31 July 2019 Reference No. 1899915-001-L-Rev0

Laura Beckett, Municipal Planner, MURP, MCIP, RPP
Municipal Planner, Deputy Approving Officer
District of Highlands
1980 Millstream Road
Victoria, BC V9B 6H1

RESULTS OF 2018 GROUNDWATER LEVEL MONITORING PROGRAM, DISTRICT OF HIGHLANDS, BC

Dear Ms. Beckett,

As requested by the District of Highlands (the District), Golder Associates Ltd. (Golder) conducted a groundwater level monitoring program in the District of Highlands, BC (the Highlands) for 2018. Golder conducted the work in accordance with our proposal titled "Work Plan and Cost Estimate for 2018 Groundwater Level Monitoring Program, District of Highlands, BC" (Golder Reference No. P1899915-001-P-Rev0) and dated 18 May 2018.

Our letter should be interpreted and used in accordance with the limitations and considerations set out in Golder Associate Ltd.'s *Study Limitations*, provided at the end of this letter.

1.0 BACKGROUND AND OBJECTIVE

The Highlands is one of 13-member municipalities of the Capital Regional District (CRD), encompassing approximately 37 square km and located northwest of Victoria, BC. The majority of the residential population of approximately 2,120 obtains potable water from private, individual water wells. Commercial groundwater use is limited to the southern portion of the Highlands. The Hanington Estates subdivision, located along the southern portion of the Highlands, obtains water from a water system ("Hanington Estates Water System") that is supplied by two communal supply wells. Irrigation water for the Bear Mountain Golf Course (Bear Mountain) is sourced from groundwater wells located within the Highlands. Some businesses within the Millstream Industrial Park, located in the Highlands and Langford, also use groundwater for commercial purposes.

Golder Associates Ltd.
2nd floor, 3795 Carey Road Victoria, British Columbia, V8Z 6T8 Canada T: +1 250 881 7372 +1 250 881 7470

1.1 Aquifer Description

Groundwater supplies within the Highlands are derived primarily from drilled wells completed in the Wark-Colquitz Aquifer. This bedrock aquifer is identified as Aquifer No. 680 by the BC Ministry of Environment and Climate Change Strategy (ENV) and is categorized as class IIB under the BC Aquifer Classification System, indicating moderate demand relative to aquifer productivity and moderate vulnerability of the aquifer to contamination from surface sources.

Sewage servicing within the Highlands is primarily by individual septic systems.

1.2 Highlands Monitoring Program

On behalf of the District, Golder initiated a groundwater level monitoring program in the Highlands in 2009 in support of the District's Groundwater Protection Study. The water level information was used to assess seasonal groundwater level variations and, in 2012, to refine the numerical groundwater model that Golder developed and calibrated. The refined numerical model was then used to develop groundwater conservation and protection measures. At the completion of the Groundwater Protection Study, Golder recommended that the District continue to monitor groundwater conditions at select locations in the Highlands to assess long term trends. If trends were to be observed, the results would provide the basis for guiding implementation of management strategies including conservation and groundwater protection measures, and public education efforts. Further details are provided in Golder's report titled "Phase 3: Groundwater Protection Study District of Highlands, District of Highlands Victoria, BC" (Golder Report No. 0714140014-501-R-Rev2-3000) and dated 18 December 2012.

The groundwater monitoring program has been continued since 2009 to the present. At the end of 2018, electronic data loggers (i.e., pressure transducers) were deployed in five monitoring wells located across the Highlands to collect continuous water level data at strategic locations, and one additional pressure transducer (a "barologger") is present to monitor changes in barometric (i.e., atmospheric) pressure. The locations of monitoring wells DOH-01, DOH-03, DOH-04B, DOH-07B and DOH-09A are presented on attached Figure 1. Monitoring Well DOH-02A, which had been included in the monitoring program since 2009, was removed from the monitoring program in February 2018 at the property owner's request. The location of DOH-02A is also shown on Figure 1.

Monitoring wells DOH-02A, DOH-07B and DOH-09A are unused wells that are not equipped with pumps (i.e., are not in operation). Therefore, the water levels in these wells are generally considered to be representative of static groundwater levels in the aquifer in the vicinity of the wells.

DOH-03 and DOH-04B are equipped with pumps and operated as supply wells for non-potable uses (i.e., not for drinking water). Although DOH-01 is an unused well, the water level in this well is influenced by pumping in an adjacent well. Water levels in DOH-01, DOH-03 and DOH-4B are not considered representative of the water levels in the surrounding aquifer during periods of pumping; however, the high water levels that represent static (i.e., non-pumping) periods provide a basis to assess groundwater conditions in the areas of these wells.

1.3 Objective

The objective of the 2018 groundwater level monitoring program was to compile and analyse data from the Highlands and stakeholder monitoring programs to assess regional groundwater conditions and potential long-term trends.

2.0 METHODS

2.1 Groundwater Level Monitoring

The transducers that are installed in the Highlands monitoring wells, including the barologger that is deployed at monitoring location DOH-01A, are programmed to collect data every twelve hours. Under the current program, Golder downloaded pressure transducer data and collected a manual depth-to-water measurement at each monitoring location in the Highlands on 29 May 2018, 12 September 2018 and 3 January 2019. Golder also downloaded transducer data and collected water level measurements at the monitoring wells earlier in the year on 27 February 2018 as part of the 2017 monitoring program.

As requested by the well owner, the well at monitoring location DOH-02A was removed from the monitoring program. During the 27 February 2018 monitoring event, Golder removed the transducer from DOH-02A. Removal of this well from the program is not considered to be a significant gap in the monitoring network, as monitoring well DOH-04B and ENV Observation Well No. 372 (ENV Well No. 372) located approximately 980 m northwest and 810 m north from DOH-02A, respectively, provide coverage for the western portion of the Highlands. If an additional well in the western portion of the Highlands at a relatively high elevation (e.g., greater than 240 m above sea level; asl) were to be available for monitoring, it could be added to the monitoring well network as a replacement for DOH-02A.

2.2 Data Compilation and Analysis

In addition to the District's monitoring program, Golder also obtained data from other stakeholder monitoring programs in the Highlands including:

- ENV Observation Well Network: water level data available on-line from ENV Well No. 372, located in the western portion of the Highlands
- Hanington Estates Water System: flow data available from Island Flow Control Water Solutions Ltd. (IFCWS) for the Hanington Estates Water System, in the southern portion of the Highlands
- Bear Mountain Monitoring Program: water level and flow data available from Ecoasis Developments LLP for the Bear Mountain Golf and Country Club in the southern portion of the Highlands
- University of Victoria (UVic) School-Based Weather Station Network: data available on-line for UVic weather stations, located at various areas of the Highlands, as described below

The locations of the monitoring wells and weather stations from the various stakeholder monitoring programs are presented on attached Figure 1.

Golder compiled the raw pressure data from the Highlands monitoring wells and corrected the data for variations in barometric pressure, as recorded by the barologger, to calculate depths to groundwater levels for each Highlands monitoring well. Golder also compiled water level data available from ENV Well No. 372. Golder compiled data from the UVic weather stations that have been analysed during previous years; however, limited precipitation data were available for some of the weather stations. Therefore, similar to recent annual monitoring programs, Golder compiled precipitation data from weather stations with available data as follows:

- Southern Highlands: Water level data for DOH-01 and DOH-03 were compared to precipitation data for the District of Highlands Office weather station, adjacent to DOH-03, for the period up to 31 January 2016 and the Millstream Elementary School weather station for the period 1 February 2016 to 31 December 2018. The Millstream Elementary School station is located approximately 1.4 km to the south of, and at an elevation 24 m lower than, the District of Highlands Office station (Figure 1).
- Western Highlands: For the period 1 January 2012 to 28 February 2017, water level data for DOH-02A, DOH-04 and ENV Well No. 372 were compared to precipitation data from the West Highlands District Firehall weather station, located approximately 200 m northwest from DOH-04. Beginning in March 2017, data for the West Highlands District Firehall Station were only available for certain periods. Therefore, data from the Calle Revelle Nature Sanctuary Weather Station, located approximately 3.5 km northeast of the West Highlands District Firehall station were compared to water level data from DOH-02A, DOH-04 and ENV Well No. 372 for the period 1 March 2017 to 31 December 2018.
- Eastern Highlands: Water level data for DOH-09A had been compared to precipitation data for the East Highlands District Firehall weather station up until 31 May 2014, after which data were no longer available for the station. For the period 1 June 2019 to 31 December 2018, water level data from DOH-09A were compared to precipitation data from the Calle Revelle Nature Sanctuary Weather Station, located approximately 4 km northwest from DOH-09A.

Data from the Highlands and stakeholder monitoring programs were plotted and the results analysed to assess seasonal and long term trends.

Golder also reviewed flow data for the Hanington Estates Water System, as provided by IFCWS, and the results from the Bear Mountain Monitoring Program presented in the report prepared by Western Water Associates Ltd. (WWAL) titled “Bear Mountain 2017-2018 Annual Groundwater Monitoring Report” (WWAL File No. 16-092-01) and dated 8 May 2019. Golder did not conduct a detailed review of the data presented in WWAL’s report. Rather, Golder assessed the results from the Bear Mountain Monitoring Program in the context of the regional groundwater system.

3.0 RESULTS AND DISCUSSION

3.1 District of Highlands Monitoring Program

Detailed water level data for monitoring wells DOH-01, DOH-02A, DOH-03, DOH-04B, DOH-07B and DOH-09A for the period from 1 January 2012 through 31 December 2018, together with daily precipitation data from nearby weather stations, are presented on Figures 2 through 7. The precipitation data are provided to illustrate the relationship between precipitation and groundwater levels. As discussed in Section 2.2, data from the District of Highlands Office and East Highlands District Firehall weather stations, which had been used during previous monitoring years to assess precipitation in the southern and eastern portions of the Highlands, respectively, were supplemented with precipitation data from nearby stations within the UVic School-Based Weather Station Network. Although it is expected that there is some variability in precipitation patterns across the Highlands, the precipitation data presented on Figures 2 through 7 are considered suitable for the purposes of assessing general groundwater level patterns. Furthermore, groundwater recharge into the bedrock aquifer is interpreted to be controlled by the properties of the bedrock and not necessarily the intensity of specific precipitation events. Therefore, it is anticipated that minor changes in precipitation in different areas of the Highlands would not necessarily be reflected in water level data.

Similar to previous years, in 2018 the water levels that were recorded in the majority of the Highlands monitoring wells were consistent with seasonal precipitation patterns that were observed in previous years. Groundwater elevations were highest in the wet winter months of December to April, declining to a seasonal low during the dry summer period from May to early September before increasing in response to precipitation between September and November. Seasonal responses in 2018 ranged from approximately 5.5 m in DOH-01 and DOH-07B to approximately 3.1 m in DOH-03.

In 2018, less precipitation was recorded during the summer compared to previous monitoring years. The total precipitation of 36.8 mm that was reported for the Calle Revelle Nature Sanctuary weather station from May through August 2018 was less than what had been reported for the same months since the Highlands monitoring program began in 2009, with values ranging from 45.8 mm in the summer of 2015 to 139.5 mm in the summer of 2010. Similarly, precipitation at the Millstream Elementary School weather station was reported to be 32.4 mm from May to August 2018 compared to values of 53.1 mm and 57.1 mm that were reported for the same period in 2016 and 2017, respectively.

As noted in Section 2.1, DOH-02A was removed from the monitoring program in February 2018. Up until the time when monitoring was discontinued, the water level in this well exhibited a seasonal pattern that was consistent with previous years.

The water level in monitoring well DOH-01 is influenced by pumping in one or more nearby wells and DOH-03 is periodically pumped to supply water to the District office. The inferred static groundwater levels that were measured during the summer of 2018 in DOH-01 and DOH-03 were similar to previous monitoring years at values of approximately 10.7 metres below the top of the casing (mbtoc) and 7.6 mbtoc, respectively. As presented on Figure 2, the lowest isolated (i.e., pumping induced) water level of 16.6 mbtoc that was recorded for DOH-01 during the summer of 2018 was higher than those that were to be below 25.9 mbtoc during the summers of 2012, 2016 and 2017. This could potentially reflect less sustained pumping from nearby wells during the summer of 2018. The seasonal high-water levels of approximately 8.6 mbtoc (DOH-01) and 4.4 mbtoc (DOH-03) that were

recorded during the winter months from late 2017 to early 2018 were within the ranges that were observed in previous monitoring years (Figures 2 and 4).

The seasonal low water levels in DOH-04B and DOH-09A were relatively higher in 2018 when compared to recent monitoring years (Figures 5 and 7). The seasonal low water levels in both of these wells has generally increased from approximately 9.5 mbotc in the summer of 2012 to 7.0 mbotc in the summer of 2018 in DOH-04B and from approximately 5.2 mbotc in the summer of 2012 to 4.4 mbotc in the summer of 2018 in DOH-09A. The seasonal high water levels in these wells have generally been consistent during the monitoring period, in the range of approximately 1.9 to 2.2 mbtoc in DOH-04B and approximately 0.1 m below to 0.1 m above the former top of the casing of DOH-09A, prior to the casing for this well being extended by approximately 1.24 m in October 2011.

Consistent with less precipitation and less corresponding groundwater recharge during the summer of 2018, the seasonal low water level of 11.4 mbtoc that was recorded in DOH-07B in mid-September was lower than the seasonal low levels that had been reported for most of the previous monitoring years (Figure 6). With the exception of 2015, when a low water level of 12.2 mbtoc was recorded, seasonal low water levels for DOH-07B have ranged from 10.5 mbtoc in 2011 to 11.0 mbtoc in 2015. In 2018, the water level in DOH-07B recharged in the wet fall months to 5.95 mbtoc by 31 December. Water levels in this well have typically continued to increase past the end of the calendar year into the following year to seasonal high levels as high as 5.3 mbtoc in April 2011. As presented on Figure 6, the seasonal high and low values for DOH-07B are consistent with a slight declining trend over the monitored period. This trend may reflect relatively less precipitation or a change in land use and a corresponding reduction in groundwater recharge, or increased pumping from one or more nearby wells; however, although relatively lower water levels have been observed for this well in recent years, the lowest water level recorded is approximately 140 m higher than the reported depth of the well (152.4 mbgs).

3.2 BC Ministry of Environment and Climate Change Strategy Observation Well

Water level data for ENV Well No. 372 are plotted with precipitation data from the West Highlands District Firehall and Calle Revelle Nature Sanctuary weather stations on Figure 8.

The water level patterns observed in ENV Well No. 372 were generally consistent with those observed in the Highlands monitoring wells, declining through the summer months and then increasing in response to seasonal precipitation in the fall of 2018. The seasonal low water level of 61.8 mbtoc that was reported for ENV Well No. 372 in early November 2018 was lower than values that had been reported for previous monitoring years; however, as presented on Figure 8, periods of consistent water levels that were reported in the dry seasons of 2015, 2016 and 2017 are inferred to reflect periods when the water level dropped below the pressure transducer that was deployed in the well.

The water level in ENV Well No. 372 began increasing in November 2018 in response to seasonal precipitation. In late 2017 and early 2018, when the water level in the well reflected the seasonal high for the winter, the water level in the well was as high as 51.0 mbtoc. This level is similar to what had been recorded the previous winter in 2017 and 2012; variable water levels that were reported for this monitoring well during the period of the Highlands monitoring program may reflect movement of the transducer and potentially placement at different depths that may have affected the data.

3.3 Hanington Estates Water System

Water supply for the Hanington Estates Water System is sourced from two groundwater supply wells. Well 409 (Well Tag No. 85183) is operated as the primary water supply for the Hanington System and Well 500 (Well Tag No. 85184) is operated periodically as a backup supply. During the 301-day period from 5 February 2018 to 3 December 2018, the total flows from Wells 409 and 500 were reported to be 20,289 cubic metres (m^3) and 3,983 m^3, respectively, for a combined flow of 24,272 m^3. Average groundwater use for the Hanington Estates Water System during this period was estimated to be 80.6 m^3/day which is slightly higher than the value of 78.5 m^3/day that was estimated for 2017; however, the average rate of daily groundwater use for 2017 was calculated for the 410-day period from 22 December 2016 to 5 February 2018 which included relatively more days in the winter period when daily water use is lower and would result in a lower calculated daily average.

IFCWS also provided flow monitoring data for the overall water system. Although considered to be less accurate than the flow data for the individual wells (Well 409 and Well 500), the data for the water system suggest that approximately 58% of the annual use in 2018 occurred between May and September, with the demand in the summer months of June through August more than double the demand in the winter months. These results, which are inferred to reflect higher irrigation and other outdoor water use during the hotter, drier summer months, are consistent with the data water system data that were reported for 2016 and 2017 when approximately 60% of the annual use was between May and September.

The population in the Hanington Estates subdivision is reported to have been 200 residents in 2018, the same as 2017 and up from 190 residents in 2016[1]. Based on this information, the average per capita water use for the Hanington Estates water system was calculated to be approximately 403 litres per person per day (L/p/d) for the period from 5 February to 3 December 2018. The average per capita estimate for 2018 is slightly higher than the value of 388 L/p/d that was calculated for 2017; however, the average for 2017 was calculated from water usage between 22 December 2016 and 5 February 2018, a period that includes relatively more winter months when water use is lower.

Water level data were not provided for Well 409 and Well 500 for 2018.

3.4 Bear Mountain Monitoring Program

For the 2017-2018 Bear Mountain Groundwater Monitoring Program, continuous water level data were collected with dedicated pressure transducers that were deployed in Irrigation (i.e., pumping) Wells 405, 407 and 411, and Observation Wells 400 and 412. Irrigation Wells 405, 407 and 411 are each equipped with a flow meter to measure flow rates.

[1] Population information, as provided by the District of Highlands in file “Estd Pop_Hanington Creek Estates_2013-2017.docx”, that is based on Occupancy Permits, Stats Canada 2011 Census data and Building Official’s observations.

Bear Mountain pumped a total groundwater volume of 269,201 cubic metres (m^3) from its irrigation wells in 2018, less than the volumes of 300,450 m^3 and 344,500 m^3 that were pumped from the irrigation wells in 2017 and 2016, respectively. In 2018, pumping of Wells 407, 407 and 411 began on 9 May and continued until 10 September for Well 405, 12 September for Well 407 and 3 October for Well 411. Extraction rates for the individual wells were not reported. Based on digital flow meter data, WWAL reported that 157,221 m^3 of the total groundwater from the irrigation wells in 2018 was pumped into the Osborne Pond (the primary reservoir for the Valley Golf Course) and 111,980 m^3 was pumped into the Mountain Pond.

WWAL also noted that a water balance that had been conducted by Colquitz Engineering Ltd. indicated that due to leakage from the Osborne Pond, approximately 74% of the groundwater that is pumped into the pond recharges the aquifer. Based on this information, WWAL estimated the net groundwater extraction from the irrigation wells for the Valley Golf Course to be approximately 40,877 m^3 in 2018, less than the value of 44,650 m^3 that was reported for 2017. At the time of this report, Golder had not reviewed the water balance study that was conducted by Colquitz Engineering Ltd.; however, Golder has been retained by the District to review the water balance study and we will document the results of our review under separate cover.

During the pumping period in 2018, maximum drawdown in the irrigation wells was reported to be approximately 42 m, 42 m and 79 m in Wells 405, 407 and 411, respectively (compared to values of 42, 43 and 86 m in 2017, respectively). In the fall of 2018, the water levels in the irrigation wells recovered to 100% of the pre-pumping groundwater levels within approximately 7 weeks compared to recovery periods of approximately 5 weeks in 2017. WWAL attributed the variation in recovery periods to the timing of the onset of the rainy season.

WWAL also reported that in 2018 the static water levels in Observation Wells 400 and 412 did not appear to be impacted by pumping of the irrigation wells, similar to the results for Observation Wells 413 and 414 in previous years. WWAL interpreted these results to indicate that the observation wells are hydraulically separate from the lineament (i.e., fault/fracture zone) in which the irrigation wells are completed.

WWAL noted that the application that Ecoasis had submitted to the Province of British Columbia for an Existing Use Groundwater License for an annual diversion of 375,000 m^3 of groundwater from its three Irrigation Wells 405, 407 and 411) was in progress with the Province.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

The results from the 2018 groundwater monitoring program were generally consistent with the seasonal patterns reported for previous years. Although less precipitation was recorded during the summer of 2018 compared to previous monitoring years, water levels in the Highlands monitoring wells were within the range of those observed in previously monitored years (i.e., since 2010). The seasonal low water level observed in monitoring well DOH-07B was higher than what was reported in 2016. The water level in DOH-07B, which is interpreted to have been influenced by pumping of an adjacent well late in the dry season of some years, may reflect a change in land use or increased pumping from one or more nearby wells. Further monitoring is required to determine if the lower water levels that were observed for DOH-07B in recent years compared to earlier monitoring years represent a long-term decline in dry and wet season water levels at this location or reflect variability between monitoring years. It should be noted that the lowest water level that has been observed in DOH-07B is still approximately 140 m higher than the reported depth of the well (152.4 mbgs).

The average water use at Hanington Estates was estimated to be approximately 80.6 m^3/day for the period February to December 2018, within the range of values that have been reported since annual well flow data have been provided (2013). When the population of the Hanington Estates subdivision is considered the per capita water use for the Hanington Estates water system has declined steadily from 473 L/p/d in 2013 to 388 L/p/d in 2017. The value of 403 L/p/d that was estimated for 2018 was calculated for a period that included relatively fewer low water demand winter months compared to the period for 2017.

A total volume of 269,201 m^3 of groundwater was reported to have been pumped from Bear Mountain Irrigation Wells 405, 407 and 411 during the dry season of 2018, lower than the volumes reported for recent years. The pumping-induced drawdown levels that were observed in the irrigation wells in 2018 were also within the range of levels that have been reported in previous monitoring years. In 2018, the water levels in the irrigation wells recovered to 100% of the pre-pumping levels within approximately 7 weeks, compared to the range of 10 days to 6 weeks that were observed in 2013 and 2014, respectively.

4.2 Recommendations

Golder recommends that the groundwater monitoring program continue in 2019 to document water levels and provide the basis to assess seasonal patterns and long-term trends in groundwater levels across the Highlands.

Removal of monitoring well DOH-02A from the Highlands monitoring program is not considered to be a significant gap in the monitoring network; however, if an additional well in the western portion of the Highlands at a relatively high elevation (e.g., greater than 240 masl) were to be available for monitoring, it could be added to the monitoring well network as a replacement for DOH-02A.

The results of stakeholder programs should also continue to be reviewed on an annual basis to monitor groundwater conditions in the southern portion of the Highlands where production wells are operated.

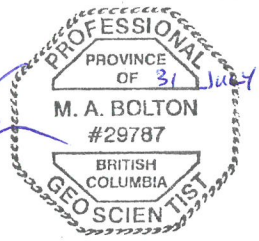
In previous annual monitoring reports, Golder recommended that the water balance study that was prepared by Colquitz Engineering for Bear Mountain be reviewed to understand groundwater extraction and water use at the property. Golder is currently conducting a review of the water balance study on behalf of the District.

5.0 CLOSURE

We trust the above information meets your current needs. If you have any questions or require additional information, please do not hesitate to contact the undersigned.

Yours truly,

Golder Associates Ltd.



31 July 2019

Mark Bolton, MSc, PGeo
Associate, Senior Hydrogeologist

Jillian Sacré, MSc, PGeo
Principal, Senior Hydrogeologist

MAB/JS/lmb

Attachments: Figure 1: Monitoring Locations District of Highlands
Figure 2: Depth to Groundwater Monitoring Well DOH-01 and Precipitation in Southern Highlands
Figure 3: Depth to Groundwater Monitoring Well DOH-02A and Precipitation in Western Highlands
Figure 4: Depth to Groundwater Monitoring Well DOH-03 and Precipitation in Southern Highlands
Figure 5: Depth to Groundwater Monitoring Well DOH-04B and Precipitation in Western Highlands
Figure 6: Depth to Groundwater Monitoring Well DOH-07B and Precipitation in Northern Highlands
Figure 7: Depth to Groundwater Monitoring Well DOH-09A and Precipitation in Eastern Highlands
Figure 8: Depth to Groundwater Monitoring Well MoE Observation Well 372 and Precipitation in Western Highlands

https://golderassociates.sharepoint.com/sites/25417g/deliverables/issued to client - reserved for wp/1899915-001-l-rev0/1899915-001-l-rev0-2018 gw monitoring report-31jul_19.docx

6.0 STUDY LIMITATIONS

Golder Associates Ltd. (Golder) has prepared this letter in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and geoscience professions currently practicing in British Columbia, subject to the time limits and physical constraints applicable to this letter. No other warranty, express or implied is made.

The letter is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other letters prepared by Golder for the Client relative to the specific site described in the letter. In order to properly understand the suggestions, recommendations and opinions expressed in this letter, reference must be made to the whole of the letter. Golder cannot be responsible for use by any party of portions of the letter without reference to the entire letter and other relevant communications between Golder and the Client.

In preparing this letter, Golder has relied in good faith on information provided by the individuals and agencies noted in this letter. We accept no responsibility for any deficiency or inaccuracy contained in this letter as a result of errors, omissions, misinterpretations or fraudulent acts of the persons or agencies contacted.

The information, recommendations and opinions expressed in this letter are for the sole benefit of the Client. No other party may use or rely on this letter or any portion thereof without Golder's express written consent. The letter, all plans, data, drawings and other documents as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder, who authorizes only the Client to make copies of the letter, and only in such quantities as are reasonably necessary for the use of the letter by those parties. The Client may not give, lend, sell, or otherwise make available the letter or any portion thereof to any other party without the express written permission of Golder. The Client acknowledges that electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client cannot rely upon the electronic media versions of Golder's letter or other work products.

If new information is discovered in the future, Golder Associates Ltd. should be requested to re-evaluate the content of this letter and provide amendments as required prior to any reliance upon the information presented herein.

PATH: \\golder.gds\gal\burnaby\CAD-GIS\Client\District_of_Highlands\DoH_GW_Monitoring\99_PROJECTS\1899915\02_PRODUCTION\1899915_FIG_1_Monitoring_Locations.mxd PRINTED ON: 2018-12-06 AT: 11:19:54 AM

460000

SAANICH INLET

FINLAYSON ARM

Pease Creek

Pease Lake

Durrance Lake

Hazlitt Creek

PEASE CREEK WATERSHED

DOH-07A

DOH-07B

Cal Revelle Nature Sanctuary

Third Lake

DOH-06

DOH-05

Second Lake

Fork Lake

Killarney Lake

Mill Stm.

Mitchell Lake

MOE 372

West Highlands District Firehall

DOH-04A

DOH-04B

Highlands Weather Station

East Highlands District Firehall

DOH-09B

DOH-09A

Fizzle Lake

Eagles Lake

DOH-02B

DOH-02A

CRAIGFLOWER CREEK WATERSHED

MILL STREAM CREEK WATERSHED

DOH-01

Mary Lake

413

414

Teanook Lake

Pike Lake

Matson Lake

411

District of Highlands Office

DOH-03

407

McKenzie Lake

409

500

INSET

0 3,000 6,000

1:300,000 METRES

Millstream Elementary School

5370000

460000

LEGEND

- District of Highlands Monitoring Well Location
- Hanington Creek Estates Well
- Bear Mountain Monitoring Well
- Ministry of Environment Observation Well No. 372
- Environment Canada Weather Station
- University of Victoria Weather Station
- Contour (20m Interval)
- Watercourse
- Waterbody
- Cadastre Information
- Major Watershed Boundary
- Municipality Boundary

Elevation - metres above sea level (masl)

- 0 - 100
- 101 - 200
- 201 - 300
- 301 - 400
- 401 - 500

0 500 1,000

1:30,000 METRES

REFERENCES

1. DATA PROVIDED BY THE DISTRICT OF HIGHLAND AND BC ILMB.
2. BASE DATA CONTAIN INFORMATION LICENCED UNDER THE OPEN GOVERNMENT LICENCE – BRITISH COLUMBIA/CANADA.
3. WEATHER STATIONS OBTAINED FROM ENVIRONMENT CANADA AND THE UNIVERSITY OF VICTORIA SCHOOL-BASED WEATHER STATION NETWORK.
4. IMAGERY COPYRIGHT © 20130727 AND 20160401.ESRI AND ITS LICENSORS. SOURCE: CNES/AIRBUS DS AND DIGITALGLOBE. USED UNDER LICENSE, ALL RIGHTS RESERVED.

COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N

CLIENT
DISTRICT OF HIGHLANDS

PROJECT
GROUNDWATER PROTECTION STUDY
HIGHLANDS, B.C.

TITLE
MONITORING LOCATIONS

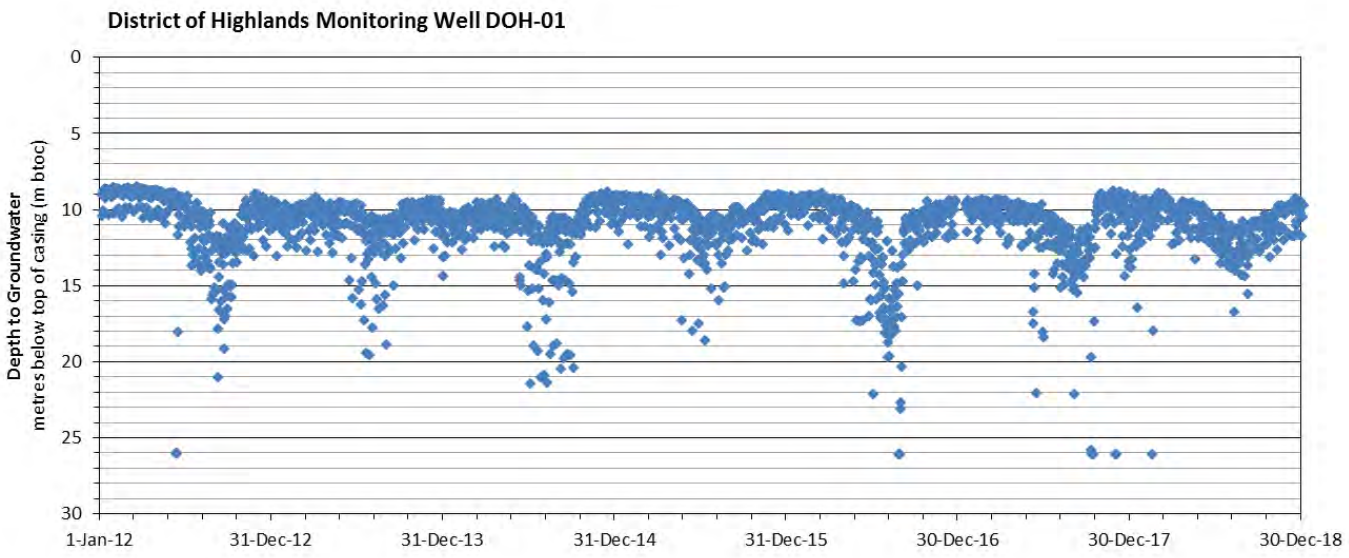
CONSULTANT
GOLDER

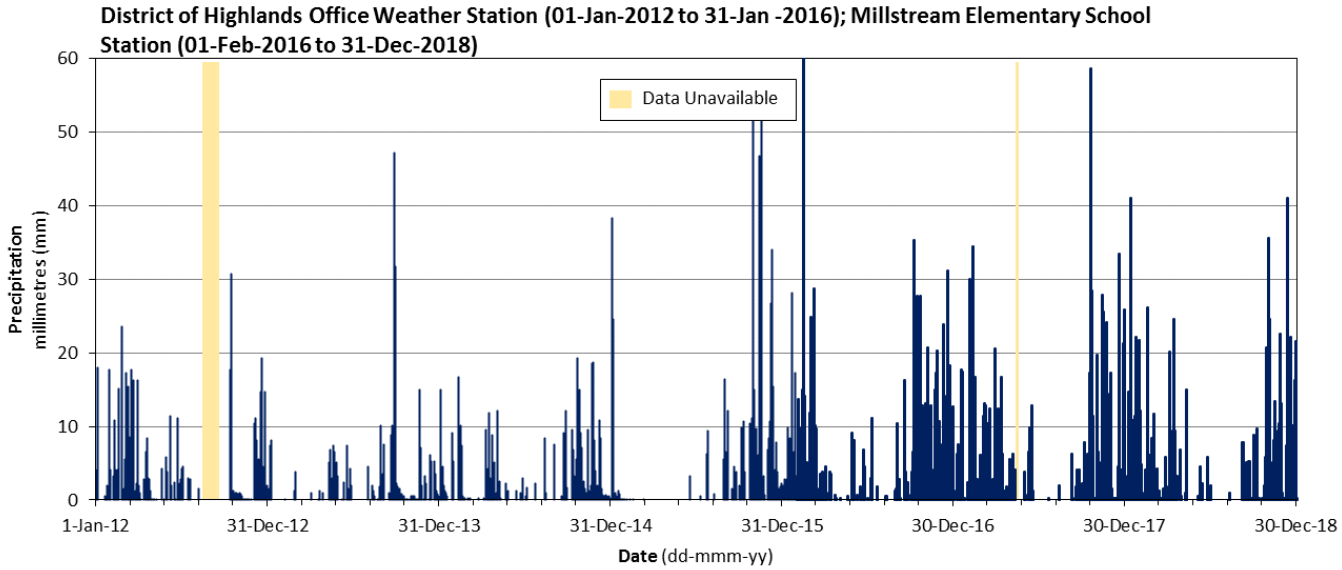
YYYY-MM-DD	2018-12-06
DESIGNED	MB
PREPARED	DSC/AD
REVIEWED	MB
APPROVED	JS

PROJECT NO.	CONTROL	REV.	FIGURE
1899915		0	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

0 25mm



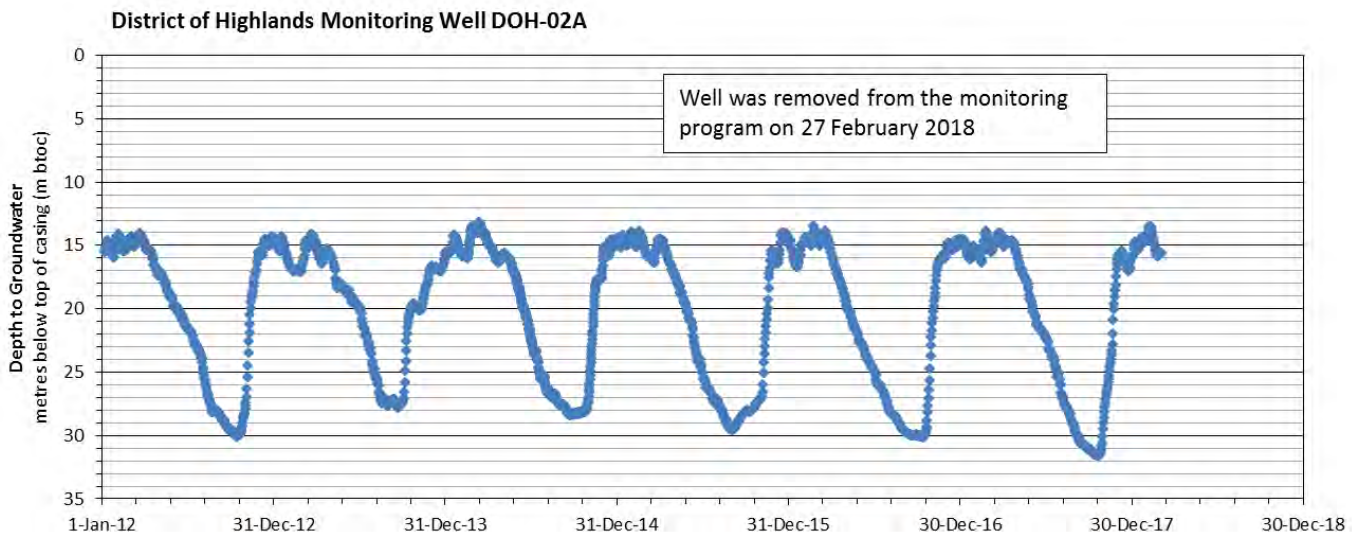


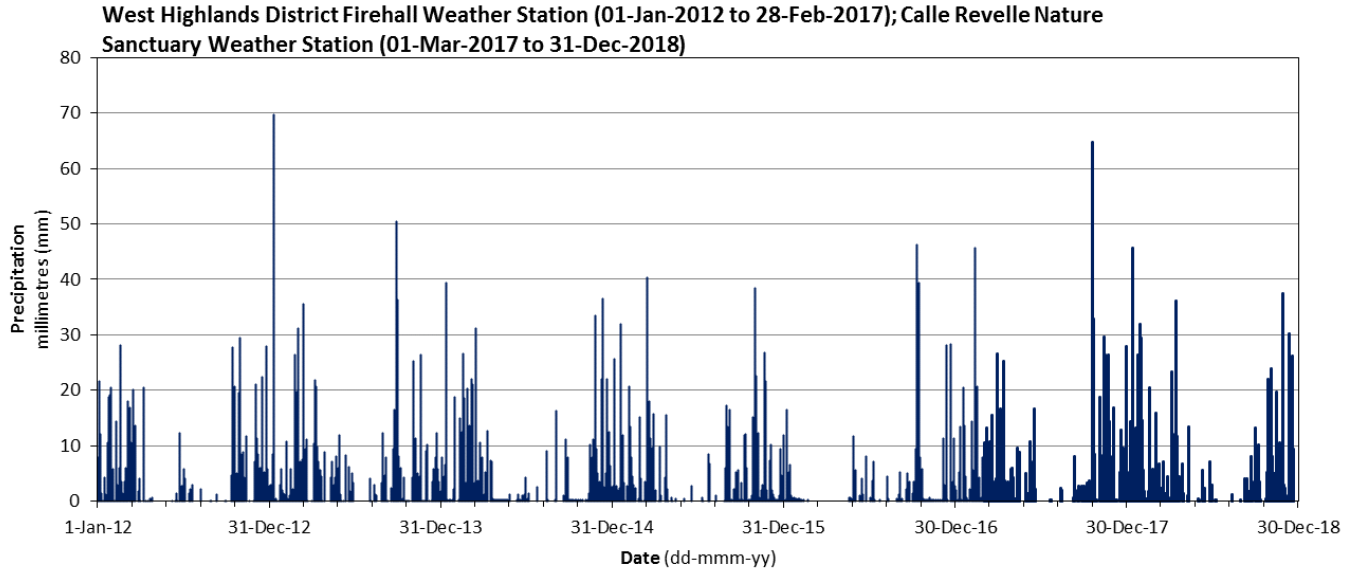
Notes

Water level data collected under the District of Highlands Groundwater Monitoring Program.

Precipitation data obtained online from the University of Victoria School-Based Weather Station Network.
http://www.victoriaweather.ca/

PROJECT	DISTRICT OF HIGHLANDS 2018 GROUNDWATER MONITORING PROGRAM HIGHLANDS, BC				
TITLE	DEPTH TO GROUNDWATER MONITORING WELL DOH-01 AND PRECIPITATION IN SOUTHERN HIGHLANDS				
GOLDER	PROJECT No. 1899915			FILE No. ----	
	DESIGN	CB	14NOV06	SCALE NTS	REV.
	CADD	CB	15JAN16	FIGURE 2	
	CHECK	MAB	25JUL19		
	REVIEW	JPS	25JUL19		



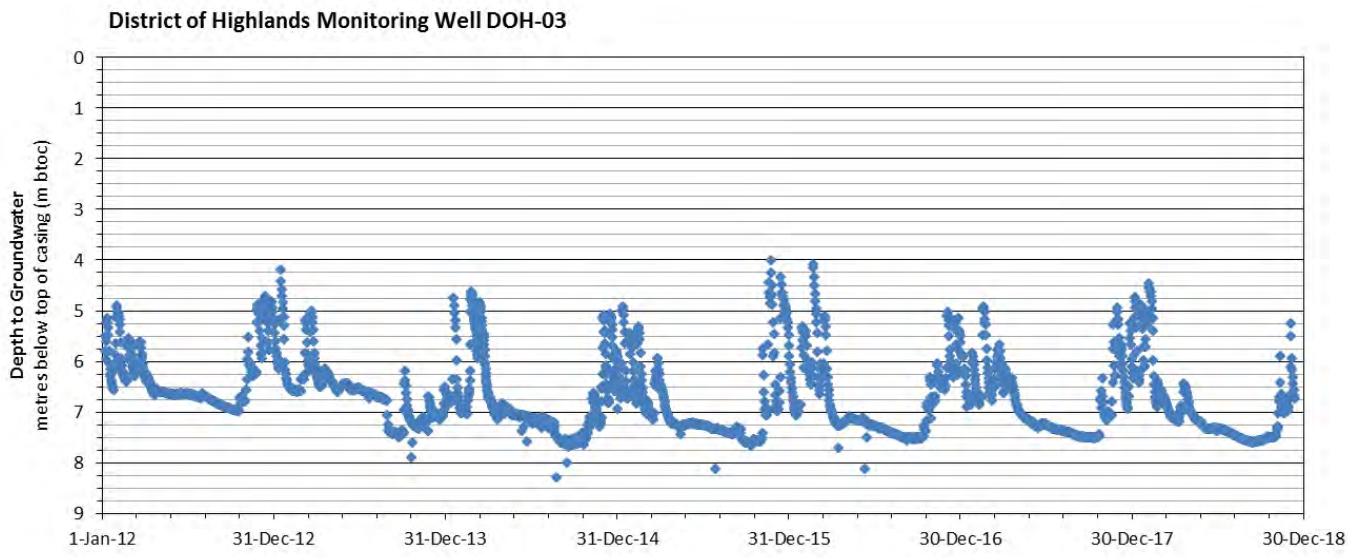


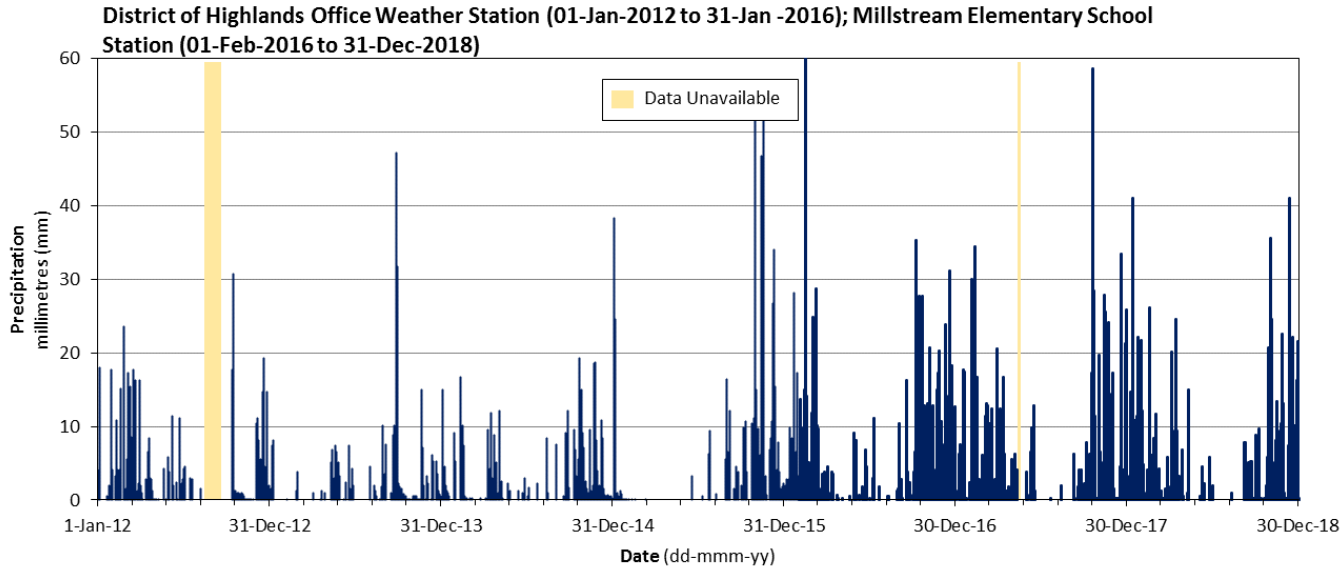
Notes

Water level data collected under the District of Highlands Groundwater Monitoring Program.

Precipitation data obtained online from the University of Victoria School-Based Weather Station Network.
http://www.victoriaweather.ca/

PROJECT	DISTRICT OF HIGHLANDS 2018 GROUNDWATER MONITORING PROGRAM HIGHLANDS, BC				
TITLE	DEPTH TO GROUNDWATER MONITORING WELL DOH-02A AND PRECIPITATION IN WESTERN HIGHLANDS				
GOLDER	PROJECT No. 1899915			FILE No. ----	
	DESIGN	CB	14NOV06	SCALE NTS	REV.
	CADD	CB	15JAN16	FIGURE 3	
	CHECK	MAB	25JUL19		
	REVIEW	JPS	25JUL19		





Notes

Water level data collected under the District of Highlands Groundwater Monitoring Program.

Precipitation data obtained online from the University of Victoria School-Based Weather Station Network.
http://www.victoriaweather.ca/

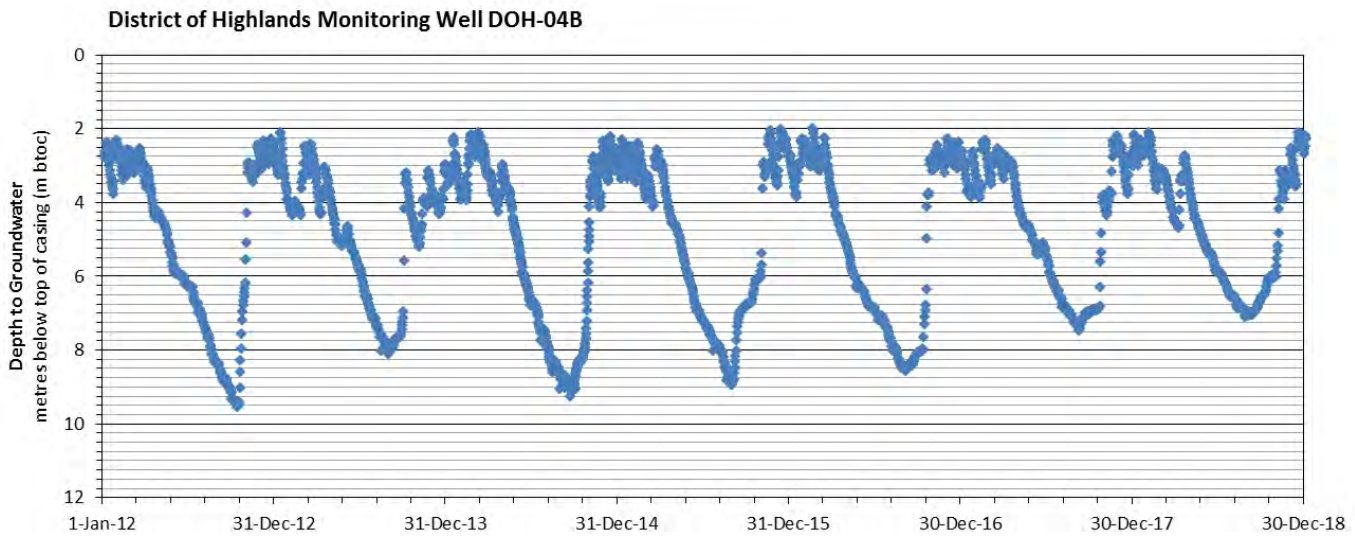
PROJECT
DISTRICT OF HIGHLANDS
2018 GROUNDWATER MONITORING PROGRAM
HIGHLANDS, BC

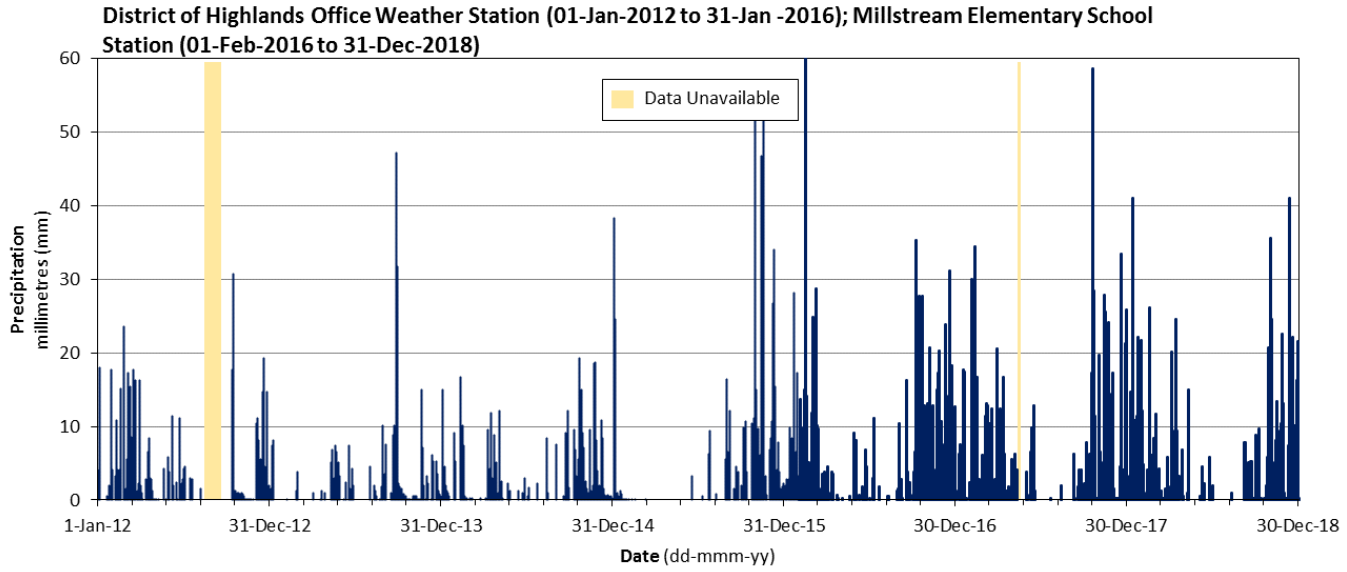
TITLE
DEPTH TO GROUNDWATER MONITORING WELL DOH-03 AND PRECIPITATION IN SOUTHERN HIGHLANDS

GOLDER

PROJECT No. 1899915			FILE No. ----	
DESIGN	CB	14NOV06	SCALE NTS	REV.
CADD	CB	15JAN16	**FIGURE 4**	
CHECK	MAB	25JUL19		
REVIEW	JPS	25JUL19		

FILE: https://golderassociates.sharepoint.com/sites/25417g/SitePages/Home.aspx



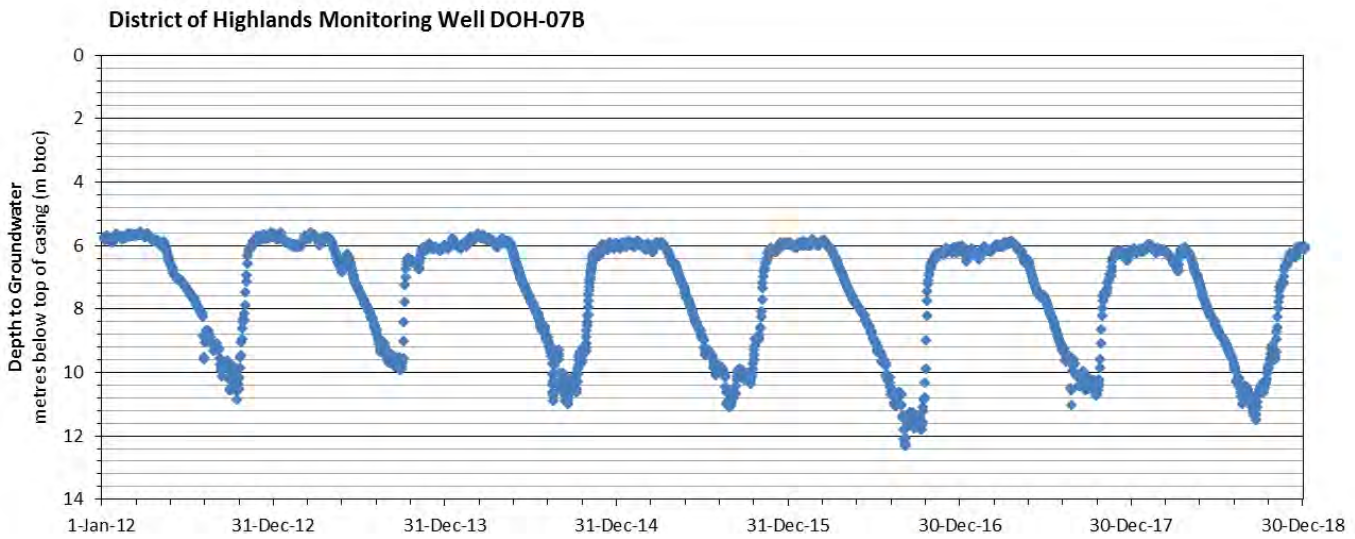


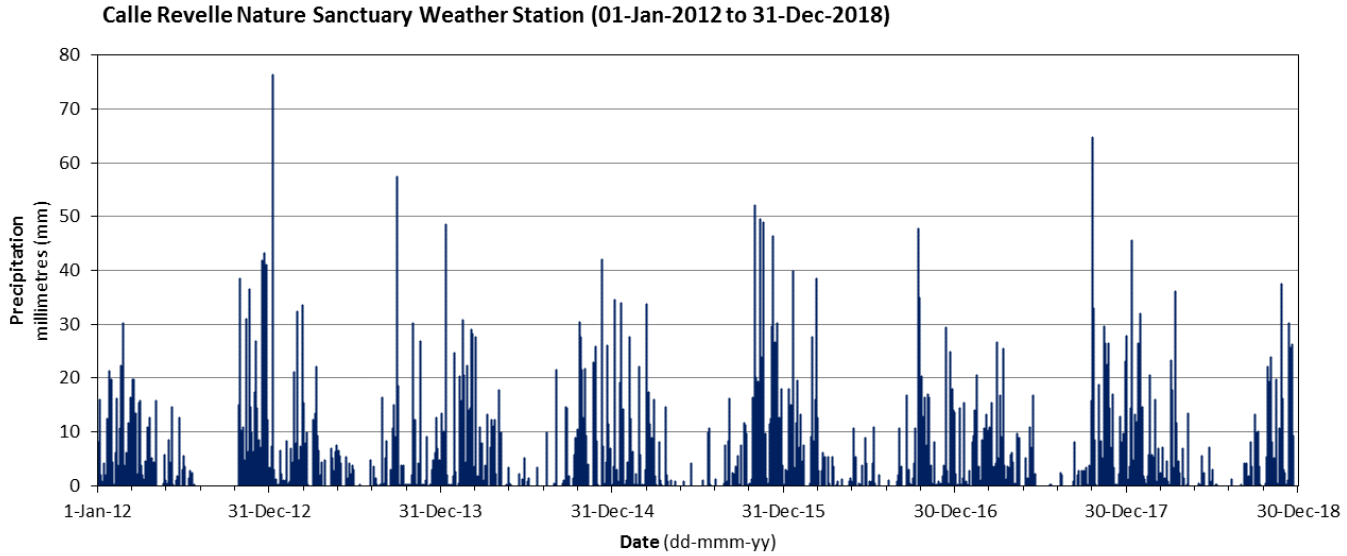
Notes

Water level data collected under the District of Highlands Groundwater Monitoring Program.

Precipitation data obtained online from the University of Victoria School-Based Weather Station Network.
http://www.victoriaweather.ca/

PROJECT	DISTRICT OF HIGHLANDS 2018 GROUNDWATER MONITORING PROGRAM HIGHLANDS, BC				
TITLE	DEPTH TO GROUNDWATER MONITORING WELL DOH-04B AND PRECIPITATION IN WESTERN HIGHLANDS				
GOLDER	PROJECT No. 1899915			FILE No. ----	
	DESIGN	CB	14NOV06	SCALE NTS	REV.
	CADD	CB	15JAN16	FIGURE 5	
	CHECK	MAB	25JUL19		
	REVIEW	JPS	25JUL19		



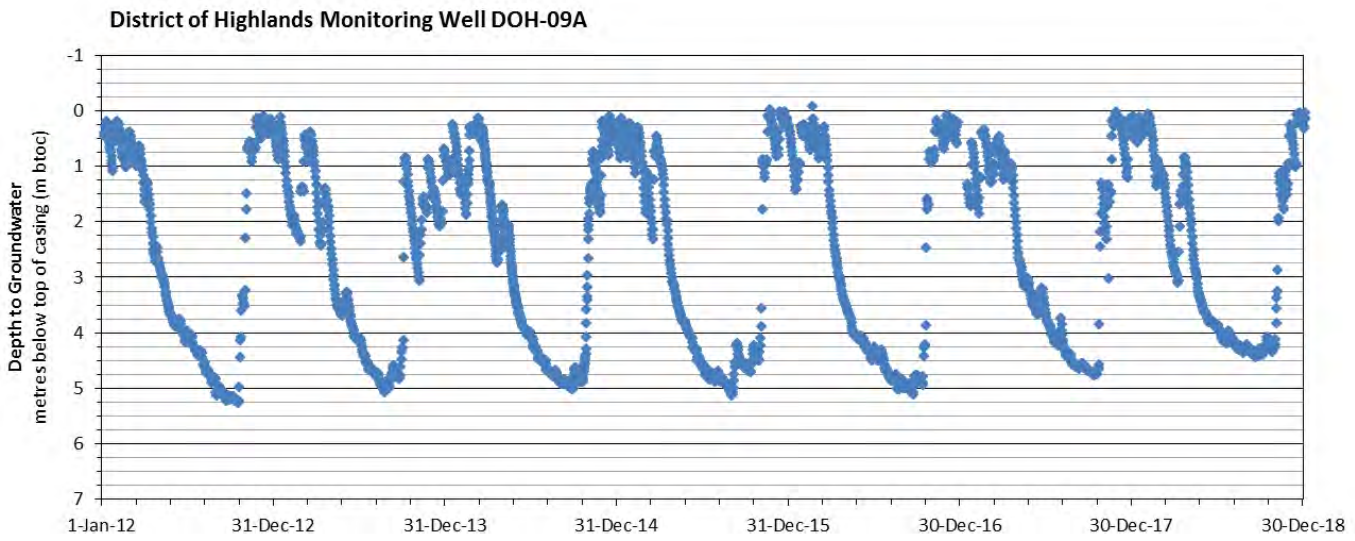


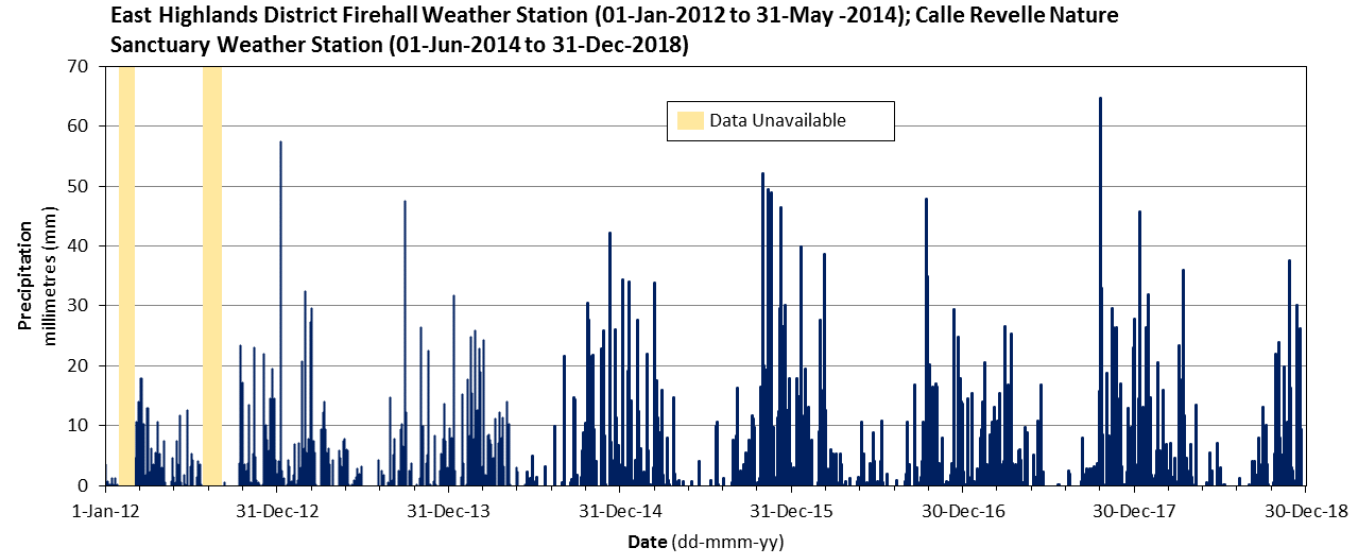
Notes

Water level data collected under the District of Highlands Groundwater Monitoring Program.

Precipitation data obtained online from the University of Victoria School-Based Weather Station Network.
http://www.victoriaweather.ca/

PROJECT	DISTRICT OF HIGHLANDS 2018 GROUNDWATER MONITORING PROGRAM HIGHLANDS, BC				
TITLE	DEPTH TO GROUNDWATER MONITORING WELL DOH-07B AND PRECIPITATION IN NORTHERN HIGHLANDS				
GOLDER	PROJECT No. 1899915			FILE No. ----	
	DESIGN	CB	14NOV06	SCALE NTS	REV.
	CADD	CB	15JAN16	FIGURE 6	
	CHECK	MAB	25JUL19		
	REVIEW	JPS	25JUL19		



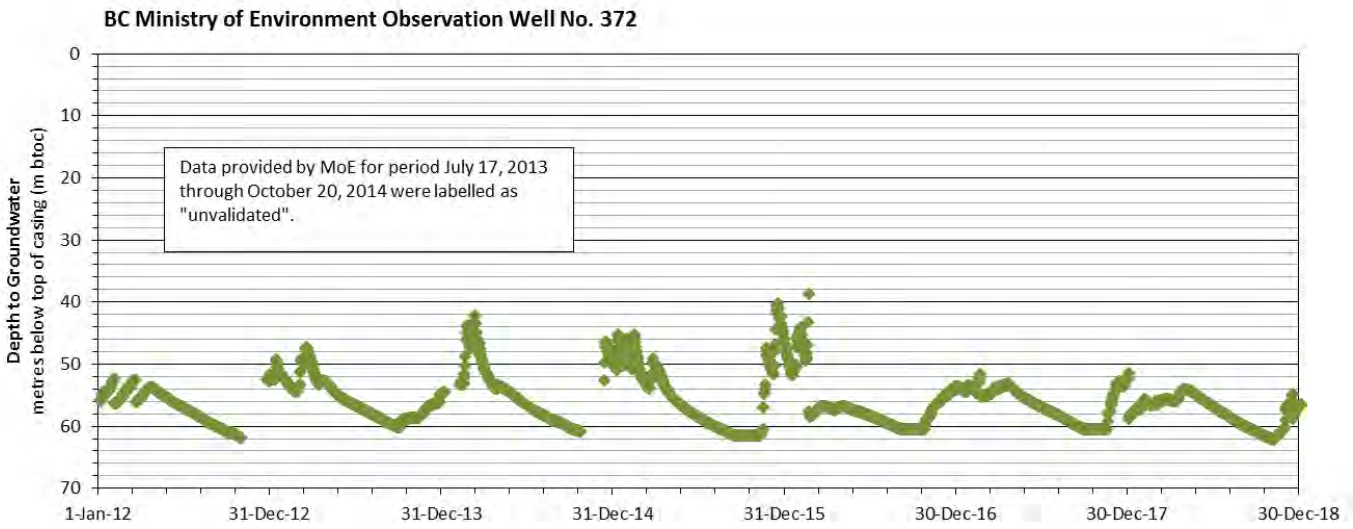


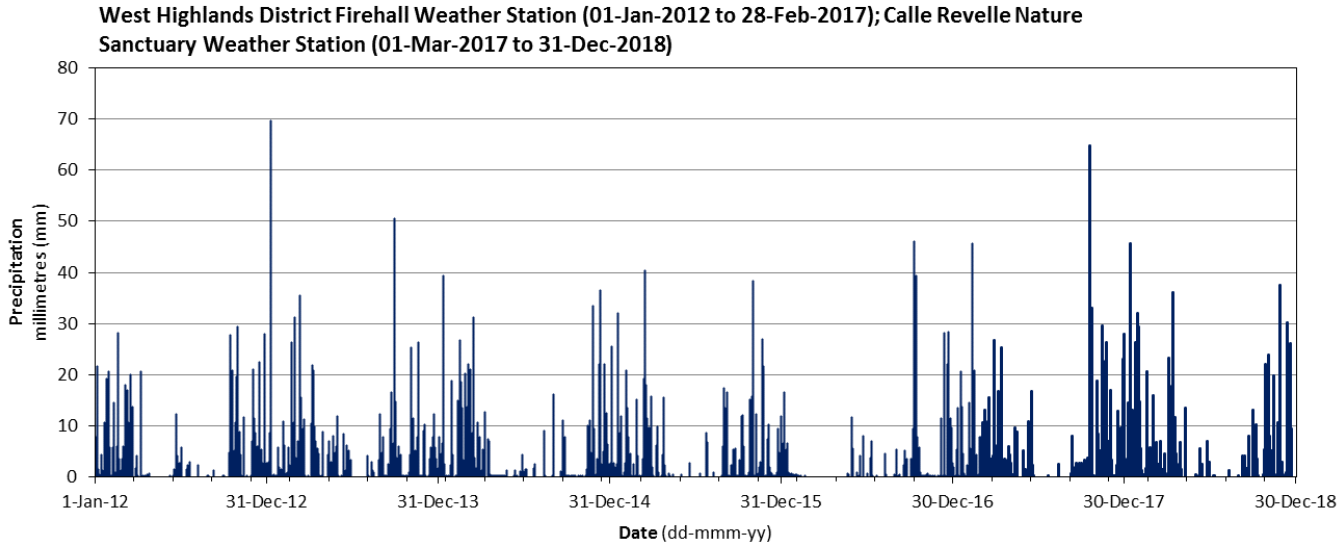
Notes

Water level data collected under the District of Highlands Groundwater Monitoring Program.

Precipitation data obtained online from the University of Victoria School-Based Weather Station Network.
http://www.victoriaweather.ca/

PROJECT	DISTRICT OF HIGHLANDS 2018 GROUNDWATER MONITORING PROGRAM HIGHLANDS, BC				
TITLE	DEPTH TO GROUNDWATER MONITORING WELL DOH-09A AND PRECIPITATION IN EASTERN HIGHLANDS				
GOLDER	PROJECT No. 1899915			FILE No. ----	
	DESIGN	CB	14NOV06	SCALE NTS	REV.
	CADD	CB	15JAN16	FIGURE 7	
	CHECK	MAB	25JUL19		
	REVIEW	JPS	25JUL19		





Notes

Water level data obtained online from the Ministry of Environment British Columbia Groundwater Observation Network.
http://www.env.gov.bc.ca/wsd/data_searches/obswell/map/obsWells.html

Precipitation data obtained online from the University of Victoria School-Based Weather Station Network.
http://www.victoriaweather.ca/

PROJECT	DISTRICT OF HIGHLANDS 2018 GROUNDWATER MONITORING PROGRAM HIGHLANDS, BC				
TITLE	DEPTH TO GROUNDWATER MOE OBSERVATION WELL 372 AND PRECIPITATION IN WESTERN HIGHLANDS				
GOLDER	PROJECT No. 1899915			FILE No. ----	
	DESIGN	CB	14NOV06	SCALE NTS	REV.
	CADD	CB	15JAN16	FIGURE 8	
	CHECK	MAB	25JUL19		
	REVIEW	JPS	25JUL19		