanding issues from a meeting held a few years ago, and report back to the LTC.

13.4 Recommendations from the Howe Sound Community Forum October 13, 2017

13.4.1 Letter of Local Government Support for the Expansion of Glass Sponge Protection in Howe Sound

13.4.2 Request to Provide Financial Support for the Development of the Howe Sound Marine Reference Guide

Trustee Stamford reported that at the May meeting of the Howe Sound Community Forum, a task force was developed to take recommendations from the book "Howe Sound Marine Reference Guide" and try to find ways to implement those action items into local government policies. Discussion ensued.

GM-2017-073
It was MOVED and SECONDED
that the Gambier Island Local Trust Committee forward the summary of the Ocean Watch Howe Sound Marine Reference Guide to the Executive Committee including a request to Trust Council for support of the Guide's development, including a commitment of $500.00 per year for 3 years as in Section 8(1)(h) of the Islands Trust Act which provides for public education around the history and heritage of the Salish Sea area.

CARRIED

Trustee Stamford provided background information regarding a federal government consultation on the protection of glass sponge reefs.

GM-2017-074
It was MOVED and SECONDED
that the Gambier Island Local Trust Committee request the Executive Committee to write a letter to the Department of Fisheries and Oceans (DFO) supporting the protection of glass sponge reefs in Howe Sound, either presently known or that may be discovered in the future, and in the process of developing that protection that the DFO consult with local governments, stakeholders and First Nations who may be affected by steps taken to preserve and protect glass sponge reefs in the area.

CARRIED

13.5 2018 Local Trust Committee Meeting Schedule

GM-2017-075
It was MOVED and SECONDED
that the Gambier Island Local Trust Committee schedule its regular business meetings on the following dates in 2018: January 25, March 8, April 19, May 24, June 28, July 26, August 30, November 15.

CARRIED

14. UPCOMING MEETINGS

14.1 Next Regular Meeting Scheduled for Thursday, November 30, 2017 at 10:45 am at John Braithwaite Community Centre, Meeting Room 2, 145 West 1st Street, North Vancouver, BC

15. TOWN HALL

Points made included:

- The District Lot 696 hydrogeological study does not seem to contain basic information. The only source of water is rainfall on most of the island. There are no alternatives, no provision for piping water to Islands Trust Islands. The proposal is to put wastewater to land. What are their sources of water? What are the alternatives? What if there was an accident? If the well area were contaminated, where would they go for water in the future, as an alternative? If they propose to put wastewater where there is potential water, what is the rationale for that? What are the alternatives? Those basics need to be discussed, and discarded for a reason or agreed to for a reason. You need to look at the big picture before making land use decisions.
- Support the legalizing of leaseholder tenure on DL696. The point of the process is to become legal. The source for drinking water should be the most important consideration, and protecting that source needs to be looked at. The Terms of Reference is being changed to get away from the core subject. What potential source of clean safe drinking water should we protect – rather than where to put the septic field. The regulations say 100 feet, but when we have options to go further away, the risk is too high. Look at where is the best place to protect the water, and put the septic somewhere else. They are focusing on if it is legal.

- Comment on accuracy of the assessments of water: when the septic system was designed, 11.45 gallon per minute was the assessment for the cottagers for full build out of the 110 properties. The recent hydrogeological report says it would be 6.5 gallons per minute, a 68% difference, outside acceptable margin of error.
- Some leaseholders have concerns with the plan but are not voicing their concerns, as well as concerns regarding the Baptist Convention's communications with leaseholders.
- There is a lot of failed septic on Keats Island. People do not maintain their septic fields properly. If there is a septic failure and contamination of the aquifer, what can be done? It could wreck the aquifer for all time. People put a lot of things in their septic tanks, like shampoo or pharmaceuticals. We have had extraordinary weather events, with lots of water all at once. An extra word for the precautionary principle.

16. CLOSED MEETING

16.1 Motion to Close the Meeting

GM-2017-076
It was MOVED and SECONDED
by the Gambier Island Local Trust Committee that the meeting be closed to the public in accordance with the Community Charter, Part 4, Division 3, s.90(1)(d) and (i) for the adoption of in camera minutes dated April 27, 2017; and to receive legal advice subject to solicitor-client privilege and that the recorder and staff attend the meeting.

CARRIED

The Local Trust Committee moved to closed meeting at 2:50 pm.

16.2 Recall to Order

Chair Morrison recalledthe meeting to order in open meeting at 3:17 pm.

16.3 Rise and Report

Chair Morrison announced that the Local Trust Committee had adopted the In Camera minutes of April 27, 2017.

17. ADJOURNMENT

By general consent the meeting was adjourned at 3:17 pm.

_____
Susan Morrison, Chair

Certified Correct:

_____
Diane Corbett, Recorder

Resolutions Without Meeting

Gambier Island

Resolution #	Action	Resolution Desciption	Resolution Date
2017-07	In Favour	"THAT the Gambier Island Trust Local Trust Committee cancel the regular business meeting scheduled for November 30, 2017 and reschedule the meeting to December 11, 2017".	09-Nov-2017
2017-08	In Favour	"THAT the Gambier Island Local Trust Committee send a letter to congratulate Bruce Milne on his new role as Chair of the Sunshine Coast Regional District Board of Directors".	19-Nov-2017

Islands Trust

Print Date: November 23, 2017

Follow Up Action Report

Gambier Island

27-Apr-2017

Activity	Responsibility	Target Date	Status
Staff to prepare written communication materials for distribution to Gambier Island residents regarding the adoption of Bylaws 140 and 141. Update: pending DPA 3 minor amendments	Madeleine Koch	31-Aug-2017	On Going

27-Jul-2017

Activity	Responsibility	Target Date	Status
Staff to incorporate Squamish words and place names into local trust committee communications	Becky McErlean Sonja Zupanec Penny Hawley Ann Kjerulf Fiona MacRaild Madeleine Koch		On Going

31-Aug-2017

Activity	Responsibility	Target Date	Status
Staff to prepare a draft bylaw to amend the Gambier Island LUB DPA 3 guidelines	Madeleine Koch	05-Oct-2017	On Going
Staff to notify the MFLNRORD and all First Nations with interests in Gambier Island as noted in the Provincial Consultative Areas Database, of the intent to amend the Gambier Island Land Use Bylaw for the purpose of making minor revisions to DPA 3	Madeleine Koch		On Going

20-Sep-2017

Activity	Responsibility	Target Date	Status

Follow Up Action Report

GM-RZ-2004.1 (DL 696 Keats Island) - Bylaw 143 given first reading as amended - done BM - Follow up referrals to SCRD and Squamish FN - Proceed no further with Bylaw 144 - done BM - staff to prepare amendments for LTC consideration re: CS2 parking regs and MC zone boundary changes - staff to prepare a restrictive covenant as per staff report recommendations - staff to work with the applicant and resolve gaps in hydrogeological assessment	Becky McErlean Sonja Zupanec	26-Oct-2017	On Going

26-Oct-2017

Activity	Responsibility	Target Date	Status
Add Standing Resolution regarding Development Permit Area (DPA) No. 3: Riparian Areas administration to Gambier Standing Resolutions Database	Penny Hawley	09-Nov-2017	Done
Staff to refer Bylaw No. 147 to FLNRORD (Resource Management Objectives Branch), Ministry of Municipal Affairs and Housing, MOTI, SCRD, Squamish First Nation, Tsleil Waututh First Nation, and Musqueam Nation.	Becky McErlean	16-Nov-2017	Done
Staff to refer Bylaw No. 145 to FLNRORD (Resource Management Objectives Branch), Ministry of Municipal Affairs and Housing, MOTI and SCRD	Becky McErlean	16-Nov-2017	Done
Staff to amend draft Bylaw No. 146 to have similar language to Bylaw No. 147 and refer this to FLNRORD for comment on its acceptability.	Ann Kjerulf	16-Nov-2017	Done
Staff to follow-up with Metro Vancouver regarding any outstanding issues from the last Gambier/Metro Vancouver interagency meeting.	Ann Kjerulf	09-Nov-2017	Done
Staff to update Gambier LTC Project webpages to reflect updates to the Gambier OCP and RAR Implementation projects.	Ann Kjerulf Madeleine Koch	15-Dec-2017	On Going

Islands Trust

Top Priorities

Gambier Island

No.	Description	Activity	R/Initiated	Responsibility	Target Date
1	Riparian Areas Regulation	Implement RAR across Gambier Island Local Trust Area.	26-Oct-2011	Ann Kjerulf Madeleine Koch	
2	Gambier OCP Comprehensive Review	Includes developing a "Shared Narrative of Place" with First Nations	12-Feb-2015	Fiona MacRaild Madeleine Koch	
3	Keats Island OCP/LUB Amendments	Consideration of amendments to policies and regulations regarding docks and other foreshore development on Keats Island	27-Jul-2017	Sonja Zupanec	
4	OCP Advocacy Policies - Implementation & Support	Supporting the advocacy policies of the Gambier, Keats, and Associated Islands OCPs, and Islands Trust Strategic Plan (e.g. woodlots, industrial facilities, Howe Sound)	24-Oct-2013	Kate-Louise Stamfor Dan Rogers Susan Morrison	

Islands Trust

Projects

Gambier Island

Description	Activity	R/Initiated
Development Approval Information Bylaw	Develop and adopt a D.A.I bylaw for the Gambier Trust Area.	
Squamish First Nation Consultation	Scope interim strategies pending completion of a possible protocol agreement to address protection of archaeological and heritage resources.	31-Jan-2012
Gambier LUB Review	Review Gambier LUB to address: - definition of breakwater - trams (currently silent) - advocacy policies around pump out stations - review of title Wilderness Conservation - 2013: REVIEW KEATS AND GAMBIER LUBS FOR ACCOMMODATION of OCEAN LOOP GEO-EXCHANGE SYSTEMS - 2010: GHG Emissions (a more proactive approaches to plan for GHG reductions especially in relation to Policies 6.1 and 6.2 in consultation with SCRD.) Initiative arises from recommendation of SCRD in comments about bylaws 111 & 112.	22-May-2014
Gambier Site-specific Water Zones	Staff to research the history of Site-Specific water zones on Gambier.	26-Sep-2013
Recreational Camp and Private Institutional Regulation Review	Review Recreational Camp and Private Institutional regulations in all Local Trust Area land use bylaws. Review to ensure that regulations properly balance ecological protection with current realities re: rentals as income source for rec camps.	28-Jul-2016

Islands Trust

Applications

Development Variance Permit

File Number	Applicant Name	Date Received	Purpose
GM-DVP-2002.1	Land Plan Group Inc. **Planner:** Sonja Zupanec	24-Jan-2002	PID: 014-385-694\nKeats Island - Keats Camp cottage lots - siting variances\nDL 696

Planning Status

Status Date: 10-Apr-2008
still on hold pending rezoning

Status Date: 13-Aug-2007
on hold pending rezoning application

Status Date: 16-May-2006
Met with applicant. Outstanding items forwarded for attention. May be add'l fees.

File Number	Applicant Name	Date Received	Purpose
GM-DVP-2011.2	Corin and Larouche, Elena and France **Planner:** Marnie Eggen	22-Mar-2011	PID: 024-212-041 1250 Taki-Te-Si Road, Gambier Island\nvary the setback to the natural boundary of the sea for retaining wall

Planning Status

Status Date: 14-Oct-2016
Requested documents not received in the time provided. File passed over to bylaw enforcement.

Status Date: 11-Jul-2016
Staff sent letter requesting information to complete the DVP application. Property owner given 90 days to respond to request.

Status Date: 09-Jun-2015
no change

Rezoning

File Number	Applicant Name	Date Received	Purpose

Applications

GM-RZ-2004.1	LandPlan Group Inc.	16-Jun-2004	PID: 014-385-694 Keats Island - Keats Camp rezoning application DL 696

Planner: Sonja Zupanec

Planning Status

Status Date: 25-May-2017

CIM scheduled for July 27th to provide draft bylaw amendments to enable a comprehensive development zone; transfer LUC provisions and enable subdivision.

Status Date: 20-Apr-2017

Revised draft ToR for hydro.assessment sent to applicant for review.

Status Date: 10-Mar-2017

Draft Terms of Reference for hydrogeological assessment sent to applicant for review

Subdivision

File Number	Applicant Name	Date Received	Purpose
GM-SUB-2013.1	Creus Engineering	09-Dec-2013	PID: 014-385-694 The Convention of Baptist Churches of BC\nKeats Island\n9 Lot Subdivision

Planner: Sonja Zupanec

Planning Status

Status Date: 20-Apr-2017

New drawings January 20, 2017 endorsed by MOTI staff

Status Date: 06-Oct-2016

New drawings submitted to MOTI September 9, 2016.

Status Date: 01-Aug-2016

New subdivision application submitted to MOTI on July 16, 2016.

POLICIES AND STANDING RESOLUTIONS

Updated: November 9, 2017

No	Meeting Date	Resolution No.	Issue	Policy
1.	October 6, 2010	**GM-082-2010**	Guidelines for the appointment of members to the advisory planning commission	It was **MOVED** and **SECONDED** that the Gambier Island Local Trust Committee endorses the following guidelines for the appointment of members to the advisory planning commission and requests that such guidelines be posted on the Islands Trust website and are used in any posting to solicit expressions of interest from candidates for advisory planning commission membership: "The Gambier Island Local Trust Committee shall make all reasonable efforts, in the consideration of appointments to the advisory planning commission that members are: a. Representative of a broad cross section of the geographical areas of the Gambier Island Local Trust Committee area; b. Representative of a range of backgrounds and expertise that is supportive to each other in the consideration of matters referred to the advisory planning commission; c. Where feasible and practical of a balanced representation of gender and age groups. Consideration shall be given to the following criteria in any appointment: • Previous experience as a member of a Board of Variance; • Experience on a local government council, board, local trust committee, commission or other body; • Experience with other volunteer boards, commissions or committees; • Experience and credential in a planning, design or related profession; • Experience and credentials in a building or design trade; • Educational background; • Length of residency in the local trust area; • Availability, and willingness to travel between local trust areas.
2.	March 26, 2015	**GM-2015-018**		**It was MOVED and SECONDED,** that the Gambier Island Local Trust Committee amend the APC appointment guidelines to allow for representation of members to be weighted to a geographic area subject to a current top priority project.

3.	October 26, 2017	**GM-2017-065**	Development Permit Area)DPA) No. 3: Riparian Areas administration	**It was MOVED and SECONDED** that the Gambier Island Local Trust Committee adopt a Standing Resolution which directs staff to administer Development Permit Area (DPA) No. 3: Riparian Areas in the interim before formal amendments are made to the DPA, as follows: a. The "Designated Area" provisions of Section 12.3.1 of Gambier Island Official Community Plan No. 73 should be used to determine whether or not a proposed development is subject to DPA No. 3: Riparian Areas; b. When development is proposed within the "Designated Area", applicants shall be required to have a Qualified Environmental Professional assess the water feature to determine whether or not it is subject to the Riparian Areas Regulation; c. When development is proposed within the "Designated Area" of a water feature which is determined to be subject to the Riparian Areas Regulation, a DPA No. 3: Riparian Areas Development Permit shall be required; d. When development is proposed within the "Designated Area" of a water feature which is determined not to be subject to the Riparian Areas Regulation, a DPA No. 3: Riparian Areas Development Permit shall not be required.

STAFF REPORT

File No.: GM-RZ-2004.1
(CBCBC, DL 696 Keats Island)

DATE OF MEETING:	December 11, 2017
TO:	Gambier Island Local Trust Committee
FROM:	Sonja Zupanec, RPP, MCIP and William Shulba, P. Geo. Local Planning Services
COPY:	Kevin Healey, Applicant
SUBJECT:	Hydrogeological Assessment for DL696, Keats Island Applicant: Kevin Healey Location: District Lot 696, Keats Island

RECOMMENDATION

1. That the Gambier Island Local Trust Committee request the applicant for GM-RZ-2004.1 (CBCBC, DL696 Keats Island) undertake the following prior to Local Trust Committee consideration of scheduling a public hearing for Proposed Bylaw No. 143:

    a. address Land Use Bylaw section 7.7.1 by providing the Local Trust Committee with additional information on well catchment areas for any existing or proposed well location intended to supply water to the community water system(s);

    b. provide written confirmation from Vancouver Coastal Health for conditional approval for the siting of sewage disposal field 'E1' and interceptor trench;

    c. provide written confirmation from the Ministry of Health/Ministry of Forests, Lands, Natural Resources Operations and Rural Development that the existing and proposed wells on DL 696 will be subject to the Ministry of Health *Guidance Document For Determining Ground Water At Risk of Containing Pathogens (GARP) Including Ground Water Under Direct Influence of Surface Water*;

    d. investigate the opportunity to install a groundwater monitoring well for the Ministry of Forests, Lands and Natural Resource Operations and Rural Development in the future location of the SCRD park as a donation to the 'Provincial Groundwater Observation Well Network'.

2. That the Gambier Island Local Trust Committee request staff to add to the 'Projects List': review definition of 'structure' to ensure adequate regulation of the siting of underground sewage disposal systems with setbacks to lot lines and the natural boundary of the sea.

REPORT SUMMARY

The purpose of this report is to provide an analysis of the hydrogeological study – Phase 1 report dated November 9, 2017 for DL 696, Keats Island.

BACKGROUND

The Gambier Island Local Trust Committee (LTC) passed the following resolutions at the September 2017 meeting:

GM-2016-055
It was MOVED and SECONDED
that the Gambier Island Local Trust Committee amend Bylaw No. 143 cited as "Keats Island Land Use Bylaw, 2002, Amendment No. 2, 2016" as specified in Attachment 1 of the staff report dated September 20, 2017. as amended, by removing "caretaker" in section 2.4.7, bullet 2, and section 2.4.9, bullet 1.

CARRIED

GM-2016-056
It was MOVED and SECONDED
that the Gambier Island Local Trust Committee Bylaw No. 143 cited as "Keats Island Land Use Bylaw, 2002, Amendment No. 2, 2016" be read a first time as amended.

CARRIED

GM-2016-057
It was MOVED and SECONDED
that the Gambier Island Local Trust Committee request staff to undertake Bylaw No. 143 referral follow up with the Sunshine Coast Regional District regarding community park zoning and Skwxwú7meshulh Nation regarding marine and land zoning changes.

CARRIED

GM-2016-058
It was MOVED and SECONDED
that the Gambier Island Local Trust Committee proceed no further with Bylaw No. 144 cited as "Gambier Island Trust Committee Land Use Contract Authorization Bylaw, 1978 (Convention of Baptist Churches of British Columbia), Amendment No. 1, 2016".

CARRIED

GM-2016-059
It was MOVED and SECONDED
that the Gambier Island Local Trust Committee endorse the 'GM-RZ-2004.1 September 2017 Frequently Asked Questions' document (as amended by the Local Trust Committee), for mail out to all property owners and residents of Keats Island and posting to the Local Trust Committee 'Current Applications' webpage.

CARRIED

GM-2016-060
It was MOVED and SECONDED
that the Gambier Island Local Trust Committee:

a. Request staff to prepare a draft restrictive (conservation) covenant for the Salmon Rock 'Private Conservation (PC) Zone' portion of District Lot 696, Keats Island, consistent with Islands Trust Policy 5.3 'Best Practices for Local Trust Committees in Holding Conservation Covenants', which includes a provision for annual monitoring to be paid for by the owner, for Local Trust Committee consideration prior to a Public Hearing for Bylaw No. 143;
b. Request the applicant for GM-RZ-2004.1 submit a baseline ecological report for the covenant area consistent with the Islands Trust Fund baseline report template, for Local Trust Committee consideration prior to a Public Hearing for Bylaw No. 143; and
c. Request the Islands Trust Fund Board assist with annual monitoring of the covenant area as the property is adjacent to the proposed Sandy Beach Nature Reserve.

CARRIED

GM-2016-061
It was MOVED and SECONDED
that the Gambier Island Local Trust Committee has reviewed the template statutory right-of-way to be held by the Ministry of Transportation and Infrastructure for the 2 metre wide strip abutting each side of the public trail to Salmon Rock, District Lot 696, Keats Island and considers the template to be consistent with the conditions of Bylaw No. 144 cited as "Gambier Island Trust Committee Land Use Contract Authorization Bylaw, 1978 (Convention of Baptist Churches of British Columbia), Amendment No. 1, 2016 regarding the dedication of an "unopened road".

CARRIED

GM-2017-062
It was MOVED and SECONDED
that the Gambier Island Local Trust Committee request staff to work with the proponent on GM-RZ-2004.1 to resolve any identified gaps in the hydrogeological report, including the provision of diagrams showing septic field flow, and report back to the Local Trust Committee as soon as possible.

CARRIED

All relevant background staff reports, memos and presentation slides are available on the LTC 'Current Applications' webpage.

ANALYSIS

Hydrogeological Report

As a result of LTC resolution GM-2017-062, the applicant has submitted a hydrogeological report (Attachment 1) to replace the assessment memorandum that was submitted in September 2017. Islands Trust planning and senior freshwater staff reviewed the hydrogeological report and can confirm the applicant has adequately addressed the June 2017 Terms of Reference (ToR). The professional opinion provided by the hydrogeologist stipulates:

> ***"Projected potable water needs for the Convention's proposed 110 cottage lots and Keats Camp expansion can be satisfied from on-site groundwater sources, and neither the proposed groundwater extractions nor proposed new community sewerage systems will have adverse impacts on local groundwater resources, groundwater users, and receiving waters."***

An analysis of the hydrogeological report is provided below. Based on the findings of the hydrogeological report, the LTC may determine it has a high level of comfort that the groundwater and sewage disposal issues have been adequately addressed in order to advance Proposed Bylaw No. 143 to second reading. Islands Trust staff identified the following issues from the hydrogeological report as relevant to the LTC's jurisdiction and consideration:

- Requesting confirmation from the applicant of conditional provincial approvals for sewage disposal and water systems prior to a public hearing;
- Compliance of proposed sewage disposal field 'E1' with the siting provisions of Keats Island Land Use Bylaw Sections (LUB) 2.7.6 and covenant requirements of 7.7.1;
- Advocating for additional monitoring of groundwater as a requirement of a provincial groundwater licence; and
- Reviewing the Keats Island Land Use Bylaw definition of "structure" to include sewage disposal systems independent from the processing of this application and as a separate project.

Aquifer Productivity and Groundwater Demand:

The balance between aquifer productivity and safe yield to satisfy water needs of the camp and cottages expansion relates to: the hydrogeological properties of the aquifer (transmissivity and storativity), the geological structure of Keats Island (fractures and architecture), the efficiency of the Camp Wells (specific yield), and the rate and volume groundwater withdrawn from the aquifer (demand). The Islands Trust ToR were informed by the *BC Water Sustainability Act* and *Groundwater Protection Regulation,* and requested specific data and information for Islands Trust staff review as well as an educational exercise to inform staff, trustees, the applicant, and the public on the dynamics and risks associated with aquifer productivity, vulnerability, and demand.

A high-level summary of the hydrogeological report supplied the following information*:*

<u>The Property</u>

- The DL 696 property covers an area of 169 acres (68.3 hectares)

Site-Wide Aquifer Recharge

- The total site-wide aquifer recharge is 46,785m3 (assuming an average recharge rate of 5% of the annual precipitation of 1,370mm).

Sub-Catchment Aquifer Recharge

- The drainage sub-catchment associated with Camp Wells #1 and #2 covers an area of approximately 24.2 hectares approximately 35% of the site.
- The total recharge potential of the sub-catchment is 16,580 m3 (assuming an average recharge rate of 5% of the annual precipitation of 1,370mm).

Groundwater Demand

- The estimated annual withdrawal volume of 14,850m3 (applying the projected 50% increase from 2016 of 9,900m3).
- The projected demand is 19.2 USgpm for the 110-lot build-out and expanded camp scenario.

Wells and Preliminary Pumping Test

- The head of both Camp Wells are approximately at 17 meters above local datum.
- Camp Well #1 (Well Tag Number 21256) was constructed in 1968 to a reported depth of 49 meters below ground (160 ft-bg) or 32 meters below local datum.
- Camp Well #2 (Well Tag Number 92985) was constructed in 2004 to a reported depth of 59 meters below ground (193 ft-bg) or 42 meters below local datum.
- Camp Well #1 and Camp Well #2 were relatively stable and ranged from approximately 16 to 17 meters above local datum (m ald, high tide line).
- Preliminary pumping tests estimated the sustained yield of Well #1 is estimated to be 6 USgpm and the sustained yield of Well #2 is estimated to be 23 USgpm.
- The total drawdown during pumping was Well #1 water level stabilized at 6 meters below local datum and Well #2 stabilized at approximately 6 meters above local datum.

Figure 10 of the hydrogeological report identifies the 24.2 hectare camp wells "sub-catchment" area. In the opinion of the Islands Trust Freshwater Specialist, it is logical to assume that the percentage of contributing recharge to the camp wells from the sub-catchment is greater than 35% area of total site cover. In the hydrogeological report, it is noted that the sub-catchment supplies 35% of the site-wide aquifer recharge, which may be logical, but it does not accurately inform the total percentage of recharge to the wells, which may be greater than 90% with only 10% leakage from other catchments.

If the Wells were to be 100% recharged from the sub-catchment, the resulting annual recharge volume at 5% total precipitation would be 16,580m^3. If the estimated demand of 14,580m^3 is an appropriate approximation for the camp and cottages expansion, the resulting demand is 88% of total estimated recharge. Often in water resource allocations, 70% or less of recharge withdrawal is considered *safe yield*. Recharge is difficult to estimate due to heterogeneities of the landscape, the dominance of fractured media of Keats Island, and the intensities of winter storm runoff. The hydrogeological report suggests that the water levels in the camp wells respond rapidly to static water levels in periods of non-pumping. This demonstrates that during winter, the aquifer storage may fill up rapidly during the onset of winter rains. Therefore, precipitation may not readily recharge the aquifer during this time and increased runoff may occur leading to the premise that precipitation volume may not be an appropriate metric for determining recharge and thus available groundwater. These values can be determined by assessing transmissivity and storativity values in a pumping test that contributes to an aquifer water balance assessment.

It is assumed that there is an aquifer hydraulic connection outside of the sub-catchment to surrounding areas due to responses in the Benson Drilled Well during testing of camp wells. Surface watershed delineations do not completely capture the entire recharge zone of a groundwater well since aquifer flow regimes have the potential to transcend surface watershed boundaries. This is due to geological subsurface structure and fracture connectivity that results in hydrostatic pressure effects throughout the system. It is probable that precipitation that falls on the DL 696 recharges (to some percentage) the Benson Drilled Well and that precipitation that falls on the Benson Property, recharges (to some percentage) the camp wells. However, it is logical to assume that the sub-catchment area defined in Figure 10 is the most critical and significant zone with respect to available groundwater volume recharge for use in the camp wells.

The sub-catchment should be considered a sensitive and significant recharge zone for the camp wells and thus due to its direct connection with precipitation, may be considered a "source of domestic water supply" under section under 2.7.6 of the LUB.

As wells age, they lose efficiency. The fractures that interact with a drilled borehole can become less permeable due to mineralization. Biofouling of wells can cause less effective yield. Thus, it may be assumed that a new well will have a greater specific yield than an existing one. It is probable that a new well that is drilled and installed proximal to Well #2 will exhibit a specific yield greater than 23 USgpm. The percentage of how much more efficient a new well would be is unknown and cannot be predicted prior to drilling and well construction. Therefore, the only consideration for sustained yield of 23 USgpm is from testing by Keats Island Construction Services in November 2013, which has known associated errors and was not completed for the purposes of the hydrogeological report. The estimated demand of 19.2 USgpm is 83% of the reported sustained yield.

Similar to total demand on aquifer recharge, safe yield is usually less than 70% of specific yield. Here it is estimated that over 80% of the available yield would be used to satisfy estimated demand. This estimated specific yield calculation is within 5% of the recharge demand. This demonstrates that the proposed demand of cottage and camp expansion is greater than the 70% safety factor that is usually applied to water resource allocations.

Aquifer Vulnerability and Groundwater Quality:

Due to the reported presence of coliforms in drilled wells on Keats Island, it is reasonable to assume that these wells should be assessed under the Ministry of Health *Guidance Document For Determining Ground Water At Risk of Containing Pathogens (GARP) Including Ground Water Under Direct Influence of Surface Water (GWDUI).* Confirmation of this from the provincial ministry is recommended. Since coliforms are not widely distributed in groundwater system, the presence of coliforms either indicates a failing groundwater well, a poorly constructed groundwater well, or timely connection of surface water to the groundwater system. From data contained in the Camp Well #2 drillers report it can be suggested that due to the age and common drilling practices of the day that the well does have a surface seal.

Furthermore, the surficial geology and bedrock of an island has great influence over the connection of surface water (or shallow groundwater) to the deeper bedrock groundwater. The surficial confining layer in the south of Keats Island is reported to be discontinuous and bedrock outcrops are present throughout DL696. As groundwater preferentially flows along boundaries of geologic material, an outcrop of bedrock has the potential to transport significant volumes of precipitation and shallow groundwater to deeper reaches of the groundwater system.

The presence of a geological structure in DL 696 separating the Bowen Island Group and Coast Plutonic also raises concern regarding direct pathways of surficial pathogens to deeper reaches of the groundwater system. This geological structure is located within the sub-catchment system for the camp wells. The risk of land-use

change and disposal of sewage within the sub-catchment area and proximal to the main geological structure of the island are variables that contribute to risk of impacting receiving waters including the camp wells and other groundwater users on Keats Island.

The hydrogeological report Figure 14 illustrates that the proposed sewage disposal distribution dispersion for the 'E1' disposal field would be possibly within the sub-catchment area, 30 metres from the eastern property boundary, 30 meters from the dug well on the adjacent property to the east ("Dug Benson Well") (Figure 1 below), and subject to section 2.7.6 which prohibits such infrastructure within 30 metres of a domestic water supply.

Figure 10 of the hydrogeological report identifies a large 24.2 hectare "sub-catchment" area surrounding the existing wells #1, #2, "Dug Benson Well" and possibly includes "Drilled Benson Well". As this entire sub-catchment is a considerable recharge zone for the wells, it is to be considered a "source of domestic water supply" under section under 2.7.6 of the LUB; the siting of sewage disposal area 'E1' in this area continues to raise concerns despite the illustrative analysis and preliminary assurances in the hydrogeological report. A covenant area for any new or modified existing well would be a condition of subdivision; however staff recommend that the "catchment area" for any intended well, to be used as part of the community water system, be delineated by a qualified professional to ascertain any conflict with the proposed sewage disposal locations.

Unlike sewage disposal areas A, B, C, D and F, proposed sites 'E1' and 'E2' have not received conditional approval from Vancouver Coastal Health (VCH) and the report is suggesting on page 21 that site 'E1' *"is considered feasible based on interpreted southward dispersal of effluent-affected groundwater, which available information indicated will not enter the Dug Benson Well, due to an estimated horizontal offset of approximately 40m (130 ft) and will not enter local drilled wells due to the cross slope position of the wells…."*

The 'E1' site also relies upon a prototype 'interceptor trench' described on page 17 along the northern and northwestern boundaries of the proposed disposal field boundaries to collect groundwater flowing from upslope areas and disposing of the groundwater *"to a controlled discharge location(s) [to be determined]."* This particular design element proposes to move groundwater into the marine environment where there is no ability for recharge to the aquifer.

The following policy guidance in the Islands Trust Policy Statement supports a precautionary approach and further consideration to alternatives to the proposed site 'E1' sewage disposal field/interceptor trench proposal:

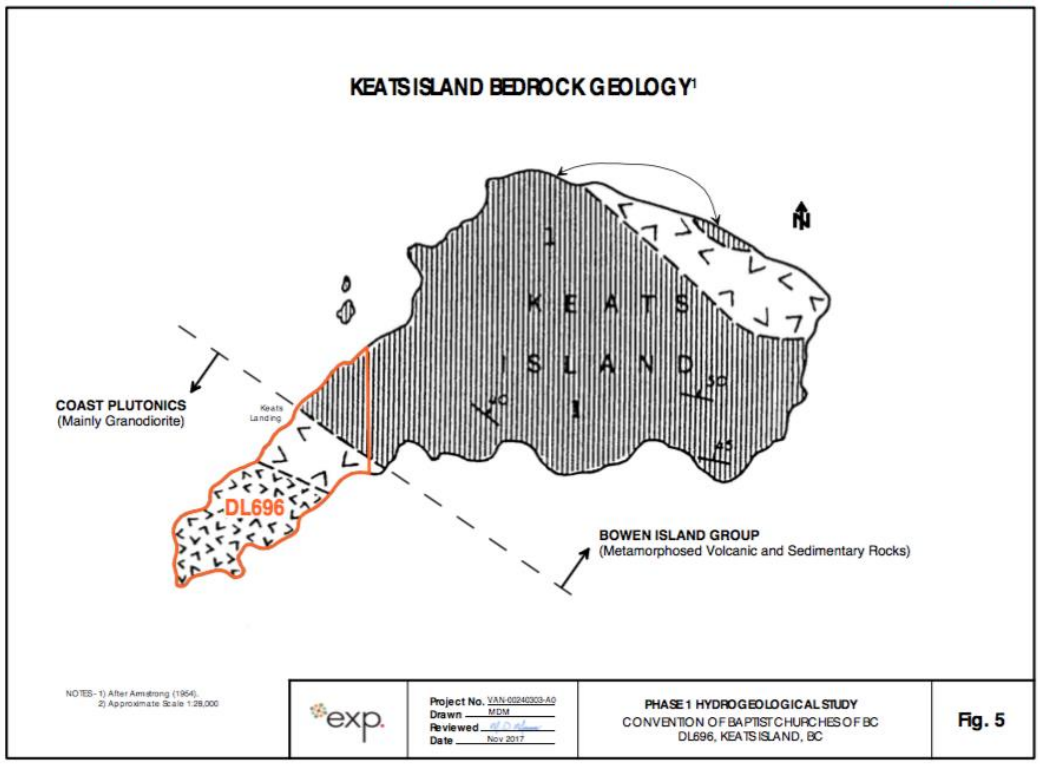
> *3.1.5 Local trust committees and island municipalities shall, in their official community plans and regulatory bylaws, address the regulation of land use and development to restrict emissions to land, air and water to levels not harmful to humans or other species.*
>
> *4.4.2 Local trust committees and island municipalities shall, in their official community plans and regulatory bylaws, address measures that ensure:*
> *• neither the density nor intensity of land use is increased in areas which are known to have a problem with the quality or quantity of the supply of freshwater,*
> *• water quality is maintained, and*
> *• existing, anticipated and seasonal demands for water are considered and allowed for.*
>
> *4.4.3 Local trust committees and island municipalities shall, in their official community plans and regulatory bylaws, address measures that ensure water use is not to the detriment of in-stream uses.*

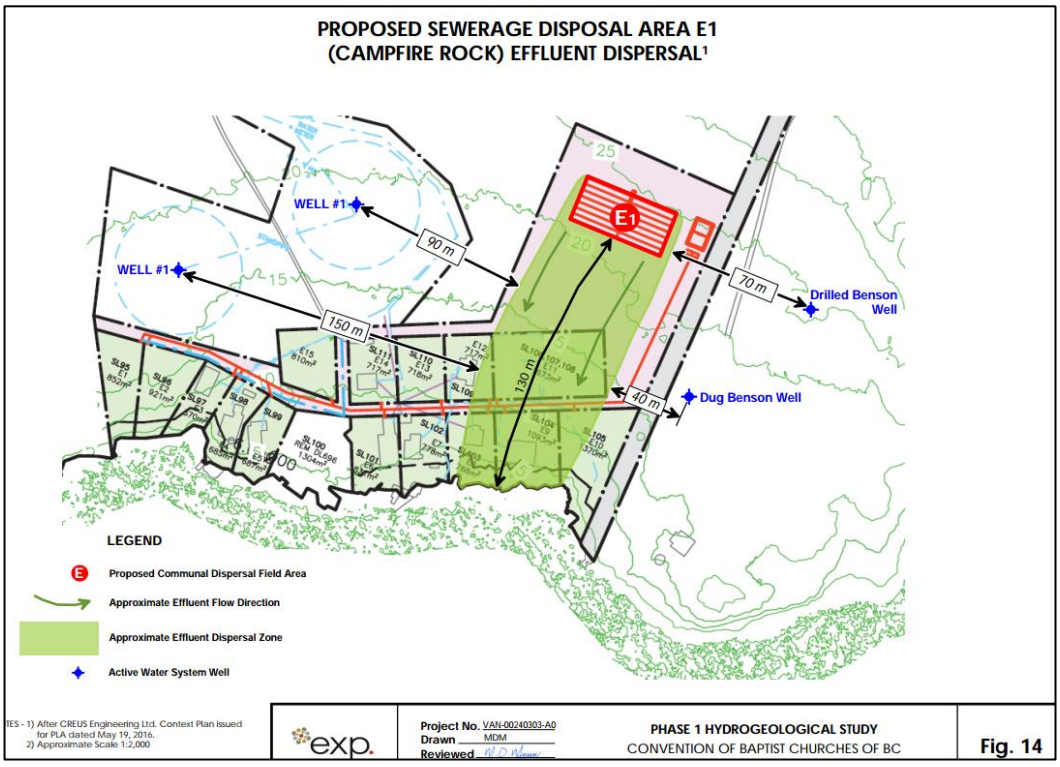
Regardless of what VCH guidelines or regulations require as a minimum standard for human health and risk to the environment, the LTC can be more stringent in exercising zoning discretion around groundwater protection and groundwater re-direction for the purposes of sewage treatment. Zoning regulations can:

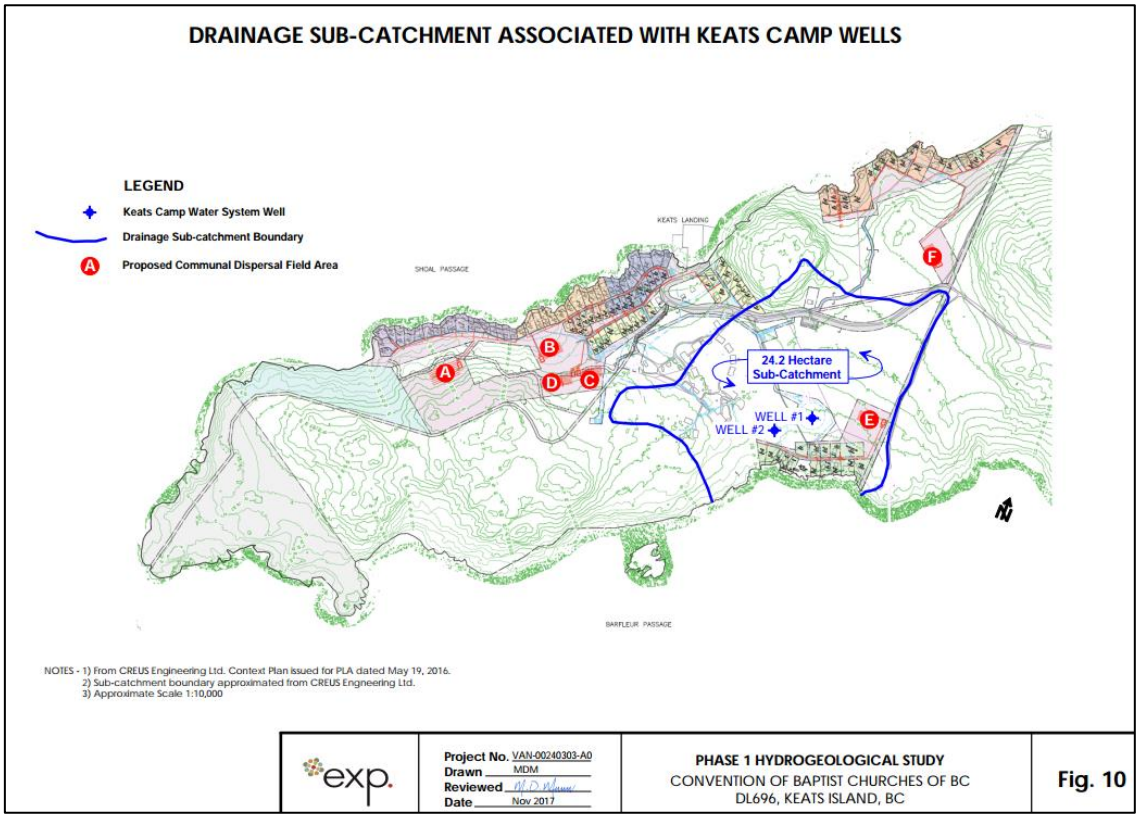
1) prohibit communal sewage disposal fields within an aquifer sub-catchment area;
2) stipulate a greater setback than section 2.7.6 requires for a communal disposal field from a specific domestic water source or zone boundary; or
3) be subject to adoption upon conditional approval by VCH.

If the applicant comes back with VCH conditional approval and catchment areas defined, the LTC can also consider incorporating a site specific setback in the proposed 'Comprehensive Development (CD2) Zone' that prohibits the siting of a new well or sewage disposal system within a specified distance (i.e. 150 metres) from the western property boundary of LOT A DISTRICT LOT 876 PLAN 18419 002-619-806 to further address groundwater quality and quantity issues in the sub catchment area for adjacent, existing wells.

Attachment # 7




PROPOSED SEWERAGE DISPOSAL AREA E1
(CAMPFIRE ROCK) EFFLUENT DISPERSAL¹
WELL #1
WELL #1
90 m
150 m
E1
70 m
Drilled Benson Well
130 m
40 m
Dug Benson Well
LEGEND
Proposed Communal Dispersal Field Area
Approximate Effluent Flow Direction
Approximate Effluent Dispersal Zone
Active Water System Well
TES - 1) After CREUS Engineering Ltd. Context Plan issued for PLA dated May 19, 2016.
2) Approximate Scale 1:2,000
exp.
Project No. VAN-00240303-A0
Drawn MDM
Reviewed
PHASE 1 HYDROGEOLOGICAL STUDY
CONVENTION OF BAPTIST CHURCHES OF BC
Fig. 14


DRAINAGE SUB-CATCHMENT ASSOCIATED WITH KEATS CAMP WELLS
LEGEND
Keats Camp Water System Well
Drainage Sub-catchment Boundary
Proposed Communal Dispersal Field Area
KEATS LANDING
SHOAL PASSAGE
BARFLEUR PASSAGE
24.2 Hectare Sub-Catchment
WELL #1
WELL #2
NOTES - 1) From CREUS Engineering Ltd. Context Plan issued for PLA dated May 19, 2016.
2) Sub-catchment boundary approximated from CREUS Engineering Ltd.
3) Approximate Scale 1:10,000
exp.
Project No. VAN-00240303-A0
Drawn MDM
Reviewed
Date Nov 2017
PHASE 1 HYDROGEOLOGICAL STUDY
CONVENTION OF BAPTIST CHURCHES OF BC
DL696, KEATS ISLAND, BC
Fig. 10

Regulating the location of proposed sewage disposal fields:

The following LUB sections pertain to the siting of proposed sewage disposal field 'E1'

- Section 2.7.6 stipulates: *"No underground sewage disposal system, including all septic tanks, absorption fields and related appurtenances may be sited within 30.0 metres (100 feet) of a watercourse, well or source of domestic water supply."*

- Section 7.7.1 stipulates: *"Where a community water supply system is proposed to serve a subdivision:*

    - *the water system must comply in all respects with provincial enactments;*
    - *no community water supply system must be supplied with water that is not obtained on the island on which the system is located; and*
    - *if the community water system is to be supplied by a well, the immediate catchment area of the well, as defined by an engineer, is to be protected from pollution by a covenant complying with Subsection 1.2.4 prohibiting the installation of sewage disposal fields or other sanitary facilities."*

The applicant's plan for sewage disposal field 'E1' does not appear to comply with LUB section 2.7.6. At the time of subdivision, the applicant would also need to comply with section 7.7.1. Staff recommends that further information on the "immediate catchment area" as defined by an engineer be provided to the LTC by the applicant.

Advocating for groundwater monitoring:

Section 4.9 of the hydrogeological report details the additional groundwater monitoring that may be required by VCH or recommended by the EXP consultants. VCH observation wells within new dispersal zones of each communal sewage field may be required by VCH to facilitate shallow groundwater sampling to confirm sewage system function. The report recommends that Well #3 should be converted to a permanent monitoring well to evaluate aquifer water level data, saltwater intrusion or other indicator parameters to alarm of anthropogenic and climatic impacts to the groundwater system; however this well is currently inactive and clearly outside the sub-catchment area where any new well may conceivably be located for the community water system.

The Ministry of Forests, Lands and Natural Resource Operations and Rural Development (FLNRORD) has a provincial observation well network with no monitoring well on Keats Island. FLNRORD's preference is for a monitoring well to be situated on public lands to secure access, in a location that provides maximum quality and quantity data. The LTC could, as a condition of rezoning, require the applicant to install a monitoring well in the location of the proposed SCRD park (which is within the sub-catchment area as shown on Figure 10 of the report) prior to the dedication of the land, to the satisfaction of FLNRORD; OR advocate that FLNRORD require a monitoring well as a condition of their water license. To date, such a condition has never been issued by the south coast FLNRORD office which is why staff is recommending the applicant explore the option of installing a monitoring well in the location of the proposed parkland with FLNRORD and report back to the LTC prior to scheduling a public hearing.

Defining "structure" in the Keats Land Use Bylaw:

Currently the Keats LUB excludes "*underground sewage disposal systems including septic tanks, absorption fields and related appurtenances*" from the definition of "structure". Sewage disposal fields are therefore not required to meet the setback requirements in any zone regulations. Staff recommend the LTC add to the projects list, a review of the definition of 'structure' in order to adequately address best management practices for regulating the siting of sewage disposal fields anywhere on Keats Island.

Rationale for Recommendation

The LTC requested the applicant provide a comprehensive hydrogeological assessment report to address key groundwater concerns pertaining to this application. It is the opinion of staff that the submitted assessment addresses the ToR requirements and also identifies risks that can be addressed either by Proposed Bylaw No. 143 or through receipt of additional information in advance of a public hearing.

ALTERNATIVES

The LTC may consider the following alternatives to the staff recommendation:

1. **Give Second Reading to Proposed Bylaw No. 143 and proceed to Public Hearing**

   The LTC may be satisfied with the findings of the hydrogeological report provided by the applicant, proceed to second reading, and request staff to schedule a public hearing in accordance with the requirements of the *Local Government Act*. If this alternative is selected the following resolutions may be considered:

   1. "That Gambier Island Local Trust Committee Bylaw No. 143 cited as "Keats Island Land Use Bylaw, 2002, Amendment No. 2, 2016" be read a second time."

   2. "That the Gambier Island Local Trust Committee request staff to schedule a Community Information Meeting and Public Hearing for Bylaw No. 143 cited as "Keats Island Land Use Bylaw, 2002, Amendment No. 2, 2016" conditional upon receipt of the following:

      1) a draft conservation covenant for the Salmon Rock area;
      2) a letter from the owner agreeing to discharge the Land Use Contract;
      3) receipt of a letter of undertaking to deposit plans for the dedication of the SCRD park, public road and trail upon adoption of Bylaw No. 143; and
      4) receipt of a letter of undertaking to deposit a plan of subdivision for the transfer of Sandy Beach Nature Reserve to the Island Trust Fund upon adoption of Bylaw No. 143;

2. **Request Additional Information**

   The LTC may request the applicant provide specific additional information prior to requesting staff prepare further bylaw amendments. If this alternative is selected recommendation #2 on page one of the report should be amended to include the specific information request.

NEXT STEPS

Staff is preparing amendments to the 'Community Service 2' zone parking requirements as discussed at the September 2017 LTC meeting. The LTC can consider any new information from the applicant and amending Proposed Bylaw No. 143 at second reading at the regular business meeting scheduled for January 25, 2018.

Submitted By:	Sonja Zupanec, Island Planner William Shulba, P.Geo, Senior Freshwater Specialist	November 20, 2017
Concurrence:	Ann Kjerulf, MCIP, RPP Regional Planning Manager	November 20, 2017

ATTACHMENTS

1. EXP Hydrogeological Report DL 696 Keats Island, November 2017

HYDROGEOLOGICAL STUDY - PHASE 1
DL 696, Keats Island, BC
Hydrogeological Report

Prepared For:

Convention of Baptist Churches of BC
c/o Islands Trust
700 North Road
Gabriola Island, BC V0R 1X3

Attn: Sonja Zupanec, RPP, Island Planner, Islands Trust

Prepared By:

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Project Number:

VAN-00240303-A0

Report Date:

November 9, 2017

Table of Contents

Attachments

1 Introduction

EXP Services Inc. ("EXP") was retained by the Convention of Baptist Churches of BC (the "Convention") to complete a Phase 1 Hydrogeological Study to support an on-going rezoning application process for the Convention's property DL 696 on Keats Island, BC. Scope for the Phase 1 Hydrogeological Study was developed primarily through consultation with the Convention's civil engineering consultant, CREUS Engineering Ltd. ("CREUS"), who directly consulted with Islands Trust regarding initial terms of reference and amended terms of reference for a hydrogeological assessment of the subject property, and supplementary input from BC Ministry of Forests, Lands, Natural Resource Operations & Rural Development ("FLNRO").

Consistent with the preamble of Islands Trust's June 2, 2017 Terms of Reference[1] (Attachment #1), the primary objective of EXP's Phase 1 Study was to complete a preliminary data review and assessment to provide rezoning-stage confirmation that potable water needs for the Convention's proposed lots and intended uses can be satisfied from on-site groundwater sources, and that neither the proposed groundwater extractions nor proposed community sewerage systems will have adverse impacts on local groundwater resources, groundwater users, and receiving waters.

Assessment methodologies employed for the Phase 1 Study and the resulting Statements of Opinion (Section 5) are appropriate for the current rezoning-stage process and anticipate mandatory hydrogeological assessments, evaluations and reports will be required to support Provincial Government agencies' comprehensive permitting and licencing processes at subdivision stage. Specifically, prior to issuing permits for construction of proposed new communal sewerage disposal fields, Vancouver Coastal Health ("VCH") will require submission of a detailed "Hydrogeological Assessment" that evaluates human health risks related to potential groundwater contamination and, prior to VCH issuing a permit for expansion of the existing Keats Camp water system, a separate "Hydrogeologist Report" must be submitted that assesses groundwater quantity and quality risks and confirms all water source wells meet current *Groundwater Protection Regulation (2016)* requirements. Further, as a condition of subdivision approval, the Convention must obtain a Groundwater Licence under the *Water Sustainability Act (2016)*, through application to statutory decision makers at FLNRO. A primary objective of FLNRO's licencing process is to ensure sustainable groundwater resource (i.e., aquifer) management and, accordingly, includes inter-government notifications, external stakeholder referrals, and a peer-level technical review by FLNRO hydrogeology staff, whom EXP has engaged at Islands Trust's request during development of the Phase 1 scope.

This Phase 1 Study supersedes EXP's previous "Hydrogeological Study – Phase 1" memorandum dated July 27, 2017 and two "Supplementary Information" memoranda dated September 12 and September 15, 2017. The Phase 1 Study was completed in general agreement with EXP's Work Plan delivered to the Convention on May 17, 2017. Use of this report must include consideration of the Section 6 Limitations and the attached "Interpretation & Use of Study and Report" (Attachment #2).

[1] Islands Trust's June 2, 2017 Terms of Reference specifically request "*confirmation at the rezoning stage that the potable water needs of the proposed lots and intended uses can be met and the proposed wells and sewage disposal system(s) will have no adverse impacts on surrounding wells, groundwater resources and receiving waters*".

2 Background

The Convention's DL 696 property (the "Site") covers an area of approximately 169 acres within the southwest tip of Keats Island (Attachment #3). Development of the Site commenced in 1926 and generally approached current level of occupation and use during the 1950's. Land use currently includes 84 individual cottages located on 110 leased lots and a youth camp (i.e., Keats Camp) with several accommodations buildings and related structures.

The leased cottage lots and Keats Camp (the "Camp") are serviced by two on-site water supply wells (designated Well #1 and Well #2) located near the southern Site boundary (shoreline), which withdraw groundwater from a bedrock aquifer underlying the entire Site (Attachment #4). A third, inactive Camp well (designated Well #3) is located within the north-central portion of the DL 696 lands. The current water system was built in 2004 and is operated by Keats Island Construction & Service Ltd. ("KICAS") under a VCH Permit to Operate issued in March 2008. The Camp has four existing communal sewerage systems and additional single building disposal fields. The existing 84 cottages are serviced by a range of on-lot and shared sewerage systems. Six proposed new communal dispersal field areas are shown on Attachment #4 and are referenced according to the Strata section serviced (i.e., Strata A, B, C, D, E1/E2 and F field areas).

The property owner has applied for rezoning for the purposes of better delineating current zoning of the 110 lots and Camp, to facilitate transfer of lands for "Sandy Beach" to the Island Trust Fund, road dedication to MOTI of an existing gravel road, dedication of "Triangle Park" to the SCRD, dedication of unopened ROW for the existing trail to Salmon Rock, and a nature covenant on the Salmon Rock lands (CREUS, 2017a). A rezoning application has been submitted for 110 residential lots, camp operation and community park uses, which is largely consistent with existing zoning except the addition of one park and adjustment to some lot lines. It is proposed this be accomplished through Island Trust Bylaw 143, which has received first reading (CREUS, 2017a). Further development plans include subdivision of the 110 leased lots as strata with the Camp on the remainder. Islands Trust's rezoning requirements stipulate completion of a "preliminary hydrogeological assessment" to confirm that potable water needs can be met following subdivision and build-out of the proposed 110 lots and expansion of Camp facilities, and that neither the increased water system demand nor the proposed communal sewerage systems will adversely impact existing groundwater users (on-site and off-site), groundwater resources or receiving waters.

3 Methodology

Work completed for the Phase 1 Hydrogeological Study included the following four primary tasks:

- Task 1 – Scope Development;
- Task 2 – Desktop Data Review;
- Task 3 – Site Visitation; and,
- Task 4 – Reporting (Technical Report).

3.1 Task 1 – Scope Development

EXP was initially engaged by CREUS, on behalf of the Convention, to review Islands Trust's "DRAFT Terms of Reference for a Hydrogeological Assessment for DL 696 Keats Island" dated March 10, 2017, and to provide a related scope of work suitable for the immediate rezoning process. In consultation with CREUS, scope for a Phase 1 rezoning-stage study was prepared, assuming that separate Phase 2 studies would be required at subdivision stage (as referenced in Section 1).

Islands Trust stipulated that FLNRO staff be consulted during development of the Phase 1 Study scope. Accordingly, FLNRO Regional Hydrogeologist, Mr. Mike Simpson, P.Geo., was contacted by email on May 17, 2017 to request FLNRO's review and comments on EXP's proposed rezoning-stage work plan. FLNRO's response was received by email on May 30, 2017 and forwarded to Islands Trust on May 31. FLNRO generally expressed agreement with the suitability of the proposed work plan for the intended rezoning process, but also identified pending Ministry technical requirements for the subsequent subdivision stage hydrogeological assessment/reporting.

3.2 Task 2 – Desktop Data Review

Concurrent with the Phase 1 scope development (Task 1), review and assessment of the Site commenced based on information available in documents provided by the project proponents and/or obtained from public sources. Information and data sources utilized in preparing this report are summarized in Section 8 and are referenced in the report.

3.3 Task 3 – Site Visitation

EXP Senior Hydrogeologist, Mr. Matthew Munn, P.Eng., attended the Site on June 12, 2017, with Mr. Kevin Healy of CREUS and Messrs. Andrew Nadler and Alex Laidlaw of KICAS, to complete a reconnaissance-level visual survey of the Site (Attachment #4), which included the following:

- Completion of a visual survey transect:
  - Southwestward from Keats Landing through central portion of Site to western end of proposed Strata E lots;
  - Northeastward through Strata E lots to dug well on Benson property;
  - Northward along eastern Site boundary trail to Benson Well (drilled);
  - Westward and southward through proposed E1 dispersal field area;
  - Northward along eastern Site boundary trail to proposed E2 and F dispersal field areas;

  - Southwestward (overall) to Keats Camp water system treatment facility;
  - Northwestward to eastern end of proposed Strata C and Strata D dispersal field areas;
  - Southwestward through proposed Strata C and Strata D dispersal field areas;
  - Northwestward toward proposed Strata B dispersal field area;
  - Southwestward (overall) toward proposed Strata A dispersal field area; and,
  - Northeastward (overall) to Keats Landing.
- Observation of proposed new communal sewage dispersal field areas identified in CREUS PLA drawings;
- Observation of existing open test pits within proposed E1 (Campfire Rock) sewage dispersal area and interception trenches along nearest downslope parcels;
- Observation of registered drilled well (Benson Well) and unregistered dug well on adjacent Benson property;
- Observation of Keats Camp Wells #1 and #2 and related operational discussions with KICAS personnel;
- Observation of inactive Keats Camp Well #3;
- Observation of unregistered dug well (vault) on proposed Strata Lot 26 (C11); and,
- Discussions with KICAS personnel regarding delivery of system operational data and 2013 well monitoring graphs, as referenced in the Task 2 summary.

3.4 Task 4 – Reporting

Delivery of this report represents completion of the authorized scope of work.

4 Results and Assessment

4.1 Physiography

Keats Island is situated within Howe Sound, approximately 1 km (kilometre) east of the Town of Gibsons (Attachment #3), and has a total land area of approximately 600 hectares (excluding smaller associated islands) and coastline of approximately 14 km (kilometre) length. Island terrain is characterized by deeply eroded, rugged slopes with bedrock-controlled topography and frequent bedrock outcrops. The shoreline includes numerous rock cliffs with intermittent sandy and sand/gravel beaches. Upland areas comprise peaks of approximately 200m elevation forming a series of ridges along the island's overall north-eastward trending alignment (Attachment #5).

DL 696 covers an area of approximately 169 acres within the southwest tip of Keats Island and has a total length (measured along a northeast-southeast axis) of approximately 2,000m and consistent width of approximately 500m to 600m width (Attachment #6). The southern two-thirds area of DL 696 is primarily undeveloped bedrock uplands with several steep-sided hills with peaks ranging from 60m to 75m elevation. An isolated steep-sided hill with a peak of approximately 80m elevation is located adjacent to the Keats Landing wharf. Existing leased lots are located along an approximately 1,500m segment of the northern shoreline of DL 696, commencing at the northwest property boundary, except for a 300m section of steep shoreline terrain along the northern flank of the Keats Landing hill. Keats Camp is situated within a broad area of gently sloping and flat terrain near 30m elevation located between the prominent Keats Landing hill and the northern flanks of the southern upland. The coastline of DL 696 is comprised almost entirely of steep competent bedrock extending below the marine water line with lesser areas of localized gently-sloping sandy and gravelly beach (Good, 2010).

4.2 Climate

Keats Island is located within the Georgia Lowland Ecosection of the Georgia Depression Ecoprovince (Demarchi, 1996), which is affected by the Vancouver Island Ranges rainshadow that creates generally drier conditions than in coastal areas adjacent to the Pacific Ocean (Demarchi, 2010). Local air temperatures are influenced by both the Pacific Ocean and local inshore marine waters. Rainfall is characterized by protracted seasonal (i.e., Fall and Winter) rains that include intense long-duration rainfall events during the period of October to February. The winter rains generally originate from the northeast Pacific (i.e., from the west and northwest), through the Strait of Juan de Fuca, or over the Vancouver Island Mountains (Demarchi, 1996).

Climate data available for the Government of Canada "Gibsons" meteorological station reports a total annual precipitation value of 1,370mm (based on monthly normals) and 165.1 days per year with detectable precipitation (Government of Canada, 2017).

4.3 Bedrock and Surficial Geology

4.3.1 Bedrock Geology

Mapping by the Geological Association of Canada indicates Keats Island bedrock includes two rock types comprised of relatively older Bowen Island Group metamorphosed volcanic and sedimentary rock, which are intruded by Coastal Plutonics granitic rocks (Armstrong, 1990). Coastal Plutonics occur

within the southwest tip and northeast end of the island (Attachment #7) and are characterized by coarse grained, relatively light coloured grey/green granodiorites (Armstrong, 1954). Bowen Island Group rocks underlie a much larger portion of Keats Island and occur as comparatively fine grained, relatively dark coloured grey/green/black lavas, related pyroclastics and metasediments.

The northeast corner of DL 696 is underlain by metamorphic rocks and the remaining DL 696 area to the south underlain by granitic rocks. The mapped intrusive contact between these rock groups (Armstrong, 1954) is aligned northwest-southeast from the Keats Landing wharf area, along the toe of slopes comprising the Keats Landing hill, and crosses the northern boundary of DL 696 at a location approximately 100 m from the southern shoreline (Attachment #7).

4.3.2 Surficial Geology

The extents and types of surficial sediments overlying bedrock within the southwest tip of Keats Island, including the DL 696 property and adjacent lands, have not been examined and reported on published maps by either government or private agencies. However, surficial sediments within DL 696 have been directly examined at eighty-two (82) exploratory test pit sites located either within or adjacent to the proposed new sewerage dispersal areas (Attachment #8) and described in associated reports (JEEL, 2010; CREUS, 2017b). Given the distribution and density of the exploratory excavations (Attachment #8), and the conformance of the reported surficial sediment data with standard geological lexicon, the resulting test pit data is considered suitable for interpretation of the DL 696 surficial geology.

Examination of surficial sediments within proposed sewerage dispersal areas A, B, C, D, and F, and within an area immediately north of the proposed E1 dispersal area, was completed in 2010 by John Enevoldson Engineering Ltd. (JEEL, 2010). The 2010 exploration included eleven (11) test pits within or near the proposed Strata A field area, eighteen (18) test pits within or near the proposed Strata B, C and D field areas, nineteen (19) test pits within or near the proposed F field area and E2 field area, and twenty-four (24) test pits immediately north of the proposed E1 dispersal area (Attachment #8). Subsurface conditions were confirmed to be consistent within all examined areas. Soil textures were primarily sand and gravel with average effective depths of 37 inches (Strata A field), 38 inches (Strata B, C, D fields), 33 inches (near E1 field area) and 40 inches (Strata F field and E2 field areas). Glacial till was encountered in one (1) Strata A field area test pit at 48-inch depth and also reported in four (4) Strata B, C and D test pits at depths ranging from 33 inches to 48 inches. Till was not encountered in either the Strata F field area excavations or E2 field area excavations.

In July 2015, CREUS commissioned an examination of the proposed E1 dispersal field area near Campfire Rock. Ten (10) shallow test pits excavated within the primary and reserve field areas (Attachment #8) confirmed the area was underlain by a silty clay loam stratum encountered at depths ranging from 24 inches to 39 inches (average 35 inches) below ground, overlain by a 16 inch to 35 inch (average 26 inch) thick sequence of sandy loam with gravel and silt components (CREUS, 2017b).

4.4 Surface Water Resources

The BC Ministry of Government Communications and Public Engagement (GCPE) is responsible for maintenance of iMapBC, which is an online mapping interface that provides online access to the BC Geographic Warehouse's (BCGW) repository of geographic data from across the BC Government, municipal and regional governments and public sector agencies. Accordingly, the iMapBC interface is a primary tool for government agencies, consultants and the public to view and analyze the available

data, which includes base mapping with place names, administrative boundaries, topography, surface water features (e.g., streams, lakes, wetlands) and government program information such as forest cover and ecosystems.

EXP's review of iMapBC confirms there are no mapped and/or designated surface water features within the DL 696 lands or adjacent properties (GCPE, 2017). This result is consistent with EXP's June 12, 2107 site reconnaissance survey, which did not observe wetland features, standing water (current and former) or evidence naturally channelized surface flow. A preliminary geohazard assessment (Good, 2013) commissioned by The Convention also did not report evidence or indicators of channelized or concentrated surface water flow within the DL 696 lands.

4.5 Groundwater Resources and Users

4.5.1 Aquifers

The principal source for publicly available hydrogeology information in British Columbia is the BC Ministry of Environment (BC MOE) "Water Resources Atlas" ("WRA"), which is an online mapping interface summarizing data from BC MOE's registered water supply well database and Aquifer Classification Database. EXP's review of the WRA confirmed that BC MOE has mapped and classified two aquifers on Keats Island (Attachment #9). The entire island is underlain by a common bedrock aquifer designated "Keats Island Aquifer" (BC MOE Aquifer #0548), which is classified as having "low" productivity relative to a "low" demand and "moderate" vulnerability to contamination from surface sources (BC MOE, 2001). A sand and gravel aquifer (BC MOE Aquifer #0547) of approximately 0.7 km^2 area overlies the Keats Island Aquifer within the southeast corner of Keats Island near the community of Eastbourne.

4.5.2 Registered and Licenced Water Users

The WRA provides approximate locations, construction records and subsurface information for registered water supply wells. The level of detail in the Province's "Detailed Well Records" can vary significantly, but typically includes some combination of construction information, stratigraphy encountered during drilling, water depth and estimated well yield. The WRA does not indicate which water supply wells are currently operational; therefore, wells appearing in the WRA represent a summary of both existing and former wells. The WRA also provides approximate locations for licenced points-of-diversion for surface water. Locations of all registered water supply wells and licenced surface water points-of-diversion on Keats Island are shown on Attachment #9.

The WRA search confirmed there are three registered water wells and two licenced surface water points of diversion within the DL 696 lands, and another two registered water supply wells on properties adjacent to the eastern property boundary of DL 696. During the June 12, 2017 site reconnaissance survey, two (2) additional unregistered water supply wells (one on the DL 696 property and one on the adjacent Benson property) were confirmed to be present. The verified locations (i.e., surveyed or field confirmed) of the registered wells, unregistered wells and licenced points-of-diversion are shown on Attachment #10.

Copies of BC MOE records for the registered wells are provided as Attachment #11 and relevant details for registered and unregistered wells are summarized in Table 1 (Attachment #12). Copies of FLNRO water licence records for the two points-of-diversion were obtained from the Province's Scanned Water

Licence Directory (FLNRO, 2017) and are provided as Attachment #13. Relevant details from the licencing documents are summarized in Table 2 (Attachment #14).

4.5.2.1 Registered Wells

The five (5) registered wells located on DL 696 lands and adjacent properties are constructed as open boreholes into bedrock of the Keats Island Aquifer (Table 1).

Keats Camp Water System Wells

The Keats Camp water system currently withdraws groundwater from two 6-inch diameter bedrock wells. Well #1 (Well Tag Number [WTN] 21256) was constructed in 1968 to a reported depth of 160 ft-bg (feet below ground) at a location approximately 500 ft (150m) from the marine foreshore. Well #2 (WTN 92985) was constructed in 2004 to a reported depth of 193 ft-bg at a location approximately 80m (260 ft) from the foreshore and 85m (280 ft) west of Well #1. Drilling reports indicate bedrock was overlain by a 12m (40 ft) thick "clay till" sequence at the Well #1 site and an approximately 2m (6 ft) layer of unknown overburden at the Well #2 site. Well #2 is currently the primary source of water for the Keats Camp water system and is operated during peak demand periods and "shoulder" periods, whereas use of Well #1 is limited to low demand (e.g., winter) periods and maintenance periods for Well #2. The two water system wells are not operated simultaneously. Keats Camp Well #3 (WTN 77128) was drilled in 1999, at a location immediately north of the developed Keats Camp area, through a 1m (3 ft) surficial till layer and into bedrock to a reported depth of 247 ft-bg. Well #3 was never outfitted with a pump and remains inactive.

Off-Site Wells

A registered bedrock water supply well is located on the neighbouring Benson property, adjacent to the southwest corner of the Site, approximately 200m (660 ft) east of Well #1. It was constructed to a depth of 125 ft-bg (38 m-bg) in 2004 through an 8.0 ft (2.4m) sequence of rocky surficial sediments and assigned Well Tag Number 92997 (Table 1). For reporting purposes, it is designated "Drilled Benson Well".

A registered bedrock water supply well (WTN 20428) is located on the neighbouring Bentall property, approximately 100m (330 ft) from the northwest corner of the Site. It was constructed in 1967 to a reported depth of 80 ft-bg (24 m-bg). Surficial sediments were not reported by the driller (Table 1). For reporting purposes, it is designated "Bentall Well".

4.5.2.2 Unregistered Wells

One unregistered on-site dug well (designated Lot 26 Well) of unknown age is located on proposed Strata Lot 26 (C11). It was constructed as an open-bottom concrete vault that intercepts shallow groundwater present in surficial sediments overlying bedrock. Another unregistered off-site dug well (vault) is located on the Benson property at a location approximately 80m (260 ft) south of the Drilled Benson Well and is designated "Dug Benson Well" for reporting purposes. Information provided to EXP indicates the Dug Benson Well is used for residential irrigation purposes and the Drilled Benson Well for potable applications. There are no other known unregistered wells within 500m (1,640 ft) of either the Keats Camp well field or proposed new communal dispersal field areas.

4.5.2.3 Surface Water Points-of-Diversion

Two (2) water licence points-of-diversion are located within the northwest corner of the Site and are designated by FLNRO as "Resort Spring" and "Eureka Spring". Authorized works depicted and described in the licencing documents for both points-of-diversion (Attachment #13) indicate the installed works do not impound or collect surface water and, instead, are comprised of shallowly excavated sumps that intercept shallow groundwater from surficial sediments. Accordingly, although the authorized works have been appropriately licenced for surface water diversion, the installed structures are functionally equivalent to a shallow dug well that impounds groundwater.

Resort Spring

Two (2) separate licences for 1,000 Igpd (Imperial gallons per day) are authorized for the Resort Spring point-of-diversion (Table 2). FLNRO's water licence database indicates Shelter Island Estates Ltd. is actively diverting water for domestic purposes to two residential lots on Shelter Island, immediately north of Keats Landing. The Convention also currently holds a licence to divert water to DL 696 Lot 18, but the diversion is "inactive" due to hook-up of Lot 18 to the Keats Island water system.

Eureka Spring

Three (3) licences have been authorized by FLNRO for the Eureka Spring point-of-diversion (Table 2). The Convention formerly held a licence for diversion of 1,000 Igpd to DL 696 Lot 8 and Lot 11/12, but the licence was intentionally "abandoned" following hook-up of these lots to the Keats Island water system. Similarly, two other licences for diversion of 500 Igpd to both DL 696 Lot 6 and Lot 9 are currently "inactive" following hook-up to the Keats Island system. Accordingly, the Eureka Spring water diversion works are currently "inactive".

4.6 Generalized Hydrogeology

The hydrogeology of the DL 696 property and adjacent lands is comprised of a shallow groundwater system hosted by surficial sediments and a deeper bedrock aquifer.

4.6.1 Shallow Groundwater System

A portion of the rainfall and snowmelt within DL 696 infiltrates the surficial sediments that overly bedrock and is temporarily stored and transmitted within the sediments. Rapid vertical downward movement of the infiltrated water is constrained by the presence of fine-textured (i.e., silty and clayey) sediments and/or dense till that form the base of the surficial sediments, which causes water to accumulate and preferentially flow laterally within the relatively permeable surficial sediments. Precipitation is the primary source of water "recharge" to the shallow groundwater system, but dispersal of highly-treated sewerage effluent into the near-surface surficial sediments is also a significant source of "recharge" for the shallow groundwater system.

Given that permeable surficial sediments of similar texture and thickness occur within the developed DL 696 lands, subsurface flow directions within the sediments can be reasonably approximated accordingly to overall topographic trends. In general, flow directions within the shallow groundwater system are northward (overall) with portions of the DL 696 lands comprised of north-facing slopes and are southward (overall) within portions of the DL 696 lands comprised of south-facing slopes. Near the

DL 696 shoreline, surficial sediments become thinner or are absent and, therefore, shallow groundwater that does not contribute to wetting of the basal till or silt/clay sediments, and is not intercepted by a dug well or by a point-of-diversion sump, will ultimately be released from the exposed saturated sediment and discharged to the marine environment. Local flow directions within the shallow groundwater system are further discussed with the context of communal sewerage dispersal in Section 4.8.

The two (2) shallowly excavated dug wells and two (2) point-of-diversion sumps (Section 4.5.2) are the only shallow groundwater system "receptors" present on DL 696 lands and adjacent properties. There are no additional surface water features or water bodies or ecosystem receptors whose function is dependent on interception, receipt or conveyance of shallow groundwater.

4.6.2 Bedrock Aquifer

The entire DL 696 property and adjacent lands are underlain by the Keats Island Aquifer. Water present in the aquifer originates primarily as precipitation that enters bedrock fractures exposed in local upland areas where surficial sediments are absent, and, in areas where surficial sediments cover the aquifer, can enter bedrock fractures as leakage of water from the overlying shallow groundwater system. Specifically, because the silt/clay sediments and/or dense till that form the base of the surficial sediments are wetted by water present in the overlying permeable sediments, a proportion of the shallow groundwater will transmit through the basal sediments as "recharge" to the underlying aquifer.

The two bedrock types present within DL 696 and adjacent lands are not porous; therefore, bedrock fractures and discontinuities are the pathways for groundwater movement. Fracture characteristics such as orientation, frequency and condition will locally influence and control groundwater flow directions and flow rates under natural conditions and during pumping conditions. Actual aquifer water flow directions and flow rates cannot be determined from the available information, but some primary aquifer attributes can be reasonably interpreted. Aquifer water depths reported for Well #3 at the time of construction (Table 1) were 6 m-bg (20 ft-bg), which infers groundwater was "mounded" to a height of approximately 30m (98 ft) above mean sea level at the time of measurement. Comparison with aquifer levels reported for Well #2 and the Drilled Benson Well at the time of construction (Table 1) infers an overall southward flow direction under an apparent 5% gradient. The mounded groundwater conditions generally infers that ambient aquifer water flow directions can be approximated based on gross topographic trends. Accordingly, aquifer flow directions are interpreted to be southward and southeastward (overall) with the southern developed portion of the DL 696 property and are interpreted to be northward and northwestward (overall) with the northern developed portion of the DL 696 property.

Groundwater moving through bedrock fractures toward the northern and southern marine shorelines will form an interface where the bedrock water chemistry transitions from a "fresh" condition on the landward side of the interface to "sea water" on the seaward side of the interface. The rate of lateral movement of the fresh groundwater, toward the shoreline, can be reduced by the density contrast between the "fresh" water and "salt water", resulting in the imposition of a slight upward flow gradient in the vicinity of the interface.

4.7 Keats Camp Water System

4.7.1 Groundwater Withdrawal and Consumption

The Keats Camp water system operator monitors water consumption with multiple flow meters that report total volumes. Groundwater withdrawals from Well #1 and Well #2 are measured by a common flow meter designated "WELLS" in the operator's records and consumption of treated water measured by two dedicated flow camp facility meters (designated "Old Camp" and "New Camp") and consumption by cottage lots by one dedicated flow meter (designated "Cottages"). Locations of the four referenced flow meters are shown on an operator's sketch provided as Attachment #15. A near-continuous record of daily water volumes, monthly water volumes and annual water volumes for the 9-year period of September 2008 to August 2017 was provided to EXP for the Phase 1 Study.

During a September 20, 2017 meeting of the Local Islands Trust Committee, a former Keats Camp water system operator indicated that the WELLS flow meter had calibration issues that caused groundwater withdrawal volumes from Wells #1 and #2 to be misreported by 50%. Based on this information, EXP devised a field testing program to determine the WELLS meter accuracy by filling a 15,000 gallon water tank and comparing the reported WELLS meter volume with the known water quantity. This simple test generally confirmed the WELLS meter was over-reporting water volumes by approximately 42%. Accordingly, prior to utilizing the operator's 9-yr record of monitoring data, a 42% correction (i.e., reduction) was applied to all reported groundwater withdrawal volumes.

For assessment purposes, reported monthly volumes for "Well", "Camp" and "Cottages" were converted to equivalent daily average (sustained) flow rates expressed in USgpm (US gallon per minute) units, which is a standard approach for evaluating well hydraulic function and sustainable yield relative to an assumed uninterrupted demand. The resulting calculated monthly "Well" withdrawal rates (sustained) and consumption rates (sustained) for both "Camps" and "Cottages" are summarized on Attachment #16). Peak groundwater withdrawal periods are evident as recurring annual maximum values in July and August for all years on record (Attachment #16). The highest withdrawal rate on record occurred in July 2017 and is calculated to be 12.8 USgpm assuming uninterrupted pumping for 31 days.

Site development proposes to increase the number of occupied cottage lots by 31% (from 84 to 110) and Camp expansion could potentially increase that demand by 50%. Conservatively assuming the 50% increase in water consumption applies to both Camp expansion and increased cottages use, and assuming Well withdrawals are correspondingly adjusted to accommodate these increased demands, the revised Well peak period pumping rate is estimated to be 19.2 USgpm (sustained on monthly basis).

4.7.2 Well and Aquifer Hydraulics

Aquifer water levels were monitored continuously in Well #1, Well #2 and neighbouring Benson Well using pressure transducers with automated data loggers during a 3-day (November 19 to 23, 2013) non-pumping period (Attachment #17) and 21-day (November 23 to December 14, 2013) pumping period using sustained withdrawal rates under various operational scenarios, including individual pumping of wells and concurrent pumping of wells (Attachment #18). Water levels in the Dug Benson Well were not measured.

Well monitoring data collected during non-pumping conditions (Attachment #17) represent natural (ambient) hydraulic conditions within the portion of Keats Island Aquifer that is penetrated by the monitored wells, and provides a requisite "baseline" for subsequent aquifer response testing. Under ambient conditions, water levels in both Well #1 and Well #2 were relatively stable and ranged from approximately 52 ft (16m) to 56 ft (17m) above local datum (high water/tide level). Water level changes

in Wells #1 and #2 correlated strongly with tidal variation, but were very attenuated (low magnitude), which generally indicates a lack of direct connectivity to the tidal regime.

Water levels in the Drilled Benson Well exhibited a similarly strong correlation with tidal trends, but were only attenuated approximately 50% of the tidal fluctuation, which could be an indicator of potential foreshore connectivity. Groundwater levels recorded in the three monitored wells confirms there is a strong seaward aquifer flow gradient along the southern boundary of the Site.

Consistent trends and magnitude of water levels in both Wells #1 and #2 under non-pumping conditions (Attachment #17) suggest these wells are constructed within the same aquifer hydraulic domain. Conversely, the significantly lessened tidal attenuation (approximately 10 times) measured in the Drilled Benson Well suggests it sources groundwater from bedrock that is hydraulically distinct from the rockmass that yields groundwater to both Wells #1 and #2.

The sequence of long-duration aquifer pumping tests (Attachment #18) conducted in Well #1, Well #2 and the Drilled Benson Well were generally compliant with current BC MOE guidelines for conducting well pumping tests (BC MOE, 2016a) and current BC MOE hydraulic testing and reporting protocols for an application for a groundwater licence (BC MOE, 2016b). Accordingly, the graphical summary of pumping test results (Attachment #18) is relevant for assessment of both well hydraulics and inter-well behavior.

Sustained independent long-duration operation of Well #1 and Well #2 induced drawdown responses of less than approximately 0.5m (1.6 ft) in the Drilled Benson Well. Similarly, sustained independent operation of the Drilled Benson Well at a reported value of approximately 18 USgpm induced drawdown responses of less than approximately 0.5m (1.6 ft) in Well #1 and no measurable drawdown in Well #2. These pumping test results generally support an interpretation that both Camp wells are hydraulically distinct from the Drilled Benson Well.

Sustained independent operation of Well #1 at 9.0 USgpm caused rapid drawdown in Well #1 to approximately 23m (82 ft) below the pre-pumping level. Well #1 drawdown stabilized at 23m (82 ft) within 24 hours of commencing pumping. Testing of Well #1 also induced an interference drawdown response in Well #2, which stabilized at approximately 3m (10 ft) within 24 hours of commencing pumping. Sustained independent operation of Well #2 at 15.3 USgpm induced a drawdown response in Well #2 of approximately 10m (33 ft) below the pre-test level and induced a rapid interference drawdown response in Well #1 of approximately 7m (23 ft). These combined inter-well pumping test observations confirm the two Keats Camp wells have significant hydraulic connectivity and, therefore, derive groundwater from the same hydraulic domain within the Keats Island Aquifer.

4.7.3 Water Supply Assessment

4.7.3.1 Water Availability

Conservatively assuming the drawdown in both Well #1 and Well #2 is limited to approximately 15m (49 ft) to ensure maintenance of a positive seaward flow gradient in both wells, the sustained yield of Well #1 is conservatively estimated to be 6 USgpm and the yield of Well #2 estimated to be approximately 23 USgpm. These yield estimates are calculated based on stabilized drawdown measured during the 2013 pumping tests and further assumes zero aquifer recharge for three months, per CPCN assessment approaches for estimating the long-term sustainable yield of wells (BC MELP,

1999). On this basis, the sustainable yield of Well #2 is considered adequate to satisfy the projected demand of 19.2 USgpm estimated for the 110 lot build-out and expanded camp scenario.

Potential for hydraulic interaction of operating Wells #1 and #2 on the Drilled Benson Well is considered negligible, based on concurrent monitoring of both Site wells and the Drilled Benson Well under ambient conditions and during pumping tests that generally satisfied current BC MOE guidelines.

4.7.3.2 Local Aquifer Water Balance

EXP instructed the water system operator to suspend pumping and allow recovery of the aquifer water level in Well #2 to the natural (i.e., non-pumping) depth. The resulting stabilized non-pumping water level in Well #2 was measured on July 17, 2017 at 6.8 m-bg (22 ft-bg), whereas the water level reported at the time of construction in July 2004 was 7.9 m-bg (26 ft-bg) (Table 1). These results are interpreted to be a significant positive indicator of overall aquifer health, given that operation of the Keats Camp water system during the period of 2004 to 2017 has apparently not impacted aquifer water levels, which infers current and historic groundwater withdrawals are sustainable and not exceeding the overall rate of aquifer recharge.

The Keats Camp water system operator records indicate the highest annual volume of groundwater withdrawal occurred in 2016 and was 9,900m^3. Applying the projected 50% increase to this value results in an estimated annual withdrawal volume of 14,850m^3. Given the DL 696 property covers an area of 169 acres (68.3 hectares) and assuming an average recharge rate of 5% of the annual precipitation of 1,370mm, the resulting aquifer recharge volume is approximately 4.7 times the projected withdrawal volume. The drainage sub-catchment associated with Wells #1 and #2 covers an area of approximately 24.2 hectares (Attachment #19) would contribute approximately 35% of the overall Site-wide aquifer recharge. The annual aquifer recharge associated with this sub-catchment area is calculated to be 16,580m^3, which exceeds the projected annual withdrawal volume and infers that local (i.e., sub-catchment) recharge is adequate for additional aquifer withdrawal on an annual basis.

In discussions with CREUS staff, it is understood that proposed development of DL 696 will not alter surface water runoff rates and that pre-development conditions will be maintained. Specifically, it is a regulated requirement of the Stormwater Management Plan that pre-development flows match post-development flows up to a 10-year event (CREUS, 2017a). The cleared Site areas currently total 36,000m^2 and is expected to increase by 12,000m^2 (~1% DL 696 area) with the majority of the newly cleared area converted to vegetated fields. Other specific mitigations include placement of all pipeworks in existing dirt or gravel roadways and no new paved surfaces. Conventional stormwater management features such as rain gardens and shallow infiltration trenches will be primary approaches to managing runoff rates.

4.7.3.3 Shallow Groundwater System Interaction

Operation of Wells #1 and #2 will not impact shallow groundwater present in surficial sediments overlying the bedrock aquifer or ephemeral flow (if any) within terrain overlying the aquifer. The ubiquitous presence of dense till and/or clayey strata provides an effective vertical flow barrier that prevents rapid entrance of shallow groundwater into the underlying bedrock aquifer. Detection of coliform bacteria has occurred intermittently in untreated water from both Wells #1 and #2 (VCH, 2008, 2010, 2016), but these occurrences cannot be attributed to particular seasonal conditions or correlated with other prevailing factors, except maintenance issues with an existing dispersal field. However,

Well #1 is assessed as having inherent potential for interaction with near-surface water that could naturally contains coliform bacteria due to a well age (i.e., 1968) that predates requirements for installation of the protective surface seal mandated under the former *Ground Water Protection Regulation (2004)* and affirmed under the *Water Sustainability Act (2016)*. Also, because Well #2 was constructed in 2004 during phasing-in of the *Ground Water Protection Regulation*, and because there are no references to a full-profile surface seal in Well #2 records, it is probable that Well #2 also lacks the mandated surface seal. Accordingly, to reduce potential for migration of near-surface waters along the outside of the well casings and into the aquifer, both water system wells should be considered for retrofitting with surface seals constructed either into or through the till overburden. It is understood that as part of subdivision application, there has been a commitment to implementing a Wellhead Protection Plan and covenant.

4.7.3.4 Aquifer Hydraulic Parameters

Aquifer hydraulic parameters (e.g., hydraulic conductivity, transmissivity) were not determinable from the available water system monitoring and testing data. Although the long-duration pumping tests and associated water level monitoring completed in 2013 did produce data suitable for estimation of aquifer hydraulic parameters, these data were not available to EXP for analyses.

A primary objective of the Phase 1 Study was to provide a preliminary assessment of the availability of groundwater for the proposed Camp expansion and increased cottages demand. The assessment method employed by EXP included consideration of the specific capacity of Well #2 in determining the projected long-term sustainable yield, per BC MOE guidelines for yield determinations. Aquifer hydraulic parameters (e.g., hydraulic conductivity, transmissivity) are not required for the specific capacity approach to estimating long-term sustainable yield. However, aquifer parameters are a primary input for determination of well capture zones and, therefore, must be determined at subdivision stage to support development of a mandatory Wellhead Protection Plan (per VCH permit).

4.7.3.5 Replacement of Well #1 (New Well)

From discussions with KICAS, it is understood that water from both Wells #1 and #2 requires arsenic treatment to satisfy Guidelines for Canadian Drinking Water Quality, and that arsenic levels in raw water from Well #1 are considerably higher than Well #2 water. Given the declining hydraulic efficiency of Well #1 (approximately 25% of Well #2) and operational costs associated with arsenic removal, Well #1 should be considered for decommissioning and replacement with a new production well to provide full water supply redundancy and also potentially remove or reduce the arsenic treatment component. Options for redeveloping Well #1 to improve the productivity are limited to hydraulic fracturing, due to the bedrock construction, but this approach is not recommended given the proximity (<100m [300 ft]) to the marine foreshore.

The immediate purpose for constructing a “New Well” would be solely to provide redundancy for existing Well #2, so the water system has full capacity during times of well maintenance or unscheduled shut-down. The site for a New Well has not been identified on the ground but, based on currently available site information, is expected to be constructed in close proximity to Well #2, but likely at a relatively uphill location. The actual drilling site for a New Well would be selected based on the results of a geophysical survey, which would yield subsurface profiling data required to support optimal siting of the New Well. Hydraulic testing and assessment of the New Well would be completed in accordance with current BC MOE guidelines for hydraulic testing for groundwater licencing purposes. Hydraulic

testing of the New Well would also be reviewed and assessed to confirm the capacity of the bedrock aquifer to accommodate increased withdrawals. Following issuance of VCH permitting to incorporate the New Well into the Keats Camp water system, operation of Well #1 would be discontinued and it would be utilized solely as a "sentinel" to monitoring aquifer water levels in proximity to the Keats Camp well field.

4.7.3.6 Saltwater Intrusion

Consultations with the Keats Camp water system operator confirm that saltwater intrusion has not occurred in either Well #1 or Well #2 and that the primary chemical indicators of saltwater intrusion potential (i.e., upward trending chloride and/or Electrical Conductivity and/or Total Dissolved Solids concentrations) have not been observed. The existing positive seaward gradient below the Keats Camp well field is interpreted to be the primarily natural hydraulic attribute that has effectively controlled saltwater intrusion potential. Therefore, maintaining the positive gradient should remain a primary operational objective. A review of saltwater intrusion potential is a component of FLNRO's groundwater licencing reporting process and must be comprehensively assessed prior to FLNRO issuing a licence for operation of the anticipated New Well. It is anticipated at subdivision stage that FLNRO will stipulate the mandatory saltwater intrusion risk assessment include approaches developed by FNLRO and Simon Fraser University (Klassen et al., 2016), which may require installation of one or more aquifer observation wells between the Keats Camp well field area and the shoreline.

4.7.3.7 Climate Change

According to the Intergovernmental Panel on Climate Change ("IPCC"), global sea levels are currently rising and are predicted to further rise due to climate change related to greenhouse gas emissions (IPCC, 2014). Global sea level rise predictions to the year 2100, using various modelling approaches and scenarios, range from approximately 0.2m to 0.8m above current mean sea level (Church et al., 2013). Along portions of the southern British Columbia coast, extreme high estimates of relative sea level rise range from 0.8m to 1.2m (Bornhold, 2008).

The projected 1.2m sea level rise does not have implications for either the communal sewerage fields or groundwater withdrawals proposed for the DL 696 lands. The existing and proposed new sewerage and water supply infrastructure are not positioned within the increased high tide level, so there is no risk of routine inundation. The estimated long-term sustainable yield of Well #2 could conceivably be reduced, as a result of reduced available drawdown (above high tide level) in the well, but, the yield of Well #2 would still satisfy the projected sustained demand of 19.2 USgpm.

4.8 Communal Sewerage Review and Assessment

At subdivision, Keats Camp will remain as one legal parcel with the existing Camp sewerage systems, and the leased cottage lots and proposed new communal sewerage systems will be strata. The six proposed new Type 2 communal sewerage systems would each service 15 to 20 cottage lots at a rate of 250 gallons per day (gpd) per lot; therefore, loading of each communal field will be less than the 5000 gpd guideline. The 250 gpd per lot value was proposed by Enevoldson Engineering (JEEL, 2010) based on a doubling of daily lot water use, which at that time was estimated at 125 gpd based on peak usage (i.e., summer long weekend) data provided by the former Keats Camp water system operator. This value was also referenced by VCH in providing condition approval of the sewerage system designs

proposed by Enevoldson Engineering (VCH, 2012). Actual average daily water use per occupied lot has since been determined to be less than 75 gpd over summer months (CREUS, 2017a).

Each lot will require a septic tank with effluent filter and a pump chamber equipped with a grinder pump for lift to the proposed communal pressure sewer. The condition of existing septic tanks and pump chambers on pre-developed lots will be evaluated and upgraded, if required, before connecting to a new common system. As existing individual systems age and building permits are issued, more cottages will connect to the new common systems and eventually only the six proposed communal systems will be operating with no stand-alone cottage systems in operation. Prior to issuing a building permit, Sunshine Coast Regional District will require applicants to submit a "Proof of Filing Form" for septic systems for new single family dwellings and for any renovations or additions that involve addition of a bedroom (SCRD, 2017).

For discussion and assessment purposes, the six proposed new communal dispersal field sites/areas identified on the attached drawings are referenced according to the corresponding Strata section serviced (e.g., Strata C field area). All lots will be under one strata, but there will be 6 fields to service the 6 strata areas A through F. The current assessment considers two optional field areas (designated E1 and E2) for management of Strata E effluent. The proposed zoning has been configured to include all potential identified field locations (CREUS, 2017b).

4.8.1 Strata Dispersal Field Areas A, B, C, D and F

Examination of five (5) of the currently proposed sewerage dispersal areas (i.e., Strata A, B, C, D, and F field areas) was completed by Mr. John Enevoldson, P.Eng., whose declared areas of expertise include "wastewater treatment/management". Mr. Enevoldson's 2010 report to VCH (Section 4.3.2) included identification of primary and reserve communal disposal field sites, and determination of field sizes and design details for these five communal dispersal field areas. VCH provided conditional approval of the proposed sewerage system(s) following review of the design report (VCH, 2012). Accordingly, subsurface conditions within and near proposed Strata A, B, C, D and F communal field areas have been previously determined as suitable for in-ground dispersal of Type 2 effluent from 15 to 20 cottages producing 250 gpd each.

The dispersal field sites examined by Enevoldson (2010) have adequate thickness of suitably permeable sediment (primarily sand/gravel) to receive and convey the intended effluent hydraulic loads. There are no surface water features, groundwater water users (i.e., wells or points-of-diversion) or known breakout points within terrain downslope of the field areas (Attachments #20, #21 and #22) and the sediment profile within all downslope areas is interpreted to be similar to reported dispersal field conditions. Accordingly, effluent discharged to these field areas will reside within the near-surface sediment profile due to the common presence of dense and/or very fine-textured strata overlying bedrock, which will also effectively prevent rapid vertical movement of effluent into bedrock. Available horizontal separation of Strata A, B, C, D and F from the shoreline (Attachments #20, #21 and #22) will also provide adequate subsurface residency for post-dispersal renovation prior to any effluent discharging (as seeps) to the marine environment.

On this basis, dispersal of Type 2 effluent within the proposed new Strata A, B, C and D and F communal fields will not impact local groundwater resources, groundwater users, or receiving waters.

4.8.2 Strata E Dispersal Field Options E1 (Campfire Rock) and E2

Two sewage dispersal options (i.e., areas) are being considered for management of Strata E effluent. Area E1 is located within the southeast corner near Campfire Rock and Area E2 located approximately 55m (180 ft) southwest of the proposed Strata F communal field area (Attachment #4).

4.8.2.1 Area E1 (Campfire Rock) Review

CREUS and KICAS personnel revisited the E1 (Campfire Rock) dispersal field area on April 17, 2017, with a VCH Environmental Health Officer, specifically to review the site during "wet season" conditions. These specified seasonal conditions were confirmed by data from the nearest climate station (i.e., Gibsons), which reported rainfall during 9 of the 10 days preceding the site visit and also reported 123.3 mm of total precipitation for the period of April 1-16. Groundwater depths measured in two temporary PVC standpipe piezometers installed in the primary field area indicated 4 inches to 5 inches of water was present at two former E1 test pit sites. By comparing these measurements to CREUS's 2015 test pit records (CREUS, 2017b)**,** and assuming both piezometer tips/ends were placed at the bottom of the original test pit excavations prior to backfilling, these groundwater depths indicate the sandy loam strata at both piezometer sites was unsaturated (full profile) on April 17, 2017.

The E1 dispersal field design includes installation of a rock-filled interceptor trench along the northern and northwestern field boundaries to collect groundwater flowing from upslope areas. Incident surface water would also be intercepted (Attachment #24). An impermeable liner keyed into the silty clay restrictive layer will extend to ground surface on the downslope trench wall to minimize southward lateral flow into the field area. Perforated pipe positioned along the trench bottom will convey collected groundwater around the field area to a controlled discharge location(s) [to be determined].

The proposed E1 dispersal field area is located approximately 70m (230 ft) cross-slope and southwest of the Drilled Benson Well (Attachment #23). The field is also located at approximately 5m (16 ft) higher elevation and 80m (260 ft) northwest from the Dug Benson Well. Wells #1 and #2 are located approximately 80m (260 ft) and 170m (560 ft) southwest from the proposed field, respectively, and at approximately 5m (16ft) lower elevation. The marine shoreline is approximately 130m (430 ft) south of the field area. There are groundwater interceptor trenches (i.e., shallow unshored excavations) on some cottage lots farther south of the E1 field area, which were installed to divert groundwater around existing individual septic fields.

4.8.2.2 Area E1 (Campfire Rock) Assessment

Previous reviews and examination of the proposed E1 dispersal field area identified potential constraints, although it is expected these can be addressed with specific design elements that ensure proper dispersal function. Reported percolation rates (11.3 min/inch average) are higher than other communal dispersal sites proposed for the Site, but are within the typical design range for loam soils. The average restrictive layer depth was estimated to be 35 inches (CREUS, 2017b) and 32 inches (VCH, 2017), which is marginally less than the required minimum 36 inch depth (Table D of VCH Subdivision Guide, 2010); however, it is anticipated this potential constraint could be adequately managed (subject to VCH approval) through complementary design elements, such as installation of the proposed upslope interceptor trench and importing specified fill materials to increase vertical separation below the field area. It is understood that interceptor trench construction is tentatively scheduled for winter 2017, followed by a groundwater monitoring program to confirm the effect on

groundwater levels within the field area. Assuming the pending groundwater monitoring program verifies water depths can be adequately managed, and that dispersal of treated effluent does not interact with the Dug Benson Well, it is anticipated VCH can confirm site suitability for dispersal of Type 2 effluent from 15 lots.

Post-dispersal movement of treated effluent within near-surface sediments will be primarily southward as a "plume" originating from the E1 field area, consistent with local and larger-scale topographic trends and corresponding local shallow groundwater flow directions (Attachment #23). This assumed subsurface flow pattern is considered valid, given the relative uniformity of both the local stratigraphy (as reported in test pit records and well records) and topography, although installation and monitoring of multiple shallow groundwater monitoring wells is required to confirm the assumed "plume" alignment.

There are three (3) pathways for effluent-affected groundwater to potentially influence water quality in wells. Within the context of the E1 dispersal field setting, these include:

- Pathway #1 – Lateral movement of affected groundwater within near-surface sediments and into a dug well that sources water from the same sediments;
- Pathway #2 – Lateral movement of affected groundwater within near-surface sediments toward the casing of a drilled well, followed by downward vertical migration of the affected water along the casing and into the source aquifer; and,
- Pathway #3 – Vertical infiltration of affected groundwater from near-surface sediments into the underlying bedrock aquifer hosting drilled wells.

A "plume" of effluent-affected groundwater projected southward from the E1 field does not intercept the Dug Benson Well (Attachment #23). The eastern extent of the "plume" would be approximately 40m (130 ft) from the Dug Benson Well; therefore, potential well water quality impacts related to Pathway #1 are not applicable. Similarly, Pathway #2 is interpreted to not apply to the E1 field setting, since the three drilled wells are positioned at significant distances from the projected effluent "plume". Wells #1 and #2 are both located cross-slope (i.e., not down-gradient) from field E1 and 90m (300 ft) and 150m (490 ft) west of the "plume", respectively. The Drilled Benson Well is also located cross-slope from field E1 and approximately 70m (230 ft) east of the projected "plume". Pathway #3 is also not considered applicable, given that available information suggests the E1 dispersal field area and drilled well sites are underlain by dense and/or low-permeability soils that constrain rapid vertical movement of shallow-groundwater into the underlying bedrock. On this basis, dispersal of Type 2 effluent within the proposed E1 communal field will not impact local groundwater resources or groundwater users.

There are no potential effluent breakout points located within 15m (50 ft) of the E1 field area. Although existing shallow groundwater diversion ditches on lots south of the E1 field are within the projected effluent "plume", it is expected the quality of groundwater entering the ditches will not be impacted due to the available horizontal separation from the E1 field and the inherent renovative capacity of the loam soils within the dispersal area. Similarly, given the significant horizontal separation [130m (425 ft)] from the marine foreshore and E1 dispersal field, shallow groundwater discharge (seeps) to the foreshore area will not impact marine waters. On this basis, dispersal of Type 2 effluent within the proposed E1 communal field area will not impact local receiving waters.

4.8.2.3 Area E2 Review and Assessment

The E2 optional area for dispersal of Strata E effluent was examined in 2010 (Attachment #8) and subsurface conditions within and adjacent to Area E2 described and reported as part of Enevoldson

Engineering's assessment and design (JEEL, 2010) of the nearby Strata F dispersal field. Given the similarity of surficial sediments textures and thicknesses reported by Enevoldson Engineering for all exploratory text pits excavated within and adjacent to both the Area E2 field and Area F field, and given VCH's 2012 conditional approval of Area F for communal sewerage dispersal, Area E2 is interpreted to be likewise suitable for in-ground dispersal of Type 2 effluent.

There are no surface water features, groundwater water users (i.e., wells or points-of-diversion) or known breakout points within 200m (660 ft) of the E2 field area (Attachment #22) and the sediment profile within all downslope areas is interpreted to be similar to E2 field conditions. Accordingly, effluent discharged to the E2 field area will remain within near-surface sediments due to the presence of underlying dense and/or very fine textured strata overlying bedrock, which also will effectively limit rapid vertical movement of effluent into bedrock. Horizontal separation of the E2 area from the shoreline (Attachment #22) provide adequate subsurface residency for post dispersal renovation prior to discharging to the marine environment.

On this basis, dispersal of Type 2 effluent within the Area E field will not impact local groundwater resources, groundwater users, or receiving waters.

4.9 Additional Monitoring

Multiple new monitoring wells will either be installed or established within both the shallow groundwater system and underlying bedrock aquifer, as mandated by Provincial decision makers and/or recommended by EXP. At filing stage, VCH will require that one or more dedicated Observation Wells be constructed within the dispersal zones of each proposed new communal field. These mandatory Observations Wells will facilitate shallow groundwater sampling required to confirm sewerage system function and will also allow monitoring of shallow groundwater levels across the Site. In consultations with VCH, the Convention has also committed to installing several new monitoring wells in the shallow groundwater system within and adjacent to the Area E1 (Campfire Rock) field, both prior to and following the planned installation of a prototype interception trench (Attachment #24) in Fall 2017. These planned shallow Area E1 monitoring wells will initially provide data needed to evaluate the interception trench effectiveness, but will also be used to confirm actual shallow groundwater flow directions needed to more fully assess the extent of the Area E1 effluent "plume" in relation to the Dug Benson Well. During eventual hydraulic testing of Keats Camp's requisite New Well, the shallow Area E1 monitoring wells will also be used to assess potential interaction of the New Well with the overlying shallow groundwater system (per VCH permitting requirements and FLNRO licencing requirements).

EXP has recommended existing Keats Camp Well #3 (inactive) be converted to a permanent monitoring well, initially to acquire ambient aquifer water level data needed to support a groundwater licence application and, in the long-term term, to obtain aquifer water level data required to inform Keats Camp water system operational decisions. Prior to commencing hydraulic testing of the requisite New Well, it is anticipated a new aquifer observation well will be constructed at a location between the existing Keats Camp wells and the shoreline to obtain data required to quantitatively assess saltwater intrusion risks. Continuous monitoring of this new bedrock observation well would be maintained following commissioning of the New Well, to obtain aquifer response data needed for water system operational decisions. For this same purpose, EXP has recommended Well #1 be converted to a permanent aquifer observation well following commissioning of the required New Well.

5 Statement of Opinion

Based on our review of the publicly available and provided site information referenced in this report and related discussions with the Keats Camp water system operator and CREUS staff, combined with the results and interpretations of this preliminary (i.e., Phase 1) hydrogeological study described in the preceding sections, EXP provides the following Qualified Professional opinion:

> ***Projected potable water needs for the Convention's proposed 110 cottage lots and Keats Camp expansion can be satisfied from on-site groundwater sources, and neither the proposed groundwater extractions nor proposed new community sewerage systems will have adverse impacts on local groundwater resources, groundwater users, and receiving waters*.**

The above statement of opinion is based primarily on the following Phase 1 Study findings, results and interpretations, and related property owner commitments (both existing and pending mandated requirements) to further assess and evaluate DL 696 groundwater availability and communal sewerage:

- Water system operator data from a recently-calibrated flow meter confirms the highest monthly demand (as well withdrawal volume) on record occurred July 2016 and was equivalent to an uninterrupted pumping rate of 12.8 USgpm. A projected demand of 19.2 USgpm is calculated by conservatively assuming both Camp expansion and leased lot water use increase by 50%.

- Water level monitoring data (pumping rates and water levels) were acquired for Well #2 in 2013 by the former Keats Camp water system operator using a methodology consistent with current BC MOE requirements for assessment of the sustainable yield of a bedrock well. Analyses of these monitoring data (including flow rate corrections from recent calibrations) indicate Well #2 has a sustainable yield of approximately 23 USgpm, which exceeds the projected peak demand of 19.2 USgpm.

- Water system operator data confirms the highest annual groundwater withdrawal volume on record occurred in 2016 and was is 9,900m^3. A projected annual demand of 14,850m^3 is calculated by conservatively assuming both Camp expansion and leased lot water use increase by 50%.

- Annual recharge to the Keats Island Aquifer from the sub-catchment area associated with the Keats Camp water system Wells #1 and #2 is estimated to 16,580m^3, which exceeds the projected annual withdrawal of 14,850 m^3.

- The Keats Camp water system has never experienced water scarcity. Well #1 productivity has naturally declined due to age, but this is an indicator of reduced well connectivity to the surrounding aquifer and not indicative of declining groundwater availability.

- Stabilized, non-pumping aquifer water level measurements obtained in Well #2 in July 2017 confirm current aquifer water levels are effectively unchanged since the time of construction in July 2004. This is a primary indicator of the overall health of the portion of the Keats Island Aquifer that provides water to the Keats Camp water system wells, and specifically indicates the local aquifer water balance has not been exceeded by operation of the Keats Camp wells.

- Proposed stormwater management approaches will necessarily target a zero net change in stormwater runoff within developed areas, which will effectively maintain current rainwater and snowmelt infiltration opportunities and sustain current rates of aquifer recharge.

- The Keats Camp water system operators have not reported saltwater intrusion or related indicators of potential saltwater intrusion, such as increasing trends in water quality parameters (chloride, total dissolved solids or electrical conductivity). The natural seaward aquifer flow gradient below the Keats Camp well field significantly reduces the potential for saltwater intrusion. Assessment of the 2013 monitoring data, coupled with the July 2017 non-pumping aquifer water level information, indicates a seaward flow gradient can be maintained under the projected pumping rate 19.2 USgpm. This assessment includes consideration of an extreme sea level rise of 1.2m.

- Review of the former Keats Camp water system operator's 2013 water level monitoring data confirms sustained operation of both Keats Camp Well #1 and Well #2 induced a relatively small (i.e., 0.5m [1.6 ft]) and stable (i.e., not increasing) drawdown in the neighbouring Drilled Benson Well. This magnitude of drawdown does not reduce the availability of water from that neighbouring well, given the magnitude of the remaining available drawdown and comparatively low demand applied to the Drilled Benson Well. Under an expanded Camp and subdivided lot scenario, the current availability of water from the Drilled Benson Well will also not be reduced, given the available drawdown in the Drilled Benson Well.

- VCH has provided conditional approval of communal sewerage systems for dispersal of Type 2 effluent within proposed Areas A, B, C, D and F. There are no surface water features, groundwater water users (i.e., wells or points-of-diversion) or known breakout points within the projected down-gradient dispersal zones of these proposed fields and the available horizontal separation between potential receptors, including the marine environment, provides adequate subsurface residency for post-dispersal renovation.

- Dispersal of Type 2 effluent within proposed Area E2 is considered feasible based on subsurface conditions reported by a Qualified Professional, which were consistent with Area F subsurface attributes and are expected to warrant VCH's eventual approval, subject to receipt and filing of a sewerage system design specific to Area E2. There are no surface water features, groundwater water users (i.e., wells or points-of-diversion) or known breakout points within the projected down-gradient dispersal zones of these proposed fields and the available horizontal separation between potential receptors, including the marine environment, provides adequate subsurface residency for post-dispersal renovation.

- Dispersal of Type 2 effluent within proposed Area E1 is considered feasible based on interpreted southward dispersal of effluent-affected groundwater, which available information indicates will not enter the Dug Benson Well, due to an estimated horizontal offset of approximately 40m (130 ft), and will not enter local drilled wells due to the cross-slope position of the wells (relative to the dispersal field and plume) and presence of dense and/or fine-textured surficial sediments overlying bedrock within Area E2 and at drilled well locations. Available horizontal separation between potential receptors, including the marine environment, provides adequate subsurface residency for post-dispersal renovation.

- The DL 696 property owner has committed to further assessing and confirming actual shallow groundwater flow directions within and adjacent to the proposed Area E1 field during

seasonally wet conditions (Fall 2017). The assessment will specifically consider the effectiveness and feasibility of a proposed interception trench to bypass shallow groundwater from the Area E1 field, and further assess the extent of the effluent-affected plume.

- As a condition of subdivision approval, the DL 696 property owner is necessarily committed to preparing a "Hydrogeological Assessment" to evaluate human health risks related to potential groundwater contamination, for submission to VCH for review prior to issuing permits for construction of any proposed new communal sewerage dispersal fields.

- As a condition of subdivision approval, the DL 696 property owner is necessarily committed to preparing a "Hydrogeologist Report" to assess groundwater quantity and quality risks and confirm all water source wells meet current *Groundwater Protection Regulation* (2016) requirements, for submission to VCH for review prior to issuance of a permit for use of a New Well (replacement for existing Well #1).

- As a condition of subdivision approval, the DL 696 property owner is necessarily committed to obtaining a Groundwater Licence under the *Water Sustainability Act* (2016), through application to statutory decision makers at FLNRO, as required to ensure sustainable groundwater resource (i.e., aquifer) management.

6 Limitations

This report and attachments have been prepared by EXP Services Inc. for the exclusive use and consideration of the Convention of Baptist Churches of BC, Islands Trust (including Local Trust Committee) and CREUS Engineering Ltd., and in a manner consistent with the level of care and skill ordinarily exercised by members of the engineering and science professions currently practicing under similar conditions in the jurisdiction in which the services were provided. Opinions, interpretations and assessments related to current and projected groundwater supply and proposed communal sewerage disposal are based on a review of publicly accessible data and site-specific information provided by the Convention of Baptist Churches of BC and its consultants.

Any use of this report for purposes other than the purposes described in the preceding sections and/or by any other party must first be verified in writing by EXP Services Inc. EXP does not accept any responsibility for damages resulting from other party's reliance on or use of the information, opinions, interpretations or conclusions contained in this report. The attached "Interpretation & Use of Study and Report" is an integral part of this document and must be considered by readers and included with any copies of this report.

7 Closure

We trust the content of this report satisfies your current requirements. If you have any questions, please contact the undersigned.

Yours truly,

EXP Services Inc.

Matthew D. Munn, P.Eng.
Senior Hydrogeologist

Jeff A. Johnson, BA (Econ), MBA
Senior Manager, Earth & Environmental
Western Canada

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Attachments

Islands Trust Terms of Reference for a Hydrogeological Assessment (June 2, 2017)
Attachment #1

Interpretation & Use of Study and Report
Attachment #2

Figure 1 – Site Location Plan
Attachment #3

Figure 2 – Existing Well Locations and Proposed Communal Sewerage Dispersal Area
Attachment #4

Figure 3 – Keats Island Topography
Attachment #5

Figure 4 – DL696 Topography
Attachment #6

Figure 5 – Keats Island Bedrock Geology
Attachment #7

Figure 6 – Surficial Geology Test Pit Sites
Attachment #8

Figure 7 – BC MOE Water Resources Atlas Summary
Attachment #9

Figure 8 – Summary of Water Supply Wells and Water Licences
Attachment #10

BC MOE Detailed Well Records – DL696 and Adjacent Lands
Attachment #11

Table 1. Water Supply Well Summary – DL696 and Adjacent Lands
Attachment #12

FLNRO Water Licence Documents – DL696
Attachment #13

Table 2. Surface Water Licences – DL696 and Adjacent Lands
Attachment #14

Operator Sketch of Keats Camp Water System
Attachment #15

Figure 9 – DL696 Water System Water Withdrawal and Consumption Rates
Attachment #16

KICAS Ambient Well Monitoring (Nov. 19 to 22, 2013)
Attachment #17

KICAS Well Pumping Tests (Nov. 23 to Dec. 14, 2013)
Attachment #18

Figure 10 – Drainage Sub-Catchment Associated with Keats Camp Wells
Attachment #19

Figure 11 – Proposed Dispersal Field Area A Effluent Dispersal
Attachment #20

Figure 12 – Proposed Dispersal Field Areas B, C and D Effluent Dispersal
Attachment #21

Figure 13 – Proposed Dispersal Field Areas E2 and F Effluent Dispersal
Attachment #22

Figure 14 – Proposed Dispersal Field Area E1 Effluent Dispersal
Attachment #23

Interceptor Trench Sketch
Attachment #24

Islands Trust

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Toll Free via Enquiry BC in Vancouver 604.660.2421 Elsewhere in BC **1.800.663.7867**
Email northinfo@islandstrust.bc.ca
Web www.islandstrust.bc.ca

June 2, 2017

Terms of Reference for a Hydrogeological Assessment for DL 696 Keats Island (GM-RZ-2004.1)

The LTC in consideration of Proposed Bylaws for this application, requires confirmation at the rezoning stage that the potable water needs of the proposed lots and intended uses can be met and the proposed wells and sewage disposal system(s) will have no adverse impacts on surrounding wells, groundwater resources and receiving waters:

At the February 2017 Gambier Island Local Trust Committee (LTC) Meeting the LTC passed the following resolution:

> **GM-2017-005**
> **It was MOVED and SECONDED**
> *That the Gambier Island Local Trust Committee request that the applicant for DL696 subdivision perform a hydrogeological study in relation to the proposed subdivision, and that the terms of reference be developed by Islands Trust in consultation with the proponent and the Ministry of Forests, Lands and Natural Resource Operations, Water Protection Branch.*

The proposed Terms of Reference for this Preliminary Hydrogeological Assessment will include:

1. Inventory and analyze available information on the ground water resource in the area, including: published reports; geologic maps; publications; well record data; exploration test holes; test pits; geophysical data; aerial photographs and well users and estimated volumes groundwater used (both pumped and from springs); conduct a site visit to verify and supplement information collected from records review. In particular describe surrounding land use, potential water quality risk, springs, surface water body features etc.

2. Prepare a hydrogeological assessment report outlining the results of the office and field investigation and analysis of the data including:
    - general description of physio/geographic setting, topography, surface water drainage, climate, soils, geomorphological conditions; as well as the existing and proposed new road network, water supply wells and sewage effluent dispersal field areas;
    - general description of geologic setting, bedrock types (stratigraphy and structural features) and surficial geologic conditions;
    - extent and information on aquifers, including hydraulic gradients, hydraulic conductivity, transmissivity and storativity;

- extent of ground water flow systems (local and regional) and interpreted flow patterns;
- surface water-ground water interrelationship (i.e. quantity and quality of ground water flowing into/out-of surface waters prior to and following the proposed development);
- existing and long-term water supply volumes required for both wet and dry seasons, along with information on existing water supply wells and any additional wells required to meet the anticipated demands;
- estimates of aquifer recharge potential and effluent dispersal field discharges and a comparison with well abstraction volumes, both prior to, and after the proposed new water supply system in operation;
- assessment of the potential for saltwater intrusion to ensure that the well field operation will be in compliance with the *Water Sustainability Act* s. Article 58(a);
- provide background hydrochemical information on historical ground water quality trends, along with anticipated future trends in well and spring waters;
- identify potential impacts of intensification of residential and institutional development on the ground water resource quantity and quality and interrelated surface water resource, and assess the significance of these impacts in terms of human and aquatic habitat needs. This assessment should include changes in rate of surface water runoff and aquifer recharge and discharge volumes;
- identify measures to be taken to mitigate any significant short and long term potential ground water resource degradation, including installation of rainwater harvesting and collection systems, and construction of surface water infiltration basins;
- If existing wells are deemed to not be able to support proposed uses, carryout drilling and pump testing of any new wells required to meet future water system demands. This work to be carried out in accordance with the guideline for Well Testing in Support of a Certificate of Public Convenience and Necessity (CPCN)
- comments on potential impacts resulting from climate change, such as: sea level rise, extended drought periods and more intense rainfall events;
- if monitoring wells are proposed, outline details of purpose, locations and design of monitoring wells including number of wells, zone(s) to be monitored, frequency and type of data collection (i.e. water levels, water quality), method of reporting and analyzing data;
- a comprehensive list of all references and data sources used in the hydrogeological assessment report.

NOTE: *Vancouver Coastal Health Authority requires a property owner/applicant to submit a hydrogeological assessment for all community sewerage systems. A professional geoscientist, licensed to practice in British Columbia, must complete this assessment. The following are minimum parameters the geoscientist is expected to address which are to be required at the time of subdivision application:*

- *Ability of site to treat and dispose of effluent.*
- *Recommendations on the protection of groundwater aquifers and drinking water sources. Refer to the Ministry of Environment standards for well separation as specified in the Municipal Wastewater Regulation.*
- *Description of the groundwater mound effect and implications.*
- *Analysis of the cumulative impact the sewerage system will have on neighbouring properties and the receiving environment.*

INTERPRETATION & USE OF STUDY AND REPORT

1. STANDARD OF CARE

This study and Report have been prepared in accordance with generally accepted engineering consulting practices in this area. No other warranty, expressed or implied, is made. Engineering studies and reports do not include environmental consulting unless specifically stated in the engineering report.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report which is of a summary nature and is not intended to stand alone without reference to the instructions given to us by the Client, communicatons between us and the Client, and to any other reports, writings, proposals or documents prepared by us for the Client relative to the specific site described herein, all of which constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. WE CANNOT BE RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF THE REPORT

The Report has been prepared for the specific site, development, building, design or building assessment objectives and purpose that were described to us by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the document are only valid to the extent that there has been no material alteration to or variation from any of the said descriptions provided to us unless we are specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT OUR WRITTEN CONSENT. WE WILL CONSENT TO ANY REASONABLE REQUEST BY THE CLIENT TO APPROVE THE USE OF THIS REPORT BY OTHER PARTIES AS "APPROVED USERS". The contents of the Report remain our copyright property and we authorise only the Client and Approved Users to make copies of the Report only in such quantities as are reasonably necessary for the use of the Report by those parties. The Client and Approved Users may not give, lend, sell or otherwise make the Report, or any portion thereof, available to any party without our written permission. Any use which a third party makes of the Report, or any portion of the Report, are the sole responsibility of such third parties. We accept no responsibility for damages suffered by any third party resulting from unauthorised use of the Report.

5. INTERPRETATION OF THE REPORT

a. Nature and Exactness of Descriptions: Classification and identification of soils, rocks, geological units, contaminant materials, building envelopment assessments, and engineering estimates have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature and even comprehensive sampling and testing programs, implemented with the appropriate equipment by experienced personnel, may fail to locate some conditions. All investgations, or building envelope descriptions, utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarising such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and all persons making use of such documents or records should be aware of, and accept, this risk. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. Where special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.

b. Reliance on Provided information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to us. We have relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, we cannot accept responsibility for any deficiency, misstatement or inaccuracy contained in the report as a result of misstatements, omissions, misrepresentations or fraudulent acts of persons providing information.

c. To avoid misunderstandings, **exp** Services Inc. (**exp**) should be retained to work with the other design professionals to explain relevant engineering findings and to review their plans, drawings, and specifications relative to engineering issues pertaining to consulting services provided by **exp**. Further, **exp** should be retained to provide field reviews during the construction, consistent with building codes guidelines and generally accepted practices. Where applicable, the field services recommended for the project are the minimum necessary to ascertain that the Contractor's work is being carried out in general conformity with **exp**'s recommendations. Any reduction from the level of services normally recommended will result in **exp** providing qualified opinions regarding adequacy of the work.

6.0 ALTERNATE REPORT FORMAT

When **exp** submits both electronic file and hard copies of reports, drawings and other documents and deliverables (**exp**'s instruments of professional service), the Client agrees that only the signed and sealed hard copy versions shall be considered final and legally binding. The hard copy versions submitted by **exp** shall be the original documents for record and working purposes, and, in the event of a dispute or discrepancy, the hard copy versions shall govern over the electronic versions. Furthermore, the Client agrees and waives all future right of dispute that the original hard copy signed version archived by **exp** shall be deemed to be the overall original for the Project.

The Client agrees that both electronic file and hard copy versions of **exp**'s instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except **exp**. The Client warrants that **exp**'s instruments of professional service will be used only and exactly as submitted by **exp**.

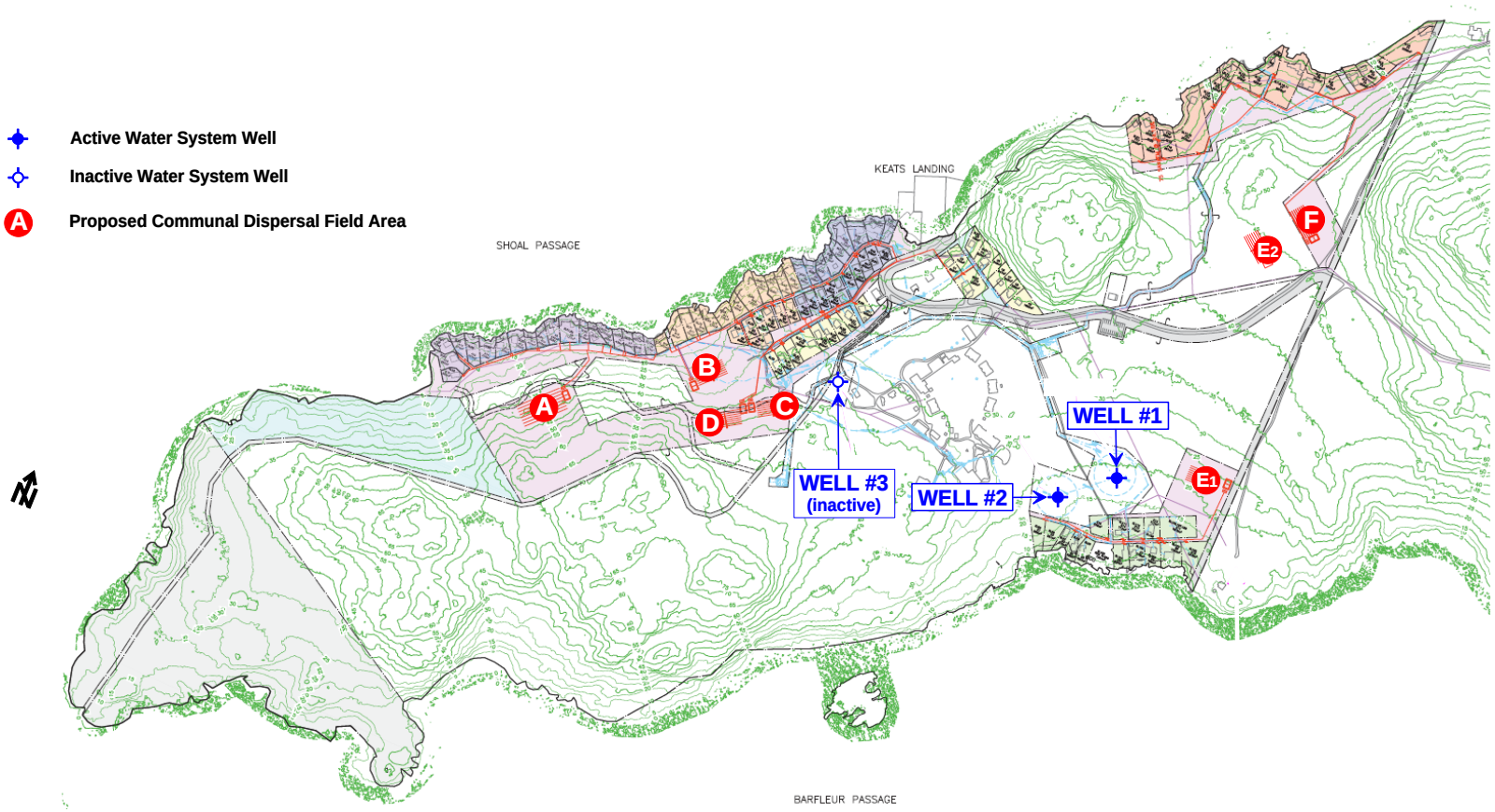
The Client recognizes and agrees that electronic files submitted by **exp** have been prepared and submitted using specific software and hardware systems. **Exp** makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

DL696, KEATS ISLAND, BC
SITE LOCATION PLAN[1]

NOTES - 1) From CREUS Engineering Ltd. drawings issued for PLA (2016).
2) Approximate Scale 1:35,000

exp.	**Project No.** VAN-00240303-A0 **Drawn** MDM **Reviewed** M.D.Mumm **Date** Nov 2017	**PHASE 1 HYDROGEOLOGICAL STUDY** CONVENTION OF BAPTIST CHURCHES OF BC DL696, KEATS ISLAND, BC	**Fig. 1**

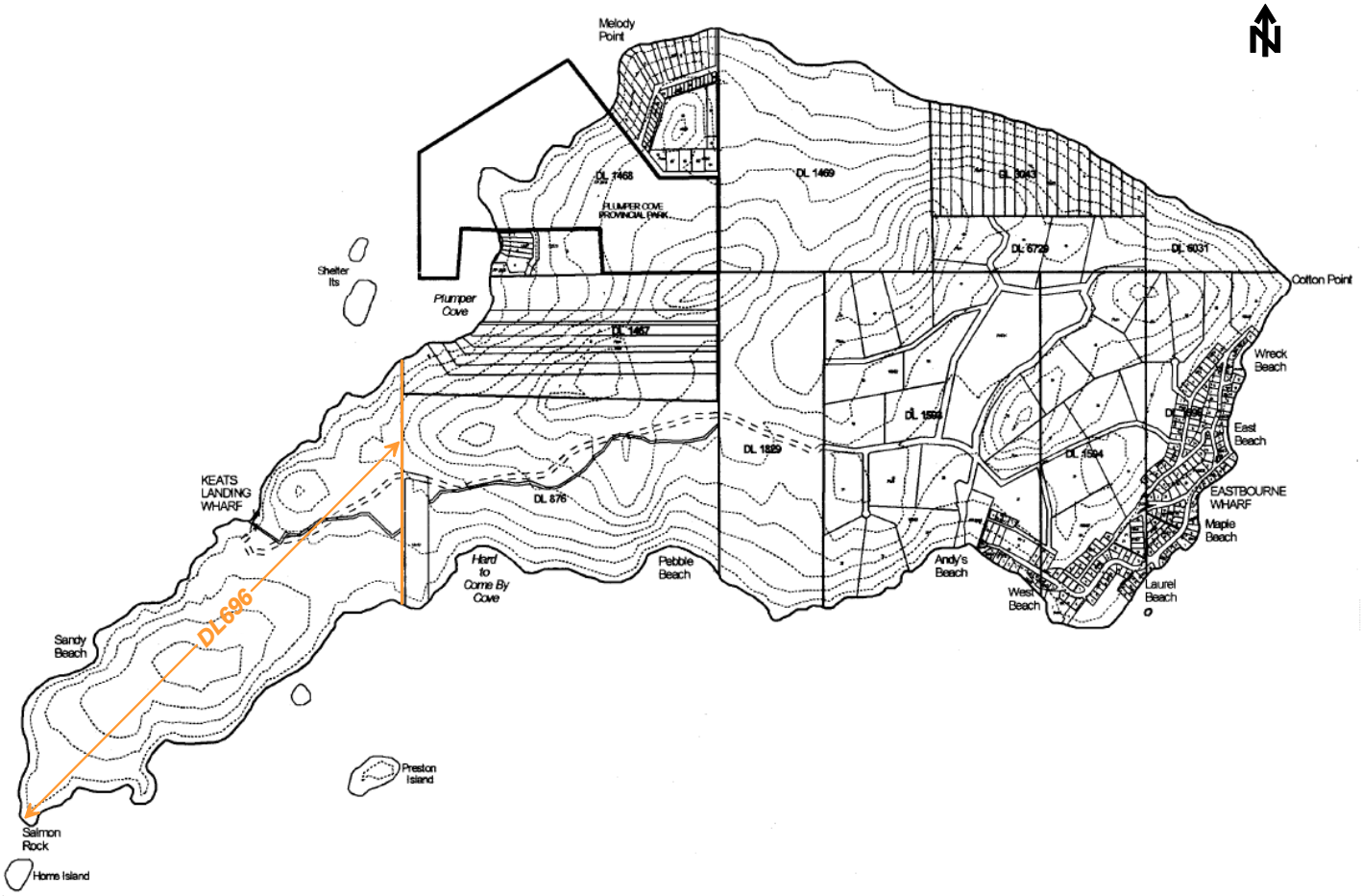
DL 696 EXISTING WELL LOCATIONS AND PROPOSED COMMUNAL SEWERAGE DISPERSAL AREAS[1]



NOTES - 1) After CREUS Engineering Ltd. Context Plan issued for PLA dated May 19, 2016.
2) Approximate Scale 1:10,000

exp.	**Project No.** VAN-00240303-A0 **Drawn** MDM **Reviewed** M.D.Munro **Date** Nov 2017	**PHASE 1 HYDROGEOLOGICAL STUDY** CONVENTION OF BAPTIST CHURCHES OF BC DL696, KEATS ISLAND, BC	**Fig. 2**

KEATS ISLAND TOPOGRAPHY

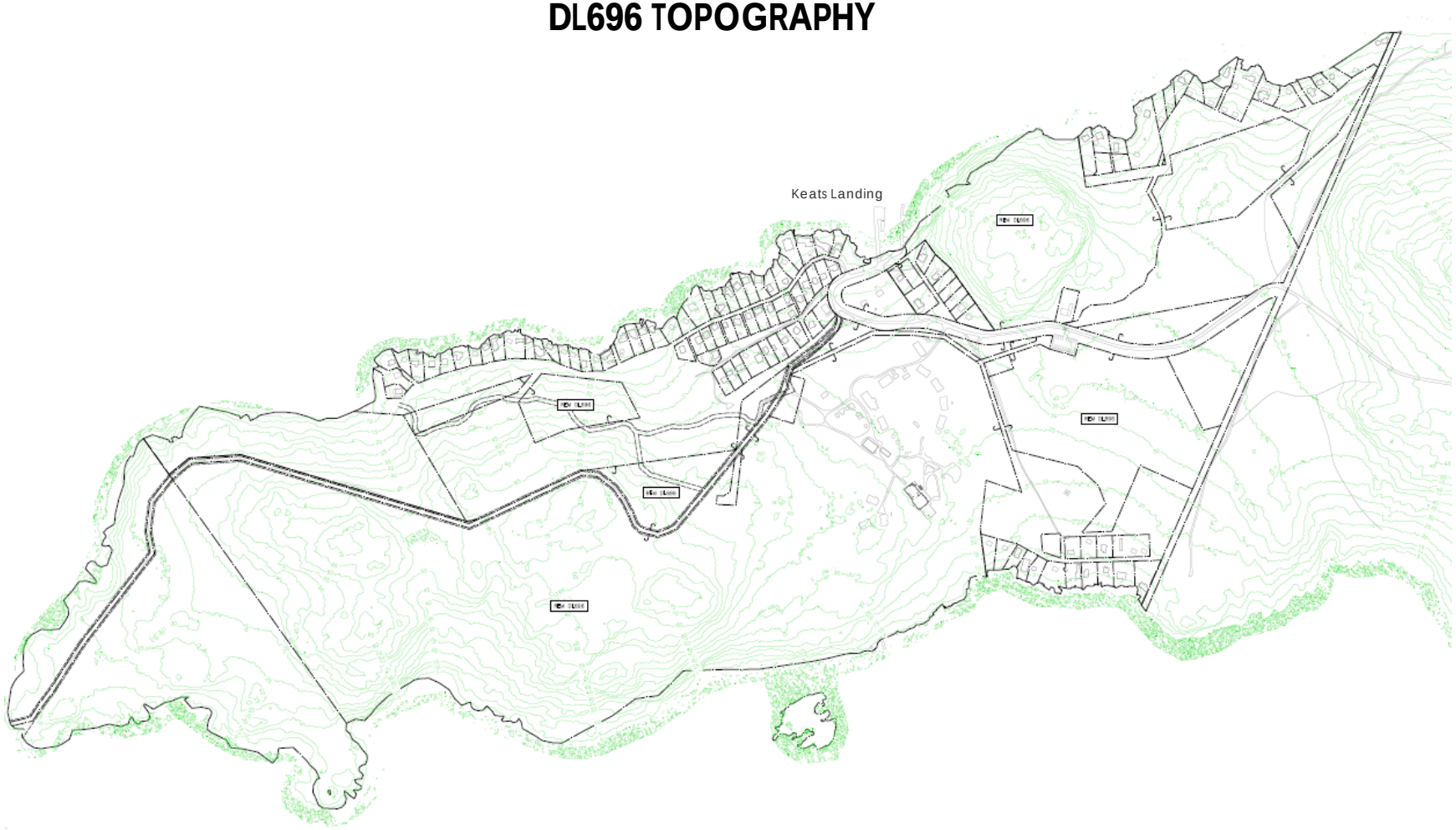


NOTES - 1) After Kneffel (2001).
2) Approximate Scale 1:27,000

exp.	**Project No.** VAN-00240303-A0 **Drawn** MDM **Reviewed** M.D.Mumm **Date** Nov 2017	**PHASE 1 HYDROGEOLOGICAL STUDY** CONVENTION OF BAPTIST CHURCHES OF BC DL696, KEATS ISLAND, BC

Fig. 3

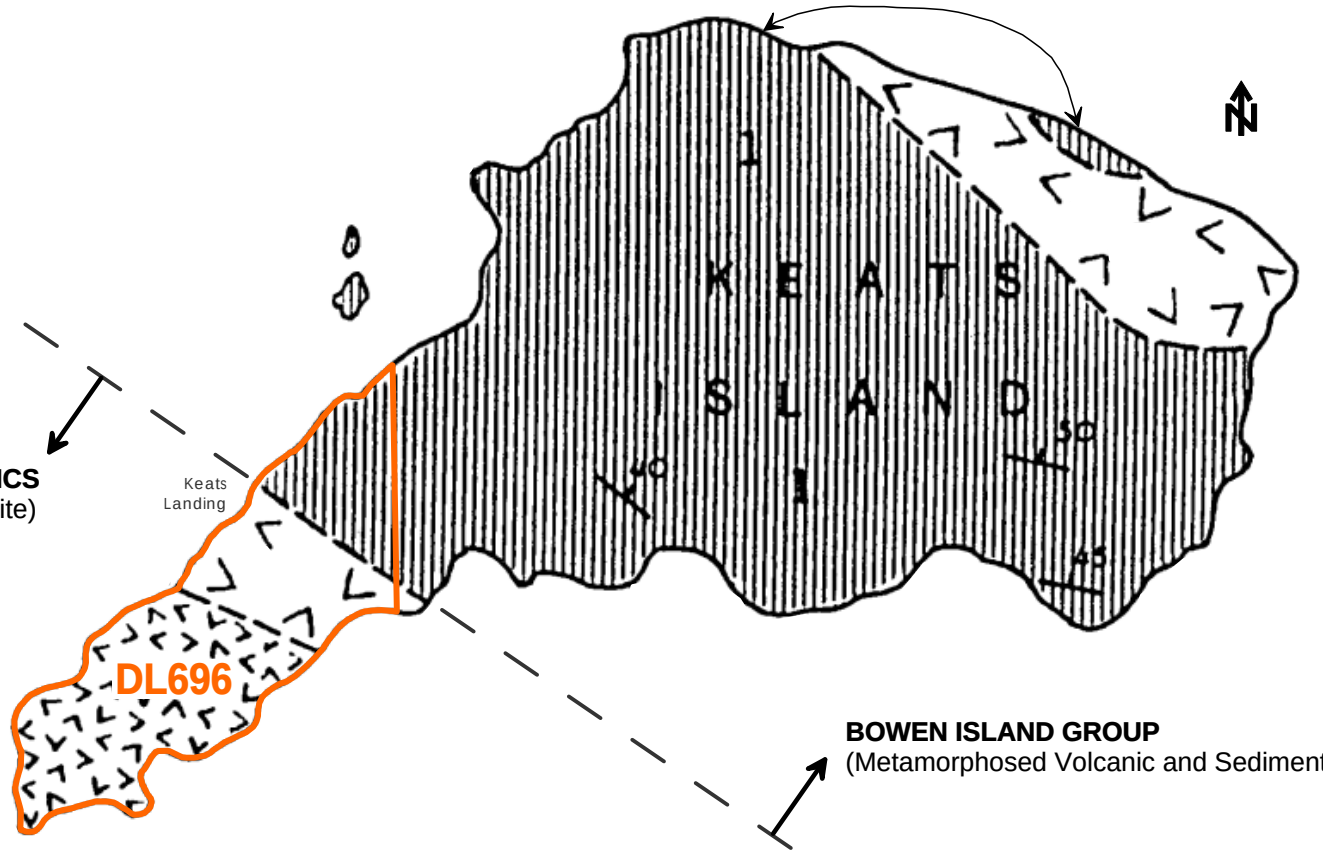
DL696 TOPOGRAPHY



NOTES - 1) From CREUS Engineering Ltd. Context Plan issued for PLA dated May 19, 2016.
2) Approximate Scale 1:8,500

exp.	**Project No.** VAN-00240303-A0 **Drawn** MDM **Reviewed** M.D.Mumm **Date** Nov 2017	**PHASE 1 HYDROGEOLOGICAL STUDY** CONVENTION OF BAPTIST CHURCHES OF BC DL696, KEATS ISLAND, BC	**Fig. 4**

KEATS ISLAND BEDROCK GEOLOGY[1]

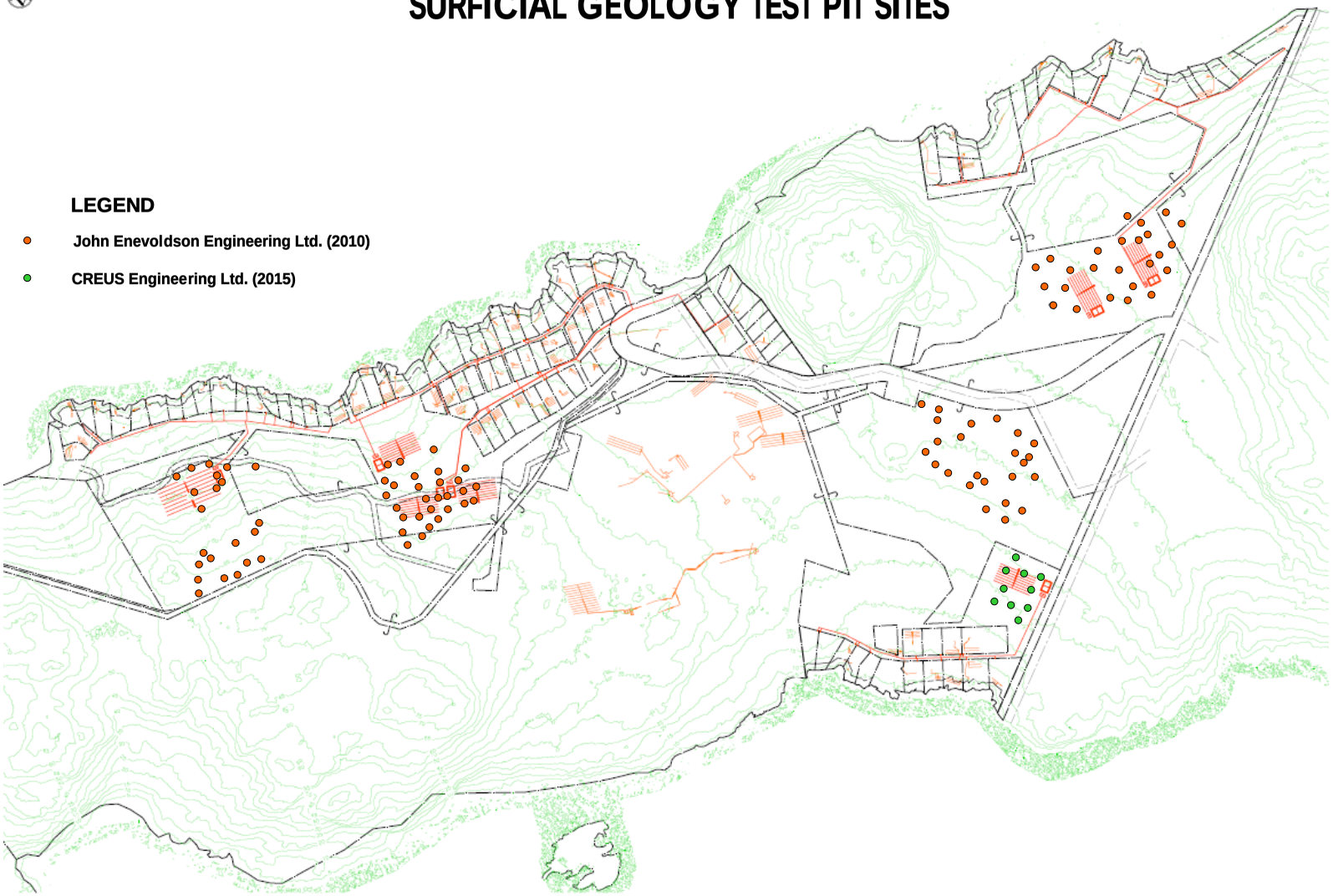


NOTES - 1) After Armstrong (1954).
2) Approximate Scale 1:28,000

exp.	**Project No.** VAN-00240303-A0 **Drawn** MDM **Reviewed** M.D.Munro **Date** Nov 2017	**PHASE 1 HYDROGEOLOGICAL STUDY** CONVENTION OF BAPTIST CHURCHES OF BC DL696, KEATS ISLAND, BC

Fig. 5

SURFICIAL GEOLOGY TEST PIT SITES



NOTES - 1) From CREUS Engineering Ltd. drawing issued for PLA dated May 19, 2016.
2) Approximate Scale 1:7,000

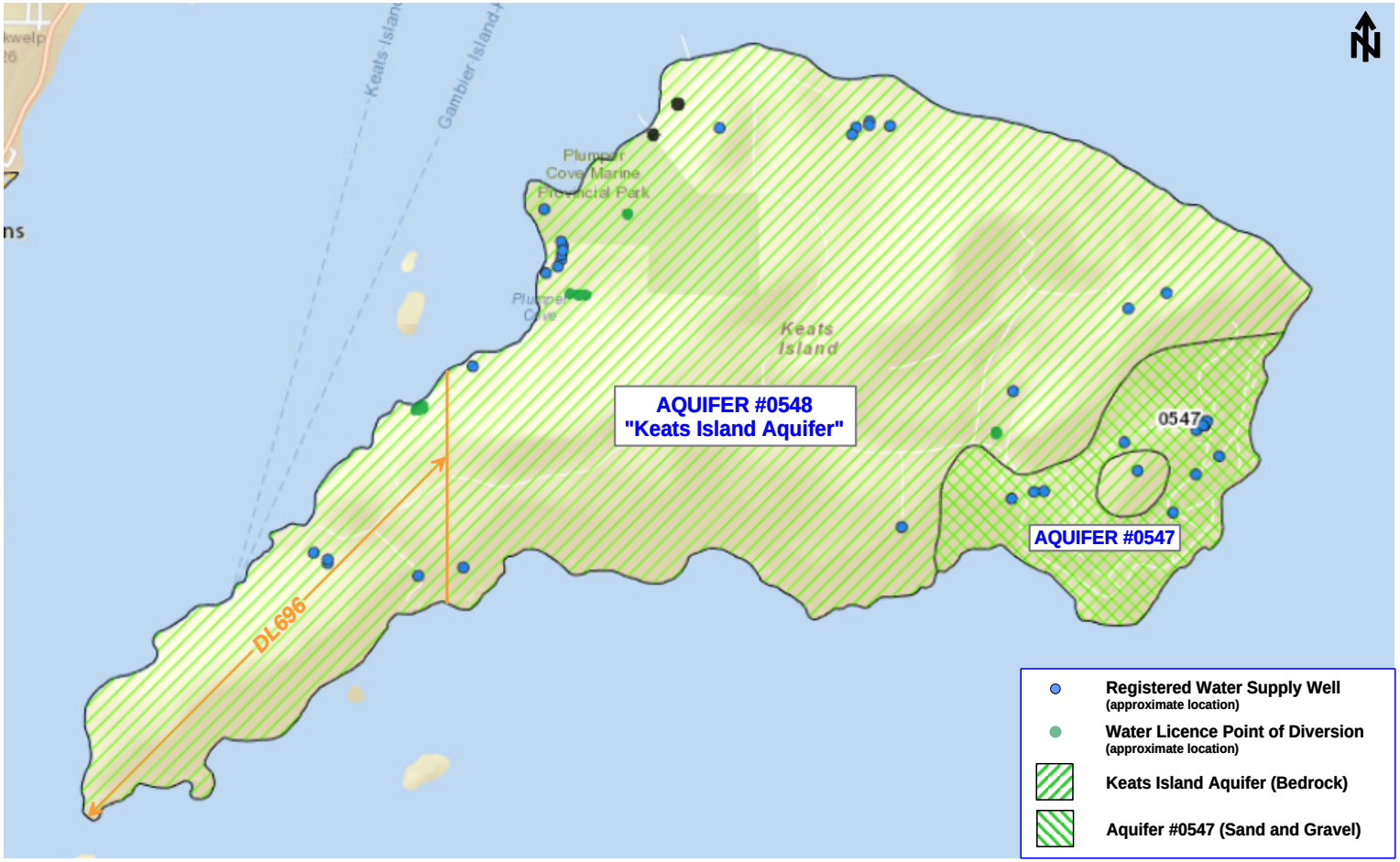
exp.

Project No. VAN-00240303-A0
Drawn MDM
Reviewed M.D.Mumm
Date Nov 2017

PHASE 1 HYDROGEOLOGICAL STUDY
CONVENTION OF BAPTIST CHURCHES OF BC
DL696, KEATS ISLAND, BC

Fig. 6

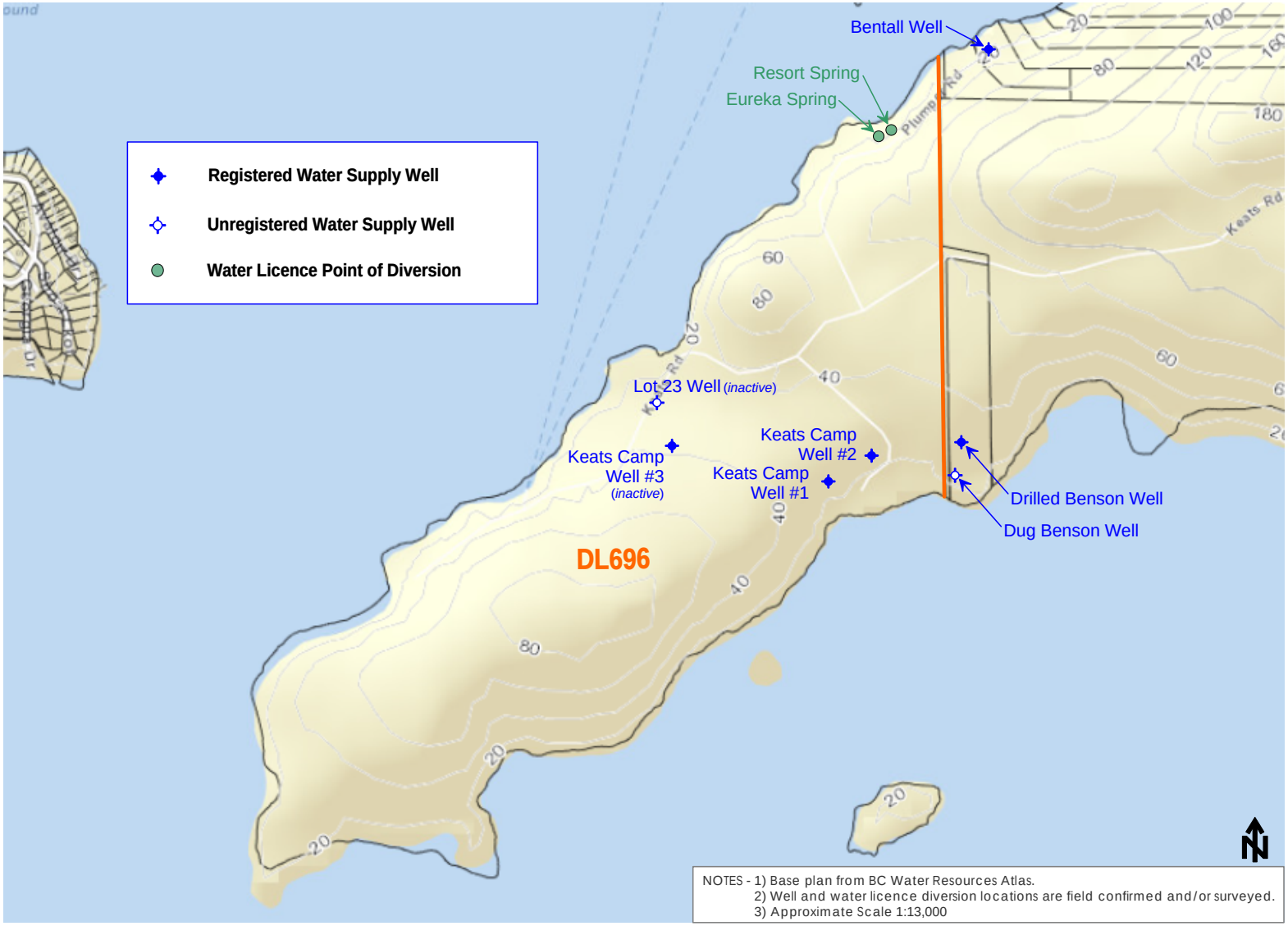
BC MOE WATER RESOURCES ATLAS SUMMARY OF KEATS ISLAND AQUIFERS, WATER SUPPLY WELLS AND WATER LICENCES[1]



NOTES - 1) From BC Water Resources Atlas. Water feature locations are approximate.
2) Approximate Scale 1:25,000

exp.	**Project No.** VAN-00240303-A0 **Drawn** MDM **Reviewed** M.D.Munro **Date** Oct 2017	**PHASE 1 HYDROGEOLOGICAL STUDY** CONVENTION OF BAPTIST CHURCHES OF BC DL696, KEATS ISLAND, BC	**Fig. 7**

SUMMARY OF WATER SUPPLY WELLS AND WATER LICENCES
DL696 LANDS AND ADJACENT PROPERTIES



exp.	**Project No.** VAN-00240303-A0 **Drawn** MDM **Reviewed** M.D.Mumm **Date** Nov 2017	**PHASE 1 HYDROGEOLOGICAL STUDY** CONVENTION OF BAPTIST CHURCHES OF BC DL696, KEATS ISLAND, BC	**Fig. 8**

Attachment # 11

Keats Camp "Well #1" - Active

BRITISH COLUMBIA

Report 1 - Detailed Well Record

Well Tag Number: 21256	Construction Date: 1968-01-01 00:00:00
Owner: KEATS CAMP(BABTIST)	Driller: Friesen Drilling
Address:	Well Identification Plate Number:
Area:	Plate Attached By:
WELL LOCATION:	Where Plate Attached:
NEW WESTMINSTER Land District	PRODUCTION DATA AT TIME OF DRILLING:
District Lot: 696 Plan: Lot:	Well Yield: 35 (Driller's Estimate) Gallons per Minute (U.S./Imperi
Township: Section: Range:	Development Method:
Indian Reserve: Meridian: Block:	Pump Test Info Flag: N
Quarter:	Artesian Flow: .01 U.S. Gallons per Minute
Island: KEATT	Artesian Pressure (ft):
BCGS Number (NAD 83): 092G033433 Well: 1	Static Level:
Class of Well:	WATER QUALITY:
Subclass of Well:	Character:
Orientation of Well:	Colour:
Status of Well: New	Odour:
Licence General Status: UNLICENSED	Well Disinfected: N
Well Use: Private Domestic	EMS ID:
Observation Well Number:	Water Chemistry Info Flag: N
Observation Well Status:	Field Chemistry Info Flag:
Construction Method: Drilled	Site Info (SEAM): N
Diameter: 6.0 inches	Water Utility: N
Casing drive shoe:	Water Supply System Name:
Well Depth: 160 feet	Water Supply System Well Name:
Elevation: 0 feet (ASL)	SURFACE SEAL:
Final Casing Stick Up: inches	Flag: N
Well Cap Type:	Material:
Bedrock Depth: 40 feet	Method:
Lithology Info Flag: N	Depth (ft):
File Info Flag: Y	Thickness (in):
Sieve Info Flag: N	WELL CLOSURE INFORMATION:
Screen Info Flag: N	Reason For Closure:
Site Info Details:	Method of Closure:
Other Info Flag:	Closure Sealant Material:
Other Info Details:	Closure Backfill Material:
	Details of Closure:

Screen from	to feet	Type	Slot Size	
Casing from	to feet	Diameter	Material	Di

GENERAL REMARKS:
ORIGINALLY RATED AT 35GPM BUT 1988 REPORT BELIEVES IT PRODUCES APPROX, 10GPM SUPPLY APPROX. 80 CABINS,FLOWS DURING WINTER MOI

LITHOLOGY INFORMATION:

From 0 to 40 Ft. stoney clay & till?

From 40 to 160 Ft. bedrock (fractured at 100ft.)

- Return to Main
- Return to Search Options
- Return to Search Criteria

Information Disclaimer
The Province disclaims all responsibility for the accuracy of information provided.

Keats Camp "Well #2" - Active

BRITISH COLUMBIA

Report 1 - Detailed Well Record

	Construction Date: 2004-07-30 00:00:00
Well Tag Number: 92985	
	Driller: Nor-West Drilling
Owner: KEATS CAMP	Well Identification Plate Number:
	Plate Attached By:
Address:	Where Plate Attached:
Area: KEATS ISLAND	PRODUCTION DATA AT TIME OF DRILLING:
	Well Yield: 20 (Driller's Estimate) Gallons per Minute (U.S./Imperial)
WELL LOCATION:	Development Method:
Land District	Pump Test Info Flag: N
District Lot: Plan: Lot:	Artesian Flow:
Township: Section: Range:	Artesian Pressure (ft):
Indian Reserve: Meridian: Block:	Static Level: 26 feet
Quarter:	
Island:	WATER QUALITY:
BCGS Number (NAD 83): 092G033433 Well:	Character:
	Colour:
Class of Well: Water supply	Odour:
Subclass of Well: Domestic	Well Disinfected: N
Orientation of Well: Vertical	EMS ID:
Status of Well: New	Water Chemistry Info Flag: N
Licence General Status: UNLICENSED	Field Chemistry Info Flag:
Well Use: Private Domestic	Site Info (SEAM):
Observation Well Number:	
Observation Well Status:	Water Utility:
Construction Method:	Water Supply System Name:
Diameter: inches	Water Supply System Well Name:
Casing drive shoe: N	
Well Depth: feet	SURFACE SEAL:
Elevation: feet (ASL)	Flag: N
Final Casing Stick Up: 48 inches	Material:
Well Cap Type:	Method:
Bedrock Depth: feet	Depth (ft):
Lithology Info Flag: N	Thickness (in):
File Info Flag: N	Liner from To: feet
Sieve Info Flag: N	
Screen Info Flag: N	WELL CLOSURE INFORMATION:
	Reason For Closure:
Site Info Details:	Method of Closure:
Other Info Flag:	Closure Sealant Material:
Other Info Details:	Closure Backfill Material:
	Details of Closure:

Screen from	to feet	Type	Slot Size	
Casing from	to feet	Diameter	Material	Drive Shoe
0	16	6	null	N

GENERAL REMARKS:
RIG #: AR#1. PUMP TEST REQUIRED FOR ACCURATE FLOW.

LITHOLOGY INFORMATION:

From	0 to	6 Ft.	
From	6 to	105 Ft.	GREENISH, SOME TIGHT FRACTURED LAYERS
From	105 to	125 Ft.	GREYISH GREEN
From	125 to	128 Ft.	10 Gallons per Minute (U.S./Imperial) green
From	128 to	145 Ft.	GREYISH GREEN
From	145 to	160 Ft.	GREYISH GREEN 50 Gallons per Minute (U.S./Imperial)
From	160 to	193 Ft.	GREYISH GREEN

- Return to Main
- Return to Search Options
- Return to Search Criteria

Keats Camp "Well 2" - Active

BRITISH COLUMBIA

Report 1 - Detailed Well Record

Well Tag Number: 92986	Construction Date:
	Driller: Nor-West Drilling
Owner: KEATS CAMP	Well Identification Plate Number
	Plate Attached By:
Address:	Where Plate Attached:
Area: KEATS ISLAND	PRODUCTION DATA AT TIME OF DRILL
	Well Yield: (Driller's Est
WELL LOCATION:	Development Method: Air lifting
Land District	Pump Test Info Flag: N
District Lot: 696 Plan: Lot:	Artesian Flow:
Township: Section: Range:	Artesian Pressure (ft):
Indian Reserve: Meridian: Block:	Static Level: 26 feet
Quarter:	
Island:	WATER QUALITY:
BCGS Number (NAD 83): 092G033433 Well:	Character:
	Colour:
Class of Well: Water supply	Odour:
Subclass of Well: Domestic	Well Disinfected: N
Orientation of Well: Vertical	EMS ID:
Status of Well: New	Water Chemistry Info Flag: N
Licence General Status: UNLICENSED	Field Chemistry Info Flag:
Well Use: Private Domestic	Site Info (SEAM):
Observation Well Number:	
Observation Well Status:	Water Utility:
Construction Method:	Water Supply System Name:
Diameter: inches	Water Supply System Well Name:
Casing drive shoe: N N	
Well Depth: 193 feet	SURFACE SEAL:
Elevation: feet (ASL)	Flag: N
Final Casing Stick Up: inches	Material: Bentonite clay
Well Cap Type: WELDED CAP	Method:
Bedrock Depth: feet	Depth (ft): 16 feet
Lithology Info Flag: N	Thickness (in):
File Info Flag: N	Liner from To: feet
Sieve Info Flag: N	
Screen Info Flag: N	WELL CLOSURE INFORMATION:
	Reason For Closure:
Site Info Details:	Method of Closure:
Other Info Flag:	Closure Sealant Material:
Other Info Details:	Closure Backfill Material:
	Details of Closure:

Screen from	to feet	Type	Slot Size
Casing from	to feet	Diameter	Material
0	193	6	Steel
16	193	6	Open hole

GENERAL REMARKS:
WELL SHOULD BE LINED BEFORE SETTING PUMP BELOW 110'. RECOMMENDED PUMP TYPE: SUBMERSIBLE. RECOMMENDED PUMPING RATE: 20 USGPM.

LITHOLOGY INFORMATION:

From 0 to 6 Ft.

From 6 to 105 Ft. GREENISH, SOME TIGHT FRACTURED LAYERS

From 105 to 125 Ft. GREYISH GREEN

From 125 to 128 Ft. green

From 128 to 145 Ft. GREYISH GREEN

From	145 to	160 Ft.	GREYISH GREEN
From	160 to	193 Ft.	GREYISH GREEN

- Return to Main
- Return to Search Options
- Return to Search Criteria

Keats Camp "Well #3" - Inactive

BRITISH COLUMBIA

Report 1 - Detailed Well Record

Well Tag Number: 77128

Owner: KEATS CAMP

Address: KEATS ISLAND

Area: HOWE SOUND

WELL LOCATION:
NEW WESTMINSTER Land District
District Lot: 696 Plan: Lot:
Township: Section: Range:
Indian Reserve: Meridian: Block:
Quarter:
Island:
BCGS Number (NAD 83): 092G033433 Well: 2

Class of Well: Water supply
Subclass of Well: Domestic
Orientation of Well: Vertical
Status of Well: New
Licence General Status: UNLICENSED
Well Use: Private Domestic
Observation Well Number:
Observation Well Status:
Construction Method:
Diameter: 6 inches
Casing drive shoe: N
Well Depth: 247 feet
Elevation: feet (ASL)
Final Casing Stick Up: inches
Well Cap Type: WELDED LID
Bedrock Depth: feet
Lithology Info Flag: N
File Info Flag: N
Sieve Info Flag: N
Screen Info Flag: N

Site Info Details:
Other Info Flag:
Other Info Details:

Construction Date: 1999-04-22 00:00:00

Driller: Drillwell Enterprises
Well Identification Plate Number:
Plate Attached By:
Where Plate Attached:

PRODUCTION DATA AT TIME OF DRILLING:
Well Yield: 2.5 (Driller's Estimate) U.S. Gallons per Minute
Development Method:
Pump Test Info Flag: N
Artesian Flow:
Artesian Pressure (ft):
Static Level: 20 feet

WATER QUALITY:
Character:
Colour:
Odour:
Well Disinfected: N
EMS ID:
Water Chemistry Info Flag: N
Field Chemistry Info Flag:
Site Info (SEAM): N

Water Utility: N
Water Supply System Name:
Water Supply System Well Name:

SURFACE SEAL:
Flag: N
Material:
Method:
Depth (ft):
Thickness (in):

WELL CLOSURE INFORMATION:
Reason For Closure:
Method of Closure:
Closure Sealant Material:
Closure Backfill Material:
Details of Closure:

Screen from	to feet	Type	Slot Size
0	0		0
0	0		0

Casing from	to feet	Diameter	Material	Drive Shoe
0	19	6	Steel	N

GENERAL REMARKS:
NR BOAT/RV YARD KEATS IS 2.5 GPM @ 65'

LITHOLOGY INFORMATION:

From 0 to 3 Ft. TILL GREYISH BROWN

From 3 to 19 Ft. BEDROCK VOLCANIC GREYISH DRILLED 8" DROPPED IN 20' OF 6" CASING GROUTED WITH BENSEAL

From	19 to	65 Ft.	VOLCANIC BEDROCK GREYISH GREEN
From	65 to	247 Ft.	GRANITE BEDROCK

- Return to Main
- Return to Search Options
- Return to Search Criteria

"Drilled Benson Well"

BRITISH COLUMBIA

Report 1 - Detailed Well Record

	Construction Date: 2004-08-04 00:00:00
Well Tag Number: 92997	
	Driller: Nor-West Drilling
Owner: BENSON	Well Identification Plate Number:
	Plate Attached By:
Address:	Where Plate Attached:
Area: KEATS ISLAND	PRODUCTION DATA AT TIME OF DRILLING:
	Well Yield: 8 (Driller's Estimate) Gallons per Minute (U.S./Imperial)
WELL LOCATION:	Development Method:
NEW WESTMINSTER Group 1 Land District	Pump Test Info Flag: N
District Lot: 876 Plan: 18419 Lot: A	Artesian Flow:
Township: Section: Range:	Artesian Pressure (ft):
Indian Reserve: Meridian: Block:	Static Level: 34 feet
Quarter:	
Island: KEATS ISLAND	WATER QUALITY:
BCGS Number (NAD 83): 092G033433 Well:	Character:
	Colour:
Class of Well: Water supply	Odour:
Subclass of Well: Domestic	Well Disinfected: N
Orientation of Well: Vertical	EMS ID:
Status of Well: New	Water Chemistry Info Flag: N
Licence General Status: UNLICENSED	Field Chemistry Info Flag:
Well Use: Private Domestic	Site Info (SEAM):
Observation Well Number:	
Observation Well Status:	Water Utility:
Construction Method:	Water Supply System Name:
Diameter: inches	Water Supply System Well Name:
Casing drive shoe: N	
Well Depth: feet	SURFACE SEAL:
Elevation: feet (ASL)	Flag: N
Final Casing Stick Up: 24 inches	Material:
Well Cap Type:	Method:
Bedrock Depth: 8 feet	Depth (ft):
Lithology Info Flag: Y	Thickness (in):
File Info Flag: N	Liner from To: feet
Sieve Info Flag: N	
Screen Info Flag: N	WELL CLOSURE INFORMATION:
	Reason For Closure:
Site Info Details:	Method of Closure:
Other Info Flag:	Closure Sealant Material:
Other Info Details:	Closure Backfill Material:
	Details of Closure:

Screen from	to feet	Type	Slot Size	
Casing from	to feet	Diameter	Material	Drive Shoe
0	18	6	null	N

GENERAL REMARKS:
RIG #: AR#1.

LITHOLOGY INFORMATION:

From	0	to	8 Ft.	ROCK & SANDY SOIL
From	8	to	83 Ft.	FRACTURED LAYERS green
From	83	to	86 Ft.	DARK GREEN
From	86	to	100 Ft.	LIGHT PINK
From	100	to	105 Ft.	DARK GREEN
From	105	to	125 Ft.	BROKEN LAYERS OF MULTI COLOURED GRANITE

- Return to Main
- Return to Search Options
- Return to Search Criteria

"Bentall Well"

BRITISH COLUMBIA

Report 1 - Detailed Well Record

Well Tag Number: 20428	Construction Date: 1967-01-01 00:00:00
Owner: DAVID BENTALL	Driller: Rural Well Drillers
Address:	Well Identification Plate Number:
Area:	Plate Attached By:
WELL LOCATION:	Where Plate Attached:
NEW WESTMINSTER Land District	PRODUCTION DATA AT TIME OF DRILLING:
District Lot: 1467 Plan: 6646 Lot: 7	Well Yield: 3 (Driller's Estimate) Gallons per Minute (U.S./Imperial)
Township: Section: Range:	Development Method:
Indian Reserve: Meridian: Block:	Pump Test Info Flag:
Quarter:	Artesian Flow:
Island: KEATS	Artesian Pressure (ft):
BCGS Number (NAD 83): 092G033434 Well: 1	Static Level:
Class of Well:	WATER QUALITY:
Subclass of Well:	Character:
Orientation of Well:	Colour:
Status of Well: New	Odour:
Licence General Status: UNLICENSED	Well Disinfected: N
Well Use: Private Domestic	EMS ID:
Observation Well Number:	Water Chemistry Info Flag: Y
Observation Well Status:	Field Chemistry Info Flag:
Construction Method: Drilled	Site Info (SEAM):
Diameter: 6.0 inches	Water Utility:
Casing drive shoe:	Water Supply System Name:
Well Depth: 80 feet	Water Supply System Well Name:
Elevation: 0 feet (ASL)	SURFACE SEAL:
Final Casing Stick Up: inches	Flag:
Well Cap Type:	Material:
Bedrock Depth: 0 feet	Method:
Lithology Info Flag:	Depth (ft):
File Info Flag:	Thickness (in):
Sieve Info Flag:	WELL CLOSURE INFORMATION:
Screen Info Flag:	Reason For Closure:
Site Info Details:	Method of Closure:
Other Info Flag:	Closure Sealant Material:
Other Info Details:	Closure Backfill Material:
	Details of Closure:

Screen from	to feet	Type	Slot Size	
Casing from	to feet	Diameter	Material	Drive Shoe

GENERAL REMARKS:
WATER ENTERS WELL PRIMARILY FROM FRACTURE AT 70 FT.

LITHOLOGY INFORMATION:

From 0 to 80 Ft. bedrock (not very hard)

- Return to Main
- Return to Search Options

- Return to Search Criteria

Information Disclaimer
The Province disclaims all responsibility for the accuracy of information provided. Information provided should not be used as a basis for making financial or any other commitments.

TABLE 1: WATER SUPPLY WELL SUMMARY – DL696 AND ADJACENT LANDS[1]

BC MOE Well Tag No.	Report Designation	Water Source	Status	Date Constructed	Reported Use	Well Depth (ft-bg)	Estimated Yield (USgpm)	Groundwater Depth at Construction (ft-bg)	Subsurface Information[2]
21256	Keats Camp Well #1	Keats Island Aquifer	In Use	1968	Drinking Water	160	35	0	Stoney clay and till to 40 ft, bedrock (fractured at 100 ft) to 160 ft
92985 & 92986	Keats Camp Well #2	Keats Island Aquifer	In Use	July 2004	Drinking Water	193	20	26	Nothing reported to 6 ft, greenish tight fractured layers to 105 ft, greyish green to 193 ft
77128	Keats Camp "Well #3	Keats Island Aquifer	Not in Use	April 1999	Drinking Water	247	2.5	20	Till greyish brown to 3 ft, bedrock volcanic greyish to 19 ft, volcanic greyish green to 65 ft, granite bedrock to 247 ft
Not Registered	Lot 26 Well	Surficial Sediments	Not in Use	Unknown	Inactive	Unknown	Unknown	Unknown	Unknown
92997	Drilled Benson Well	Keats Island Aquifer	In Use	August 2004	Drinking Water	125	8	34	Rock and sandy soil to 8 ft, fractured layers green to 83 ft, dark green to 86 ft, light pink to 100 ft, dark green to 105 ft, multi coloured granite to 125 ft
Not Registered	Dug Benson Well	Surficial Sediments	In Use	Unknown	Residential Irrigation	Unknown	Unknown	Unknown	Unknown
20428	Bentall Well	Keats Island Aquifer	Unknown	1967	Drinking Water	80	3	Unknown	Bedrock to 80 ft

NOTES:
1 – Wells located within 500 m of Keats Camp water system Wells #1 and #2 and/or proposed new communal sewerage dispersal field areas A through F.
2 – Descriptions are verbatim from BC MOE well records and contractor's records (attached to report). May not conform to standard geological vocabulary.

W.R.B. 13—0

Attachment # 13

PROVINCE OF BRITISH COLUMBIA

Water Rights Branch

DEPARTMENT OF LANDS AND FORESTS

RESORT SPRING - LICENCE NO. C024874

CONDITIONAL WATER LICENCE

William England Barter, of Gibsons, B. C.,

is/are hereby authorized to divert and use water as follows:—

(a) The source (s) of the water-supply is/are Resort Spring.

(b) The point (s) of diversion is/are located as shown on the attached plan.

(c) The date from which this licence shall have precedence is 6th August, 1958.

(d) The purpose for which the water is to be used is domestic.

(e) The maximum quantity of water which may be diverted is 500 gallons a day, and such additional quantity as the Engineer may from time to time determine should be allowed for losses.

(f) The period of the year during which the water may be used is the whole year.

(g) The land upon which the water is to be used and to which this licence is appurtenant is Lot 1428, New Westminster District, Shelter Islets.

(h) The works authorized to be constructed are sumps, pump, tank and pipe, and they shall be located approximately as shown on the attached plan.

(i) The construction of the said works ~~shall be commenced on or before the ... day of ... 19..~~ has been completed and the water ~~and shall be~~ shall be beneficially used on or before the 31st day of December, 19 60.

(j) This licence authorizes the use of water in the dwelling on the land described in clause (g) at the date hereof and in any dwelling built to replace the same but not in any other dwelling.

ENTERED ON Map No. 8221R By AEL

K. E. Paget,
Comptroller of Water Rights.

File No. 0221550 Date issued 1st May, 1959. Licence No. 24874

24874

W A T E R A C T

Section 13 (e)

FILE NO. 0221550

To correct an error in Conditional Water Licence No. 24874, Resort Spring, I hereby amend clause (e) of said licence to read:

(e) The maximum quantity of water which may be diverted is 1000 gallons a day.

VICTORIA, B.C., June 5th, 1959.

A. F. Paget,
Comptroller of Water Rights.

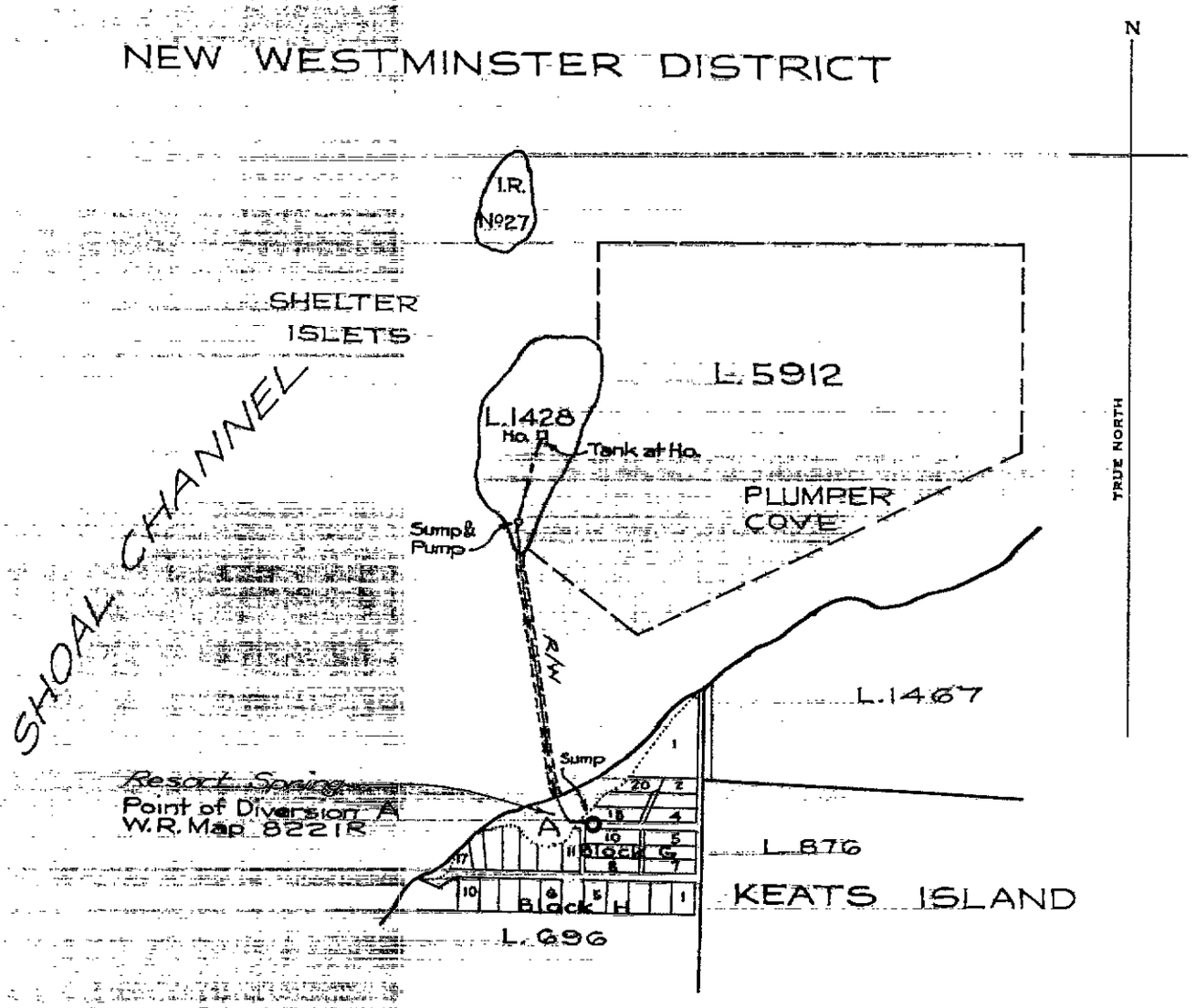
British Columbia

To accompany Conditional Licence No. 24874
and permit for Right-of-Way over Crown Land

VANCOUVER WATER DISTRICT

Scale: 500 Feet to 1 Inch

NEW WESTMINSTER DISTRICT



LEGEND

Point of Diversion O

Pipe — · —

Right-of-Way ▬▬▬

The boundaries of the land to which this licence is appurtenant are shown thus: _____

Signature _____

Date 1st MAY, 1959

EXHIBIT "A" 6A R

C.L. 24874
File 0221553
Permit No. 4511

For Right-of-Way see Ref. Map 92 G/SW-E½ (F-1)

W.R.B. 13—0

PROVINCE OF BRITISH COLUMBIA

Water Rights Branch

DEPARTMENT OF LANDS AND FORESTS

RESORT SPRING - LICENCE NO. C024804

CONDITIONAL WATER LICENCE

Gilbert and Irene Agnes Sykes, of 2162 Graveley Street, Vancouver, B. C.,

is/are hereby authorized to divert and use water as follows:—

(*a*) The source (s) of the water-supply is/are Resort Spring.

(*b*) The point (s) of diversion is/are located as shown on the attached plan.

(*c*) The date from which this licence shall have precedence is 19th August, 1958.

(*d*) The purpose for which the water is to be used is domestic.

(*e*) The maximum quantity of water which may be diverted is 1000 gallons a day,

and such additional quantity as the Engineer may from time to time determine should be allowed for losses.

(*f*) The period of the year during which the water may be used is the whole year.

(*g*) The land upon which the water is to be used and to which this licence is appurtenant is Lots 18 and 19, Block G, of Lot 696, New Westminster District, as shown on attached plan.

(*h*) The works authorized to be constructed are sump, pump and pipe,

and they shall be located approximately as shown on the attached plan.

(*i*) The construction of the said works shall be commenced on or before the 30th day of June, 1959, and shall be completed and the water beneficially used on or before the 31st day of December, 1960.

(j) This licence does not authorize the use of water in any building other than the one first constructed on the land described in clause (g) at the date hereof and in the building to be constructed after the issuance of the licence.

ENTERED ON
Map No. 8221R
By AWL

A. F. Paget,
Comptroller of Water Rights.

File No. 0221737 Date issued 1st April, 1959. Licence No. 24804

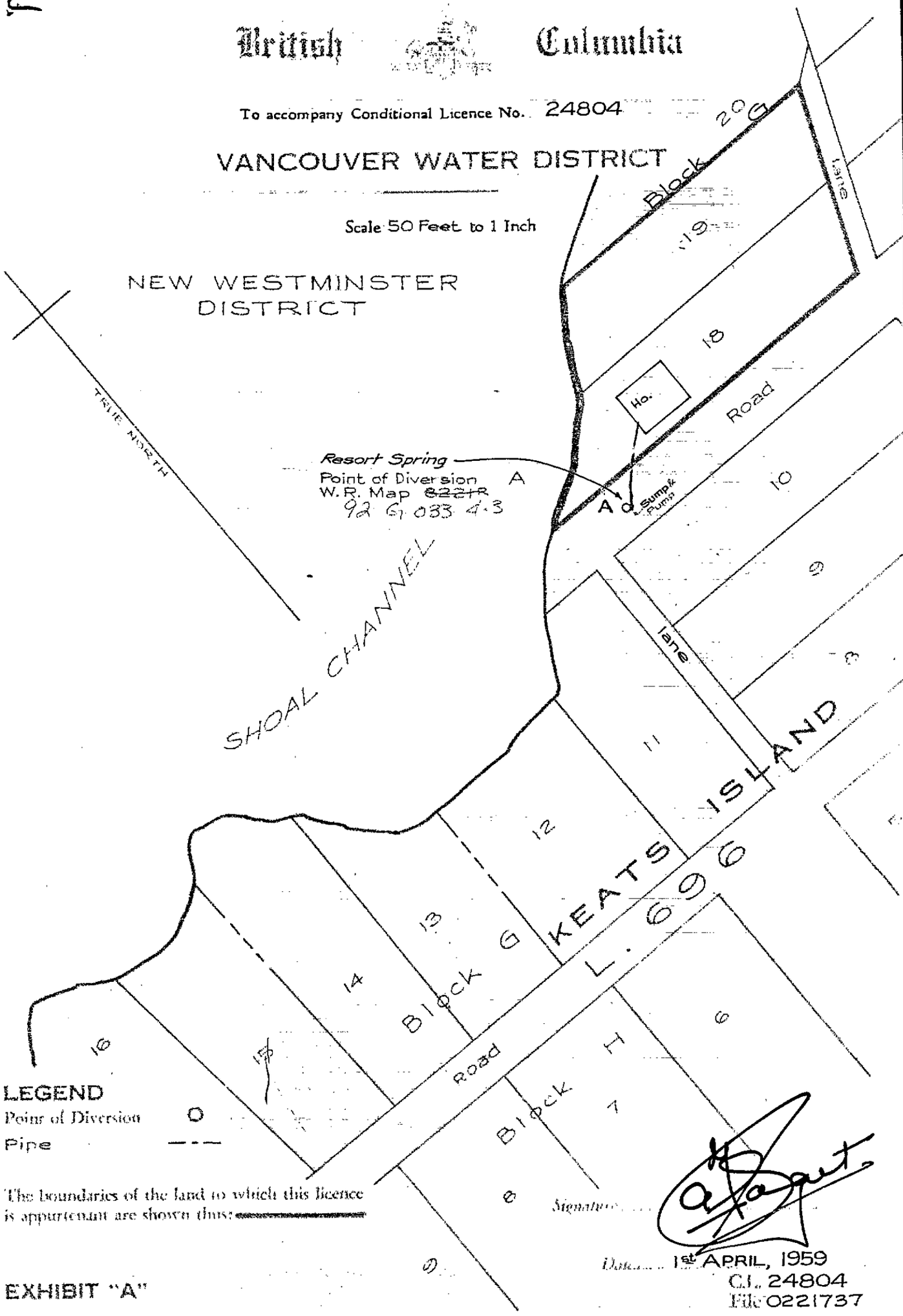
P.C.

British Columbia

To accompany Conditional Licence No. 24804

VANCOUVER WATER DISTRICT

Scale 50 Feet to 1 Inch



LEGEND

Point of Diversion O

Pipe ---

The boundaries of the land to which this licence is appurtenant are shown thus: ———

Signature

Date 1st APRIL, 1959

C.L. 24804

File 0221737

EXHIBIT "A"

WATER MANAGEMENT BRANCH

MINISTRY OF ENVIRONMENT, LANDS AND PARKS

EUREKA SPRING - LICENCE NO. C113467

THE PROVINCE OF BRITISH COLUMBIA—WATER ACT

CONDITIONAL WATER LICENCE

The owner of the land to which this licence is appurtenant is hereby authorized to divert, store and use water as follows:

(a) The stream on which the rights are granted is **Eureka Spring**.

(b) The point of diversion is located as shown on the attached plan.

(c) The date from which this licence shall have precedence is **6th July, 1998**.

(d) The purpose for which this licence is issued is **domestic**.

(e) The maximum quantity of water which may be diverted is **500 gallons a day**.

(f) Water may be used throughout **the whole year**.

(g) The land upon which the water is to be used and to which this licence is appurtenant is **Lot 6A of District Lot 696, Group 1, New Westminster District**.

(h) The works authorized to be constructed are **diversion structure, pipe, pump and tank** which shall be located approximately as shown on the attached plan.

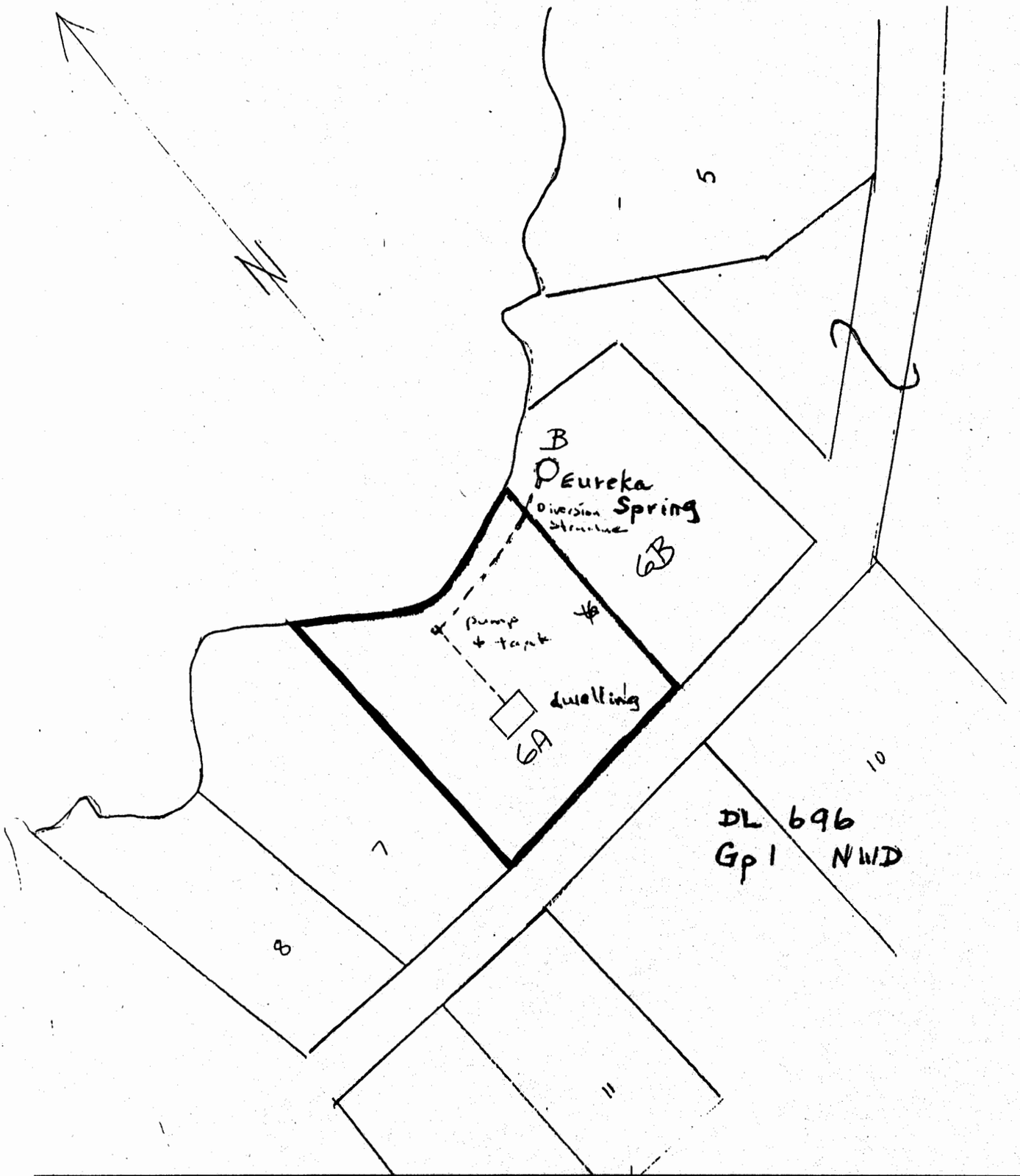
(i) The construction of the said works shall be completed and the water beneficially used prior to **31st December, 2001.** Thereafter, the licensee shall continue to make a regular beneficial use of water in the manner authorized herein.

(j) This licence authorizes the use of water for domestic purpose in **one dwelling** located approximately as shown on the attached plan.

D. Barry Paterson
Assistant Regional Water Manager

File No. **2002290** Date issued: **31st July, 1998** Conditional Licence: **113467**

Province of British Columbia



WATER DISTRICT: Vancouver
PRECINCT : Howe Sound
LAND DISTRICT : Group 1, New Westminster

Signature: _____

Date: July 31/98

LEGEND

Scale : 1" = 100'
Point of Diversion : •
Map Number : WR 92.G.033.4.3
Pipe : — — — — — —

C.L. 113467
File 2002290

The boundaries of the land to which this license

WATER MANAGEMENT BRANCH

MINISTRY OF ENVIRONMENT, LANDS AND PARKS

EUREKA SPRING - LICENCE NO. C113516

THE PROVINCE OF BRITISH COLUMBIA—WATER ACT

CONDITIONAL WATER LICENCE

The owner of the land to which this licence is appurtenant is hereby authorized to divert, store and use water as follows:

(a) The stream on which the rights are granted is **Eureka Spring**.

(b) The point of diversion is located as shown on the attached plan.

(c) The date from which this licence shall have precedence is **28th July, 1998**.

(d) The purpose for which this licence is issued is **domestic**.

(e) The maximum quantity of water which may be diverted is **500 gallons a day**.

(f) Water may be used throughout **the whole year**.

(g) The land upon which the water is to be used and to which this licence is appurtenant is **Lot 9 of District Lot 696, Group 1, New Westminster District**.

(h) The works authorized to be constructed are **diversion structure, pipe, reservoir, pump and tanks** which shall be located approximately as shown on the attached plan.

(i) The construction of the said works shall be completed and the water beneficially used prior to **31st December, 2001.** Thereafter, the licensee shall continue to make a regular beneficial use of water in the manner authorized herein.

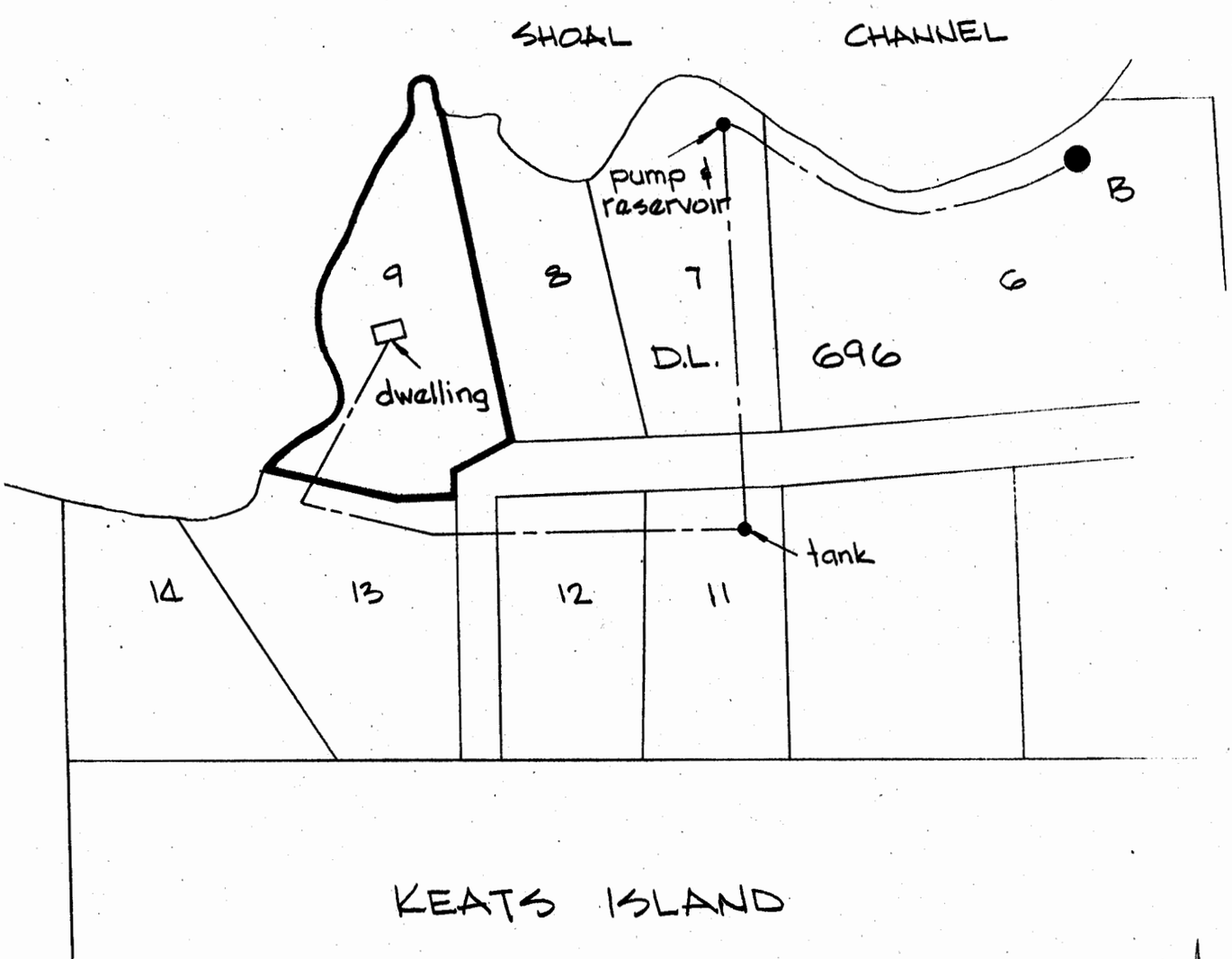
(j) This licence authorizes the use of water for domestic purpose in **one dwelling** located approximately as shown on the attached plan.

D. Barry Paterson
Assistant Regional Water Manager

File No. **2002294** Date issued: **15th September, 1998** Conditional Licence: **113516**

Province of British Columbia

GP.1



WATER DISTRICT: VANCOUVER
PRECINCT :HOWE SOUND
LAND DISTRICT :GP. 1 NEW WESTMINSTER

Signature: [signature]

Date: SEPT. 15/98

LEGEND

Scale : 1 : 750

Point of Diversion : ●

Map Number : 92.G.033.4.3

Pipe : ——————

C.L. 113516

File 2002294

The boundaries of the land to which this license is appurtenant are shown thus: ——————

WATER MANAGEMENT BRANCH

MINISTRY OF ENVIRONMENT, LANDS AND PARKS

RESORT SPRING - LICENCE NO. C112488

THE PROVINCE OF BRITISH COLUMBIA—WATER ACT

CONDITIONAL WATER LICENCE

The owner of the land to which this licence is appurtenant is hereby authorized to divert, store and use water as follows:

(a) The stream on which the rights are granted is **Eureka Spring**.

(b) The point of diversion is located as shown on the attached plan.

(c) The date from which this licence shall have precedence is **10th July, 1997**.

(d) The purpose for which this licence is issued is **domestic**.

(e) The maximum quantity of water which may be diverted is **1000 gallons a day**.

(f) Water may be used throughout **the whole year**.

(g) The land upon which the water is to be used and to which this licence is appurtenant is **Lot 7, 8, 11 and 12 of District Lot 696, Group 1, New Westminster District**.

(h) The works authorized to be constructed are **diversion structure, pipe, reservoir, pump and tank** which shall be located approximately as shown on the attached plan.

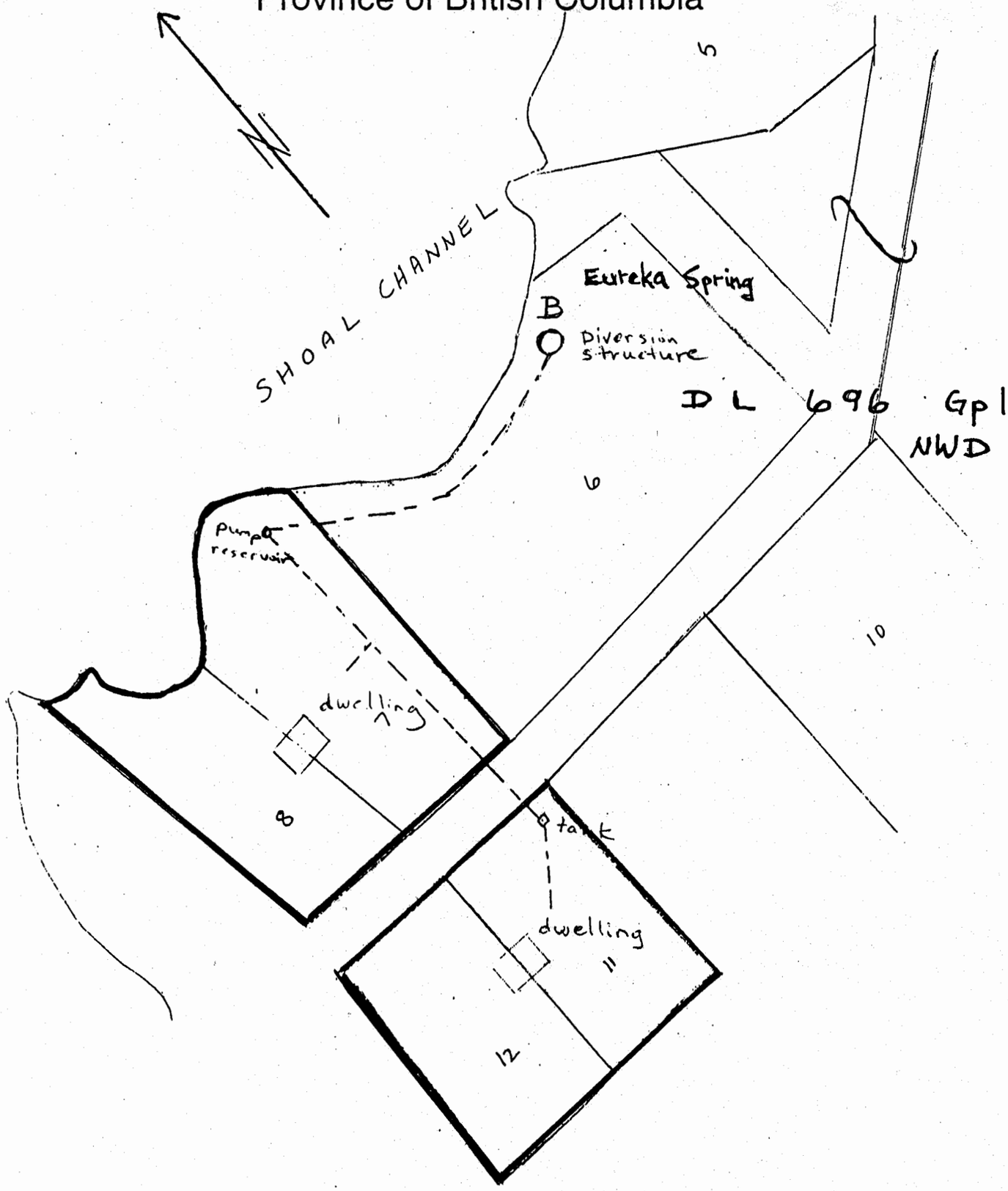
(i) The construction of the said works shall be completed and the water beneficially used prior to **31st December, 2001.** Thereafter, the licensee shall continue to make a regular beneficial use of water in the manner authorized herein.

(j) This licence authorizes the use of water for domestic purpose in **two dwellings** located approximately as shown on the attached plan.

D. Barry Paterson
Assistant Regional Water Manager

File No. **2002236** Date issued: **31st July, 1998** Conditional Licence: **112488**

Province of British Columbia



WATER DISTRICT: Vancouver
PRECINCT : Howe Sound
LAND DISTRICT : Group 1, New Westminster

Signature: _____

Date: July 31/98

LEGEND

Scale : 1" = 100'
Point of Diversion : •
Map Number : WR 92.G.033.4.3
Pipe : — — — — — —

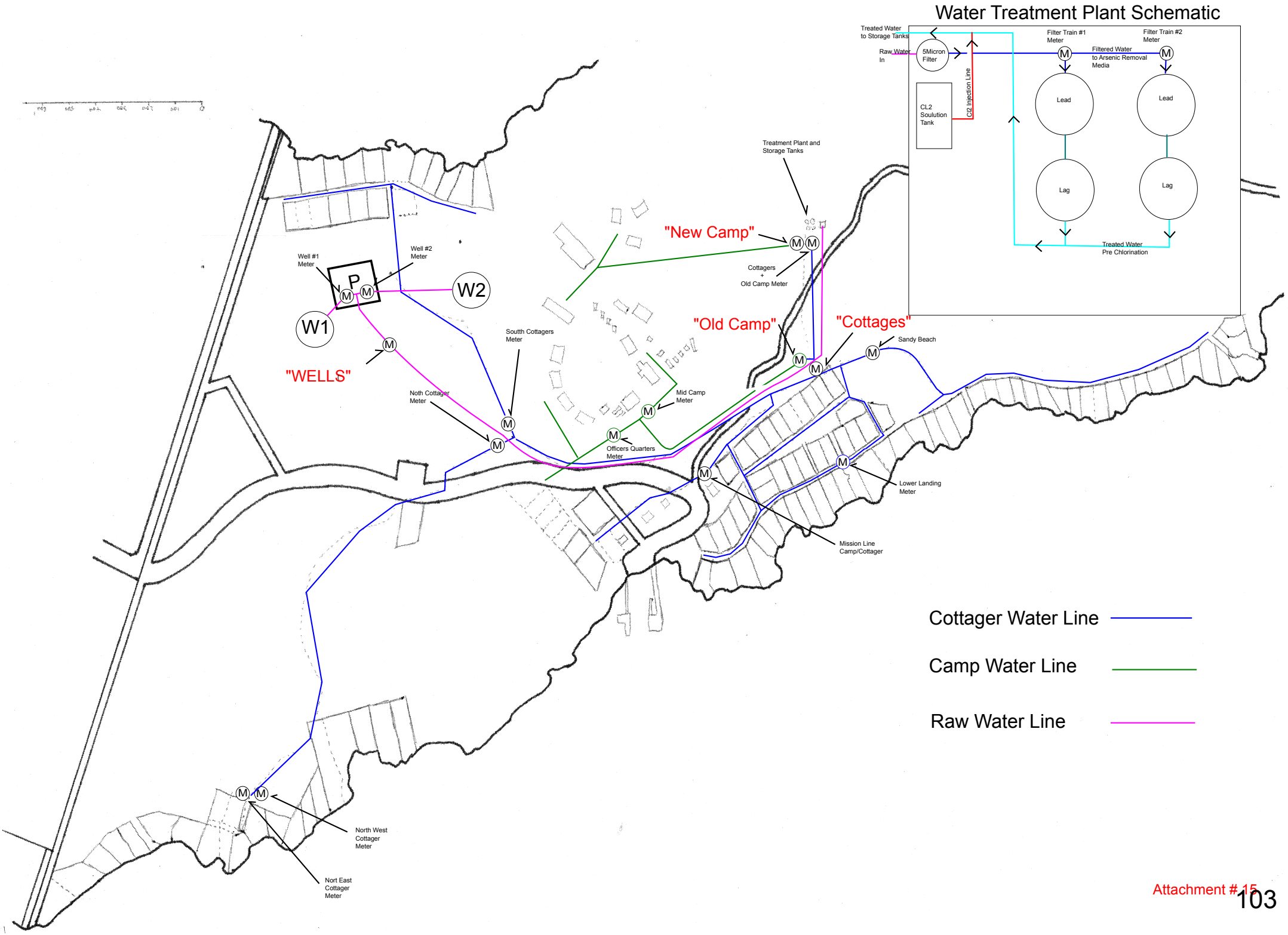
C.L. 112488
File 2002236

The boundaries of the land to which this license is appurtenant are shown thus: _____

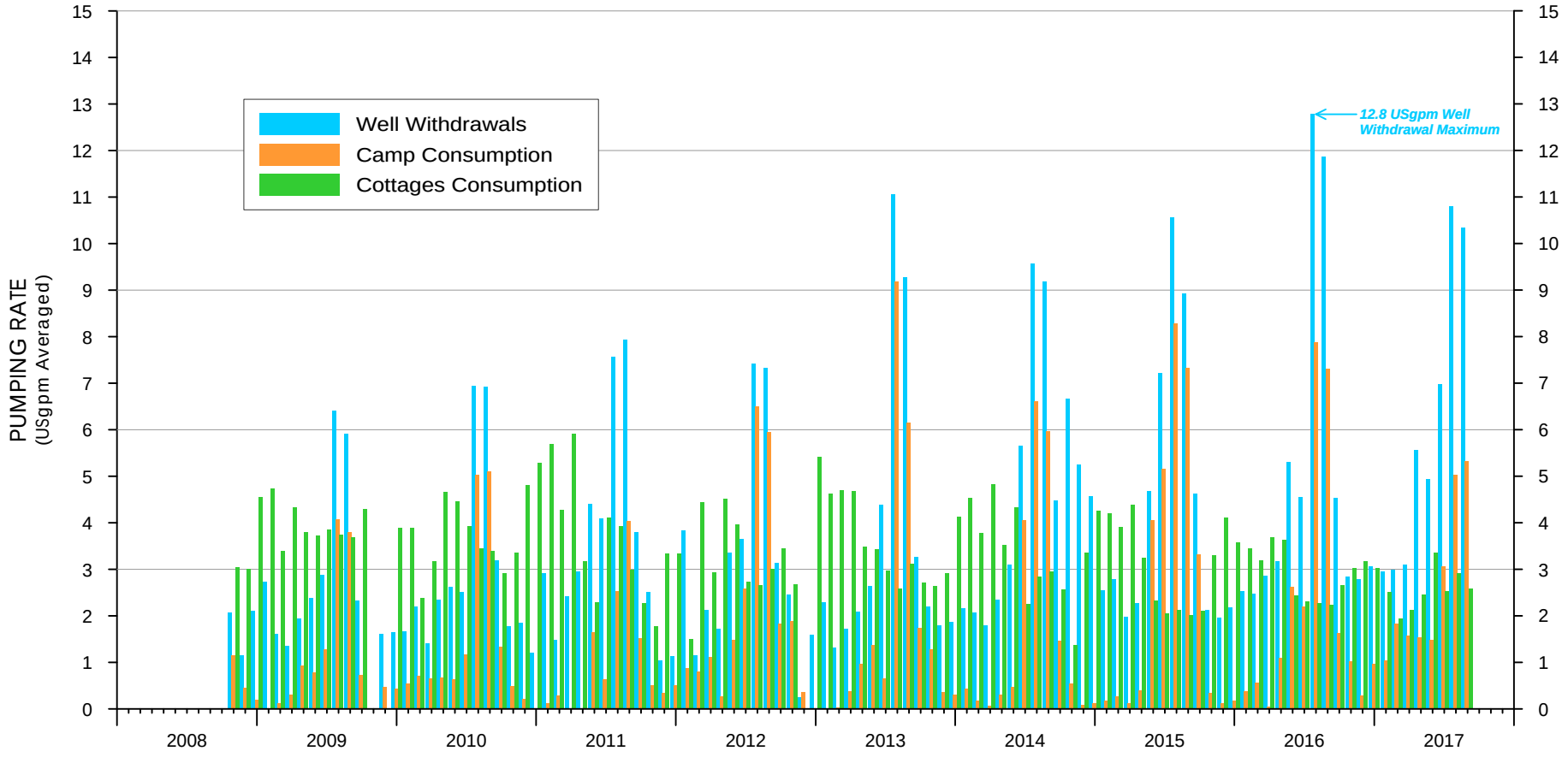
TABLE 2: SURFACE WATER LICENCES – DL696 AND ADJACENT LANDS[1]

Licenced Name	Water Source	Licence Number	Status	Licensee	Lot(s) Serviced	Purpose	Quantity (Imp. gpd)	Issue Date	Authorized Constructed Works[2]
Resort Spring	Surficial Sediments	C024874	**In Use**	Shelter Island Estates Ltd.	Shelter Island (2 Lots)	Domestic	1,000	August 6, 1958	Sump, pump, tank and pipe.
		C024804	**Inactive**	Convention of the Baptist Churches of BC	DL696 Lot 18	Domestic	1,000	August 19, 1958	Sump, pump and pipe.
Eureka Spring	Surficial Sediments	C113467	**Inactive**	Not Reported	DL696 Lot 6	Domestic	500	July 31, 1998	Diversion structure, pipe, pump and tank.
		C113516	**Inactive**	Not Reported	DL696 Lot 9	Domestic	500	Sept. 9, 1998	Diversion structure, pipe, reservoir, pump and tanks.
		C112488	**ABANDONED**	Convention of the Baptist Churches of BC	DL696 Lots 8 and 11/12	Domestic	1,000	July 31, 1998	Diversion structure, pipe, reservoir, pump and tank.

NOTES:
1 – Licenced points of diversion within 500 m of Keats Camp water system Wells #1 or #2 and/or proposed communal sewerage fields A through F.
2 – Descriptions are verbatim from Provincial Government water licence records (attached to report).


Water Treatment Plant Schematic
Treated Water to Storage Tanks
Raw Water In
5Micron Filter
Filter Train #1 Meter
Filter Train #2 Meter
Filtered Water to Arsenic Removal Media
CL2 Soulution Tank
Cl2 Injection Line
Lead
Lag
Lead
Lag
Treated Water Pre Chlorination
Treatment Plant and Storage Tanks
"New Camp"
Cottagers + Old Camp Meter
Well #1 Meter
Well #2 Meter
P
W1
W2
"WELLS"
"Old Camp"
"Cottages"
Sandy Beach
South Cottagers Meter
Noth Cottager Meter
Mid Camp Meter
Officers Quarters Meter
Lower Landing Meter
Mission Line Camp/Cottager
North West Cottager Meter
Nort East Cottager Meter
Cottager Water Line
Camp Water Line
Raw Water Line

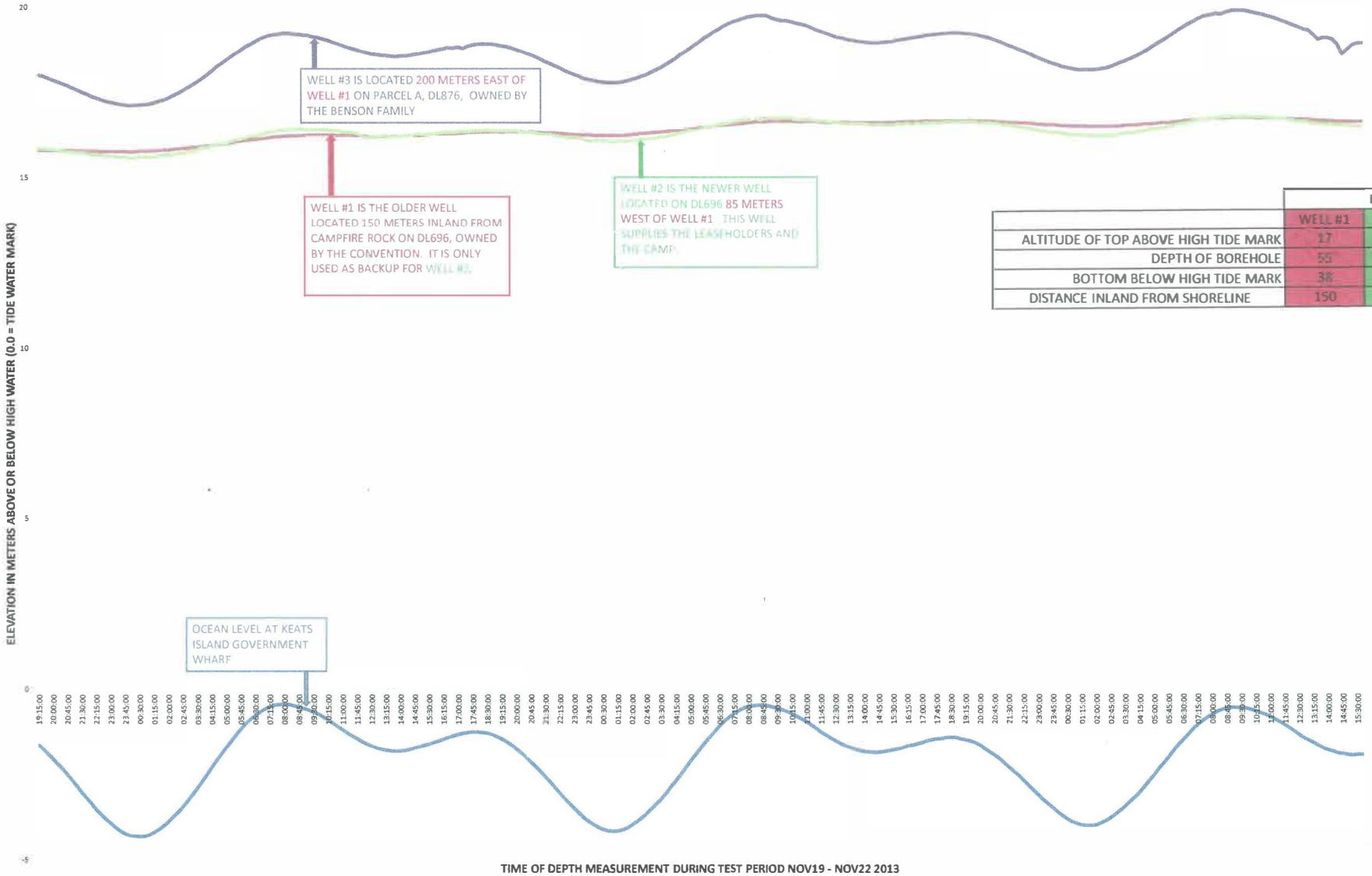
DL696 WATER SYSTEM
WATER WITHDRAWAL AND CONSUMPTION RATES[1]
(Oct 2008 to Aug 2017)



NOTES - 1) Withdrawal and consumption rates are averaged daily values assuming uninterupted pumping on monthly basis.
2) Flow rates derived from four totalizer flow meters for Camp (2 meters), Cottages (1 meter) and operating wells (1 meter).
3) DL696 water system facility designated "Keats Camp" under Vancouver Coastal Health Permit.

exp.	**Project No.** VAN-00240303-A0 **Drawn** MDM **Reviewed** M.D.Mumm **Date** Nov 2017	**PHASE 1 HYDROGEOLOGICAL STUDY** CONVENTION OF BAPTIST CHURCHES OF BC DL696, KEATS ISLAND, BC	**Fig. 9**

3 DAY PERIOD - WATER LEVELS IN 3 WELLS NEAR CAMPFIRE ROCK vs OCEAN (TIDAL) LEVELS - WELLS NOT PUMPING (ALL OFF)

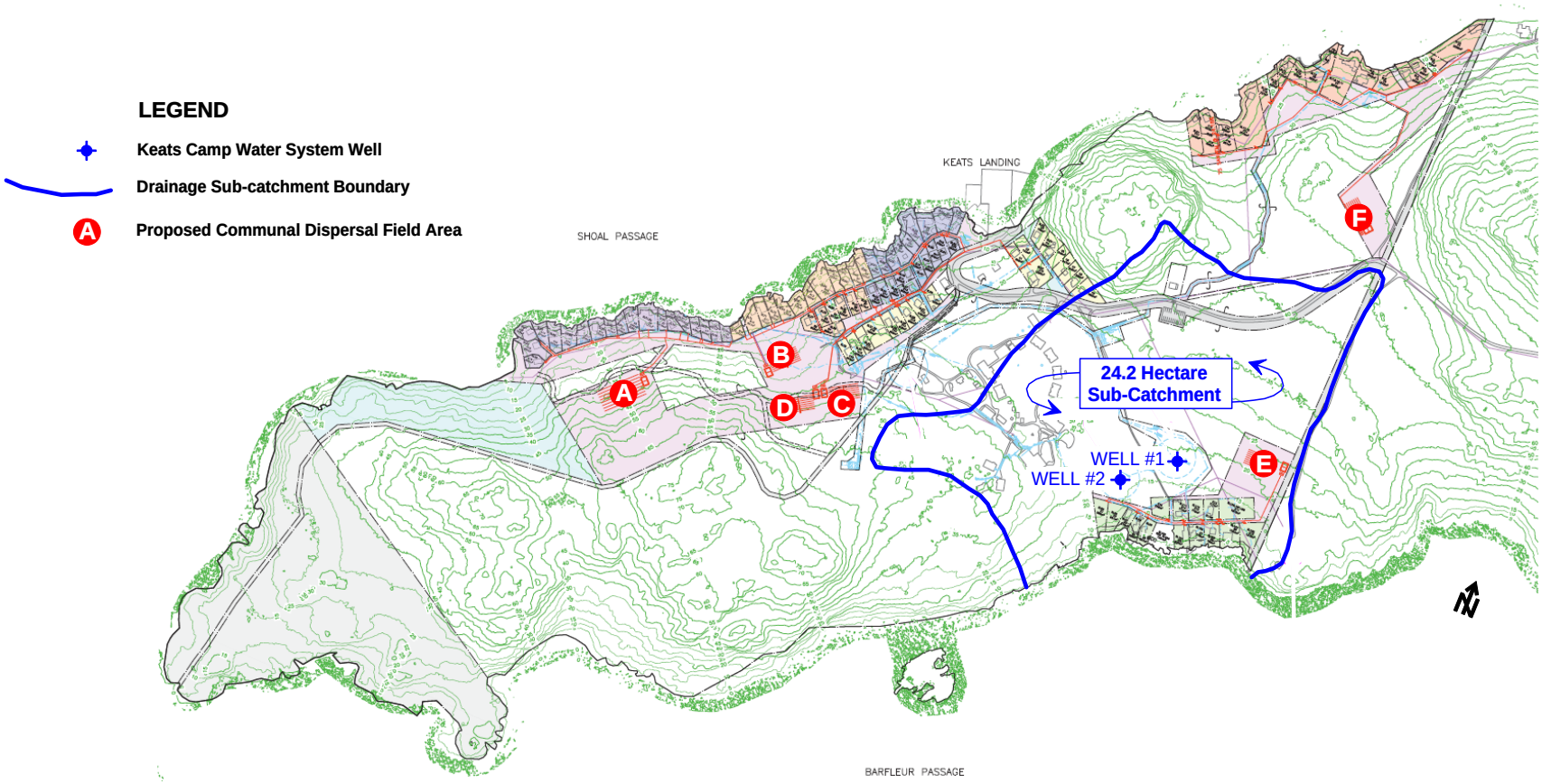


	METERS		
	WELL #1	WELL #2	WELL #3
ALTITUDE OF TOP ABOVE HIGH TIDE MARK	17	17	20
DEPTH OF BOREHOLE	55	35	30
BOTTOM BELOW HIGH TIDE MARK	38	18	10
DISTANCE INLAND FROM SHORELINE	150	80	160

TIME OF DEPTH MEASUREMENT DURING TEST PERIOD NOV19 - NOV22 2013

21 DAY PERIOD - WATER LEVELS IN 3 WELLS NEAR CAMPFIRE ROCK at VARIOUS PUMPING RATES
ELEVATION IN METERS ABOVE OR BELOW HIGH WATER (0.0 = HIGH TIDE MARK)
20
15
10
5
0
-5
-10
-15
-20
-25
WATER SAMPLE TAKEN
WATER SAMPLE TAKEN
WATER SAMPLE TAKEN
WATER SAMPLES WERE TAKEN FROM ALL WELLS ON SEP20 2013
1:00 PM
7:00 PM
1:00 AM
7:00 AM
TIME OF DEPTH MEASUREMENT DURING TEST PERIOD NOV23 - DEC14 2013
OCEAN (TIDAL) WATER LEVEL
WELL #1 DL696 WATER LEVEL
WELL #2 DL696 WATER LEVEL
WELL #3 DL876 WATER LEVEL
IMPERIAL GALLONS PER MINUTE
45
40
35
30
25
20
15
10
5
0
WELL #1 PUMPING RATE IGPM
WELL #2 PUMPING RATE IGPM
WELL #3 PUMPING RATE IGPM

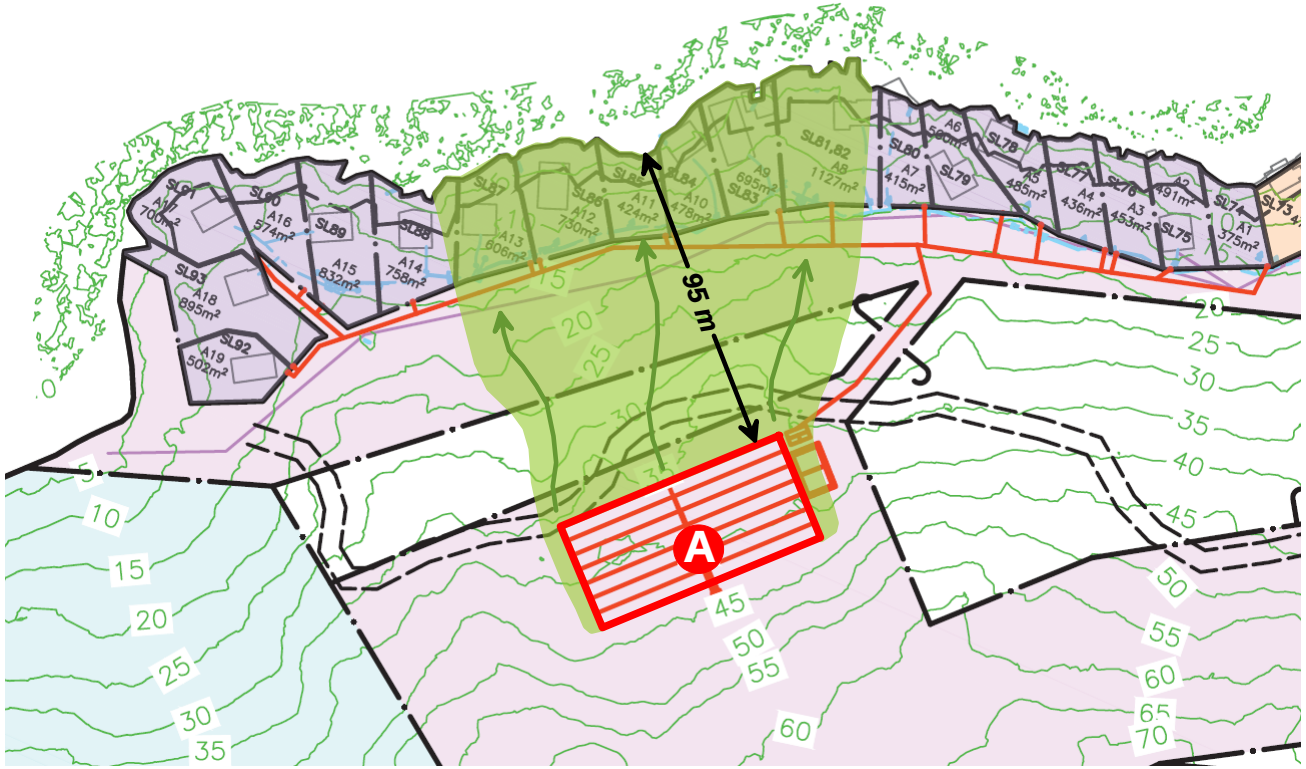
DRAINAGE SUB-CATCHMENT ASSOCIATED WITH KEATS CAMP WELLS



NOTES - 1) From CREUS Engineering Ltd. Context Plan issued for PLA dated May 19, 2016.
2) Sub-catchment boundary approximated from CREUS Engneering Ltd.
3) Approximate Scale 1:10,000

exp.	**Project No.** VAN-00240303-A0 **Drawn** MDM **Reviewed** M.D.Munn **Date** Nov 2017	**PHASE 1 HYDROGEOLOGICAL STUDY** CONVENTION OF BAPTIST CHURCHES OF BC DL696, KEATS ISLAND, BC	**Fig. 10** 107

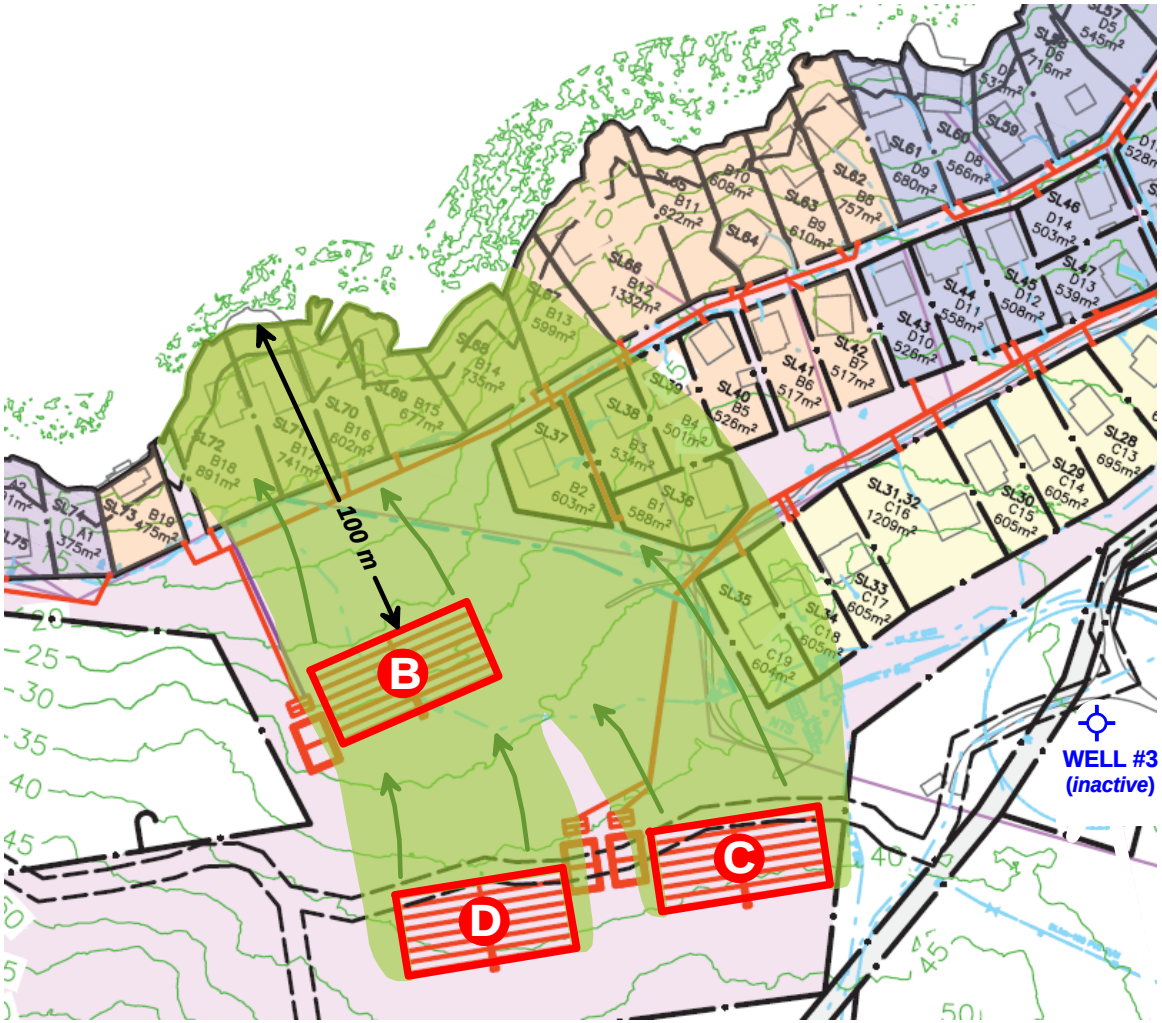
PROPOSED SEWERAGE DISPOSAL AREA A
EFFLUENT DISPERSAL[1]



NOTES - 1) From CREUS Engineering Ltd. Context Plan issued for PLA dated May 19, 2016.
2) Approximate Scale 1:2,300

exp.	**Project No.** VAN-00240303-A0 **Drawn** MDM **Reviewed** M.D.Munro **Date** Nov 2017	**PHASE 1 HYDROGEOLOGICAL STUDY** CONVENTION OF BAPTIST CHURCHES OF BC DL696, KEATS ISLAND, BC	**Fig. 11** 108

PROPOSED SEWERAGE DISPOSAL AREAS B, C AND D
EFFLUENT DISPERSAL[1]



LEGEND

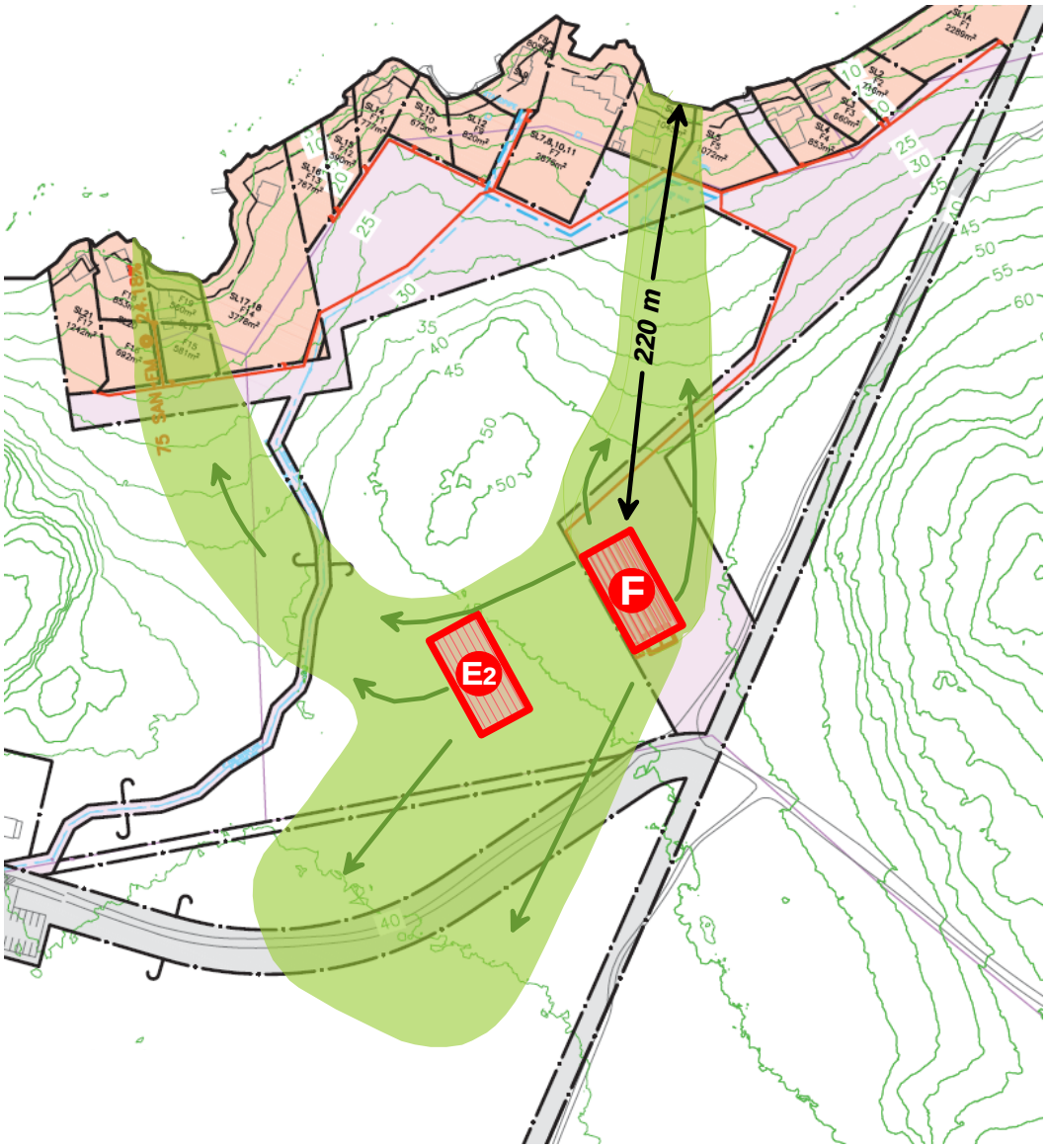
- B — Proposed Communal Dispersal Field Area
- Approximate Effluent Flow Direction
- Approximate Effluent Dispersal Zone
- Inactive Water System Well

NOTES - 1) From CREUS Engineering Ltd. Context Plan issued for PLA dated May 19, 2016.
2) Approximate Scale 1:2,200

exp.	**Project No.** VAN-00240303-A0 **Drawn** MDM **Reviewed** M.D.Munro **Date** Nov 2017	**PHASE 1 HYDROGEOLOGICAL STUDY** CONVENTION OF BAPTIST CHURCHES OF BC DL696, KEATS ISLAND, BC

Fig. 12

PROPOSED SEWERAGE DISPOSAL AREAS E2 AND F
EFFLUENT DISPERSAL[1]



LEGEND

- F — Proposed Communal Dispersal Field Area
- Approximate Effluent Flow Direction
- Approximate Effluent Dispersal Zone

NOTES - 1) From CREUS Engineering Ltd. Context Plan issued for PLA dated May 19, 2016.
2) Approximate Scale 1:5,800

exp.	Project No. VAN-00240303-A0 Drawn MDM Reviewed M.D. Munn Date Nov 2017	PHASE 1 HYDROGEOLOGICAL STUDY CONVENTION OF BAPTIST CHURCHES OF BC DL696, KEATS ISLAND, BC	Fig. 13

PROPOSED SEWERAGE DISPOSAL AREA E1
(CAMPFIRE ROCK) EFFLUENT DISPERSAL[1]

NOTES - 1) After CREUS Engineering Ltd. Context Plan issued for PLA dated May 19, 2016.
2) Approximate Scale 1:2,000

exp.

Project No. VAN-00240303-A0
Drawn MDM
Reviewed M.D.Mumm
Date Nov 2017

PHASE 1 HYDROGEOLOGICAL STUDY
CONVENTION OF BAPTIST CHURCHES OF BC
DL696, KEATS ISLAND, BC

Fig. 14

Interceptor Trench Sketch