

REPORT

Keddleston Groundwater Study

Electoral Area C, Regional District of North Okanagan, BC

Submitted to:

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1.0 INTRODUCTION

On behalf of the Regional District of North Okanagan (RDNO), Golder Associates Ltd. (Golder) conducted a groundwater study for the Keddleston area. The purpose of the study was to provide the RDNO with a better understanding of the current groundwater resources in the Keddleston area (specifically, provincially-mapped Aquifers 349, 350 and 351) and the groundwater development potential of the three aquifers, to support the RDNO in making informed decisions with regards to sustainable development in the Keddleston area with respect to groundwater supply.

Authorization to proceed with this study was provided by Mr. Alec Busby of the RDNO on 5 November 2019.

For this groundwater study, a Study Area was defined and included the extents of the Keddleston area (as provided by the RDNO and shown on Figure 1, attached). An inferred "catchment area" was defined for the three aquifers within the Keddleston area (as shown on Figure 2, attached) and includes upland areas that collect precipitation and are inferred to provide recharge to the Study Area aquifers. The catchment area is described in detail in Section 5.2 below.

2.0 SETTING

The Study Area is a semi-rural residential area, approximately 2,066.3 ha in size, and located immediately northeast of Vernon, BC, within portions of Electoral Areas "B" and "C" of the RDNO (Figure 1). At the time of writing, there were 636 lots within the Study Area, with approximately 495 of the lots developed as residential properties, based on property information provided to Golder by the RDNO. The remaining approximately 141 lots are inferred to be undeveloped. According to Agriculture Land Reserve (ALR) mapping (ALR 2019), approximately 260 ha of land within the Study Area is provincially zoned in the ALR (Figure 1). Ongoing development of the Study Area has occurred through the cumulative subdivision of larger sized lots, resulting in an increased density of water supply wells and an overall increase in groundwater extraction.

Domestic water supply to properties within the Study Area is primarily via individual on-site water supply wells, with the following exceptions:

- Approximately 24 residential properties and 5 undeveloped lots located on Aspen Road and Jackpine Road, in the central portion of the Study Area, are serviced by the Aspen Water Utility. The Aspen Water Utility supplies water via two groundwater wells that area located in the Aspen Road area and inferred to be completed in bedrock Aquifer 351.
- Approximately 18 properties in the area of Dixon Dam Road and Herbert Road, in the southwest corner of the Study Area, are serviced by Greater Vernon Water (GVW). GVW supplies water to this portion of the Study Area from the Duteau Creek surface water source located southeast (and outside) of the Study Area extents.
- Approximately 70 properties along the west side of the Study Area, from Glenhayes Road in the north to L & A Road and Grey Canal Road in the south, are serviced by GVW (Duteau Creek source).

Of the approximate 88 properties having a domestic service connection with GVW, one property in the Dixon Dam Road area and a number of properties along the west side of the Study Area also have an agricultural service connection with GVW or utilize their domestic connection with GVW for agricultural purposes, including irrigation. Some of these properties are located in the ALR and/or have "Farm Status" through the RDNO's internal process or through BC Assessment. Sewage disposal in the Study Area is serviced via individual septic fields.

The distribution of registered water supply wells in the Study Area (colour-coded by aquifer) is shown on Figure 3. The provincial iMapBC website shows that approximately 309 water supply wells are present in the Study Area; however, not all drilled wells (particularly older wells) are registered with the province and, thus, unregistered wells are generally absent from provincial mapping sources. For this study, it has been assumed that water supply to each property is via a single private water supply well completed on that property, except for properties where water is supplied by the Aspen Water Utility or by GVW. For properties serviced by the Aspen Water Utility, it is assumed that water is supplied by the Utility via two community water supply wells; however, the amount of water used by each property is inferred to be equivalent to that used by a residential property with a single private water supply well. For properties connected to GVW, it is assumed that the domestic and/or agricultural water demands for each property are serviced by GVW (with water sourced from outside the Study Area extents). It is noted that one or more properties having a service connection to GVW may also operate a private water supply well; however, detailed well information for each property connected to GVW is not available.

3.0 BACKGROUND AND OBJECTIVE

In March 2007, Golder completed a groundwater availability study that was provided as part of a larger water supply strategic plan for the RDNO (Associated Engineering 2007). The groundwater availability study completed in 2007 by Golder, which is hereafter referred to as "Golder's 2007 study", focused on Aquifer 349, a confined aquifer that was inferred to be discontinuous and unconfined in areas, including areas bordering BX Creek, and (a portion of) Aquifer 351, a confined bedrock aquifer. For the purposes of Golder's 2007 study, the extent of the Keddleston area did not include the northwest portion of Aquifer 351, nor did it include Aquifer 350, a bedrock aquifer located south of BX Creek. At the time of Golder's 2007 study, anecdotal reports from residents in the Keddleston area suggested that many of the existing water wells had been chronically or periodically underperforming with respect to sustainable yield and residents with wells in Aquifer No. 351 (bedrock) reported more concerns with water quantity and quality than did residents with wells in Aquifer No. 349 (sand and gravel). It was not known whether reduction in the yields of some wells was a result of normal well aging processes. Golder's 2007 study indicated that Aquifers 349 and 351 had limited capacity for further groundwater development, based on estimated water balance parameters (groundwater recharge and extraction) applied at the time of the 2007 study. As relatively low yields were noted for wells in both aguifers, it was inferred that development of a large capacity well, or well field, would not be feasible in either aquifer for the purpose of a community water supply. It was noted in Golder's 2007 study that water wells with relatively higher yields were identified in Aquifer 350. Based on the higher reported yields and the bedrock composition (sedimentary rocks) of Aguifer 350, the aguifer was identified as having some potential for development of a community water system; however, it was deemed unlikely that it would have the capacity to serve the existing and potential future demands of the service area, as assessed by Associated Engineering (2007) at the time of the 2007 water supply strategic plan.

Hydrogeological assessments completed by various consultants since circa 2010 for single lot developments in the Keddleston area report that wells that have been completed in Aquifer 349 and 351 generally meet the RDNO's proof of water requirements of 6.55 m³/day (RDNO 2013).

The objective of the current groundwater study was to: update the conceptual hydrogeological model of the Study Area; refine parameters used in the previous annual water balance assessment; and assess the groundwater development potential of the Study Area in relation to the following five questions posed by the RDNO regarding future water supply for Keddleston, as presented in the RDNO's Request for Proposal #2019-U21: Keddleston Groundwater Study, issued 30 September 2019:

- 1) Can future development occur with individual wells without impacting neighbouring properties or the entire area water supply?
- 2) Is there a spatial consideration to allow for individual wells?
- 3) Can a community water system within the study area be supported by either an individual well or a number of wells within one or more aquifers?
- 4) If a community water system is an available option, what is the estimate of sustainable growth based on a preliminary estimate of the capacity available?
- 5) What are other available options with respect to supplying a community water system?

The current study is intended to assess overall groundwater development potential at the regional scale; a longterm sustainable groundwater supply at individual well locations and the potential for well interferences would need to be assessed with appropriately-designed pumping tests.

4.0 SCOPE AND METHODOLOGY

Golder conducted an information review as follows:

- Surficial and geological information was obtained from the provincial iMapBC website and the BC Geological Survey mapping website.
- Information regarding existing water supply wells within the Study Area, aquifer characteristics for Aquifers 349, 350 and 351, and other general hydrogeological information for the Study Area was obtained from the provincial iMapBC website, from hydrogeological reports provided by the RDNO for the Study Area and/or sourced online, and from interviews conducted with local drillers who have knowledge of drilling conditions in the Study Area.
- Groundwater level data from Ministry of Environment and Climate Change Strategy (MoE) observation wells (Active well 311 and Inactive well 322) were accessed from the provincial Groundwater Observation Well Network website.
- Historical climate data from a nearby weather station, Vernon North, was accessed from the Environment Canada website.
- Current and future zoning/land use plans was referenced from the RDNO mapping website.
- A Leapfrog viewer file for the BX Creek area (Stewart and Allard 2017) was used to generate vertical profiles at locations within the model to aid in the 3D visualization of the subsurface stratigraphy.

Golder developed water balance estimates for the Study Area using published mean groundwater recharge rates for the Study Area and estimated groundwater extraction rates for well users in the Study Area and in the upstream catchment area to the northeast of the Study area. A map was produced showing groundwater availability across the Study Area, based on the water balance estimates for the Study Area.

To aid in the interpretation of hydrogeological conditions in the Study Area, Golder also prepared two crosssections. The locations of the cross-section lines are shown on Figure 3, attached. Cross-section A-A' is oriented in a northwest-southeast direction (Figure 4), while cross-section B-B' (Figure 5) is oriented in an east-west direction and runs at an oblique angle to cross-section A-A'. Well records used in the construction of the crosssections are provided in Appendix A.

Based on a review and analysis of the information collected, Golder prepared this report that summarizes the conceptual hydrogeological model for the Study Area (including maps and cross-sections), provides an estimated water balance for the Study Area and discusses the potential for future water supply in the Study Area.

5.0 RESULTS

5.1 Topography and Surface Water

The Study Area is located east of the Swan Lake valley bottom, along the western flank of Silver Star Mountain, and includes the relatively narrow, steep-sided valley through which BX Creek flows (Figure 1). The catchment area includes lands up-gradient of the Study Area to the northeast, towards Silver Star Provincial Park, and southeast towards Dixon Lake (formerly the Dixon Dam and reservoir) (Figure 2).

Elevations in the Study Area range from 450 metres above sea level (masl) at the northwest corner of the Keddleston area to approximately 1,000 masl at the east (top) end of the Keddleston area. Elevations increase to approximately 1,800 masl towards to the top of the catchment area, at Silver Star Provincial Park.

BX Creek enters the Study Area from the east, from its origin in Silver Star Provincial Park, and exits to the southwest into the Swan Lake valley bottom and ultimately into Swan Lake (Figure 1). Several smaller creeks join BX Creek as it passes through the Study Area, including Keddleston and Abbott Creeks, which flow from the north, and Dixon Creek, which empties Dixon Lake from the south. Other unnamed creeks are present in the northwest portion of the Study Area; these generally drain to the west, towards the Swan Lake valley bottom.

5.2 Inferred Catchment Area

The catchment area that is inferred to receive precipitation upstream of, and within, the Study Area and provide recharge to the aquifers within the Study Area includes the provincially-mapped BX Creek topographic catchment as well as a predicted catchment area in the northwest corner of the Study Area, as follows:

The provincially-mapped BX Creek topographic catchment extends from Silver Star Provincial Park at the headwaters of BX Creek to the (discontinued) streamflow gauge on BX Creek (EC 2019a; Gauge 08NM020) at the margins of the valley bottom (Figure 2). It is noted that the streamflow gauge on BX Creek coincides with the bottom (south) end of the Study Area. For the purposes of this study, the southern-most extent of the Keddleston area was included as part of this catchment area. The total area of the BX Creek topographic catchment, including the southern-most extent of the Keddleston area, is approximately 5,583 ha; with

approximately 3,538 ha present on the north side of BX Creek and approximately 2,045 ha present on the south side of BX Creek.

The northwest portion of the Study Area and the associated upstream catchment area to the northeast are located outside of the BX Creek topographic catchment area. For the purposes of this study, a topographic catchment area termed "northwest catchment area" was developed for this area (Figure 2). The total area of the northwest topographic catchment is approximately 860 ha.

Surface water runoff (overland flow) within the catchment area is directed to creeks and other water bodies within each respective topographic catchment area. Historical hydrometric information for the streamflow gauge on BX Creek indicates that the streamflow gauge was in operation between 1921 and 1999. Mean monthly discharge over the period of record ranged from a minimum of 0.065 m³/s (5,616 m³/day) to a maximum of 0.900 m³/s (77,760 m³/day), with a mean of 0.298 m³/s (25,747 m³/day) (EC 2019a).

5.3 Geological Setting

5.3.1 Bedrock

The north portion of the Study Area, generally corresponding to the area north of BX Creek, is underlain by Proterozoic to Paleozoic undivided metamorphic rocks of the Shuswap Assemblage, while the south portion of the Study Area, generally corresponding to the area south of BX Creek, is underlain by Upper Triassic sedimentary rocks of the Nicola Group (BCGS 2019) (see Figure A below).

The Okanagan Valley was formed as a result of a major fault along the main axis of the valley and there is evidence for the existence of associated smaller faults along the flanks of the Valley, including stress faults and contraction faults. A normal fault has been mapped along the west side of the Study Area, parallel to the Okanagan Valley fault (see Figure A below). Another normal fault has been mapped at the northeast corner of the Study Area and appears to be correlated to the contact between metamorphic rocks of the Shuswap Assemblage to the north and sedimentary rocks of the Nicola Group to the south (see Figure A below). This fault appears to follow the BX Creek valley; and while the fault is shown to terminate at the northeast corner of the Study Area, it may extend further to the southwest along the metamorphic-sedimentary bedrock contact but is masked by the overlying surficial sediments within the BX Creek valley.

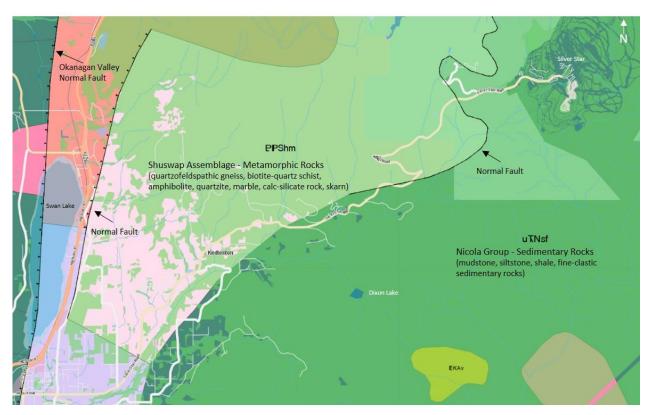


Figure A. Bedrock Geology of Study Area (BCGS 2019).

5.3.2 Unconsolidated Deposits

The bedrock in the Study Area is blanketed by a layer of unconsolidated glacial deposits comprising mostly till with some water-bearing sand, gravel and silt layers. The unconsolidated deposits are thickest on the north side of the BX Creek valley relative to those deposits on the south side of the BX Creek valley (Figure 4 and 5). At increasing distance laterally away from the BX Creek valley, and at increasing elevation towards the top of the catchment area, the surficial unconsolidated deposits trend to a thin veneer over bedrock or are not present. Within the BX Creek valley, glacial sediments have been modified by the erosive action of BX Creek. Alluvial deposits are inferred to be present within the drainage course of the tributaries of BX Creek and of smaller streams within the Study Area.

5.4 Climate

The climate in the Study Area consists of warm, dry summers and cool, moist winters. Golder reviewed climate normals from 1981 to 2010 for the Vernon North weather station, located at 50°20'39.6 N latitude and 119° 16'17 W longitude (EC 2019b). This weather station is located on the west side of Swan Lake, approximately 5 km northwest of the central portion of the Study Area, and at an elevation of approximately 538 masl. Daily average temperatures for the period between 1981 to 2010 ranged from a minimum of -0.2°C in February to a maximum of 21.0°C in July, with an annual daily average of 8.8°C. Total precipitation ranged from 25.2 mm in February to 57.5 mm in November, with an annual average of 487 mm.

5.5 Aquifer Characterization

Golder reviewed available hydrogeological information from the online iMapBC database. It is important to note that the information provided by iMapBC is based on historical records that have not been verified. Therefore, information contained in this database may be incomplete and may contain inaccuracies, especially with regards to reported well locations and the aquifer to which the well has been assigned. Furthermore, many well records in the database state the estimated yield in gallons per minute (gpm) without specifying US or Imperial units of measure. For the purposes of this report, the value was assumed to be reported in USgpm if the unit was not specified. Well yields are as reported by drillers and such yields are usually based on the results of airlift testing, which typically overestimates the long-term yield of the well. Where no formal pumping test data is provided, it is not possible to verify if the reported yields are representative or sustainable. Figure B below provides a spatial representation of reported well yields for the Study Area aquifer.

According to iMapBC, there are three main provincially mapped and classified aquifers in the Study Area: Aquifers 349, 350 and 351. The aquifers are described in the following sections.

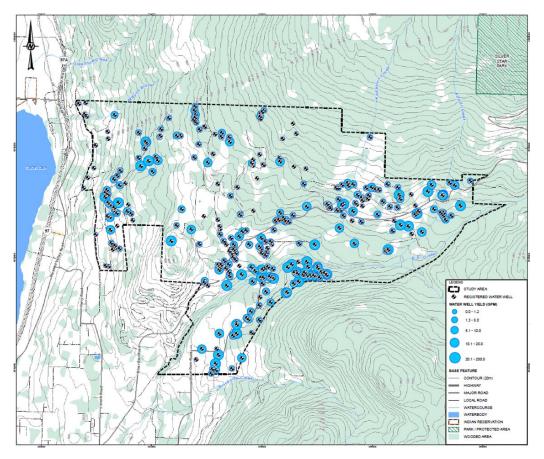


Figure B. Spatial distribution of reported well yields for registered wells in the Study Area

5.5.1 Aquifer No. 349

Aquifer No. 349 is a confined glacio-fluvial sand and gravel aquifer that is classified by the Province as IIC reflecting moderate demand relative to moderate productivity, and low vulnerability to contamination from surficial sources. This aquifer covers an area of approximately 25.5 km² and extends from the eastern boundary of the Study Area to the south end of Swan Lake (outside of the Study Area), generally following the BX Creek valley (Figure 2; the green line represents the aquifer extents as defined by ENV). Registered water wells associated with Aquifer 349 are shown in green on Figure 3. It is noted that based on a review of available water well records for wells completed in the north-central portion of Aquifer 349 (i.e., where the northern extent of Aquifer 349 forms a "peak" towards the north), the sand and gravel deposits associated with Aquifer 349 were not identified in this portion of the Study Area. Therefore, the northern extent of Aquifer 349 may not extend as far north as what is defined by ENV. Similarly, the southern extent of Aquifer 349 may not be as extensive as what is defined by ENV, based on a review of available water well records for wells completed along the south-central portion of Aquifer 349.

Within the Study Area, the sand and gravel deposits of Aquifer 349 are found to lie between the base of a thick till unit and the top of the bedrock surface (refer to cross-sections in Figure 4 and 5). The thickness of the sand and gravel deposits vary; and based on available water well records, the thickness ranges from approximately 0.1 m to 15 m, with an average thickness of 3.7 m. While Aquifer 349 appears to be confined in nature, it does not appear to be continuous within the provincially-mapped aquifer boundary. The cross-sections indicate the presence of thin perched sand and gravel layers within the till. The interconnectedness of these perched layers is not known.

Natural recharge to the aquifer is inferred to be predominantly from infiltration of precipitation and snowmelt along the edges of the aquifer on the sides of the valley, with some recharge contribution from bedrock inflows and stream leakage of BX Creek and its tributaries. Research conducted by Smerdon et al. (2009) in the BX Creek watershed (refer to Section 5.9.1 below for details of the research) reported that within the Study Area, BX Creek is a gaining stream (i.e., aquifer discharges to BX Creek); thus, stream leakage from BX Creek into the underlying sand and gravel deposits of Aquifer 349 may be minimal within the Study Area, except possibly during high flows (i.e., freshet) when the creek may provide some degree of recharge the aquifer. Smerdon et al. (2009) estimated that the volumetric flow rate of groundwater through Aquifer 349 at the south end of the Study Area (i.e., at the streamflow gauge) was 3,176 m³/day (Golder infers that this flow rate is less a groundwater extraction rate of 356 m³/day). For the current study, Golder corroborated the groundwater recharge estimates for Aquifer 349 from Smerdon et al. (2009) by calculating the approximate flow through the aquifer based on Darcy's Law. Using a hydraulic conductivity value for sand and gravel of 10⁻⁴ m/s (Freeze and Cherry 1979), an average aquifer width of 1,250 m, an aquifer thickness of 3.7 m (as above) and a hydraulic gradient of 0.08 m/m (see Section 5.7.1), Golder calculated the groundwater flow through Aquifer 349 to be approximately 3,197 m³/day, a value that is considered to be consistent with the groundwater flow rate assessed by Smerdon et al. (2009).

Based on a review of well records, there are 88 registered water wells completed in Aquifer 349 in the Study Area. The range of reported well yields was between 0.003 L/s to 3.8 L/s (0.05 USgpm to 60 USgpm), with an average reported yield of 0.6 L/s (10 USgpm). Static water levels in these wells were reported to range from 0.6 m to 73 m below ground surface (mbgs).

Approximately 19 registered wells located in Aquifer 349 and in the central portion and east end of the Study Area were reported to be flowing artesian at the time of drilling, with artesian flow values ranging from 0.0006 L/s to 1.9 L/s (0.01 USgpm to 30 USgpm).

Five wells within Aquifer 349 were reported as being dry. These wells did not have a reported yield value as they were either dry at the time of drilling or had been pumped dry and subsequently decommissioned. Final drilled depths at these locations ranged from 25 mbgs to 49 mbgs. Four of the dry wells were centrally located north to northwest of Tillicum Road and one dry well was present in east portion of the Study area, south of Jackpine Road.

5.5.2 Aquifer No. 350

Aquifer No. 350 is a fractured sedimentary rock aquifer that is classified IIC based on a low productivity under moderate demand and low vulnerability to contamination from surficial sources. This aquifer covers an area of approximately 7 km² and has been provincially mapped along the south side of BX Creek. Aquifer 350 is present along the southern boundary of the Study Area (Figure 2; the red line represents the aquifer extents, as defined by ENV). Registered water wells associated with Aquifer No. 350 are shown in red on Figure 3.

Based on a review of available water well records, there are 56 registered wells completed in Aquifer 350 within the Study Area. The range of reported well yields was 0.04 L/s to 3.8 L/s (0.6 USgpm to 60 USgpm), with an average yield of approximately 1.0 L/s (16 USgpm). Yields of wells in Aquifer 350 appear to be slightly higher than those in Aquifer 349. Static water levels in these wells were reported to range from 1.5 mbgs to 46 mbgs.

Natural recharge to Aquifer 350 is inferred to be predominantly from infiltration of precipitation and snowmelt at upstream areas within the catchment (where limited overlying surficial deposits are present), with some recharge contribution from leakage of the groundwater from the overlying unconsolidated aquifer (where Aquifer 349 overlies Aquifer 350) and stream leakage of BX Creek and its tributaries. The confined sand and gravel aquifer (Aquifer 349) overlies a small portion of bedrock Aquifer 350 in the south-central portion of the Study Area.

A number of high producing wells are located in the Dixon Dam Road area, along the south central boundary of the Study Area, and in the Ranch Road area, at the south end of the Study Area. The Dixon Dam Road wells are registered to Pure Canadian Waters Ltd. and Clearly Canadian Beverage, and it is understood that a water bottling company operated in this area in the 1990s and 2000s. It is not known if these wells are currently in use. An additional well in the Dixon Dam Road area exhibited flowing artesian conditions during drilling and reported an artesian flow value of 0.15 L/s (2.4 USgpm). Higher well yields may be related to the bedrock type, which may contain more frequent, wider and/or permeable fractures and/or may be due to the presence of a fault or contact zone between the metamorphic bedrock to the north and the sedimentary bedrock of Aquifer 350.

5.5.3 Aquifer No. 351

Aquifer No. 351 is a confined bedrock aquifer that is classified as IIC reflecting a low demand relative to a low productivity, and a low vulnerability to contamination from surficial sources. This aquifer covers an area of approximately 21.8 km² and covers the majority of the Study Area (Figure 2; the purple line represents the aquifer extents, as defined by ENV). Registered water wells associated with Aquifer No. 351 are shown in purple on Figure 3. There are 165 registered water wells completed within this aquifer. The depth to bedrock varies considerably over the extent of this aquifer, from shallow (<1 mbgs) in the northwest to as deep as 87 mbgs in some areas bordering Aquifer No. 349 in the east portion of the Study Area.

Natural recharge to Aquifer 351 is inferred to be predominantly from infiltration of precipitation and snowmelt at upstream areas within the catchment, with some recharge contribution from leakage of the groundwater from the overlying unconsolidated aquifer (where Aquifer 349 overlies Aquifer 351) and stream leakage. The confined sand and gravel aquifer (Aquifer 349) overlies a relatively large portion of bedrock Aquifer 351 in the central portion of the Study Area.

Based on available information, the hydraulic connection between bedrock fractures in Aquifer 350 and Aquifer 351 is not well characterized. Furthermore, it is not known how the fault or contact zone between the two bedrock types along the BX Creek valley, if present in the Study Area, influences the groundwater flow paths within, and between, the aquifers. As part of the research conducted by Smerdon et al. (2009), it was found that the groundwater chemistry within the sand and gravel deposits of Aquifer 349 and the surrounding bedrock fractures of Aquifers 350 and 351 (in the vicinity of Aquifer 349) exhibited similar geochemical compositions, suggestive of a common origin.

The range of reported well yields was 0.01 L/s to 3.8 L/s (0.2 USgpm to 60 USgpm), with an average yield at 0.4 L/s (7 USgpm). It is noted that one well located along the west boundary of the Study Area (and within the region of Aquifer 351) reported a well yield of 100 USgpm; however, this well was completed in granular deposits that may be associated with a separate localized aquifer. Static water level in the Aquifer 351 wells were reported to range from 1.5 mbgs to 143 mbgs.

Approximately 11 registered wells located in the northwest corner of the Study Area were reported to be flowing artesian at the time of drilling, with artesian flow values ranging from 0.0006 L/s to 0.32 L/s (0.01 USgpm to 5 USgpm).

Eleven wells located across Aquifer 351 were reported as being dry. The final drilled depth of these wells ranged from 30 mbgs to 256 mbgs.

5.6 Hydrostratigraphy

The unconsolidated and confined water-bearing sand and gravel deposits of Aquifer 349 are inferred to overlie bedrock on both sides of the BX Creek valley (Figures 2 and 3). Where the unconsolidated and confined sand and gravel deposits overly bedrock, groundwater resources may be found in the sand and gravel deposits and/or in bedrock fractures within the underlying bedrock mass. Groundwater resources may also be found in shallow (unconfined) alluvial deposits associated with tributaries of BX Creek and of smaller streams within the Study Area. A generalized illustration of this multi-aquifer system (also termed "stacked aquifers") is provided on Figure C below.

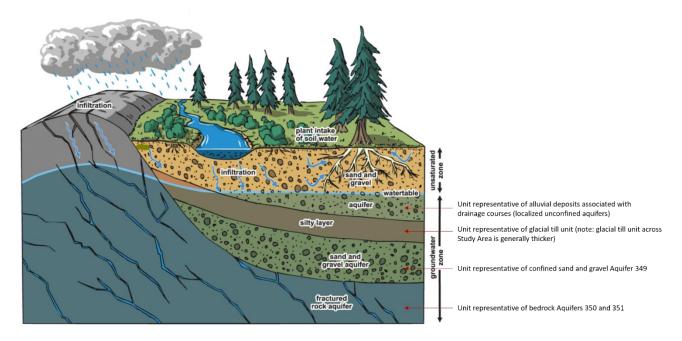


Figure C. Illustration of a multi-aquifer system (taken from the Regional District of Nanaimo's website: http://rdnwaterbudget.ca/water-101/aquifers-groundwater/).

Based on a review of water well records for the Study Area, it was generally observed that where wells were completed in the water-bearing sand and gravel deposits, the driller did not advance further and thus, the depth to bedrock and associated bedrock fractures, if present at the location drilled, were not confirmed. At a few locations, water well records indicate that the base of the unconsolidated water-bearing sand and gravel deposits was underlain by glacial till (however, the thickness of the glacial till unit and the depth to bedrock were not confirmed at these locations). It is inferred that during drilling of a water supply well within the extents of Aquifer 349, if the driller encountered a sufficient supply of water in the sand and gravel deposits, then the well was completed in these deposits and if a sufficient supply of water was not encountered in the sand and gravel deposits, then the well was drilled into the bedrock until a productive water-bearing fracture(s) was encountered.

In some regions of BC, groundwater can be encountered at the interface between the unconsolidated deposits and the underlying bedrock surface, within a weathered or fractured bedrock zone. However, based on a review of available records for water well within the Study Area, wells were generally not completed within a weathered or fractured zone at the top of the bedrock. Instead, water wells appeared to be completed either in the sand and gravel deposits or at depth within the bedrock.

5.7 Groundwater Flow Direction and Hydraulic Gradient

On a regional scale, groundwater flow is inferred to be to the west-southwest, from the bedrock dominated upland areas east of the Study Area towards the Swan Lake valley bottom west of the Study Area. Estimates of the groundwater flow direction and horizontal hydraulic gradient in each aquifer were made using reported static water levels for selected water wells and summarized in the following sections. The spatial distribution and construction date of the wells were considered when selecting the wells used to evaluate the groundwater flow direction and hydraulic gradient in each aquifer.

5.7.1 Aquifer 349

The groundwater flow direction in Aquifer 349 north of BX Creek is inferred to be south to southwest, towards BX Creek, under a horizontal hydraulic gradient of approximately 0.08 m/m. It is inferred that within the BX Creek valley, the groundwater flow direction within the sand and gravel deposits is to the west in the upper portion of the Study Area and then to the southwest in the lower portion of the Study Area, in the direction of the BX Creek valley. The water wells and reported static water levels used to evaluate the groundwater flow direction and hydraulic gradient in Aquifer 349 are summarized in Table 1 below.

WTN	Approximate Ground Surface Elevation (masl)	Approximate Groundwater Elevation (masl)	Source
111907	1006	994	iMapBC
35032	703	679	iMapBC
104005	918	907	iMapBC
57624	788	774	iMapBC

Table 1: Well Information used to evaluate groundwater flow in Aquifer 349

5.7.2 Aquifer 350

The overall groundwater flow direction in bedrock Aquifer 350 is to the southwest, under a horizontal hydraulic gradient of approximately 0.05 m/m, assuming that fractures intersected by wells completed in Aquifer 350 are sufficiently interconnected. It is noted that several wells were completed at relatively greater depths within Aquifer 350, including WTN 112011 to a depth 152 mbgs and WTN 116458 to a depth of 195 mbgs. Reported static water levels at these deep wells were lower than those reported for surrounding wells that were completed at shallower depths in Aquifer 350, indicative of a downward hydraulic gradient in the bedrock (i.e., groundwater within the shallow bedrock fractures is inferred to be recharging bedrock fractures at depth). The water wells and reported static water levels used to evaluate the groundwater flow direction and hydraulic gradient in Aquifer 350 are summarized in Table 2 below.

WTN	Approximate Ground Surface Elevation (masl)	Approximate Groundwater Elevation (masl)	Source
112011 (deep well)	735	703	iMapBC
112012	628	610	iMapBC
112071	638	630	iMapBC
116465	714	696	iMapBC
116458 (deep well)	711	668	iMapBC
111917	710	664	iMapBC
111918	697	675	iMapBC
82618	757	722	iMapBC
63251	639	629	Golder, 2004

5.7.3 Aquifer 351

The overall groundwater flow direction in bedrock Aquifer 351 is to the west and southwest under a horizontal hydraulic gradient of approximately 0.10 m/m, assuming that fractures intersected by wells completed in Aquifer 351 are sufficiently interconnected. The water wells and reported static water levels used to evaluate the groundwater flow direction and hydraulic gradient in Aquifer 351 are summarized in Table 3 below.

WTN	Ground Surface Elevation (m)	Groundwater Elevation (m)	Source
109889	723	689	іМарВС
109890	691	676	іМарВС
109891	699	687	іМарВС
109892	722	716	іМарВС
113890	683	652	іМарВС
113891	582	554	іМарВС
111951	845	766	іМарВС
113935	581	562	іМарВС
50008	848	844	Western Water, 2012
37988	859	819	іМарВС
49632	657	648	Western Water, 2017
104171	1004	998	іМарВС

Table 3: Well Information used to evaluate groundwater flow in Aquifer 351

5.8 Aquifer Water Levels

5.8.1 MoE Observation Well OW322

MoE Observation Well OW322 (WTN 60266) is located in the Wallace Subdivision, in the central portion of the Study Area, and is completed in Aquifer 349. OW322 is completed in a thin, confined, water-bearing sand and gravel layer between 29.9 mbgs and 30.8 mbgs. According to Wei (1991), this is the area of Keddleston where the till deposits are thickest. Water levels in this well were monitored from 1993 to 2003 (see Figure D below); and the water level trends from this period were discussed in detail in Golder's 2007 Study. Golder's 2007 study reported that during the period from 1993 to 2003, the water level in the aquifer increased by approximately 2 m, with seasonal fluctuations ranging from 0.5 m to 1 m. The seasonal changes were considered small and inferred to likely not affect well production in this aquifer. There was no apparent correlation between the below-normal precipitation observed in 2000 and 2001, as water levels in OW322 continued to increase in 2000 and 2001. However, it may be possible that the lag time for declining water levels in the aquifer to manifest may have been longer than 2 years and further monitoring of this well beyond 2002 would have provided further information. It appears that water levels in OBS Well 322 become flowing artesian after circa 2000. At this time, the cause of the water level rise is not known.



OBS WELL 322 - VERNON (FALCON RD.) SILVER STAR MTN

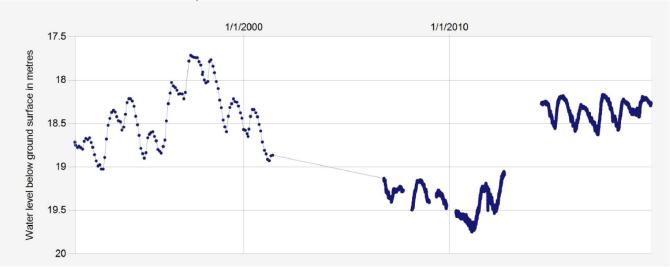
Figure D. Water levels in MoE Observation Well OW322 (MoE 2019).

5.8.2 MoE Observation Well OW311

MoE Observation Well OW311 (WTN 59305) is located on Keddleston Road, immediately north of Silver Star Road, in the central portion of the Study Area. OW311 is completed in bedrock Aquifer 351 to a depth of 93.6 mbgs. Water levels in this well were first monitored in 1991 and continue to be monitored today (see Figure E below). The data indicate that water levels in the bedrock aquifer are correlated with seasonal precipitation, with decreasing water levels occurring over the drier summer through early winter months and increasing water levels occurring over the wetter spring months. Decreasing water levels over the summer months are likely correlated with summer peak demand period. It is noted that water levels generally recover to within 0.1 m of the previous year's peak level.

It is apparent that water level changes have been more significant in OW311, which is completed within the bedrock aquifer, as opposed to OW322, which represents levels in the sand and gravel aquifer. The relatively larger fluctuations in the bedrock aquifer may reflect the lower storage capacity of bedrock.

In both observation wells, the observed changes do not appear to be related to a cumulative increase in pumping in the area, as water levels correlate with seasonal precipitation trends and recover to a relatively consistent high water level annually.



OBS WELL 311 - VERNON (KEDDLESTON RD.) BX CREEK



5.9 Annual Water Balance

Golder developed a water balance for the Study Area using published mean groundwater recharge rates for the Study Area and estimated groundwater extraction rates for well users in the Study Area and in the upstream catchment area to the northeast of the Study area. The following assumptions have been applied in the development of the water balance:

- groundwater recharge within the Study catchment area is primarily via infiltration of precipitation and snow melt to the subsurface, and precipitation and snowmelt from the entire catchment area is available for recharge of the aquifers in the Study Area
- water that recharges the higher elevation portions of the bedrock aquifers is available for extraction in lower elevation areas (i.e., a portion of the recharge does not report to a deeper regional flow regime)
- the published groundwater recharge rates have considered evapotranspiration and overland flow, and these parameters have not been further assessed in this study
- groundwater availability in the Study Area aquifers is available from the perspective of a water balance and does not consider environmental flow needs (EFNs) in surface water bodies
- there are a total of 495 developed residential properties within the Study Area. It is assumed that of the 495 developed residential properties, 25 of the developed residential properties in the area of Aspen Road and Jackpine Road obtain their water from the Aspen Water Utility and not via single private water wells. However, for water balance estimates made in this study, it has been assumed that the water usage at each residential property serviced by the Aspen Water Utility is similar to that used by a residential property with a single private water supply well. It is further assumed that the domestic and agricultural/irrigation water demands of the approximate 88 properties in the southwest corner and along the west side of the Study Area are serviced by GVW and that these properties do not operate private water supply wells. The domestic

and agricultural/irrigation water usage estimates for these approximate 88 properties are therefore not included in the water balance estimates.

- as only 309 registered wells are shown on the provincial database, an inference was made with respect to the distribution of the inferred current number of wells within the Study Area aquifers, based on the relative percentage of registered water wells within each aquifer. Additionally, at full build (assuming no lot subdivisions), a similar inference based on relative percentage of registered water wells was made with respect to the distribution of 636 wells within the Study Area aquifers
- as BX Creek is a gaining stream within the Study Area, leakage from the stream into the underlying aquifers is considered negligible; this is a conservative assumption with respect to a groundwater balance
- groundwater extraction by upgradient groundwater users within the upper catchment area is inferred to reduce recharge to the BX Creek topographic catchment area. Upgradient groundwater users include 12 residential lots in the Lander Road area and the Sovereign Lake ski resort near the top of the BX Creek catchment area. Groundwater extraction from the wells operating at the Silver Star ski resort are not considered in the estimates as they are generally inferred to be located outside the Study catchment area
- groundwater is currently being extracted for agricultural purposes in the ALR-zoned lands and used to irrigate all of the ALR-zoned lands. For comparison purposes, lower-bound scenarios have been included where groundwater is used to irrigate half of the ALR-zoned lands. Properties within the ALR-zoned lands that have a service connection with GVW (i.e., one property in the Dixon Dam Road area and a number of properties along the west side of the Study Area) have been excluded from the water balance estimates, as it is inferred that these properties obtain agricultural irrigation water from GVW and not private water supply wells.
- groundwater is not currently being extracted for water bottling purposes from bedrock Aquifer 350 in the Dixon Dam Road area.

5.9.1 Annual Groundwater Recharge Estimates

For the water balance, a mean recharge rate of 20 mm/year was used to represent the rate that precipitation recharges the subsurface in the northwest topographic catchment area; and a mean recharge rate of 30 mm/year was used to represent the rate that precipitation recharges the subsurface in the BX Creek topographic catchment area. The recharge rates were based on research conducted by Smerdon et al. (2009) in the BX Creek watershed, where a MIKE-SHE numerical model was developed to assist in predicting groundwater recharge in mountainous terrain. The study area in Smerdon et al. (2009) included the entire BX Creek watershed, from Silver Star Provincial Park at its upper extent to the valley bottom surrounding Swan Lake at its is lower extent; however, the focus of their study generally corresponded with the extents of the combined Study Area and catchment area defined in this study. Smerdon et al. (2009) found that within the BX Creek watershed, the groundwater recharge rate ranged from 0 mm/year to 20 mm/year at lower elevations (i.e., valley bottom) and increased with elevation in the upland areas to rates of 20 mm/year to 50 mm/year at the top of the watershed in Silver Star Provincial Park. The approximate mean recharge rate for the BX Creek watershed was 35 mm/year (Smerdon et al. 2009). It is noted that the current Study Area is not located within the area of the lower recharge rates presented by Smerdon et al. (2009) (i.e., not located within the area identified with recharge rates of 0 mm/year to 20 mm/year).

Although the Study Area and catchment area defined in this study are predominantly located in the upland regions of the BX Creek watershed, slightly lower mean recharge rates of 20 mm/year and 30 mm/year were used in this study, as follows:

- The northwest topographic catchment area lies within the lower range of recharge rates assessed by Smerdon et al. (2009) for the upland areas; thus, a recharge rate of 20 mm/year was used for the northwest topographic catchment area.
- The BX Creek topographic catchment area lies within the middle to high range of recharge rates assessed by Smerdon et al. (2009); however, the catchment area in this study did not include the entire upland area assessed by Smerdon et al. (2009). Thus, a conservative recharge rate of 30 mm/year was used for the BX Creek topographic catchment area.

The recharge rates of 20 mm/year and 30 mm/year are slightly lower than, but in general agreement with, the estimated annual groundwater recharge rate for the Okanagan Basin of approximately 7% of annual precipitation (Summit 2009), using the total annual precipitation at the Vernon North weather station of 487 mm (Environment Canada Climate Normals, 1981 - 2010; EC 2019b) over a total catchment area of 6,442.4 hectares (ha). The recharge rates of 20 mm/year and 30 mm/year also fall within the range of precipitation infiltration rates assessed in Golder-Summit (2009), where the percentage of the total annual precipitation anticipated to infiltrate into an aquifer ranges from 5% at lower elevations (i.e., where the approximate centroid elevation of the aquifer is less than 350 m) to 20% at higher elevations (i.e., where the approximate centroid elevation of the aquifer is greater than 800 m). It is also noted that in Golder (2007), approximately 4% of the mean annual total precipitation of 487 mm, or 19.4 mm/year, was used to represent the rate at which precipitation recharges groundwater. This rate of 19.4 mm/year is in line with the recharge rate of 20 mm/year that was used in this study for the (lower elevation) northwest topographic catchment area; and approximately 65% of the recharge rate of 30 mm/year that was used in this study for the (higher elevation) BX Creek topographic catchment area. It is inferred that application of a groundwater recharge rate of 4% of mean annual total precipitation to the Study Area may be underestimating the recharge of precipitation to groundwater within the higher elevation catchment area. Given that site-specific recharge rates were developed for the BX Creek watershed by Smerdon et al. (2009), recharge rates of 20 mm/year and 30 mm/year for the Study Area and catchment areas are more aligned with the research conducted by Smerdon et al. (2009) and have therefore been used in this study.

The distribution of recharge between areas in-filled with alluvium and the local surrounding bedrock areas is unclear; however, as in Smerdon et al. (2009), it is inferred that within the BX Creek catchment area the majority of infiltration (approximately 74%) is concentrated in the alluvium sand and gravel aquifer (Aquifer 349) and the remaining 26% of infiltration recharges the underlying and adjacent bedrock aquifers (Aquifers 350 and 351). In the northwest catchment area, it is assumed that 100% of infiltration is available for recharge to the bedrock system. Based on the geological setting and to allow for comparison of recharge to Aquifer 350 relative to that of Aquifer 351, it is inferred that the portion of the BX Creek catchment area located south of BX Creek provides the majority of recharge to the bedrock system south of BX Creek (i.e., to Aquifer 350), while the portion of the BX Creek (i.e., to Aquifer 350).

5.9.2 Annual Groundwater Extraction Estimates

Without local metering, or an accurate account of how many water wells are in use in the Study Area, it is difficult to quantify the total annual groundwater use in the Study Area. However, groundwater extraction estimates were made using the following sources and assumptions:

- The Study Area is predominantly zoned for residential land use, as per the RDNO's zoning map and an examination of aerial imagery (GoogleEarth, 2018 imagery). Lower-bound and upper-bound estimates of potential groundwater use were estimated as follows:
 - A lower-bound approximation of the annual extraction rate for residential properties was estimated based on an average water use of 0.675 m³/per person/day (OBWB 2009); the average water use of 0.675 m³/per person/day includes an average indoor residential use of 0.15 m³/day and a year-round average outdoor residential landscaping use of 0.525 m³/day/person (OBWB 2009). Assuming an average number of persons per household of 2.6 (Census 2016; North Okanagan Electoral Area C), the lower-bound approximation of groundwater extraction was estimated to be 1.76 m³/day.
 - An upper-bound approximation of the annual extraction rate for residential properties was estimated based on the RDNO's proof of water requirement of 6.55 m³/day per lot (RDNO 2013). It is understood that this proof of water requirement is intended to provide assurance that adequate water is available for residential properties at the time of development and is higher than the anticipated water use.
- Using the online BC Agriculture water calculator (http://www.bcagriculturewatercalculator.ca/), it is estimated that for each 1 ha of agricultural land irrigated over a period of 140 days per year within the Study Area, the total annual irrigation water demand is approximately 1,918 m³/year/ha (5.25 m³/day/ha), assuming a forage crop, loam soils and sprinkler irrigation system.
- Groundwater extraction by upgradient groundwater users within the upper catchment area is inferred to include 12 residential properties in the Lander Road area that use groundwater at the lower- and upper-bound rates discussed above. Additionally, it was assumed that total groundwater use at Sovereign Lake ski resort was approximately 54 m³/day (10 USgpm), representing water used in the lodge washrooms (there is no restaurant or overnight accommodations available at the lodge).

5.9.3 Water Balance Scenarios and Estimates

Table 4 summarizes the input (recharge from precipitation) and output (groundwater use for domestic and irrigation purposes) parameters for the Study Area aquifer, and Table 5 provides different scenarios with respect to the potential groundwater availability in each aquifer within the Study Area. Groundwater potential is discussed in Section 6.0.

Table 4: Summary of Water Balance Estimates for Study Area

Parameter	Valu	e / Unit	Valu	ie / Unit	
BX Creek topographic catchment area (including south end of Study Area)		5,583		ha	
Northwest topographic catchment area (northwest portion of Study Area)	of Study Area) 859 ha				
Total Catchment Area	6,442 ha				
Recharge Rates (Infiltration of Precipitation/Snowmelt)					
BX Creek topographic catchment area (including south end of Study Area)	30 BX Creek topographic catchment area (including south end of Study Area)				
Northwest topographic catchment area		20	mm/year		
Groundwater Extraction Estimates (Upstream Catchment Area)	Lower-Bou	nd Estimates		Upper-Bound Estimates	
Groundwater extraction from upgradient groundwater users (in upstream catchment area)	75	m ³ /day	133	m ³ /day	
Groundwater Recharge Estimates					
Groundwater Recharge available to aquifers within the Study Area	4,927	m ³ /day	4,985	m ³ /day	
Groundwater Recharge to Aquifer 349 (assumes 74% of recharge rate infiltrates Aquifer 349 over the BX Creek topographic catchment area)	3,297	m ³ /day	3,340	m³/day	
Groundwater Recharge to Aquifer 350 (assumes 26% of recharge rate infiltrates Aquifer 350 over the BX Creek topographic catchment area – South of BX Creek)	424	m³/day	430	m³/day	
Groundwater Recharge to Aquifer 351 (assumes 26% of recharge rate infiltrates Aquifer 351 over the BX Creek topographic catchment area – North of BX Creek; and 100% of recharge rate infiltrates Aquifer 351 over the northwest catchment area)	1,205	m³/day	1,215	m ³ /day	
Groundwater Extraction Estimates (within Study Area)	Lower-Bound Estimates		Upper-Bound Estimates		
Average Residential Water Use per Household over Study Area	1.76	m ³ /day	6.55	m ³ /day	
Agricultural Irrigation – Aquifer 349	127	m ³ /day	255	m ³ /day	
Agricultural Irrigation – Aquifer 350	183	m ³ /day	366	m ³ /day	
Agricultural Irrigation – Aquifer 351	272	m ³ /day	544	m ³ /day	

Table 5: Summary of Water Balance Scenarios for Study Area

Parameter	Valu	e / Unit	Valu	ıe / Unit
	Lower-Bound Groundwater		Upper-Bound Groundwater	l Estimates of Withdrawal
Water Balance Scenarios (Aquifer 349)				
Groundwater withdrawal, assuming 135 wells pumping at current scale of development	364	m³/day	1,139	m³/day
- Percentage of water withdrawn relative to groundwater recharge	11	%	35	%
Groundwater withdrawal, assuming 175 wells pumping at full buildout	434	m³/day	1,401	m³/day
- Percentage of water withdrawn relative to groundwater recharge	13	%	42	%
Water Balance Scenarios (Aquifer 350)				
Groundwater withdrawal, assuming 85 wells pumping at current scale of development	332	m³/day	922	m³/day
- Percentage of water withdrawn relative to groundwater recharge	77	%	217	%
Groundwater withdrawal, assuming 110 wells pumping at full buildout	376	m³/day	1,086	m³/day
- Percentage of water withdrawn relative to groundwater recharge	87	%	256	%
Water Balance Scenarios (Aquifer 351)				
Groundwater withdrawal, assuming 187 wells pumping at current scale of development	600	m ³ /day	1,769	m³/day
- Percentage of water withdrawn relative to groundwater recharge	49	%	147	%
Groundwater withdrawal, assuming 263 wells pumping at full buildout	734	m ³ /day	2,267	m³/day
- Percentage of water withdrawn relative to groundwater recharge	60	%	188	%

Based on the review of available hydrogeological information for the Study Area and the water balance estimates provided above, the following inferences regarding groundwater availability in the Study Area can be made:

- The net water balance for the Study Area suggests that, in general, within the Study Area extents, bedrock Aquifer 350 has the least capacity for further development, followed by bedrock Aquifer 351 and, to a lesser degree, sand and gravel Aquifer 349.
- Under the lower-bound scenarios (i.e., average water use and irrigation of half of the ALR-zoned lands), the percentage of groundwater that is withdrawn from each aquifer relative to the estimated recharge to each aquifer is significantly lower than the upper-bound scenario (i.e., RDNO proof-of-water water use and irrigation of all of the ALR-zoned lands).
- The water balance estimates appear to be sensitive to the residential water use value utilized in the estimates. When the lower-bound average residential water use value of 1.75 m³/day is used, a net positive water balance is obtained; however, when the upper-bound RDNO proof-of-water value of 6.55 m³/day is used, a net negative water balance is obtained for bedrock aquifers 350 and 351. It is recognized that the RDNO proof-of-water value is more than three times higher than the average residential use value; however, as this is the rate that future developments in the Study Area are required to prove to the RDNO prior to development or subdivision, as applicable, the upper-bound value is considered to be a relevant value for considerations of groundwater potential for future development.
- The water balance estimates appear to be sensitive to the agricultural water use factor. Refinement of the irrigation values for the ALR-zoned lands and other agricultural lands in the Study Area would help to better constrain assessment of the groundwater availability and groundwater potential in the Study Area.
- The net water balance estimates can be further refined for each aquifer by confirming the total number of groundwater well users in each of the aquifers.

6.0 DISCUSSION OF GROUNDWATER POTENTIAL

Based on the results of the relative water balance estimates provided in Table 4. Golder assigned the following risk ratings to the aquifers in the Study Area as follows:

- Sand and gravel Aquifer 349 has a low to medium risk with respect to groundwater availability (i.e., current predicted groundwater withdrawals are less than half of the estimated recharge to the aquifer under the lower- and upper-bound scenarios).
- Bedrock Aquifer 351 has a medium to high risk with respect to groundwater availability; however, is dependent on the residential water use and extent of irrigation on lands overlying Aquifer 351. When the lower-bound estimates of residential water use and irrigation use are applied to the water balance in Aquifer 351, approximately 49% and 60% of water is predicted to be withdrawn from the aquifer relative to groundwater recharge, based on the current scale of development and full buildout, respectively. However, when the upper-bound estimates of residential water use and irrigation use are applied, approximately 147% and 188% of water is predicted to be withdrawn from the aquifer recharge, based on the current scale of development and irrigation use are applied, approximately 147% and 188% of water is predicted to be withdrawn from the aquifer relative to groundwater recharge, based on the current scale of development and full buildout, respectively; these results are indicative that at the higher extraction rates more water is withdrawn from the aquifer than is being recharged. Bedrock Aquifer 350 has a high risk with respect to groundwater availability under both the lower- and upper-bound scenarios. When

the lower-bound estimates of residential water use and irrigation use are applied to the water balance in Aquifer 350, approximately 77% and 87% of water is predicted to be withdrawn from the aquifer relative to groundwater recharge, based on the current scale of development and full buildout, respectively. However, when the upper-bound estimates of residential water use and irrigation use are applied, approximately 217% and 256% of water is predicted to be withdrawn from the aquifer relative to groundwater recharge, based on the current scale of development and full buildout, respectively; indicative that more water is withdrawn from the aquifer than is being recharged.

The results illustrate that groundwater availability is interpreted to be relatively higher in Aquifer 349, in the central portion of the Study Area; however, these results are general and do not necessarily reflect local scale factors. Based on the overall water balance results by aquifer, the potential for groundwater development in Aquifer 349 is generally considered to be feasible throughout the aquifer; but may be limited by aquifer thickness and/or lack of presence of the aquifer deposits in some locations. Bedrock Aquifer 350 is considered to have limited to no capacity for groundwater development, except potentially in the areas of Dixon Dam Road, along the south central boundary of the Study Area and Ranch Road, at the south end of the Study Area. Water balance estimates for Aquifer 350 show that even at the lower-bound groundwater usage values, groundwater use in Aquifer 350 is estimated to be similar to the predicted recharge. The potential for groundwater development in Aquifer 351 is generally considered to be limited; however, there are areas at the bottom (west) end of the aquifer that may have potential to supply groundwater to future developments in that part of the Study Area. As stated above, the current study is intended to assess overall groundwater development potential at the regional scale; a long-term sustainable groundwater supply at individual well locations and the potential for well interferences would need to be assessed with appropriately-designed pumping tests.

7.0 CONCLUSIONS

Based on the results of the current groundwater study, the following conclusions are made in the relation to the five questions posed by the RDNO regarding future water supply for Keddleston:

1) Can future development occur with individual wells without impacting neighbouring properties or the entire area water supply?

In general, within the Study Area extents, sand and gravel Aquifer 349 is considered to have a higher relative potential to supply future development to individual properties compared to Aquifers 350 and 351. Based on domestic pumping rates and the hydrogeological properties of the sand and gravel aquifer, it is likely that relatively small domestic groundwater extraction rates from individual wells would not have an impact on neighbouring properties, and less of an impact on the entire water supply in Aquifer 349.

It is inferred that bedrock Aquifer 351 may have limited potential for further development, while bedrock Aquifer 350 is estimated to have very limited to no capacity for further development. However, there are areas within Aquifers 350 and 351 where the potential for future residential development may be greater. Although there are many undeveloped areas within the Study Area where a water supply has not been established, water balance estimates show that groundwater use in Aquifers 350 and 351 is estimated to be similar or greater to the predicted recharge, particularly if ALR-zoned lands are being irrigated and/or if large capacity wells are in use (i.e., at the water bottling facility).

A detailed hydrogeological assessment would be required on a lot-by-lot basis to confirm groundwater availability, sustainability and potential well interference between neighbouring well users, and to assess EFN in nearby surface water bodies.

2) Is there a spatial consideration to allow for individual wells?

See response in Question 1.

3) Can a community water system within the study area be supported by either an individual well or a number of wells within one or more aquifers?

As discussed above, sand and gravel Aquifer 349 appears to have a higher relative potential for further development, and a community water system servicing a limited number of lots may be feasible in this aquifer. However, the thickness and presence of the sand and gravel aquifer varies across the Study Area, and this variability may limit the areas available for development of a community water system. Furthermore, it is recommended that refinements be made to the water balance estimates, as recommended in Section 8.0 below, prior to making further estimates of aquifer capacity. A detailed hydrogeological assessment would be required to confirm groundwater availability, sustainability and potential well interference between neighbouring well users, and to assess EFN in nearby surface water bodies.

Although one or more wells could potentially be developed in the bedrock aquifers at locations that intersect productive bedrock fractures resulting in high well yield(s), based on the water balance estimates for Aquifer 350 and 351, development of a community water system in these aquifers is not considered to be feasible.

4) If a community water system is an available option, what is the estimate of sustainable growth based on a preliminary estimate of the capacity available?

Based on the water balance estimates for Aquifer 349, approximately 13% and 42% of water is predicted to be withdrawn from Aquifer 349 relative to groundwater recharge, based on full buildout under the lowerbound and upper-bound scenarios, respectively. It is inferred that sustainable growth in terms of groundwater supply in Aquifer 349 may be feasible up to at least full buildout (i.e., approximately 175 lots) within the extents of Aquifer 349. As indicated above, a detailed hydrogeological assessment would be required on a lot-by-lot basis to confirm groundwater availability, sustainability and potential well interference between neighbouring well users, and to assess EFN in nearby surface water bodies within the extents of Aquifer 349.

5) What are other available options with respect to supplying a community water system?

Drillers interviewed as part of this study noted that wells with higher yields may also be present further east (outside) of the Study Area, in the Forsberg Road area and at the first hairpin turn on Silver Star Road.

Within the Study Area, there are a number of wells registered to Clearly Canadian Beverage and Pure Canadian Water Ltd. It is not known at this time whether the wells are currently in use. If not, and depending on the water quality, long-term sustainable well yields and potential for well interferences during pumping, as well as the transfer of well ownership, these wells may be a potential option for consideration as a community water source by the RDNO. However, these wells are completed in Aquifer 350, where water balance estimates prior to accounting for pumping of these wells at the (high) rates required to supply large amounts of water predict that groundwater use exceeds groundwater recharge.

Other options with respect to supplying a community water system include connection to nearby existing water systems outside of the Study Area.

8.0 RECOMMENDATIONS

If the RDNO intends to assess the potential for development of a community water supply in the study area, based on the results of this groundwater study it is recommended that the following parameters used in the water balance estimates for the Study Area be refined:

- groundwater extraction by upgradient groundwater users.
- groundwater use for agricultural purposes in the ALR-zoned lands and other agricultural properties within the Study Area.
- groundwater extraction for commercial operations, such as for water bottling purposes.
- whether properties serviced by GVW for domestic and/or agricultural purposes also operate private water supply wells.
- total number of groundwater well users in the Study Area; this can be completed by conducting a detailed well survey of the Study Area (the results of the well survey would assist in understanding the distribution of wells in each aquifer).
- relative contribution of stream leakage, if any, to the Study Area aquifers and whether stream leakage, particularly into Aquifers 350 and 351, may increase the available groundwater in these aquifers; for the purposes of the water balance, it has been assumed that stream leakage to the aquifers is negligible, and therefore, no additional water from stream leakage was added to the aquifer recharge component in the water balance estimates.

A geological study could also be undertaken to identify major fracture zones in the bedrock within the Study Area, particularly along the BX Creek valley between Aquifer 350 to the south and Aquifer 351 to the north, to aid in locating potential sites for the construction of higher yielding bedrock wells.

If development of one or more groundwater supply wells within the Project Area are not considered feasible to supply a community water supply system, consideration could also be given to investigating the potential of water supply sources outside of the Study Area, including to the immediate east of the Study Area (near Forsberg Road) if future growth will result in an increase in water demand. However, further groundwater development in upgradient areas is expected to impact the water balance and the groundwater that is available in downgradient (lower elevation) portions of the Study Area.

9.0 LIMITATIONS

This report was prepared for the exclusive use of the Regional District of North Okanagan. The assessment was performed according to current professional standards and practices in the groundwater field and has been made using historical and technical data obtained from the sources noted within this report. Except where specifically stated to the contrary, the information contained in this report (including reports, information and data) was provided to Golder Associates Ltd. (Golder) by others and has not been independently verified or otherwise examined by Golder to determine its accuracy or completeness. Golder has relied in good faith on this information and does not accept responsibility of any deficiency, misstatements or inaccuracies contained in the report as a result of omissions, misinterpretation and/or fraudulent acts of the persons interviewed or contacted, or errors or omissions in the reviewed documentation. We accept no responsibility for any deficiency, misstatement or fraudulent acts of persons interviewed or contacted.

The services performed as described in this report were conducted in a manner consistent with the level of care and skill normally exercised by other members of the engineering and science professions currently practising under similar conditions, subject to the time limits and financial and physical constraints applicable to the services. Hydrogeological investigations and the development of conceptual site models are dynamic and inexact sciences. They are dynamic in the sense that the state of any hydrological-hydrogeological system is changing with time, and in the sense that the science is continually developing new techniques to evaluate these systems. They are inexact in the sense that subsurface conditions are not known between the specific investigation locations, and there is invariably a lack of complete information both spatially and temporally about the geological and hydrogeological conditions. The validity and accuracy of the conceptual model depends on the amount of data available relative to the degree of complexity of the geologic formations, the study area hydrogeology, and on the quality and degree of accuracy of the data entered. Therefore, every conceptual model is a simplification of reality and the model described in this report is not an exception.

The content of this report is based on information collected during the study, our present understanding of site conditions, the assumptions stated in this report, and our professional judgement in light of such information at the time of this report. This report provides a professional opinion and, therefore, no warranty is expressed, implied, or made as to the conclusions, advice and recommendations offered in this report. This report does not provide a legal opinion regarding compliance with applicable laws. With respect to regulatory compliance issues, it should be noted that regulatory statutes and the interpretation of regulatory statutes are subject to change.

The findings and conclusions of this report are valid only as of the date of the report. If new information is discovered in future work, or if the assumptions stated in this report are not met, Golder should be requested to re-evaluate the conclusions of this report, and to provide amendments as required.

Any use which third parties make of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Golder Associates Limited accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

10.0 CLOSURE

We trust that this report provides you with the information you require at this time. Should you have any questions or require additional information, please do not hesitate to contact the undersigned.

Golder Associates Ltd.

QNUSNEr

Danielle Wiesner, EIT Environmental Engineer

Reviewed by:

MAK Bolfm

Mark Bolton, MSc, PGeo Associate, Senior Hydrogeologist

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Pana Athanasopoulos, MSc, PGeo Senior Hydrogeologist

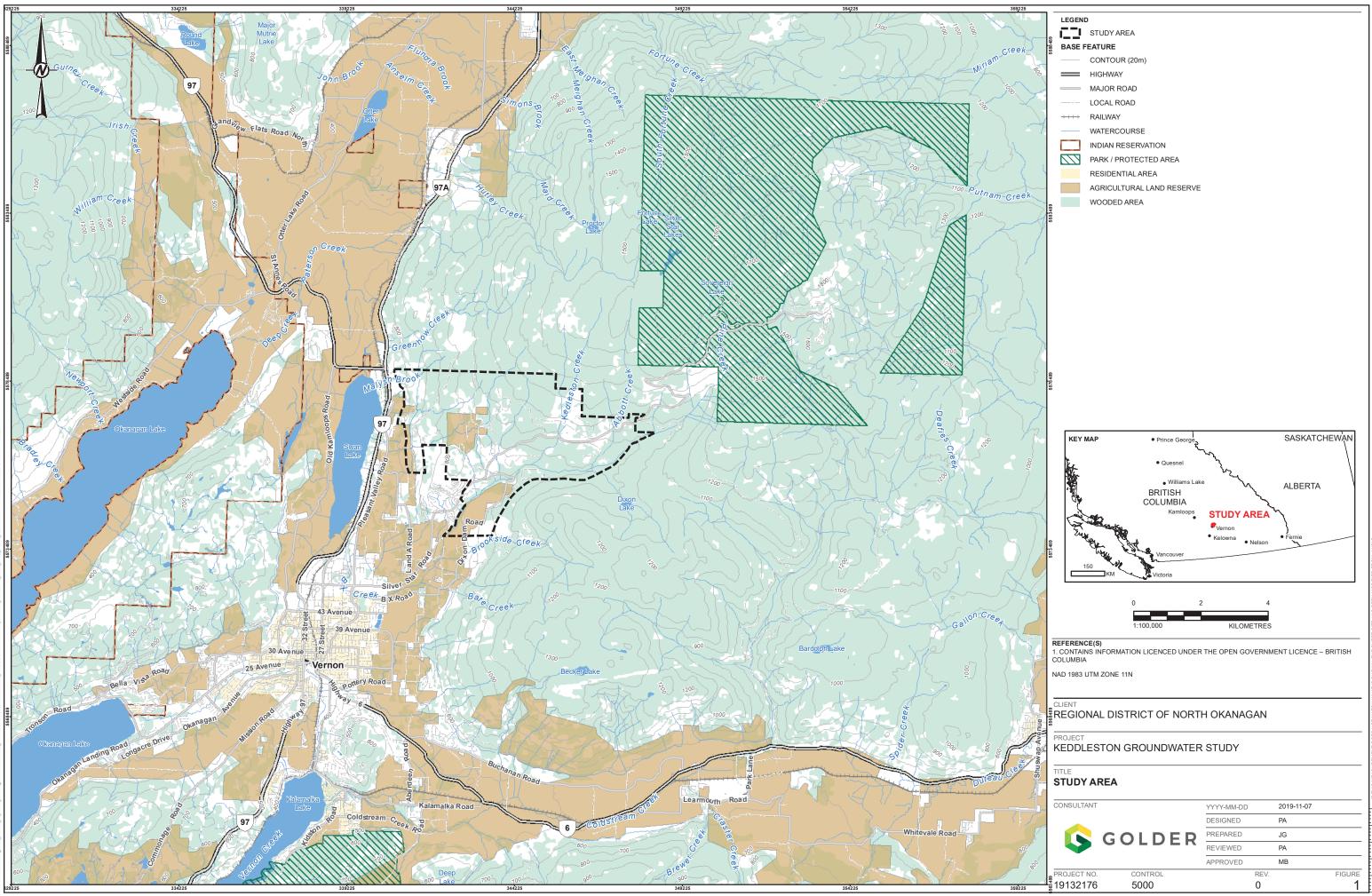
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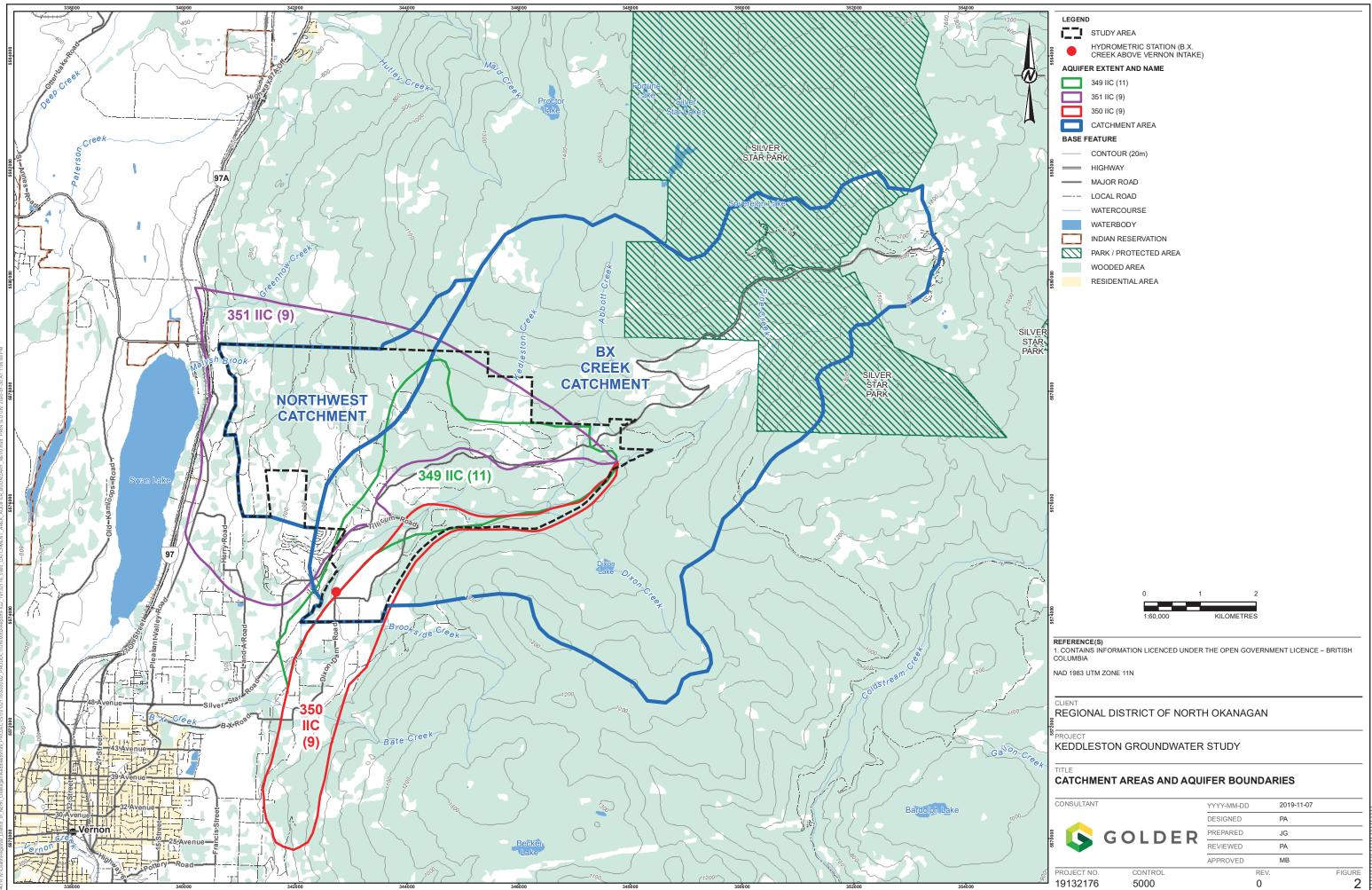
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SOURCES OF INFORMATION

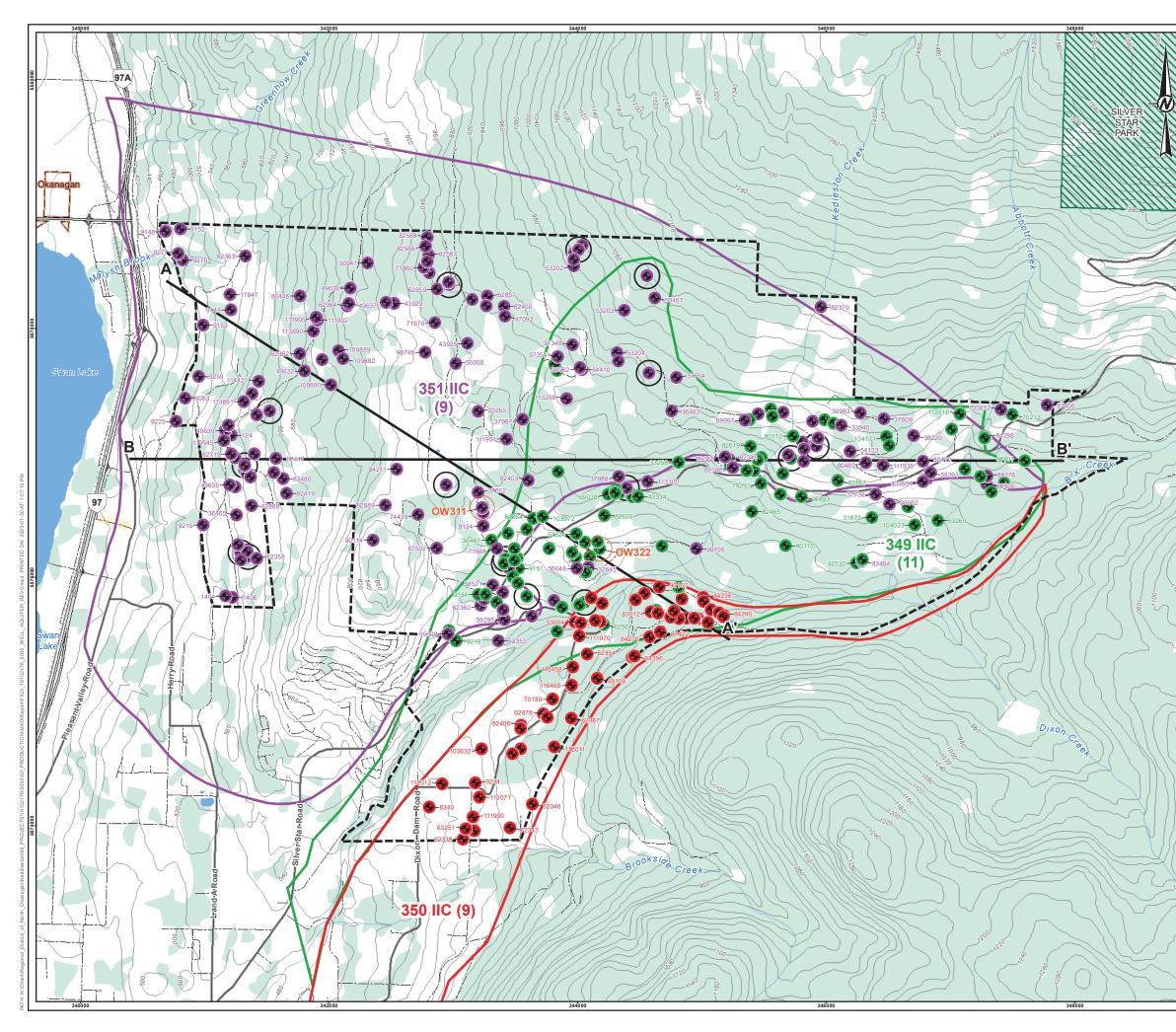
Parameter	Source
Catchment areas	Study Area extents and Parcel Map BC (accessed 2019-12-11) Ministry of Citizens Services – DataBC (https://catalogue.data.gov.bc.ca/dataset/ 4cf233c2-f020-4f7a-9b87-1923252fbc24)
Annual Groundwater Recharge rates	Smerdon et al. (2009)
Average Domestic Water Use per Household (Lot) over Study Area Extents	Average Water Use of 0.675 m3/day: https://www.obwb.ca/wsd/water- usage/residential-water-use 2.6 Person/Household: Statistics Canada; Census Profile, 2016 Census North Okanagan C, Regional district electoral area [Census division], British Columbia Total number of lots in Study Area (636 lots): Study Area extents and Parcel Map BC (accessed 2019-12-11) Ministry of Citizens Services - DataBC (https://catalogue.data.gov.bc.ca/dataset/4cf233c2-f020-4f7a-9b87- 1923252fbc24)
Agricultural Irrigation	Online BC Agriculture Water Calculator (http://www.bcagriculturewatercalculator.ca/)



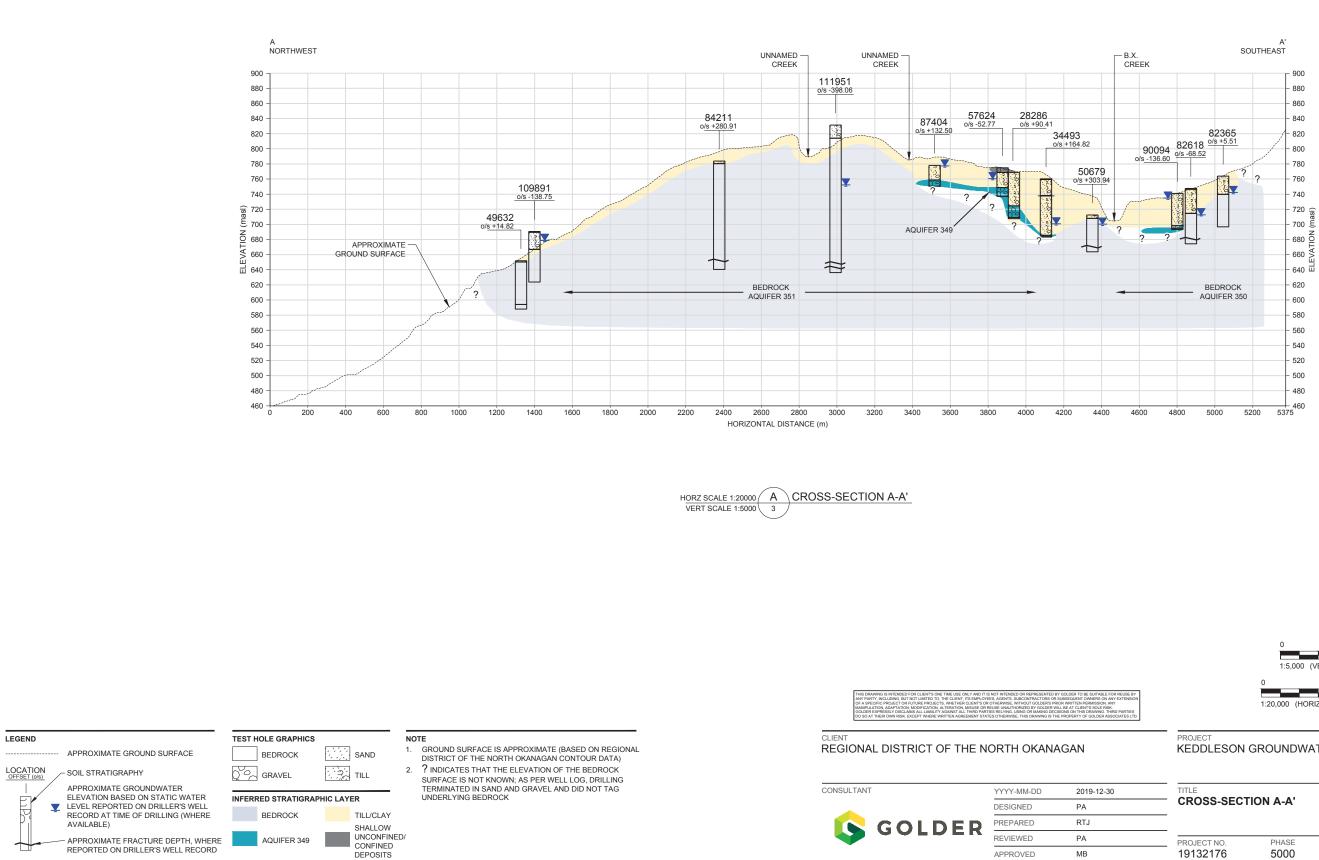
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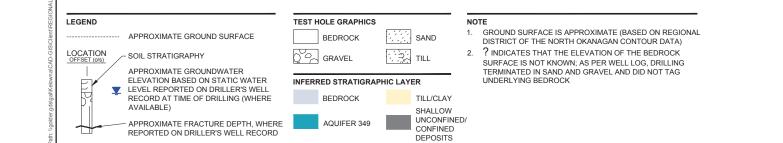


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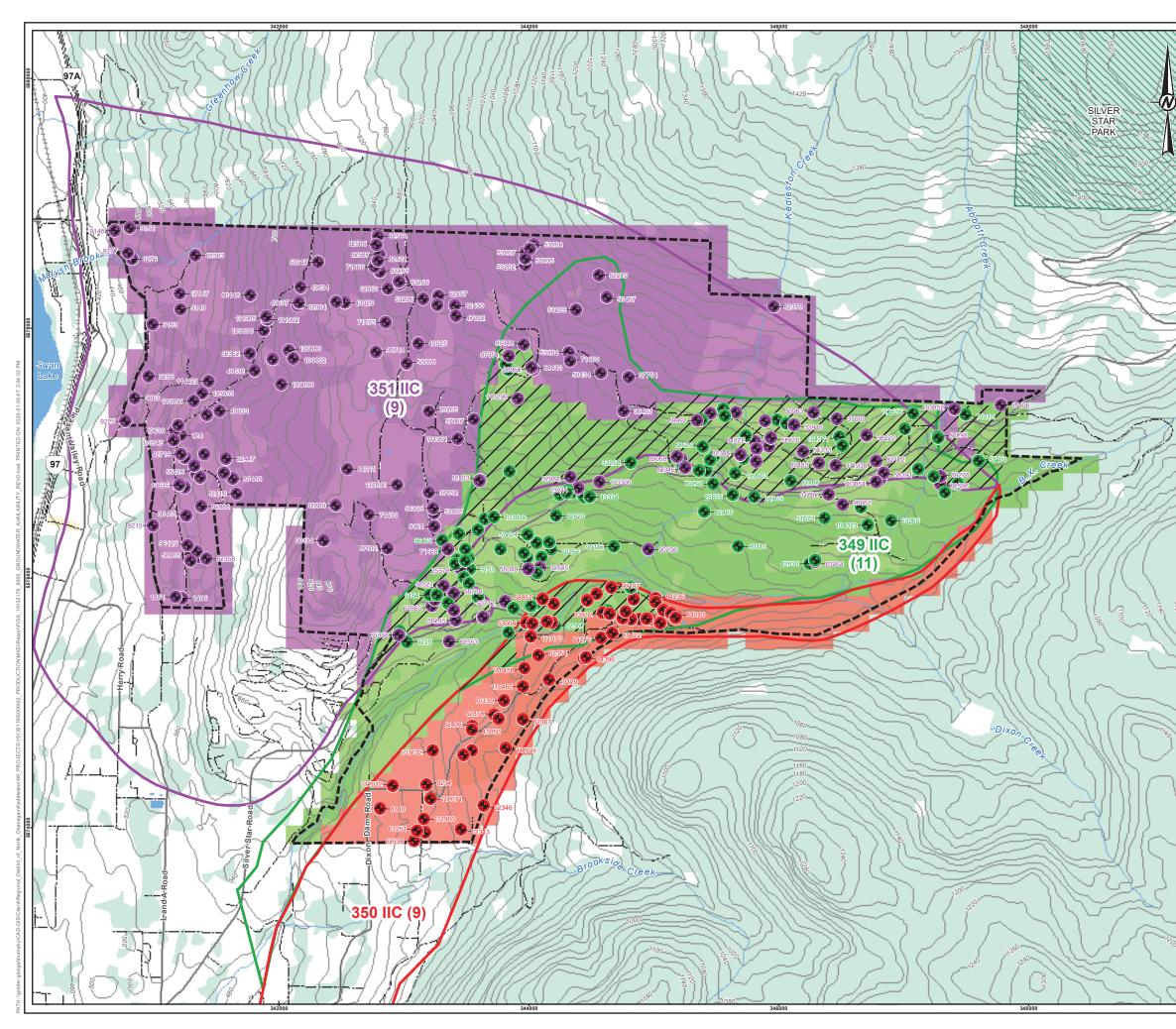


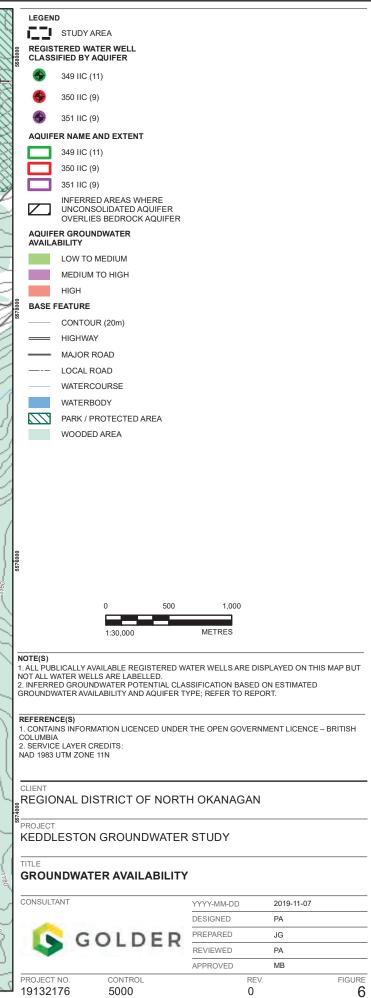


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APPENDIX A

Well Records



OKANAGAN ROTARY WATER WELLS DRILLING

Electric Logging

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Vernon, B.C.

Rock Drilling Testholes

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LOG OF WELL

Address Location Date Well Co Total Depth Static Level Screen	Ver Ver mpleted to Bott from S	Sec. 2 non. B Jun om of W urface	e 25th - 1973 ell 50 feet 15,24 cm	
THICKNESS	FROM		FORMATION FOUND IN EACH STRATUM Rock and gravel in light brown clay	1,22m
122241	01			TRANSFORMEN, SELECTION OF AN AND AND AND AND AND AND AND AND AND
853 281	4'	321	Big rocks and gravel in silty brown clay.	9,75 m
1,52 51	32'	37'	Big rocks and gravel in greyish clay.	11, 28m
3,961131	.37'	50'	Sandy gravel. (water)	15,24m
			Took out 5 1/2 Gals a minute by air lift.	
Remarks:			·····	
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大学	K			imen	t Water Management Division
****	P C	OLUMBIA WATER	R	WE	LL RECORD Dote 0,60,12,3
NTO		0821035113	WELL	L No.	ELEV Location
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Owners	Name	B Address RALPH RALFKI	NT2	FL .	7766 CHEW RD VERMON B.C. V1B 3NG
Legal D)escrip	tion & Address LOT.1 PLAN =	#20	5243	2 SEC 19, TWP 5, ODYD
Pil	D# (005-158-265, ROLL	# 13	222	65
Descrip		1 PNew Well 2 Record	and the second second	1222517	9 CASING: 1 2 Steel 2 Galvanized 3 Wood
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ME	тнор	Other			Diameter 6 Ins
3. WAT	TER	1 Domestic 2 Municipal 3 SE4 Comm. & Ind. Other	Irriga	tion	from O ft to \$6 ft
		G ADDITIVES NONE			Thickness 0.198 ins
		EMENTS from 1 Performed level 2 to	op of co	asing	Weight 12.42 Ib/ft
		casing height above ground level		ft.	Pitless unitft 1 above 2 below ground level 1 Image: Commented 3 Image: Threaded 1 Image: Commented 3
FROM ft	TO ft	6. WELL LOG DESCRIPTION		SWL ft	Perforations :
0	17	BROWNCLAY TILL		+2	Shoe(s): YES GINCH
17	18	BOULDERS CREY LLAY TILL	1		Open hole, from to ft Diameter ins Grout :
63	79	GREY SAND & GRAVEL		15 . 1	Grout : IO. SCREEN : 1 Prominal (Telescope) 2 Pipe Size
	-	FINE TO COARSE (DIRTY)			Type 1 Continuous Slot 2 Perforated 3 Louvre
79	90	BROWNSAND AND GRAV	EL		□ Other Material 1 🗗 Stainless Steel 2 □ Plastic □ Other
					Set from <u>36</u> to <u>90</u> ft below ground level
				2	RISER, SCREEN & BLANKS units
-					Length 4 ft Diam. 1 D 5 ins
				1	Slot Size 0.015 ins
					from 86 ft to 90 ft
					Fittings, top KPACKER bottom PLATE
					Gravel Pack
					II. DEVELOPED BY: 1 Surging 2 Jetting 3 Artic 4 Bailing 5 Pumping 0 Other
					12. TEST1 □ Pump 2 □ Bail 3 #Air Date 10.6 10.1 12.3
					Rate 7/5 USgpm Temp C SWL before test ft
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					13. RECOMMENDED PUMP TYPE RECOMMENDED PUMP SETTING RECOMMENDED PUMPING RATE
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					15. WATER ANALYSIS: 1 Hardness mg/L
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ABSOLUTATION OWNER A ACT	G. CONSTRUCTION RECORD
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	Date Completed for 21 / 73
PACIFIC WATER WELLS (1969) LTD. 22314 FRASER HIGHWAY LANGLEY, B.C. Phone 534-8581	Drilling Method Gald Tobl Driller J Loren Helper P Am Comb File North O/K Folio Signed By
LOG OF FORMATIONS	CASING RECORD
Depth Descriptions	Diains. Wt#/ft. Fromto
	Diains. Wt#/ft. Fromto
to	Diains. Wt#/ft. Fromto
144 to 199 ground wale	Shoe Welded Cemented
Id to I and	
19) to 200 Juli	SCREEN RECORD
to pull Boch 194	Make Material
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to	Topft. Bottomft.
to	Fittings Top Fittings Bottom
to	Gravel PackNatural
to	Development Method
to	ROCK WELL DATA
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to	ft. atGPM
to	Bail Test ft. at GPM
to	ft. at GPH Recommended Pump Settingft.
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to	Recommended Max. Pump Output GPM
to	Duration of TestHrs.
to	DUMD DATA
to	PUMP DATA
GENERAL REMARKS	Make Type Model Serial No
	Size HP Drop Pipeins.
	GPM Head ft RPM
	Motor Volts PH
	Well Seal
	Water Analysis — HardnessPPM
	PH IronPPM

A State State State

and the second s

			32104
WATER WELL DRILLING ASSOCIATION	OWNER Crim Keig	G CC	NSTRUCTION RECORD
GROUND WATER BYPELOPMENT	Address	Alter and	
	Well Location Silver		
DACIEIC WATE	Date Started Fel C		Date Completed Fal- 19 175
22314 FR	R WELLS (1969) LTD. ASER HIGHWAY SY, B.C. V3A 4H6	Driller	G Method Colle too A Thomas Helper Philometer O.K. NORTH Folio
Phone	534-8581	Signed	By Follo
LOG	OF FORMATIONS		
Depth _0 to <u>_26</u>			CASING RECORD Diains. Wt#/ft. Fromto Diains. Wt#/ft. Fromto
26 to 27	Anohig Water		Diains. Wt#/ft. Fromto
27 to 80 90 to 80	Till		Shoe Welded Cemented
96 to 90	water Bearing		
to	Dirty grow day		SCREEN RECORD Make Material
to	charles.	1 -1	Slot opening Length
90 to 91	go Bedrock.		Topft. Bottom
to			Fittings Top Fittings Bottom
to	A CARL LADOR OF THE STATE		Gravel PackNatural
to			Development Method
to			ROCK WELL DATA
to			Open Bore HoleDiair
to			Fromft. to
to			PRODUCTION DATA
to	Seal and street in the second second		Static Lough
to			Measured from
to			Pumping Levelft. atGP
to		-	Bail Testft. at GPI
to		6- 192	ft. atGP
to			Recommended Pump Settingf
to			
to			Recommended Max. Pump Output 2. GPM
to	ALACT.		Duration of TestHrs
to	MAR -		PUMP DATA
and the state of the			Make Type
GENER	AL REMARKS	- 20	ModelSerial No
			Size HP Drop Pipe
and the second second			Head ft DDM
	and a set of the set of the set		Motor Volts PH
			Water Analysis — Hardness
Contraction of the Start Start			PH IronPPM

N. C.

33258

OKANAGAN WATER WELL DRILLING LTD.

Electric

Vernon, B.C.

Rock Drilling Testholes

Driller

LOG OF WELL

Address Location Date Well Co Total Depth Static Level	Silv Lot mpleted to Bott from S	2 Seo An om of W urface	<pre>il Roach</pre>
THICKNESS	FROM	TO	FORMATION FOUND IN EACH STRATUM
43'	0'	431	Rock and gravel (dry)
51'	43'	94 '	Till, Big rocks, Gravel and sand in grey clay (silty)
1'	94 '	951	Clean sand streak with water.
4 *	951	991	Silty sand , Mica and some leaves and wood.
4'	99'	103'	Clean sand and gravel.
7'	103'	110'	Silty sand with grass, wood, and mica. Has odor.
91	110'	119'	clean beach sand and gravel.
7'	119'	126'	Till, hard blue clay with gravel.
			This flowed at 5 gals a minute.after 4 hours of developing
		2.16	it decreased to 1 1/2 gals a minute.
	n all in		we took out 20 gals a minute by air lift.
		Section 1	The water has slight odor, This could be coming from
			above. where the wood and mica is.
		1.12	
		9	
4		and the second	
		1.1	
Remarks:	•••••		• • • • • • • • • • • • • • • • • • • •
•••••	•••••		Jahn Huschek

WELL LOC WELL LOC OWNER John Ross and Address Box 1359, Verno	G CONSTRUCTION RECORD
Well Location Wallace Rd.	off Silver Star Rd
Date Started March 8, 1976	Date Completed March 31, 1976
PACIFIC WATER WELLS (1959) LTD. 22314 FRASER HIGHWAY LANGLEY, B.C. PHONE 534-8581	Drilling Method Churn Driller J. Popoff Helper R. Deptford File O.K. North Signed By
LOG OF FORMATIONS	CASING PEODD
Depth Descriptions	CASING RECORD Dia. 6 ins. Wt. 19 #/ft. From 0 to 2
0 to _3_ Gravel	Diains. Wt#/ft. Fromto
3 to 70 till with boulders	
70 to 72 gray, gravelly clay	Shoe_XWelded_XCemented
72 to 74 tight gravel, making	
to a little water	SCREEN RECORD
74 to 139 till with boulders	Make_Johnson Material_S.S.
139 to 245 dense till, some large	Slot opening 30 Length 4 ft.
torocks	Topft. Bottomft
to water bearing	Fittings TopleadpackeFittings Bottomscrew g Gravel PackNaturalX
251 to 253 till	Development Method Bailing
to	
to	ROCK WELL DATA
to	Open Bore HoleDiain
to	Fromft. toft
to	PRODUCTION DATA
to	Static Level195f
to	Measured from ground level
to	Pumping Levelft. atGPN
to	ft. atGPN
to	Bail Testft. at90GPH
to	ft. atGPH
to	Recommended Pump Setting 247 ft
to	Recommended Max. Pump Output 13 GPM
to	
to	Duration of TestHrs
	PUMP DATA
10	MakeType
GENERAL REMARKS	Model Serial No
	Size HP Drop Pipeins.
	GPM Head ft RPM
	MotorVoltsPH
	Water Analysis — HardnessPPM
	PH IronPPM

WATER	WE	LL R	ECOR	RD	Dat		11712 MO	L Y
egal Description & Address			1 and			and a get		
Descriptive Location Merchenten Rd- Ver-	v on	B.C.	N de	Colorado Maria		C. Sk	Margar P	1.2 1
Owners Name & Address D. B. D. Holding S			A. C.	attou a	y ver	non	B.C.	1
	vLL		WEL	L No.	5 (LOT 4	B	
Y Z E		N T M	Date 19					
TYPE 1 S-New Well 2 Incondition OF WORK 3 Incorporation 4 Incorporation	ed	9. CASING		1 🗆 Stee] Galvaniza] Concrete	ed 3 🗆 W	Vood
Cable test O Bored O Lette	d	Mater	IOIS	6 Othe		Concrem	•	unit
METHOD 5 Other b Greir c Oreve		Hole Diameter Diameter	611					ins
3. WATER 1 Domestic 2 Municipal 3 Irriga	ition	from	6.1					ins ft
WELL 4 Commercial & Industrial USE 5 Other Red Rock. Welt.		to Thickness						ft
DRILLING ADDITIVES		Weight						Ib/f
5. MEASUREMENTS from 1 ground level 2 top of c	asing	Pitless unit						
FROM TO 6 WELL LOG DESCRIPTION	SWL	1 Welded Perforations			3 🗆 Threa	ded 4 [New 5	UUsed
0 13 REDUR Tikk + Reck.	Π	(<u>)</u>			A State			
13 YO DARK. Rhere Rock WHITE HA,	rens	Shoe (s): Open hole,	from	to		_ft Dia	meter_6	5 11
40 90 Blen + Green Rock-	1	Grout :			10 10 1	2048-35 6 - 2042 - 1		
90 140 Rhue + WH. Te Kock. 140 170 Soft Blue Kock.		IO. SCREE			2 🗆 Pi of 2 🗆 Pe		3 🗖	Louvre
170 190 SOFT WHITE Rock.	aler.		4 🗆 Oti	her	11 A. 1			10 10 10 10 10 10 10 10 10 10 10 10 10 1
190 210 Hand Dark. Blue Kock.					el 2 🗆 Pl			
19FT of 6" Surface Cass	man		Sec. and	ALL SAME	& BLAI	6	898 ···	unit
	0	Length		Martin E				ft
AT 180ft. 1 gab.p.m-		Diam. I D Slot Size		Constant in			NI STOR	ins
11 188AT. 74 3.p.m.		from	1. 1. 1.	200	1. 1		94. T	ft ft
Phowing 15 grpm.	14	to Fittings	s, top		b	ottom		1 11
		Gravel	and the second second			Mar P.C.		
Chenned + Perchoped.	100	II. DEVEL			Surging Pumping	and the second states of the		6 Air
Rottom of Well 210/	<	I2. TEST			69	Sales prints		1.
	-125		ZJ USg	ipm Tem	pC	SWL be	efore test_	
		TIME in m	terrest of the second		ofh		Contraction of the	RY in
	19982				/L min		mins	WL
			1000	-				
				1.10	Pro St			
		13. RECOMMEND	DED PUMP 1	State St	OMMENDED PUI		ECOMMENDED P	
A Contraction of the second	1	I4.WATER	TYP		780 sh 2 1 sc		clear A	
		15. WATER	R ANA					
Address		2 Iron	1 1					
B.WELL LOCATION SKETCH		4 D No			Fie			
	A CONTRACTOR	ID No					YR MO	DY
16.		WELL CO				9/	15-	USgor
		Water Level						
	Back f		10.15				All a second	
	Well H	ead Completio	on		Sar Las	Contraction of the second	100 M	
	a late	M. Cart					Seler-	1
17.	DRIL PLEASE P	LER		WRNAME		Ri	FIRST NAME	2
A DECEMBER OF THE PARTY OF THE	PLEASE F	Signatur		- J		1.11		A.C.
		Sector Contraction	i segre		S. Sand		All al	
18	. CONT	RACTOR, A	Address					
		Contraction of the second s		Him	y Li	TD.		
		+ W.		Him.	y Li irmi	TD- m 13	. C -	

The Province of British Columbia accepts no responsibility for the contents or accuracy of this record.

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rovince of British Columbia Ministry of Environment Water Management Branch

WATER WELL RECORD Date 811/1/12

Legal Description & Address	VU MO UV
Descriptive Location pachester Rd- Nav	mm R.C.
Owners Name & Address _ D. R. D. Holding	INC. Work Gatheray Vernon B.C.
NTS MAP	WELL No. 7 Com 2 10 2558
I. TYPE 1 - New Well 2 Reconditioned OF WORK 3 Deepened 4 Abandoned	9. CASING: 1 Steel 2 Galvanized 3 Wood Materials 4 Plastic 5 Concrete
2. WORK METHOD 1 Cable tool 2 Bored 3 Jetted 4 G-Rotary a mud b air c reverse 5 Other	e Diameter 6 1 Ins
3. WATER 1 -Domestic 2 Municipal 3 Irrigatio WELL 4 Commercial & Industrial	
4. DRILLING ADDITIVES	Thickness ins Weight Ib/ft
5. MEASUREMENTS from 1 ground level 2 top of casi	ing Pitless unit ft 1 above 2 below ground level
ft ft 0. WELE LOO DESCRIPTION	1 Welded 2 Cemented 3 Threaded 4 New 5 Used WL Perforations:
0 6 Brown Till + Rock. Craw	
6 14 DARK. Blue Rock. Very Crack 14 40 DARK. Blue With Hand	
WHITE LAYERS	Grout:IO. SCREEN: 1 🗆 Nominal 2 🗆 Pipe Size
40 90 Green Rock with whitehas	
90 130 Gracked Brown Rock. With green Layers	Material 1 Stainless Steel 2 Plastic 3 Other Set fromtoft below ground level
130 160 DARK. Blue Rock. with	
160 190 Breen + Blue Rock.	Length SCREEN & BLANKS units
190 210 Bad Ly Cracked WHiTet	Diam. I D ins
Brown Rock.	Slot Size ins from ft
	to ft
10 ft. A 6" CASSing.	Fittings, topbottom
3 g.p.m AT 100 FT.	Gravel Pack Gravel Pack II. DEVELOPED BY: 1 Surging 2 Jetting 3 CAir
75'g.p.m. 180 BT.	4 Bailing 5 Pumping 6 Other
Pumpin 12 g.p.m. Ry	I2. TEST 1 Pump 2 Bail Date 1 Rate 73 ⁻ USgpm Temp °C SWL before test ft
Pumping 78 g.p.m. Ray Air Lift.	ft after test ofhrsmins
Cherned + Developed.	TIME in mins & DRAWDOWN in ft TIME in mins & RECOVERY in ft mins WL mins WL mins WL
FLOWing 10g.p.m.	
	RECOMMENDED PUMP TYPE RECOMMENDED PUMP SETTING RECOMMENDED PUMPING RATE
	Image: Image
	coloursmell; gas 1 yes 2 no
7. CONSULTANT	I5. WATER ANALYSIS: 1 Hardness mg/e
Address	2 Iron mg/ℓ 3 Chloride mg/ℓ 4 pH Field Date
8.WELL LOCATION SKETCH	
	FINAL WELL COMPLETION DATA
	Well Depthft Water FlowingUSgpm
	Static Water Level FLoorsft Pressure Headft
E	Back filled
	Well Head Completion
17. [DRILLER SURNAME FIRST NAME PLEASE PRINT Signature way Knight
	Signature with Knight CONTRACTOR, Address
	K. XW. Dr. Thing LTD
	3905-17 Ave Vernon BiC-
	Member, BCWWDA Uyes Ino;
The Province of British Columbia ao	copts no responsibility for the contents or accuracy of this record.

1	2									506-	19
と	S) P	ovince of British Columbia Ministry of							~	2.0	1.
and	Deserie	tion & Address Lot + Phan 260	W	ELL R	ECOR	D	204	Dote l	YR YR	MO	200
		V	03						<u> </u>		
		B Address TILLicum Valle,	ear	Palopa.	1/00	112-	2.	e.			
						No. L	and the second				
	MAP			N Y	WELL Date 19						
TYP		1 New Well 2 Recondition	ed	9. CASING	;:	1 1 St	eel	2 🗆 Go	alvanized	1 <u>3</u> 🗆 W	lood
	WOR		d	Mater		6 0 01		5 🗆 C	oncrete		units
2. WO ME	THOD	1 Cable tool 2 Bored 3 Jette 4 ArRotary a mud b Toir c reve 5 Other	erse	Hole Diameter Diameter	200						ins Ins
	TER	1 🗖 Domestic 2 🗌 Municipal 3 🗋 Irrigo	ition	from	-						ft
US	E	4 Commercial & Industrial 5 Cother		to Thickness							ft ins
		G ADDITIVES None		Veight Pitless unit		<i>64 4</i>					lb/ft
FROM	14 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	EMENTS from 1 ground level 2 top of c	asing SWL	1 Welded	2 🗆 Ce						
ft 0	TO ft	6. WELL LOG DESCRIPTION Rock + Brown Till	ft	Perforations	:						
15	160	Bed Roch. quoits + micha		Shoe (s) : Open hole,	from		to	ft	Diam	eter_6	in
		Jayers		Grout :						15 1 1	
		Water Jouril at 130 ft - 130 ft.	1	IO. SCREE Type	1 □ Cont					3 🗆 I	Louvre
					4 🗌 Oth 1 🗋 Stai	er					
				C. C. Martin and C. M. Martin and C. Martin And C. Martin and C. Mart	n						112
					S	CREE	N 84	BLANK	S	1	units
1				Length Diam. 1 D		1					ft
- 111				Slot Size from		-					ins ft
				to	, top			bott			ft
				and the second	Pack			DOTT	0m		Sec.
				II. DEVEL	OPED Bailing	CONTRACTOR OF STREET	1 7 10 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	-		ng 🕉 r	
				12. TEST	i 🗆 Pu	mp :	Bai	I T	Date 18	210,2	121
				×Rate_4	USgp	om Te	mp	C :	SWL befo	ore test_	
				TIME in m	ins & DR	AWDOW	N in ft	TIME in	mins 8	RECOVE	1
				mins	WL n	nins	WL	mins	WL	mins	WL
									- 51 		
				13. RECOMMEND	ED PUMP TY	'PE		ALC: NOT		DMMENDED PL	UMPING RAT
				I4.WATEF	TYPE	: 1 11					
7. CO	NSULI		re en la la	15. WATER							
	Iress			2 □ Iron 4 □ pH							
Add								Lab I	Date L	R MO	
		OCATION SKETCH	SITE								
			. FINA	ID No	MPLET	ION	DATA				
		16	• FINA		MPLET	ION	DATA Water F	lowing			USgpmft
		16	 FINA Well D Static Back 	Depth Water Level filled	MPLET	TON I	DATA Water F	lowing			US gpmft
		16	 FINA Well D Static Back 	Depth Water Level	MPLET	TON I	DATA Water F	lowing			US gpmft
		16	 FINA Well D Static Back 	Depth Water Level filled	n ale	TON I	DATA Water F	lowing			ft
		16	Vell D Static Back Well H	L WELL CC Pepth Water Level filled Head Completio	n ale	TON 1	DATA Water F Pressur	Towing re Head	FII	RST NAME	ft
		16	Vell D Static Back Well H	WELL CC bepth Water Level filled Head Completio	n ale	TON I	DATA Water F Pressur	Towing re Head	FII	RST NAME	ft
		16	FINA Well D Static Back Well H DRIL PLEASE B. CON	LER Signatur	n <u>ala</u> su 10 k e		DATA Water F Pressur	Flowing re Head	FILL	RST NAME	ft
		16	FINA Well D Static Back Well H DRILL PLEASE B. CON	LER LISINGTUR	n all suddress Dr		DATA Water F Pressur	L 7/2	FII.	RST NAME	ft
		16	FINA Well D Static Back Well H DRILL PLEASE B. CON	LER Signatur	n all suddress Dr		DATA Water F Pressur	L 7/2	FII.	RST NAME	ft

D	R 13 57624
1050 BARTHOLOMEW	14) 764-2338
KELOWNA, B.C. V1Y 8R3	TION
Wallace Rd. + Rd. Rd. IC IRRIGAT	ION EXPLORATION Nº 0720
Be WELL	
NAME: MR. Cecil Lapshinoff. ADDRESS: Wallace RD. Vernon B.C.	DATE: SPUDDED Oct 21/87 completed Oct 22/87 Rig # One Other Equip. Mack Pipe Truck
WELL LOCATION: Block Sec. TWP Range Plan	DEPTH:
PROPOSED USE: Domestic V Industrial Municipal Irrigation Test Well Other TYPE OF WORK: Owner's number of well, (if more than one)	Overburdon 122 ft. Tool Push Bedrock ft. Driller <u>Bic Beckhelt J</u> Total 122 ft. Helper Jim Genereux J
New Well Air Rotary Deepened Rotary Reconditioned Jetted	FORMATION
Cable DIMENSIONS: Diameter of well C inches	FROM TO
Drilled 1242. A Depth of completed well 122 ft.	Ground C 6Ft Sandy Soil + Gravel 6 ft 11 ft moist sand + Gravel
CASING INSTALLED 2 "Diam. from O ft. to 122 ft. Threaded '' Diam. from ft. to ft.	11 ft 15 ft Bolders
Welded V' Diam. fromft. toft.	15 ft 20 ft moist sand + Gravel 20 ft 60 ft Cons. Clay + Gravel
Type of perforator usedin. SIZE of perforationsin. byin. perforations fromft. toft. perforations fromft. toft.	60 ft 61 ± wet Gravel + Clag 61 ± ft 86 ft Cons Clay + Gravel 86 ft 89 ft wet Sand + Gravel
SCREENS: Yes No Manufacturer	89 Ft 113 Ft (water Bearing Graver fine Sand 113 Ft 124 ± water Bearing Course Gravel
Type Model No. DiamSlot Size from DiamSlot Size from	1242 water Bearing Sand + Gravel
Diam. Slot Size from ft. GRAVEL PACKED: Yes No Size of Gravel Gravel placed from FT. TO FT.	with trace Clay
SURFACE SEAL: Yes No Depth ft. Material Used In Seal 672 Steel Casing	WELL OWNER
PRODUCTION DATA AT TIME OF DRILLING: Static Level 47 Ft From Ground levet.	Hereby Agree Work has been completed in accordance with the contract and all material used has been of toppquality.
Measured from 110 ft. With Air Pump Other Pumping level 110 ft. at 12 GPM	CAPRI DRILLING (1985) LTD.
Recommended Pump Setting 10 to 105 ft. If Flowing Well GPM	GENERAL REMARKS Confirmed field of well meets Cord Requirement of
Recommended Max. Pump Output GPH Water Clear Coloured Silt Sand Duration of test 2 Krs HRS.	4.4 Gals Permin for 1 hr to 503 Gals Perday Per Bylaw 176

It is here by agreed that FORMATIONS, QUALITY, QUANTITY & TYPE of Water, along with all other remarks, are true only to the best knowledge of the Personnel & Company, and they cannot be held responsible for a mistake in calculation. The company will not be held responsible for Public Liability or Property Damage caused by flowing well wash outs or any other mishaps.

	62370
WELL	LOG
TIN	G (100-
DRILLIN	<u>G (1985)</u> I. T.
VX 306, STN. A LOWNA, B.C. Y 7N8	G (1985) LTD. PHONE: (604) 769-3408 (604) 762-1362 NO NO
Be WELL	
Address:	Rig # Three Other Equip. Mark P. pe Track
Address: UEIXEX DL WELL LOCATION: Lot	DEPTH: Overburdon 243 ft. Tool Push Bedrock ft. Driller Jim Genereus Total 243 ft. Roughneck Rery Regers
	FORMATION
TYPE OF WORK: Owner's number of well, (if more than one) One New Well Air Rotary Deepened Rotary Reconditioned Jetted Liner Installed Pressure Fractured Dimensions: Diameter of well 6'' inches Dilled 2 4 4 ft. Depth of completed well 24.3' ft. CONSTRUCTION DETAILS: S''' CASING INSTALLED: S''' CASING INSTALLED: S''' Diam. from ft. to 23.6' ft. Threaded " Diam. from ft. to ft. Velded " Diam. from ft. to ft. Velded " Diam. from ft. to ft. Velded ft. to int. PREFORATIONS: Yes No Determine ft. to Type of perforator used SIZE of perforations in. by in. perforations from ft. to ft. perforations from ft. to ft. No Deterforations from ft. to ft. Size of perforator used Size of of Perforations Type Sit in the size of of t	DEPTHFROMTOGROUND2 FtLEVEL C2 FtSandy top Scil with some Clay2 Ft155 FtBine Clay rGravel till w cobhles and155 Ft183 Ft183 Ft193 Ft183 Ft197 Ft201 Ft201 Ft201 Ft202 Ft202 Ft202 Ft202 Ft203 Ft203 Ft233 Ft233 Ft238 Ft238 Ft244 Ft244 FtFine Brown Sand with Gravel (w B)244 FtFine Brown Sand with Gravel (w B)
Diam. Slot Size C S C Iron A S C Iron A S C GRAVEL PACKED: Yes No Size of Gravel	WELL OWNER A
SURFACE SEAL: Yes & No Depthft. Material Used In Seal 6 Scheel Casing Method of Sealing strata off Drive shart Casing hammed	has been completed in accordance with the contract and all material used has been top quality.
PRODUCTION DATA AT TIME OF DRILLING: Static Level 156' from Surface ft. Measured from 242' ft. With air 1.'ff Pumping level 242' ft. at 45 GPM Recommended Pump Setting 225' fc 233' ft. ft. If Flowing Well GPM GPM Recommended Max. Pump Output 2700 GPH GPH Water Clear Coloured Silty Sandy Hrs. Hrs. Hrs. Hrs.	CAPRI DRILLING (1985) LTD

in

	WTN 744 39
LITT	NG (100
1050 BARTHOLOMEW COURT RR6 KELOWNA, B.C. V1Y 8R3 CAPRI DRILLI CAPRI DRILLI STG IG	
IRRIGAT	ION EXPLOIT Nº 0848
Ro WELL	Satisfied 23 25
De WELL	
ADDRESS: Hitchcock Road Vernon BS	DATE: SPUDDED Jul +13/92 Completed July 25/92
WELL LOCATION:	Rig # <u>イン</u> Other Equip.
Lot Block Sec	DEPTH:
TWP Range Plan PROPOSED USE: Domestic // Industrial Municipal	Overburdon 622 cased Bedrock 1177 ft. Driller Sim Genereux
Irrigation Test Well Other	Bedrock 1175 ft. Driller Jim Genereux Total 180' ft. Helper Doug + Gordi
TYPE OF WORK: Owner's number of well, (if more than one)	lotal ft. Helper
New Well Air Rotary	FORMATION
Deepened Rotary Reconditioned Jetted	
Cable	
DIMENSIONS: Diameter of well 6" inches	FROM TO
Drilled 120 ft. Depth of completed well 20 ft.	Level D Ft Top soil + Gravel
CASING INSTALLED:	1 Ft 8 Ft moist sand + Gravel w Cobbles
Threaded ' Diam. from ft. to ft.	8 ft 11 ft moist Brown Sandy Clay w Grave
Welded 🖌' Diam. fromft. toft.	11 Ft 21 Ft Blue Clay + Gravel Till
Type of perforator used Skill Saw	21 ft 39 ft Sand+ Gravel w Cobbles + Belders
SIZE of perforations 5 in. by 5" in.	39 Ft 54 ft Cemented Sand + Gravel
perforations from 160' ft. to 120' ft.	54 Ft 61 Ft Softweathered Bedrock
perforations fromft. toft.	GI Ft 33 Ft med saft Black + white Granite
SCREENS: YesNo	83 Ft 92 Ft med soft Tan Granite "
TypeModel No	92 Ft 148 Ft med soft Black + white Granite "
DiamSlot Sizefromft. toft.	
DiamSlot Sizefromft. toft.	All Granite formations had Quertz mixed
Gravel placed fromFT. TOFT.	Water Bearing Fractor at 152 ft.
SURFACE SEAL: Yes No Depth ft.	WELL OWNER
Material Used in Seal 65 sheet Casing Method of Sealing strata off Drive Shoet Casing Hammer	Hereby Agree
PRODUCTION DATA AT TIME OF DRILLING:	Work has been compreted in accordance with the contract and all
Static Level 126 From Surface ft.	material used has been of too huarity.
Measured from 179 ft. With Air Pump Other	CAPRI DRILLING (1985) LTD.
Pumping leval 179' ft. at 13 GPM Recommended Pump Setting 160' ft.	GENERAL REMARKS
If Flowing Well GPM	4" P.VE. liner installed to Protect Pump
Recommended Max. Pump Output 780 GPH	from Fractored Bedrock + left 6 Ft Below
ation of test 2 hrs Developing HRS.	Surface
is here by agreed that FORMATIONS, QUALITY, QUANTITY & TYPE of Water, Personnel & Company, and they cannot be held responsible for a mistak	

company will not be held responsible for Public Liability or Property Damage caused by flowing well wash outs or any other mishaps.

The state

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Image: Some B Address PDBE CANAPIAN WATERS LTD, 4 % FLOAD, 3205-322 ST, VEAL Indiana Control States SEC. 17 AND 20, TP, 5, ADYD, SEC. 17 AND 20, TP, 5, ADYD, Descriptive Location L OT 1 UP (Sec Work 3) Despended 1 Diameter 0 1 Diameter O Other 0 0 0 3. WATER 10 Cobit on 0 0 0 Matter 10 Cobit on 0 0 0 0 Matter 10 Cobit on 0 0 0 0 S. MASUREMENTS from 1 Defoond level 20 top of cosing and midpid Matter 10 0 112 Medied 20 Commented 30 Threaded 10 Th	NTC	MAD		111		LL RECORD Dote Q 3 /
Owners Name & Address. DURE: CANADIAN. WATERS LID. 4 (".FLOR, 3205-32*"-57, VEAL Legal Description & Address. SUB DI. J. PART OF LOT 1, PLAN. 30623, BC, VIT 2.M4 SEC. IT AND 20, TP.S., ADYD. Descriptive LocationT. Descriptive LocationT. OF WORK 10 Despended OF WORK 10 Despended 2. WORK 10 Despended 10 Onter 3 Didtied 2. WORK 10 Despended 10 Onter 3 Didtied 3. WATER 16 Observice 10 Onter 10 Inter 3. WATER 16 Observice 4. ORTILLING ADDITIVES 11 Interness / 18 28 5. MEASUREMENTS from 1 Defond level 2 lop of cosing 11 Interness / 18 28 74 00 CAEX & GARX FLY CLAY 11 Interness / 18 28 74 20 CAEX & GARX FLY CLAY 10 Interded 74 20 CAEX & GARX TEXER 11 Interness / 12 Interded 10 Interded 74 20 CAEX & GARX TEXER 11 74 20 CAEX & GARX TEXER 11 74 20 CAEX & GARX TEXER 11 75 20 CAEX & GARX TEXER 11 77 220 CAEX & GARX TEXER 11 77 220 CAEX & GARX TEXER 11	11				ELL No. 1	ELEV Accuracy
Legol Description & Address SUB. PIX. OF PART OF LOT 1, PLAN 30623, BC, VIT 2M4 SEC. 17 AND 20, TP, S, DDYD. Descriptive Location 1.07 / I. TYPE 10 Mew Well 2 Construction 1.07 / I. TYPE 10 Mew Well 2 Construction 1.07 / I. TYPE 10 Mew Well 2 Construction 1.07 / I. TYPE 10 Mew Well 2 Construction 1.07 / Well 1.06 Descend 4.1 Abandoned Method 2 Construction 3.1 Constructin 3.1 Construction 3.1 Construction 3.1 Construction 3	Owner	s Nome	B Address PUBE C	ANADIAN	WA	TERS LTD. 4th, FLOOR, 3205-32 dist. VE
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2. WORK it is a bindle is Gir is a list if a list if a list is a list if a list if a list is a list a	OF	WOR	3 Deepened			Materials 4 Plastic 5 Concrete
MATER 100 metric 2 Municipal 3 Irrigation WELL USE4 Comma.kind. 0 Other 1 4. DRILLING ADDITIVES Image design above ground level 1 1 5. MEASUREMENTS from 1 Bd/found level 2 I to of cosing casing height above ground level n 1 1 7. ORLILING ADDITIVES n n 1 1 1 8. MEASUREMENTS from 1 Bd/found level 2 I to of cosing casing height above ground level n 1 <td></td> <td></td> <td>A FIL Palance - FI-</td> <td>ed 3 🛛 Jett b 🗗 Gir c 🗆 rev</td> <td>ed</td> <td></td>			A FIL Palance - FI-	ed 3 🛛 Jett b 🗗 Gir c 🗆 rev	ed	
WELL USE4 © Comm. & Ind. © Other 4. DRILLING ADDITIVES			0 0ther			Diometer 8
5. MEASUREMENTS from 1 Byfound level 2 □ top of cosing easing height above ground level It It </td <td></td> <td></td> <td></td> <td>nicipal 3 🗆 Irrig Other</td> <td>ation</td> <td>to 79</td>				nicipal 3 🗆 Irrig Other	ation	to 79
5. MEASUREMENTS from 1 Defound level _ to pool cosing casing height above ground level _ n n FROM Tr 0 6. WELL LOG DESCRIPTION 2 Pittess unit	4. DRI	LLIN	G ADDITIVES			
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8 40 GAEY GRAVELY CLAY Guidely - for a 220 ft biameter_6 40 77 GAEY CLAY, AOCK S d Grout: Grou	ft	0				
40 27 GAEY CLAY, AQCKS d 79 220 GREY CRANITE WITH YELLOWY, WEATHERED ID. SCREEN: 1 Doninuous Slot 2 Derforated 3 D.ov. 10. SCREEN 10. SCREEN: 1 Doninuous Slot 2 Derforated 3 D.ov. ID.ov. 11. Delow ground level ID. SCREEN & DLANKS ID. ID. ID. 11. Delow ground level ID. SCREEN & DLANKS ID. ID. 11. Delow ground level ID. SCREEN & DLANKS ID. 11. Delow ground level ID. SCREEN & DLANKS ID. 11. Delow ground level ID. SCREEN & DLANKS ID. 11. Delow ground level ID. ID. 11. Delow ground level ID. ID. 11. DEVELOPED BY: 10.Surging 2 Delting 3 (PAR) ID. ID. 11. DEVELOPED BY: 11. Durging 2 Delting 3 (PAR) ID. ID. 12. TEST 10 Pump 2 Delail 3 (DAR) ID. ID. 13. [ICCOMERCICE POWER TITE] ID. SUBMERSTREE 200 m. APROX, 4/DU ID. 13. [ICCOMERCICED ROWE TITE] ID. SUBMERSTREE 2.00 m. APROX, 4/DU ID. 13. [ICCOMERCICED ROWE TITE] ID. SUBMERSTREE 2.00 m. APROX, 4/DU ID. 13. [ICCOMERCICED ROWE TITE] ID. DECOMERCICED ROWE TITE] ID.		40	GREY GRAVEL	Y CLAV		Shoe (s): VES
Aboult DERS 79 220 GREY GRANITE WITH YELLOWY, WEATHERED Nock + QUARTZ LAYERS Nock + QUARTZ Nock + QUARTZ Nock + QUARTZ Nock + QUART N	40	79	GREY CLAY, RO	DCKS +		Grout:
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4 □ Bailing 5 □ Pumping □ Other						
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BOX 306, STN. A			Ų.	PHONE: (604) 769-340
			2	(604) 762-136
KELOWNA, B.C. V1Y 7N8		PLORA	5	
ESTIC .	Anthe Hills	ORA	11	
IRRIGA	ION EX	PLO		NQ
	Satisfied			
Name: GIRL GUIDES OF CHAINDA.	1			
Address: FOR TILLICUIT LONGE	DATE: Spudde	od DEC		Completed 1211
Address: TILLICUIT Rd. VERNION B.C.	Rig # Onde	C Other	Equip.	
WELL LOCATION: LotPLDL	DEPTH:	1		
	Overburdon	108	ft. Tool Push	ROLY ROLERS
PROPOSED USE: Domestic Industrial Municipal Irrigation Test Well Other	Bedrock Total	240	ft. Driller ft. Roughnee	CK PICKY / SPTIN
TYPE OF WORK: Owner's number of well, (if more than one)	FORMATION			
New Well Air Rotary	DEPTH			
Reconditioned Jetted	FROM	то	7	
Liner Installed Pressure Fractured	GROUND		Same	1 Carrier
Dilled 240 ft. Depth of completed well 240 ft.	LEVEL	3	SAND :	CLAYFGRAUEL
CONSTRUCTION DETAILS:	8	83		Some Berners
CASING INSTALLED: "Diam. from ft. to ft. Threaded"Diam. from ft. to ft.	83	97	DAME	(101
Welded 1676" Diam. from ft. to 108 ft.	97	108	-	HULL TE MINE
PREFORATIONS: Yes No Type of perforator used	108	240	BEDRO	К
SIZE of perforations in. by in.				
perforations from ft. to ft.			FRACTOR	10.00721=1561
perforations from ft. to ft.				
Manufacturer				
Type Model No. Diam. Slot Size fromft. toft.				
Diam. Slot Size from ft. to ft.				
GRAVEL PACKED: Yes No Size of Gravel	WELL OWNE	<u>R</u> :		
$\frac{\text{SURFACE SEAL: Yes in No in Depth}{(10.6)} ft.$	- I		•	Hereby Agree wo
Material Used In Seal STEEL DRIVE SHEE Method of Sealing strata off CASING & CASING AND THE		npleted in acco	ordance with the o	ontract and all material used has been
	-	LING (1985) LI	rD+	
Static Level ft.	GENERAL R		1	
Measured from ft. With			- 219 W	
Pumping level Z 10 ft. at 15 GPM Recommended Pump Setting Z 20 ft.	Eikili	-2 BIT	SIZE 61	
If Flowing Well GPM				
Recommended Max. Pump Output GPH				
Water Clear Coloured Silty Sandy Hrs.				
	1			

THE COMPANY WILL NOT BE HELD RESPONSIBLE FOR PUBLIC LIABILITY OR PROPERTY DAMAGE CAUSED BY FLOWING WELL WASH OUTS OR ANY OTHER MISHAPS.

ALL MATERIALS SHALL REMAIN PROPERTY OF CAPRI DRILLING UNTIL ACCOUNT IS PAID IN FULL.

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	1		APAT _ D	ironmen	
SQ	20	OLLIMBIA			Water Management Division
	· · ·		WATER	WE	LL RECORD Date 2017 017
NTS	MAP			WELL No.	ELEV Location Accuracy
¥ Z			E		N Well Well
Owners	s Name	& Address KATH X	GALLOW	AY YO	7480 HITCHCOCK RD. VERNON BS VAB3N8
Legal	Descript	tion & Address LOT	6 KAP 4	9151	O,D,Y,D,
			Sec. 19	TP5	- 0040
		ocation			
I. TYF	PE Work	1 🗂 New Well 3 🗆 Deepened	2 🗌 Recondi 4 🗌 Abandor		9. CASING: 1 🖾 Steel 2 🗆 Galvanized 3 🗆 Wood Materials 4 🗆 Plastic 5 🗆 Concrete
		1 🗆 Çeble tool 2 🗆	······································		Materials 4 Diastic 5 Concrete
2. WO ME	THOD	4 🕒 Rotary a 🗆 mud		reverse	Hole in s
3 W/A	TER	Other 1 Domestic 2	Musicipal 3 DI-	rigation	Diameter 💰 Ins from 🧑
WE	LLU	SE4 Comm. & Ind.	Other		to II ft
4. DR	ILLIN	G ADDITIVES -			Thickness 188 ins
5. ME	ASUR	EMENTS from 1 Bgro	ound level 2 🗆 top	of casing	Weight 2.22 Ib/ft I above 2 below ground level
		casing height above gro	und level	ft.	1 Welded 2 Cemented 3 Threaded 1 Crive 2 Used
FROM ft	TO ft	6. WELL LOG DESC	CRIPTION	SWL ft	Perforations:
0	5	BROWN CLAY			Shoe (1): VES
5	11	GABY CLAY,			Open hole, from <u>11</u> to <u>470</u> ft Diameter <u>6</u> ins
	240	COBBLES			Grout :
_11	340	GREY BROW SHIST WITH			IO. SCREEN: 1 🗆 Nominal (Telescope) 2 🗆 Pipe Size
		LENSES	GUANIZ		Type 1 Continuous Slot 2 Perforated 3 Louvre
340	435	G-BEY G-RANI	TE		Material 1 🗋 Stainless Steel 2 🗆 Plastic 💷 Other
		GREY GRANIT	EWITH		Set fromtoft below ground level
		QUARTZ SE	AMS(FRACTO	URED)	RISER, SCREEN & BLANKS units
440	470	G-BEY C-RAN	ITE		Length ft Diam. I D ins
					Diam. I D ins
					from ft
					to ft
			·		Fittings, topbottombrain Gravel Pack
					II. DEVELOPED BY: 1 □ Surging 2 □ Jetting 3 ⊠Air 4 □ Bailing 5 □ Pumping □ Other
					12. TEȘT1 🗆 Pump 2 🗆 Bail 3 🖉 Air Date L <u>0, 2 0, 6 1, 9</u>
					Rate 10 USgpm TempC SWL before testft
					Water Levelft after test ofhrs
					13. RECOMMENDED PUMP TYPE RECOMMENDED PUMP SETTING RECOMMENDED PUMPING RATE SUBMERSIBLE 450 ft APROX, 10 USgpm
					I4. WATER TYPE:1 Ofresh 2 salty 3 Clear 4 cloudy
					colour; gos 1 □ yes 2 €no
[I5. WATER ANALYSIS: 1 Hardness
		ANT			2 Iron mg/L 3 Chloride mg/L
8.WE	LL L(OCATION SKETCH		SITE	Lab Date
			16	1	NELL COMPLETION DATA EST.
			10.		470 ft Well Yield 10 US gpm
					er Level ft Artesian US gpm Head ft
				Back fille	d
				Well Head	Completion CAPPED
1				N	OLINER
1					
			17.		SURNAME FIRST NAME
			17.	DRILLEF PLEASE PRINT	SICHIBLII MAXIIII
					SiGitt/1BiLi/1 + + + + MAX + + + + + + + + + + + + + + + + + + +
					SIGNH/IBILI/IIIII MAXIIII Signature Mfan Achili CTOR, SCHIBLI DRILLING
					SiGitt/1BiLi/1 + + + + MAX + + + + + + + + + + + + + + + + + + +
					SIGNH/IBILI/IIIII MAXIIII Signature Mfan Achili CTOR, SCHIBLI DRILLING

The Province of British Columbia accepts no responsibility for the contents or accuracy of this record.

	D	BCar	87401
X -	BRITISH E	nvironmen	t Water Management Division
	OLUMBIA WATE	ER WE	
U	0821035123	WELL No.	ELEV Accuracy
Ť Z I I		16937	
Owners Name	& Address PAUL STACK 8	566 GRI	EENAWAY RO VERNON BC. V1B3M6 DYD, PLAN KAP60353
Descriptive Lo	ocation A.PSN. 50° 19'29	.3" w. 119	1 08 27.9" 7 20' WELLTAL # 15919
	1 P New Well 2 Reco 3 Deepened 4 Abar		9. CASING: 1 Desteel 2 Galvanized 3 Wood Materials 4 Plastic 5 Concrete
OF WORK	1 Cable tool 2 Bored 3		Materials 4 Plastic 5 Concrete Other units
2. WORK METHOD	A Rotary a mud h mir c	reverse	Hole ins Diameter S 6 Ins
. WATER	1 Domestic 2 Municipal 3	□ Irrigation	Diameter g 6 Ins from 0 0 ft
WELL U	SE4 Comm. & Ind. Other		to 1.6 2.67 ft Thickness 0.025 0.0188 ins
. DRILLIN	G ADDITIVES NONE		Thickness 0.025 0.0198 ins Weight 2.5 12.42 1b/ft
5. MEASUR	EMENTS from 1 Deground level 2 casing height above ground level 2		Pitless unitft 1 above 2 below ground level
FROM TO	6. WELL LOG DESCRIPTION	SWL	1 ⊡ Welded 2 □ Cemented 3 □ Threaded 1 ⊡ New 2 □ Used Perforations:
ft ft 0 175	GREY CLAYTILL	+17+	
175 178	GREY SAND AND GRAVEL		Shoe (s): <u>VES 61MCH</u> Open hole, from to ft Diameter in
	CREY CLAYTILL		Grout :
257 271	BROWNSAND & GRAVED	2	IO. SCREEN: 1 Horizonial (Telescope) 2 Pipe Size
			Type 1 Continuous Slot 2 Perforated 3 Louvre
			Material1 🔁 Stainless Steel 2 🗆 Plastic 🔹 Other Set from 267 to 271 ft below ground level
			RISER, SCREEN & BLANKS units
		1	Length 4 ft
			Diam. I D 5 ins Slot Size 0.020 ins
A CONTRACT			from 267 ft
		Carlos Carlos	to 27/ ft Fittings, top K PALKER bottom PLATE
		and the strength	Gravel Pack
			II. DEVELOPED BY: 1 Surging 2 Jetting 3 Air
			4 Bailing 5 Pumping Other
	and the second second		12. TEST1 □ Pump 2 □ Bail 3 PAir Rate 60 USgpm TempC SWL before test
			Water Level ft ofter test of hrs
			DRAWDOWN in ft RECOVERY in ft mins WL mins WL mins WL mins WL
		State and	
1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 -			
			RECOMMENDED PUMP TYPE RECOMMENDED PUMP SETTING RECOMMENDED PUMPING RA
			SUBMERSIBLE 260 # APPROX 60 User 14. WATER TYPE:1 Ettresh 2 Usalty 3 Ectear 4 Octoody
		Star Land	colour smell; gas 1 Uyes 2 Eno
			15. WATER ANALYSIS: 1 Hardness mg/L
7. CONSULT	[ANT		2 Iron mg/L 3 Chloride mg/L
Address	OCATION SKETCH		4 pH Field Date
D. WELL L	OCATION SKETCH	Constant Providence	E I D No Lab Date
	and the second second		WELL COMPLETION DATA ESTIMATE L271 ft Well Yield 60 USgpm
		Static Wa	ter Level 1 23 ft Artesian 30 US gpm Pressure 123
		Back fille	d
		Well Head	Completion GAP WELL SEAL INSTALLED
		SEAL	ED BETWEEN 8" AND 6"
		17 000115	
	the state of the second second	17. DRILLE	R SICIHIBCIIIIII
			Signature David Black
		18. CONTRA Address	CTOR, SCHIBLI DRILLING
			BOX729 LUMBY B.C. VOE260
- Menni			
		Member	, BCWWDA Dyes Dno ;

BRITIS	SH		construction	Report	Sta	one/fax/em	any name/ac ail here, if d	esired.	Ministry	y well ID plate number: 1033 y Well Tag Number: 900 irmation/alternative specs. atta nal well construction report att	eched
			inimum manda		nation.						
Owner n	name: L	Jayne	Benott	Mailing ad	dress:	7957	Vallace	Town_	Vernor	Prov BC Postal Code	VIB 3no
			Street no							Rg. Land District OT	DYD
~ ~										53.82	
			M Northing: M Easting:			m (or) L	atitude: deg	1190	min	1) non Dert fo	ee reverse er notes &
	DG work:	5				111 •	.ongnude. de	9111	""""	1 1 1 1 1 1	efinitions of obreviations.
			tary 🗌 cable tool								
			ical Chorizontal							Method:	
										industrial other (specify):	
Litholo	ogic des	cription	n or closure	descripti	ion (se	e reverse on	how to fill ou	t)			
From (ft bgl)	To (ft bgl)	Relativ Hardne					ended terms or nount, if applica		Water-bear Estimated F (USgpm)	low Observations (e.g., fractured	
0	140	then		tin		a a a a a a a a a a a a a a a a a a a	in or provide the second se	,	(oogpiii)		
145	151	m	BK	Si	14 4	craul					
151	157	m	Br	San	Jü	graul IAta b	earing		10		
							~				
									·····		
			ų								
			A.								
		_									
-	details		Cooing	Wall	Deixe	Lineseed	Screen			-	
(ft bgl)	(ft bgl)	(in)	Casing Material	(in)	Shoe	Uncased Hole	From (ft bgl)	10 (π bgl)	Dia (in)	Type (see note 12) K-paken d risen	Slot Size
0	153	633	steel	.219	-		153	157	6"	Screen	15
	124							1		m 🛛 Uncased hole	
	seal: Type			epth (ft):					scope	pe size el Plastic Other (specify):	
Method of Backfill:		ion: Pou	ured Dumped	Depth (ft):	s (in):	1	Screen op	ening: 🗹	Continuous s	lot Slotted Perforated	
Liner: 🗆			•••		ess (in):				ail Plug	Plate Other (specify): erial:	
From:	ft bgl To	o:ft bo	gl Perforated: F	rom:ft	bgl To:	ft bgl				To:ft Thickness:	in
	oped by								pletion da		
	ng 🗆 Sur (specify):		etting 🗌 Pumpin		uration:	hrs	Final stick u	drilled: .p: Ha	the in	t Finished well depth: 157 Depth to bedrock: 06	ft bgl
Notes:							SWL:	20	ft (btoc)	Estimated well yield: 35	USgpm
	ield esti		by: Bailing Other	(coocifu):						m, or artesian pressure: Well disinfected: Yes	ft] No
Rate:	25		USgpm Durat	ion:	1	hrs	Where well	ID plate is	attached:	to casing	
			ft (btoc) Pumping			ft (btoc)	Reason for		formatio	n:	
1			y characteri		G	as	Method of c	losure:	Poured P		Reit
Colour/od		a orea	Olddy			llected:	Sealant ma Details of cl			Backfill material:	1
Well di	riller (ple	ase print):			1		Data of	·	1		
			Last na			050920	Date of Started (Y		061511	Completed (YYYY/MM/DD):	2015/12
	ant (if appli					- te	Comment		1 11	· · · · · ·	22.1.2
PLEAS			nation recorded in						on, Form	# 00008888 - WELL OW	NER COPY

BRITIS	SH		nstruction osure Repo	Report	Sta	ne/fax/em	any name/addr ail here, if des	ired.	Ministry W	ell ID plate number: 12. ell Tag Number: 90 ation/alternative specs. at	114 tached
Red let	tering in	dicates min	iimum manda			ity D	illing 1	inc	Original	well construction report a	ttached
Owner n	ame: (Jame 1	Sematt	Mailing ad	dress:					Prov <u>Bc</u> Postal Coc	IE UIB 3
							allace			vn Venon	
0		R. Contraction		0						tg. Land District	
Zone:	- Series	(and) UTM	Northing:			m (or) I	atitude: deg	50°	min /9	sec off	See reverse
ot #c	3	UTM	Easting:			I	.ongitude: deg	1190	min 10	sec jos w	for notes & definitions of
											abbreviations
							☐ jetting ☐ exca Ground elevation				
							-class of well:				
For water	supply wel	s, indicate inte	ended water use	: Private do	mestic 🗌	water supply	/ system 🗌 irrigatio	on 🗆 com	nmercial or indu	strial 🗌 other (specify):	
Litholo From	gic des	Relative					how to fill out) ended terms on re		Nater-bearing stimated Flow	, Observations (e.g., fracture	ed weathered
(ft bgl)	(ft bgl)	Hardness	Colour				nount, if applicable		(USgpm)	well sorted, silty wash), c	
0	100	m	br	11.4		1 1					
100	100	m	br			8 (10+				silly WASK	
106	108	m	br								
139	118	m	6	til	1 550	~0					
112	270	H	W	bedro	cK						
270	287	11	W	bets					50		
Caeino	details						Screen de	taila			
From (ft bgl)	(ft bgl)	Dia (in)	Casing Material	Wall Thickness	Drive Shoe	Uncased Hole	From (ft bgl) To		Dia (in)	Type (see note 12)	Slot Size
(it bgi)	118		219560	(in) •219	Shee	TIOIC					
	1.9		- 12-4	211							
							Intake: Screen type:			Uncased hole	
		: Bento	nte De	epth (ft):	(in):	1				Plastic Other (specify):	
Backfill:	Туре:			Depth (ft):	(11)	-				□ Slotted □ Perforated late □ Other (specify):	
	-		C. Desferete di E			31 09 hal	Filter pack: T				
	al by i	o. <u>ææ</u> nt ogi	Fenorated. Fi		bgi io. _a		F	rom:	ft To:	ft Thickness:	in
Liner: 🗹 From: 🖊							Final well Total depth dri	lled: 28	77_ft	Finished well depth: 37	7ft bgl
From: 10 Develo Air liftin			ng 🗌 Pumping					250	in De	oth to bedrock: 118	
Prom: / C Develo Air liftin Other (:			ng 🗌 Pumping	g ∐ Bailing Total du	ration:	hrs	Final stick up: SWL:			stimated well yield: 50	ft bgl USgpm
From: Image: Comparison of the second seco	ng				ration:	hrs	SWL: 80	non	ft (btoc) E	stimated well yield: <u>50</u> r artesian pressure:	USgpm
Pevelo Air liftin Other (: Notes: Nell yi Pumpir	ng Sur specify):	ging _ Jettin imated by lifting _ Ba	/: iling □ Other	Total du	ration:		SWL: 2 Artesian flow: Type of well ca	ADA	ft (btoc) E USgpm, c USgpm, c	stimated well yield: <u>50</u> r artesian pressure: Well disinfected: 2 Yes	USgpm
From: 10 Develo Air liftin Other (1 Notes: Well yi Pumpir Rate:	ng Sur specify):	ging _ Jettin imated by lifting _ Ba	/: iling □ Other ISgpm Durati	Total du (specify): on:		hrs	SWL: 80	ap: <u>Verm</u> plate is at	ft (btoc) E USgpm, c 	stimated well yield: <u>50</u> r artesian pressure: Well disinfected: 2 Yes	USgpmft
From: / C Develo Air liftin Other (: Notes: Well yi Rate: SWL befo	eld est	ging Jettin imated by lifting Ba U 80 ft (/: iling □ Other ISgpm Durati btoc) Pumping	(specify): on: water level:			SWL: Artesian flow: Type of well ca Where well ID Well closu Reason for close	plate is at ure info	ft (btoc) E USgpm, c USgpm, c tached: +	stimated well yield: <u>50</u> or artesian pressure: Well disinfected: Yes	USgpmft
Comparison of the second seco	ig Sur specify): eld est ng Air ore test: Js wate Salty	imated by lifting Ba U 8 ft (r quality o	/: iling □ Other ISgpm Durati	(specify): on: water level: stics:		hrs ft (btoc)	SWL: Artesian flow: Type of well ca Where well ID Well closu Reason for clos Method of clos Sealant materi	ap: <u>Utra</u> plate is at ure info sure: sure: point Po al:	ft (btoc) E USgpm, c USgpm, c tached: transformation:	stimated well yield: <u>50</u> or artesian pressure: Well disinfected: Tyes CGSING ed	USgpmft
Trom: 1 Develo Air liftin Other (Notes: Well yi Pumpir Rate: SWL befo Obviou Fresh Colour/od	g Sur specify): eld est ng Air re test: Js wate Salty lour:	imated by lifting Ba U 8 ft (r quality o	7: iling Other ISgpm Durati btoc) Pumping characteris	(specify): on: water level: stics: Sediment		hrs ft (btoc)	SWL: Artesian flow: Type of well ca Where well ID Well closu Reason for clos Method of clos Sealant materi Details of closu	ADA Ap: Urran plate is at ure info sure: ure: Po al: ure:	ft (btoc) E USgpm, c USgpm, c tached: transformation:	stimated well yield: <u>50</u> or artesian pressure: Well disinfected: Tyes CGSING ed	USgpmft
Trom: / Trom:	g Sur specify): eeld est mg Air ure test: us wate Salty iour: riller (ple	imated by iffing Ba 8 ft (r quality ase print):	I: Iling Other ISgpm Duratin btoc) Pumping characteris Cloudy Last nar	(specify): on: water level: Sediment Water sa		hrs ft (btoc) S ected: []	SWL: Artesian flow: Type of well ca Where well ID Well closu Reason for clos Method of clos Sealant materi Details of closu Date of woo	plate is at ure info sure: ure: pre:	_ft (btoc) E USgpm, c on proof tached: prmation:	stimated well yield: <u>50</u> or artesian pressure: Well disinfected: Tyes CGSING ed	USgpm ft No

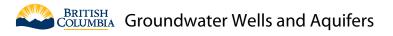
PLEASE NOTE: The information recorded in this well report describes the conditions at the time of construction, alteration, or closure only. Water quantity and water quality are not guaranteed and may change over time.

BRIT	MBIA	□ We	ell Construc ell Closure F ell Alteration	Report	Sc	amp compa	LI DRI any name/ad nail here, if d	dress/	Ministr Con	y Well y Well firmati	ID Plate Nur Tag Number on/alternativ	nber: :: <u> </u>	ached
Ministry of E Red lett		icates mi	inimum manda	tory inform	nation.			Se		a set		100	breviations.
			ND DIA	and the second second		15					2		11.0.0
-			8 SILVER		Street nam		Town	VERA	ION		Prov.	Postal Co	ode VIB3
_	ation: Ad		Plan		Street nam		Block	Sec.	Twp.		Rg. La	nd District	
or) PID:			and Descrip									UTHW	657 14
	2.42		YD EXCE					AND	K.Ar	74.	621 ote 3): N.S	0' 19'	20.9'
see note			UTM Ea	asting:			m	or	Longitude	: W.	1908'1		
			ary 🗌 cable tool								specify):		
	ion of wel well (see		cal horizontal	Ground	elevation:	Sub-class o		Metho	d (see note	e 4):			
			ded water use: 🗗	private dome				ation 🗌 co	mmercial c	r indus	trial 🗌 other	(specify):	
CONTRACTOR OF THE OWNER.	NAME AND ADDRESS OF TAXABLE PARTY.		n (see notes 7-1		Real South State State State	Constitute of the second second	ELEN DESIGNATION CONTRACTOR		Water-be		and the second second	1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 -	
From ft (bgl)	To ft (bgl)	Relative	e Colour	Material De	scription (U	se recomme	ended terms or ount, if applica	reverse.	Estimated (USgpi	Flow			ed, weathered losure details
0	6		BROWN										
6	18		BROWN										
18	163		GREY	CLAY	1711	1							
163	185		GREY	CEME	NTEL	7 SAN	DANDO	RAVE	(
185	201		BROWN	Ceme	NTED	SANT	AND	S R AUE	2				
201	215		BROWN	CLA	4								
215	295		GREY					-					
295							DANDO	FRAUE	C				
			BROWN	SANT	ANT	SGRA	VER						
Casino	details				Wall		Screen	details					
Casing From ft (bgl)	t details	Dia in	Casing Material /		in	Shoe	From ft (bgl)	To ft (bgl)	Dia in		Type (see r	ote 18)	Slot Size
From	To	Dia in	Casing Material /		Thickness	Shoe	From	То	in		Type (see r	ote 18)	
From	To ft (bgl)	Dia in			Thickness in	Shoe	From ft (bgl)	To ft (bgl)	in		Type (see r	ote 18)	
From	To ft (bgl)	Dia in			Thickness in	Shoe VCS	From ft (bgi)	To ft (bgl) 306	in 5				
From ft (bgl)	To ft (bgl) 302 eal: Type:_	Dia in 6 BE	STEEL	C	Thickness in O. 1454 Depth:	Shoe V/CS	From ft (bgl) 307	To ft (bgl) 306	in 5 Open bo		Uncased h		
From ft (bgl)	To ft (bgl) 302 eal: Type: f installation	Dia in 6 BE	57 <i>EEL</i>	E Thickness:	Thickness in O. 1454 Depth:	Shoe VCS	From ft (bgl) 302 Intake:	To ft (bgl) 306 Screen	in 5 Open bc ccope	Pipe si	Uncased h	ole	0.070
From ft (bgl)	To ft (bgl) 302 eal: Type: f installation	Dia in 6 B C	STEEL	E Thickness:	Thickness in 0.144 Depth:	Shoe V/S	From ft (bgl)	To ft (bgl) 306 Screen [a:]:Teles terial:]:]:] sning:]:]	in 5 Open bo coope Stainless st Continuous	Pipe si eel [slot]	Uncased h ze Plastic Slotted	ole Other (specif] Perforated p	y):
From ft (bgl)	To ft (bgl) 302 eal: Type: f installation ype: PVC	Dia in 6 R C R C R C R C R C R C R C R C R C R C	STEEL	Thickness:	Thickness in 0.1444 Depth: Depth:	Shoe VCS	From ft (bgl)	To ft (bgl)	in 5 Open bc cope Stainless st Continuous iil Plug	Pipe si eel [slot]	Uncased F ze Plastic Slotted Plate Oth	ole Other (specif] Perforated p	y):
From ft (bgl)	To ft (bgl) 302 eal: Type: f installation ype: PVC	Dia in 6 R C R C R C R C R C R C R C R C R C R C	STEEL	Thickness:	Thickness in 0.1444 Depth: Depth:	Shoe VCS	From ft (bgl)	To ft (bgl)	in S Open bc cope Stainless st Continuous iil Plug ft To:	Pipe si eel [slot]	Uncased F ze Plastic Slotted Plate Oth	ole Other (specif Perforated p er (specify):	0.070 y):
From ft (bgl) Surface so Method of Backfill: T Liner: D Diameter: From:	To ft (bgl) 302 eal: Type: f installation ype: PVC	Dia in 6 R C - A: Poure Other (specific in c: ft (t	STEEL	Thickness:	Thickness in 0.1444 Depth: Depth:	Shoe VCS	From ft (bgl) 302 Intake: Screen typ Screen por Screen por Screen por Screen por Filter pack: Type and s Final wo	To ft (bgl)	in S Open bc cope Stainless st Continuous iil Plug ft To: rial: Dettion	Pipe si eel [slot] g []1 ft data:	Uncased h ze Plastic Slotted ilate Oth Th	ole Other (specif Perforated p er (specify): _ ickness:	y):i
From ft (bgl) Surface so Method of Backfill: T Liner: D Diameter: From: Develo	To ft (bgl) 3o2 eal: Type: finstallation ype: PVC ft (bgl) ft (bgl) mg Surr	Dia in 6 8 8 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	STEEL	Thickness: Thickness: From:ft	Thickness in Outputh: Depth: Depth: (bgl) To: ng	Shoe V/CS 2 O ft 2 in ft in ft (bgl)	From ft (bgl)	To ft (bgl)	in S Open bc cope Stainless st Continuous iil Plug ft To: rial: Dettion	Pipe si eel [slot] ft data:	Uncased h ze Plastic Slotted ilate Oth Th	ole Other (specifi] Perforated p er (specify): _ ickness:] I depth:	y):
From ft (bgl) Surface so Method of Backfill: T Liner: D Diameter: From: Air liftin Other	To ft (bgl) 302 eal: Type: finstallation ype: PVC ft (bgl) To pped by:	Dia in 6 8 8 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	STEEL	Thickness: Thickness: From:ft	Thickness in Outputh: Depth: (bgl) To:	Shoe V/CS 2 O ft 2 in ft in ft (bgl)	From ft (bgl)	To ft (bgl)	in S Open bc cope Stainless st Continuous iil Plug ft To: rial: Detion 306	Pipe si eel [slot] ft data: ft in oc)	Uncased h ze Plastic Slotted Plate Oth Tr Finished we Depth to bed Estimated w	ole Other (specif Perforated p er (specify): _ ickness: I depth: I depth: I depth: I depth:	y):i
From ft (bgl) Surface so Method of Backfill: T iner: D Diameter: From: Diameter: From: Air liftin Other Notes: Well yi	To ft (bgl) 302 eal: Type:f installation ype: PVC ft (bgl) To pped by: ng Sur (specify): ield esti	Dia in 6 R C R C R C R C R C R C R C R C R C R C	STEEL	Thickness: Thickness: Thickness: Thickness: Thickness: Thickness: Thickness: Thickness: Thickness: Thickness:	Thickness in Outputh: Depth: Depth: (bgl) To: ng	Shoe V/CS 2 O ft 2 in ft in ft (bgl)	From ft (bgl)	To ft (bgl)	in S Open bc cope Stainless st Continuous iil Plug ft To: rial: Detion of 30 ft (bt	Pipe si eel [slot] ft data: ft in oc) USgp	Uncased h ze Plastic Slotted Plate Oth Th Finished we Depth to bed Estimated w m, or Artesian	ole Other (specify): _ ickness: I depth: Irock: ell yield: pressure:	y): oipe 0.6ft (bg ft (bg ft (bg
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number of factors, including natural variability, human activities and condition of the works, which may change over time.

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Surface se Aethod of Backfill: Ty iner: F Diameter: rom: Develo Air liftin Other (lotes: Nell yie SWL befor Dbviou Fresh Colour/odc Nell dr Lame (fin Registrati Consultar ECLARAT as been do	installation rpe: pvC ft (bgl) To ped by: g Sun specify): eld estin g Air s water S sally bur: st, last) (on no. (so tt (if applic rion: well one in acco	B C. B C. D ther (speci- in b: ft (bgl ging Jett mated by lifting B; U ft (bgl clear D Clear D Clea	MTOMIN Pumped fy): Perforated: F ing Pumpia r: ailling Cthe Sgpm Duratic foc) Pumping: characteris Charact		ft Intake in Screen ft Screen ft Screen in Screen ft Screen	type: Tele material: opening: bottom: Back: From: nd size of mat well com epth drilled: tick up: n flow: f well cap: well ID plate is closure in f well cosure: of closure: of closure (see of work (Y	Open bottom scope Pipe Stainless steel Continuous slot ail Plug ft To: ft ail: Pletion data ft Goin ft (btoc) USg CATU s attached: formation: Poured Pu note 17): YYY/MM/DD):	size Plastic Other (spec Stotted Plate Other (specify): Ihickness: a: Finished well depth: Depth to bedrock: Estimated well yield: gpm, or Artesian pressure: Well disinfecte Mumu	fy): pipe 5 2 ft (ft (5 USg d:] Yes [
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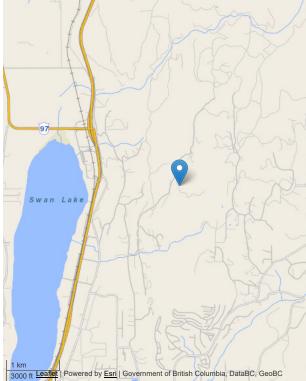
BRIT			Vell Construc Vell Closure I	tion Repo Report	St	amp comp	DRILL Dany name/ad mail here, if d		Ministr	y Well Ta	Plate Number ag Number: /alternative sp	245	rs '
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CONTRACTOR OF THE OWNER OF THE			minimum manda					S	ee reverse	e for note	es & definition	is of abbi	reviations.
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lailing a Vell Loca	ddress: ation: Ad	S&	66 <u>R066</u> Street no. <u>826</u>	K R St	V reet nam	eROLI					Prov. BE.F		e <u>V1133</u>
or) Legal	descript	tion: Lot	5_Plan 24	652	reet nam	D.L	.384 Block				Land Di		DVD
			S/ and Descri				ketch, if nec.):						
AD 83:	Zone:			orthing:			m		Latitude (see note	3): N.50°	10' 2	45"
see note			- and UTM E				m				90 00'2		
			otary Cable too								ecify):		
	on of wel well (see		tical horizontal	Ground el		ub-class	ft (asl)	Metho	d (see note	e 4):			
			ended water use: 🛃	private domesti				ation 🗌 c	ommercial c	or industria	I 🗌 other (spec	cify):	
CRAMERICA CONTRACTOR	-		ON (see notes 7-1	12.	1201 100				Water-be				
From ft (bgl)	t (bgl) ft (bgl) Hardness List in order of decreasing a						ended terms or	reverse.	Estimated (USgp	Flow O	bservations (e.g vell sorted, silty		
0	8												
8	16			CLAY									
16	20			SANDI									
20	56			SAND			ALITA						
56	161						OWN LA	VERS					
	101		Derivis	2117906	0-11			16.1					
From ft (bgl)	To ft (bgl)	Dia in	Casing Material /	Open Hole Th	Wall hickness in	Drive Shoe	From ft (bgl)	To ft (bgl)	Dia in		Гуре (see note 1	18)	Slot Siz
0	56	6	STEEL	C	0.188	YES							
	eal: Type:		BENJONI		th:	<u>18</u> ft					Uncased hole		
Method of Backfill: Ty		n: 🖵 Pou	ured Dumped	Thickness: Dep	oth:	2 in ft	Screen type Screen mat				lastic 🗌 Othe	r (specify)	
iner: 🗗 f	_	Other (s	specify):								Slotted Per		be
Diameter:		-1_ir		Thickness:	and and an array		Screen bott Filter pack:				te 🗌 Other (sp Thickne		
-rom: 4	≦ft (bgl) I	ο: <u>761</u> π	(bgl) Perforated: I	-rom: <u>121</u> π (b)	gi) io:	<u>6 / π</u> (bgl)	Type and si				THORAT		
Develo	ped by	:					Final we	ell com	pletion	data:			
_	0	rging	Jetting Dumpi	0			Total depth Final stick u		16		inished well dep epth to bedrock	2	4 ft (l
Other (Notes:	(specity):			Total dur	ation:	hrs	SWL:	17	6 ſl (bl		stimated well yie		S O USgr
Nell yi	eld esti	imated	l by:				Artesian flo				or Artesian pres		
		-	Bailing Othe				Type of well				Well dis	sinfected:	Yes
Rate: Au	re test:		USgpm Durati ft (btoc) Pumping			hrs ft (btoc)	Well clo				71100		
Obviou	is wate		ity characteris			,	Reason for		Downood	D			
			Ir Cloudy C				Method of c Sealant mat		r-oured l		d Backfill material	l:	
Colour/odd			ONE	Water sam	ple colle	cted:	Details of clo	osure (see	note 17):				
	riller (pri rst, last)): te 19): DAU	ID SCL	IBL	1							
Registrat	tion no. (s	see note	20): 0000	a la materia	103		Date of v						
			ime and company): tion, well alteration of	well closure as	the case	may be	Started:		106/1	2 0	ompleted: 7	008	106/1
has been d	lone in according to the long state of the long	ordance w	vith the requirements	in the Water Act	and the C	Ground	Comments						
PLEASE N	OTE: The	informatio	n recorded in this we	Ind la report describe	DIA.	ka and hud-		ons at the	ime of con-	truction 1	white: Oustand	convl	
Iteration o	or closure, a	as the cas	e may be. Well yield, ural variability, huma	well performance	e and wat	ter quality ar	e not quarantee	d as they a	re influence	d by a	white: Customer o canary: Driller copy bink: Ministry co	copy y Sheet	tof
182	6.0.	251	132							1		-	



Well Summary

Well Tag Number: 109891 Well Identification Plate Number: 385 Owner Name: ROBERT GALLAWAY Intended Water Use: Private Domestic	Well Subclass:	Observation Well Number: Observation Well Status: Environmental Monitoring System (EMS) ID: Alternative specs submitted: No
Licensing Information		
Licensed Status: Unlicensed	Licence Number:	
Location Information		
Street Address: 7601 MCLENNON ROA Town/City: VERNON	D	1 All Amond
Legal Description:		- II A Man
Lot		ELL & Sty Party
Plan		
District Lot		
Block		A G J MAN
Section		A BALL LAR
Township		
Range		The for the state
Land District		Swan Lake Argent Lake
Property Identification Description (PID)	010911352	AFIR AFF.

Description of Well Location: WELL DESCRIPTION NOT PROVIDED



Geographic Coordinates - North American Datum of 1983 (NAD 83) Latitude: 50.330633 UTM Easting: 341946 **Zone:** 11

Longitude: -119.220767 UTM Northing: 5577751 Coordinate Acquisition Code: (10 m accuracy) Handheld GPS with accuracy of +/- 10 metres

Well Activity

Activity	\$ Work Start Date	\$ Work End Date	\$	Drilling Company	\$ Date Entered	\$
		There has been no act	tivity related	I to this well.		

Well Work Dates

Start Date of	End Date of	Start Date of	End Date of	Start Date of	End Date of
Construction	Construction	Alteration	Alteration	Decommission	Decommission
2014-09-15	2014-09-17				

Well Completion Data

Total Depth Drilled: 220.00 feet	Static Water Level (BTOC): 39.00 feet	Well Cap: WELDED CAP
Finished Well Depth: 220.00 feet	Estimated Well Yield: 30.000 USGPM	Well Disinfected Status: Not Disinfected
Final Casing Stick Up: 12.000 inches	Artesian Flow:	Drilling Method: Air Rotary
Depth to Bedrock: 78.00 feet	Artesian Pressure:	Orientation of Well: VERTICAL
Ground elevation: 2312.00	Method of determining elevation: GPS	

Lithology

From (ft bgl)	To (ft bgl)	Raw Data	Description	Moisture	Colour	Hardness	Observations	Water Bearing Flow Estimate (USGPM)
0.00	4.00	SILT			black	Soft		
4.00	78.00	GRAVEL SILT			brown	Medium		
78.00	80.00	BEDROCK			purple	Medium		
80.00	92.00				white	Medium		
92.00	140.00				green	Medium		
140.00	185.00	BLACK & WHITE				Hard	FRACTURED	2.0000
185.00	218.00	GREEN & WHITE MARBLE				Hard		30.0000
218.00	220.00	BLACK & WHITE QUARTZ & CLAY				Soft		

Casing Details

From (ft)	To (ft)	Casing Type	Casing Material	Diameter	Wall Thickness	Drive Shoe
0.00	80.00		Steel	6.000	0.250	Installed

Surface Seal and Backfill Details

Surface Seal Material: Bentonite clay Surface Seal Installation Method: Poured Surface Seal Thickness: 2.00 Surface Seal Depth:		Backfill Ma Backfill Dej		e Surface Seal:					
Liner Details									
Liner Material: PVC				Liner perfora	tions				
Liner Diameter: Liner Thick		ess:		From		То	То		
Liner from:	Liner to:			180.00 ft		220.00 ft			
Screen Details									
Intake Method:		Installed So	reens						
Type:		From	То	Diameter	Assembly Type		Slot Size		
Material: Opening: Bottom:		There are no records to show							
Well Development									
Developed by:		Developme	ent Total D	uration: 2.00 hours					

Well Yield		
No well yield data available.		
Well Decommission Information	on	
Reason for Decommission: Sealant Material: Decommission Details:	Method of Decommission: Backfill Material:	
Comments		
No comments submitted		
Alternative Specs Submitted: No		
Documents		
No additional documentation available for th	s well.	

Disclaimer

The information provided should not be used as a basis for making financial or any other commitments. The Government of British Columbia accepts no liability for the accuracy, availability, suitability, reliability, usability, completeness or timeliness of the data or graphical depictions rendered from the data.

BRIT COLU Ministry of E	MBIA	🗆 Wel	I Construc I Closure I I Alteration	Report	St	one/fax/e-	any name/a nail here, if lare Dvi	desired.	Ministr	ry Wel	ID Plate Number:	attached
Owner na Mailing a	ame: E address: ation: Ad	deliw 7360 dress: Stree	et no.	Ranch			Town In Bann Block	5	See revers	Tov	otes & definitions of Prov. BL Postal vn Rg. Land District	
or PID: NAD 83: (see note		1111	0	orthing: (325	n (attach sk 1456 1849	retch, if nec.) n n	or	Latitude Longitud	(see no		
Orientation Class of the	on of wel well (see	I: 🗹 vertical note 5):	cable too	Ground	elevation:	178 ub-class	ft (asl) Metho Dom	avating Dd (see note	e 4):	specify):	
Litholo From ft (bgl)	To ft (bgl)	Relative Hardness	(see notes 7-1 Colour	Material Des	cription (Us	se recomme	(see notes 1 ended terms o ount, if applic	n reverse.	Water-be Estimated (USgp	Flow	Observations (e.g., fract well sorted, silty wash)	
76	76		Brawn	Sau	d t Gra	Gruel	avel					
											14 Pum	42' PTest
Casing From ft (bgl)	details To ft (bgl)	Dia Ca in	sing Material /	Open Hole	Wall Thickness in	Drive Shoe	Screen From ft (bgl)	details To ft (bgl)	Dia in		Type (see note 18)	Slot Size
+3 ,	145	8	Steel			Yes	144	155	.8	K-	tacker! See	*n 200
	installation	Other (specif in : ft (bgl)	Pumped	Thickness: De Thickness:	pth:	ft in ft in ft (bgl)	Screen typ Screen ma Screen ope	e: Telesterial: Control terial: Control terial: Control terial: Control terial: Control terial teria	scope Stainless st Continuous ail Plug ft To:	Pipe siz eel [slot [Uncased hole Uncased hole Plastic Other (spee Slotted Perforate Plate Other (specify) Thickness:	d pipe
			ng 🗌 Pumpir	ng 🔲 Bailing Total du		hrs	Total depth Final stick SWL:	udrilled: up:	pletion of 155	ft in oc)	Finished well depth: Depth to bedrock: Estimated well yield:	ft (bgl) ft (bgl) USgpm
Pumpir Rate: SWL befor	ng 🖸 Air re test:	ft (bto	iling Dother Sgpm Duratic Dc) Pumping v characteris	on: water level:		hrs ft (btoc)	Reason for	Il cap: ID plate is sure in closure:	s attached: formatic	d on:	tick-up	ft ed: 🖸 Yes 🗌 No
Fresh Colour/odo	Salty our:	Clear	Cloudy 🗌 S	ediment	Gas mple collec	ted: 🗌	Method of o Sealant ma Details of cl	terial:	Poured [note 17):] Pum	ped Backfill material:	
Registrati Consultar DECLARAT has been do Water Prote	ion no. (se nt (if applic FION: Well of one in accor action Regul	ee note 20): able; name a construction, w dance with the ation.	nd company): vell alteration or e requirements in	well closure, a in the <i>Water Ac</i>	s the case n and the G	nay be, round	Date of started: Comments	2012		15	Completed: 201	0/07/19
PLEASE NO	OTE The in	formation reco the case may ding natural v	ible orded in this well be. Well yield, y ariability, human	report describ vell performan activities and	es the work ce and wate condition of	s and hydrog er quality are the works, v	geologic conditi not guarantee which may char	ons at the t d as they a nge over tin	time of const re influenced ne.	ruction, I by a	white: Customer copy canary: Driller copy pink: Ministry copy	heetof



Well Summary

wen Summary		
Well Tag Number: 111905 Well Identification Plate Number: 39422 Owner Name: KLAUS HOLLENBACH Intended Water Use:	Well Status: New Well Class: Water Supply Well Subclass: Aquifer Number:	Observation Well Number: Observation Well Status: Environmental Monitoring System (EMS) ID: Alternative specs submitted: No
Licensing Information		
Licensed Status: Unlicensed	Licence Number:	
Location Information		
Street Address: 7616 MCLENNAN ROAD Town/City: VERNON Legal Description:		
Lot		
Plan		
District Lot		Belginan Rd
Block		
Section		
Township		
Range		
Land District		
Property Identification Description (PID)		
Description of Well Location: SUBDIVISION OF	THE #7616	



300 ft Leaflet Powered by Esri | Government of British Columbia, DataBC, GeoBC

Coordinate Acquisition Code: (10 m accuracy) Handheld GPS with accuracy of +/- 10 metres

Well Activity

Activity 1	Work Start Date	\updownarrow	Work End Date	\$	Drilling Company	\$ Date Entered	\updownarrow
			There has been no activity rela	ted	l to this well.		

Well Work Dates

Start Date of	End Date of	Start Date of	End Date of	Start Date of	End Date of
Construction	Construction	Alteration	Alteration	Decommission	Decommission
2014-05-15	2014-05-20				

Well Completion Data

Total Depth Drilled: 420.00 feet	Static Water Level (BTOC): 101.00 feet	Well Cap: ALUMINUM
Finished Well Depth: 420.00 feet	Estimated Well Yield: 30.000 USGPM	Well Disinfected Status: Disinfected
Final Casing Stick Up: 21.000 inches	Artesian Flow:	Drilling Method: Air Rotary
Depth to Bedrock: 7.00 feet	Artesian Pressure:	Orientation of Well: VERTICAL
Ground elevation: 2269.00	Method of determining elevation: GPS	

Lithology

From (ft bgl)	To (ft bgl)	Raw Data	Description	Moisture	Colour	Hardness	Observations	Water Bearing Flow Estimate (USGPM)
0.00	6.00	CLAY AND ROCKS			brown			
6.00	420.00	BEDROCK					400'=6-10 GPM	
385.00								2.0000
415.00							FRACTURED	28.0000

Casing Details

From (ft)	To (ft)	Casing Type	Casing Material	Diameter	Wall Thickness	Drive Shoe
0.00	18.00		Steel	6.000	0.219	Installed

Surface Seal and Backfill Details

Surface Seal Material: Bentonite clay Surface Seal Installation Method: Poured Surface Seal Thickness: 1.00 Surface Seal Depth:		Backfill Ma Backfill De		ve Surface Seal:			
Liner Details							
Liner Material: PVC				Liner perfora	tions		
Liner Diameter:	Liner Thickness:			From		То	
Liner from:	Liner to:			380.00 ft		420.00 ft	
Screen Details							
Intake Method:		Installed S	creens				
Туре:		From	То	Diameter	Assembly Type		Slot Size
Material: Opening:			1	Th	ere are no records to sho	w	

Well Develo	pment

Developed by:

Bottom:

Development Total Duration:

Well Yield

No well yield data available.

Reason for Decommission: Sealant Material: Decommission Details:	Method of Decommission: Backfill Material:
Comments	
LINER PERFORATED=ALSO 220	
Alternative Specs Submitted: No	
Documents	
No additional documentation available for this well.	
Disclaimer	

The information provided should not be used as a basis for making financial or any other commitments. The Government of British Columbia accepts no liability for the accuracy, availability, suitability, reliability, usability, completeness or timeliness of the data or graphical depictions rendered from the data.



Well Status: New

Well Subclass:

Aquifer Number:

Licence Number:

Well Class: Water Supply

Well Summary

Well Tag Number: 111907	
Well Identification Plate Number: 39418	
Owner Name: KEVIN FRAME	
Intended Water Use: Private Domestic	

Licensing Information

Licensed Status: Unlicensed

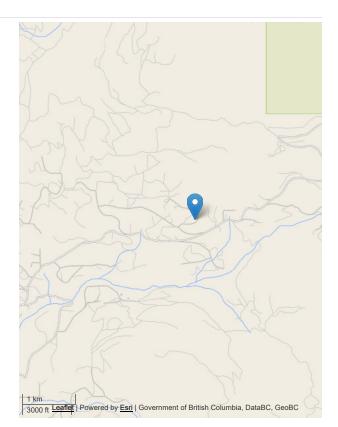
Location Information

Street Address: 8267 ROGERS ROAD Town/City: VERNON

Legal Description:

Lot	2
Plan	24658
District Lot	3848
Block	
Section	
Township	
Range	
Land District	41
Property Identification Description (PID)	005869940

Description of Well Location: NOT PROVIDED



Observation Well Number:

Alternative specs submitted: No

Environmental Monitoring System (EMS) ID:

Observation Well Status:

Geographic Coordinates - North American Datum of 1983 (NAD 83) Latitude: 50.325617 Longitude: -119.156429

UTM Easting: 346508 UTM Zone: 11 Coo acc

Longitude: -119.156429 UTM Northing: 5577059 Coordinate Acquisition Code: (10 m accuracy) Handheld GPS with accuracy of +/- 10 metres

Well Activity

Activity	tivity 1 Work Start Date 1 Work End Date 1 Drilling Company 1 Date Entered							\$	
				There has been no act	ivity related	to this well.			

Well Work Dates

Start Date of	End Date of	Start Date of	End Date of	Start Date of	End Date of
Construction	Construction	Alteration	Alteration	Decommission	Decommission
2014-05-01	2014-05-05				

Well Completion Data

Total Depth Drilled: 122.00 feet	Static Water Level (BTOC): 41.00 feet	Well Cap: ALUMINUM
Finished Well Depth: 121.00 feet	Estimated Well Yield: 10.000 USGPM	Well Disinfected Status: Disinfected
Final Casing Stick Up: 36.000 inches	Artesian Flow:	Drilling Method: Air Rotary
Depth to Bedrock:	Artesian Pressure:	Orientation of Well: VERTICAL
Ground elevation: 3200.00	Method of determining elevation: GPS	

Lithology

From (ft bgl)	To (ft bgl)	Raw Data	Description	Moisture	Colour	Hardness	Observations	Water Bearing Flow Estimate (USGPM)
0.00	13.00	CLAY AND ROCKS			brown			
13.00	16.00	BOULDER						
16.00	40.00	CLAY AND ROCKS			brown			
40.00	42.00	GRAVEL						
42.00	90.00	CLAY AND ROCKS			blue			
90.00	96.00	CLAY AND ROCKS			brown			
96.00	115.00	CLAY AND ROCKS			blue		110'=5-8 GPM WITH PUMP PROTECTION	
115.00	121.00	SAND AND GRAVEL			brown			

Casing Details

From (ft)	To (ft)	Casing Type	Casing Material	Diameter	Wall Thickness	Drive Shoe
0.00	116.50		Steel	6.000	0.219	Installed

Surface Seal and Backfill Details

Surface Seal Material: Bentonite clay Surface Seal Installation Method: Poure Surface Seal Thickness: 1.00 Surface Seal Depth:		aterial Above Surface Seal: epth:	
Liner Details			
Liner Material:		Liner perforations	
Liner Diameter: Liner from:	Liner Thickness: Liner to:	From	То
Line nom.	Line to.	Th	ere are no records to show
Screen Details			

Installed Screens

Intake Method:	From	То	Diameter	Assembly Type	Slot Size
Screen Type: Telescope	115.00 ft	117.00 ft	6.00	K_RISER	0.00
Material: Stainless Steel	117.00 ft	121.00 ft	6.00	SCREEN	12.00
Opening: Continuous Slot					
Bottom: Plug					
Well Development					
Developed by:	Development	Total Duration:			
Well Yield					
No well yield data available.					
Well Decommission Information					
Reason for Decommission: Sealant Material: Decommission Details:	Method of Dec Backfill Materi				
Comments					
SCREEN TYPE(117-121)=SCREEN & PLUG					
Alternative Specs Submitted: No					
Documents					
No additional documentation available for this well.					
Disclaimer					

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Well Summary

Well Tag Number: 111951 Well Identification Plate Number: 39417 Owner Name: AL REUMAYR Intended Water Use: Private Domestic

Licensing Information

Licensed Status: Unlicensed

Licence Number:

Well Status: New

Well Subclass:

Aquifer Number:

Well Class: Water Supply

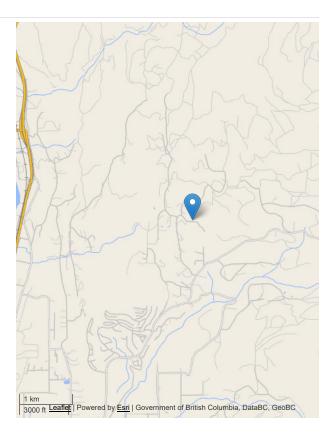
Location Information

Street Address: 7811 WILSON JACKSON ROAD Town/City: VERNON

Legal Description:

005905265

Description of Well Location: SOUTHEAST CORNER OF THE PROPERTY



Observation Well Number:

Alternative specs submitted: No

Environmental Monitoring System (EMS) ID:

Observation Well Status:

Geographic Coordinates - North American Datum of 1983 (NAD 83) Latitude: 50.325301 Longitude: -119.199676 UTM Easting: 343429 **Zone:** 11

UTM Northing: 5577114 Coordinate Acquisition Code: (10 m accuracy) Handheld GPS with accuracy of +/- 10 metres

Well Activity

Activity	\updownarrow	Work Start Date	\$ Work End Date	\$	Drilling Company	\$ Date Entered	\$
			There has been no act	ivity related	to this well.		

Well Work Dates

Start Date of	End Date of	Start Date of	End Date of	Start Date of	End Date of
Construction	Construction	Alteration	Alteration	Decommission	Decommission
2014-04-24	2014-04-30				

Well Completion Data

Total Depth Drilled: 640.00 feet	Static Water Level (BTOC): 260.00 feet	Well Cap: ALUMINUM
Finished Well Depth: 640.00 feet	Estimated Well Yield: 3.500 USGPM	Well Disinfected Status: Disinfected
Final Casing Stick Up: 24.000 inches	Artesian Flow:	Drilling Method: Air Rotary
Depth to Bedrock: 57.00 feet	Artesian Pressure:	Orientation of Well: VERTICAL
Ground elevation: 2752.00	Method of determining elevation: GPS	

Lithology

From (ft bgl)	To (ft bgl)	Raw Data	Description	Moisture	Colour	Hardness	Observations	Water Bearing Flow Estimate (USGPM)
0.00	7.00	RED/BROWN CLAY AND ROCKS						
7.00	22.00	CLAY AND ROCKS			brown			
22.00	57.00	CLAY AND ROCKS			blue			
57.00	640.00	BEDROCK					575'-600', BEDROCK, 3.25 USGPM; 620'=4-8 GPM WITH PUMP PROTECTION	

Casing Details

From (ft)	To (ft)	Casing Type	Casing Material	Diameter	Wall Thickness	Drive Shoe
0.00	57.00		Steel	6.000	0.219	Installed

Surface Seal and Backfill Details

Surface Seal Material: Bentonite clay Surface Seal Installation Method: Poured Surface Seal Thickness: 1.00 Surface Seal Depth:	1	Backfill Mate Backfill Dept	erial Above Su th:	rface Seal:			
Liner Details							
Liner Material: PVC				Liner perforation:	s		
Liner Diameter:	Liner Thickness: Liner to:			From		То	
Liner from:				620.00 ft		640.00 ft	
Screen Details		Installed Scr	eens				
Type:		From	To D	iameter	Assembly Type		Slot Size
Material: Opening: Bottom:				There a	are no records to show	V	
Well Development							
Developed by:		Developmer	nt Total Durat	ion:			
Well Yield							
No well yield data available.							

Well Decommission Information	'n	
Reason for Decommission: Sealant Material:	Method of Decommission: Backfill Material:	
Decommission Details:		
Comments		
LINER PERFORATED=ALSO 400, 500 & 600		
Alternative Specs Submitted: No		
Documents		
No additional documentation available for th	s well.	
Disclaimer		

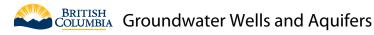
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37988 WELL LOG CONSTRUCTION RECORD OWNER Ray Juguan Well Location_ dapen RA Silver Son Date Completed Clay 2 5-77 Date Started_ til 5 Willdu Drilling Method Call Driller Mohomen Helper C JL 404 Lenk Bor File_____ _ Folio_ Signed By____ CASING RECORD LOG OF FORMATIONS Dia.____ins. Wt.____#/ft. From____to__ Descriptions Depth Dia.____ins. Wt _____#/ft. From_____to___ 0_ to 177 Dia.____ins. Wt.____#/ft. From_____to__ _____ to _____ Shoe_____ Welded_____ Cemented___ to _____ 177 to 19,-SCREEN RECORD _ to _____ Make_____ Material_____ Slot opening_____ Length_____ ____ to _____ Top_____ft. Bottom_____ft. ____ to ___ Fittings Top_____ Fittings Bottom___ ____ to ____ ____ to ____ Gravel Pack_____Natural____ to ____ Development Method to ____ ROCK WELL DATA ____ to ____ Open Bore Hole The Dia. 6 ins ___ to ____ From 177 ft. to 194 ft __ to ___ ____ to _____ PRODUCTION DATA Static Level 130 /1 _ft ____ to ____ Measured from Singles to ____ Pumping Level ______ / 9 U ft. at _____ GPM ____ to ___ _____ft. at_____GPM ____ to ___ Bail Test ______ I 9 0 ft. at 10 GPM _ to __ _____ft. at_____GPH ____ to _____ Recommended Pump Setting 190 ___ft. ___ to ____ Recommended Max. Pump Output 16 GPM _ to ____ GPH to _ Duration of Test Hrs ___ to _____ to PUMP DATA Make____ Type_ _ to __ Model_____ Serial No.___ **GENERAL REMARKS** Size_____ HP____ Drop Pipe____ ins _____ Head_____ ft.____ RPM GPM Motor_____Volts____PH___ Well Seal _____ San april 1 Water Analysis — Hardness_____ PPN PPN PH_____ Iron____

and the second second

82887 MCHARG DR SITE 20, COMP. 23, R.R. 3 🗆 SALMON ARM, B.C. 🗆 V1E 4M3 TELEPHONE 832-3264
MOBILE H497066 26 Date Dec.16 Telephone ____ 16 Owner's Name ogermai Como C. VIT 616 R.R. 3. Vernen, B. Address SIL C Location 211 Hole No. Two 192 - 200 they to der a a set navel & same 200 Total Depth ____ 1. Casing Size Type Tree Set From LINER. Casing Size _ 5/2 Type 37686 Set From 1734 STAR Length 1. Screen Stainess Slot 2. Screen _ Length __ Slot Set SECTIONS From ______82 To Pump Tested Han Lift GPM* ___ Draw Down ___ 457 Recommended Pumping Rate _ Static Water Level 14 Recommended Pump set at ft. Drilling 20 Casing Screen(s) Drive Shoe K-Packer ric Developing Other DCA Total Cost of Well Amount Paid Balance ___ **Owner's Signature** McHARG DRILLING LTD. Per _ Terms: Cash. 2% per month or 24% per annum charged on overdue accounts.

*ESTIMATE ONLY - For accuracy, a pump test is required.



Well Summary

Well Tag Number: 111938 Well Identification Plate Number: 394 Owner Name: RICHARD & THOMAS TUL Intended Water Use: Private Domestic		Observation Well Number: Observation Well Status: Environmental Monitoring System (EMS) ID: Alternative specs submitted: No
Licensing Information		
Licensed Status: Unlicensed	Licence Number:	
Location Information		
Street Address: 8283 ROGER ROAD Town/City: VERNON Legal Description:		F CA
Lot Plan		Anglia
District Lot		
Block		A KAND &
Section		WARTY P
Township		ARTIN - An
Range		A China >>
Land District		i mana and a second
Property Identification Description (PID)	006552862	Had Al

Description of Well Location: NOT PROVIDED



Geographic Coordinates - North American Datum of 1983 (NAD 83) Latitude: 50.324183 Longitude: -119.157109 UTM Easting: 346455 UTM Northing: 5576901 **Zone:** 11

Coordinate Acquisition Code: (10 m accuracy) Handheld GPS with accuracy of +/- 10 metres

Well Activity

Activity	\$	Work Start Date	\$	Work End Date	\$	Drilling Company	\$	Date Entered	\$		
	There has been no activity related to this well.										

Well Work Dates

Start Date of	End Date of	Start Date of	End Date of	Start Date of	End Date of
Construction	Construction	Alteration	Alteration	Decommission	Decommission
2014-09-29	2014-10-02				

Well Completion Data

Total Depth Drilled: 260.00 feet	Static Water Level (BTOC): 55.00 feet	Well Cap: ALUMINUM
Finished Well Depth: 260.00 feet	Estimated Well Yield: 4.000 USGPM	Well Disinfected Status: Disinfected
Final Casing Stick Up: 16.000 inches	Artesian Flow:	Drilling Method: Air Rotary
Depth to Bedrock: 179.00 feet	Artesian Pressure:	Orientation of Well: VERTICAL
Ground elevation: 3179.00	Method of determining elevation: GPS	

Lithology

From (ft bgl)	To (ft bgl)	Raw Data	Description	Moisture	Colour	Hardness	Observations	Water Bearing Flow Estimate (USGPM)
0.00	32.00	CLAY AND ROCKS			brown			
32.00	168.00	CLAY AND ROCKS			blue			
168.00	179.00	GRAVEL, SILT AND CLAY			grey			
179.00	260.00	BEDROCK					230'=4 USGPM, VERY FRACTURED; 230'=4-6 GPM WITH PUMP PROTECTION	

Casing Details

From (ft)	To (ft)	Casing Type	Casing Material	Diameter	Wall Thickness	Drive Shoe
0.00	179.00		Steel	6.000	0.219	Installed

Surface Seal and Backfill Details

Surface Seal Material: Bentonite clay Surface Seal Installation Method: Poured Surface Seal Thickness: 1.00 Surface Seal Depth: Liner Details		Backfill Material Above Surface Seal: Backfill Depth:				
Liner Material: PVC Liner Diameter: Liner Thickness: Liner from: Liner to:			Liner perforations			
		ess:	From	То		
			220.00 ft	260.00 ft		

Screen Details

Intake Method:	Installed Se	Installed Screens						
Туре:	From	То	Diameter	Assembly Type	Slot Size			
Material: Opening:		There are no records to show						
Bottom:								
Well Development								

Developed by:

Development Total Duration:

Well Yield						
No well yield data available.						
Well Decommission Information						
Reason for Decommission: Sealant Material: Decommission Details:	Method of Decommission: Backfill Material:					
Comments						
LINER PERFORATED=ALSO 140						
Alternative Specs Submitted: No						
Documents						
No additional documentation available for this well.						

Disclaimer

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	A SOUNCE DRILLING LTD Vell ID Plate Number: 503/0 2307 - 36th Ave. Ministry Well ID Plate Number: 113 299 Ministry Well Tag Number: 113 299 Confirmation/alternative specs. attached
Red lettering indicates minimum mandatory information. See reverse for	
Owner name: Tim A Boulter	11
Mailing address: <u>7961</u> <u>51097</u> <u>5707</u> <u>R</u> Town Well Location (see note 2): Address: Street no. <u>7961</u> Street name <u>510</u>	Usernon Prov. Postal Code VIB 3MZ
Or Legal description: Lot Plan D.L.	Block Sec. Twp. Rg. Land District
OPID: and Description of well location (attach sk	· · · · · · · · · · · · · · · · · · ·
property near Wilson Jackson	Road
NAD 83: Zone: 1 a2 83 (and) UTM Easting: 1190 11, 59	Latitude (see note 4): 50 19 42
(see note 3) UTM Northing: JO 11.101	
Method of drilling: ■ air rotary □ dual rotary □ cable tool □ mud rotary Orientation of well: ■ vertical □ horizontal Ground elevation: 302.7	t (asl) Method (see note 5): 6PS
Class of well (see note 6): (10512 Loop Gootham	
Water supply wells: indicate intended water use: Drivate domestic water supply	
Lithologic description (see notes 8-13) or closure description (see	notes 14 and 15)
Surficial Material Bedrock Material Col	
Etrophysical and a second a	Characteristics of the second
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7 7 7 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
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000000000000000000000000000000000000000	00000000000
Casing details	Screen details
From To Dia Casing Material/Open Hole Wall Drive ft (bgl) ft (bgl) in (see note 17) Thickness Shoe	From To Dia Type Slot Size ft (bgl) ft (bgl) in (see note 18) Slot Size
0 236 6 STEEL .219 V 236 700 6/8 Open Hule	
Surface seal: Type: Banton ta Depth: 20 ft	Intake: Screen Open bottom Uncased hole
Method of installation: Poured Pumped Thickness: 4 in	Screen type: Telescope Pipe size
Backfill: Type: ft	Screen material:
Liner: DVC Other (specify):	Screen opening: Continuous slot Slotted Perforated pipe
Diameter: in Thickness: in	Screen bottom: Bail Plug Plate Other (specify):
From: ft (bgl) To: ft (bgl) Perforated: From: ft (bgl) To: ft (bgl)	Filter pack: From:ft To:ft Thickness:in
	Type and size of material:
Developed by:	Final well completion data:
□ Air lifting □ Surging □ Jetting □ Pumping □ Balling Other (specify): Total duration: hrs	Total depth drilled: 100 ft Finished well depth: 100 ft (bgl) Final stick up: 24 in Depth to bedrock: 21.8 ft (bgl)
Votes:	SWL: ft (btoc) Estimated well yield: 4/4 USgpm
Nell yield estimated by:	Artesian flow: USgpm, or Artesian pressure: ft
□ Pumping □ Air lifting □ Bailing □ Other (specify):	Type of well cap: Ventral Well disinfected: Sy Yes INo
Rate: USgpm Duration: hrs	Where well ID plate is attached: To Casing
SWL before test: ft (btoc) Pumping water level: ft (btoc)	Well closure information:
Obvious water quality characteristics:	Reason for closure:
Fresh Salty Clear Cloudy Sediment Gas	Method of closure: Poured Pumped
Colour/odour: Water sample collected:	Sealant material: Backfill material: Details of closure (see note 16):
Well driller (print clearly): Name (first, last) (see note 19): Waltzr Hour	
Registration no. (see note 19): 050 81001	
Consultant (if applicable; name and company):	
	Date of work (YYYY/MM/DD):
DECLARATION: Well construction, well alteration or well closure, as the case may be, has been done in accordance with the requirements in the WaterAct and the Ground Water Protection Regulation.	Started: 2016 10 21 Completed: 2016 11 01
In accordance with the requirements in the water Act and the Ground water Protection Regulation. Signature of	Comments:
SE NOTE: The information recorded in this well report describes the works and hydrogeologic condit	Neer at the time of exceloration alternative in white. Availage areas in
	tions at the time of construction, alteration vhite: Customer copy canary: Driller copy



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