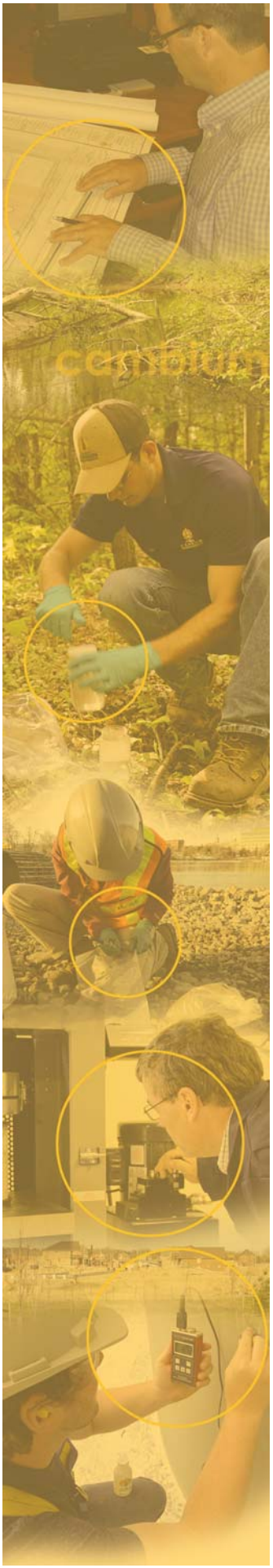

Hydrogeological Assessment, 309 Zephyr Road, Zephyr, Township of Uxbridge

Cambium Reference No.: 6199-001

2018-11-16

Prepared for: China Canada Jing Bei Xin Min Intl.
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EXECUTIVE SUMMARY

Cambium Inc. was retained by EcoVue Consulting Services Inc. on behalf of China Canada Jing Bei Xin Min Intl. (Client) to complete a hydrogeological assessment for a proposed development of 17 residential lots at 309 Zephyr Road, in the Township of Uxbridge, Durham Region, Ontario. The assessment includes a hydrogeological investigation and terrain analysis/impact assessment to support private servicing of potable water and wastewater for a proposed residential subdivision of 17 lots.

The hydrogeological assessment included an assessment of the surficial soils, the installation and hydraulic testing of three test wells, nitrate attenuation calculations and an impact assessment on an adjacent provincially significant wetland.

The results of the pumping tests indicate that there are adequate groundwater resources available on the site to support the proposed development. Further, the water withdrawal associated with the development will not negatively influence surrounding groundwater users or the adjacent provincially significant wetland. The groundwater quality is relatively good, however well PW3 should be disinfected and re-sampled to confirm the presence of total coliforms.

The nitrate attenuation calculations indicate that the site could sustain up to 23 dwellings while maintaining a boundary concentration of nitrate at less than 10 mg/L. Therefore the proposed development of 17 dwellings is with acceptable criteria.

The pre-development infiltration rate can be sustained (and slightly improved) if downspout disconnections are implemented on the dwellings included in the development. The runoff generated from the site upon development will increase when compared to pre-development conditions; however the runoff will be directed to pre-existing ponds. The ponds will buffer the flow of the runoff water in promote a minor amount of additional infiltration. As such the adjacent provincially significant wetland will not be influenced negatively from the proposed development.

Respectfully submitted,

Cambium Inc.

PROFESSIONAL GEOSCIENTIST
Nov 16 2018
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TABLE OF CONTENTS

LIST OF APPENDED FIGURES

LIST OF EMBEDDED TABLES

LIST OF APPENDICES

1.0 INTRODUCTION

Cambium Inc. was retained by EcoVue Consulting Services Inc. (EcoVue) on behalf of China Canada Jing Bei Xin Min Intl. (Client) to complete a hydrogeological assessment for a proposed development of 17 residential lots located at 309 Zephyr Road, in the Township of Uxbridge, Durham Region, Ontario. The assessment included a hydrogeological investigation and terrain analysis/impact assessment to support private servicing of potable water and wastewater for a proposed residential subdivision of 17 lots.

There are no municipal services for water or wastewater near the property; therefore, the Site will require to be serviced on-site. As such, a hydrogeological assessment was undertaken for potable water supply and wastewater, in accordance to Ministry of the Environment (MOE) Guidelines D-5-5 and D-5-4, respectively.

The hydrogeological assessment included the installation and hydraulic testing of three (3) test wells to characterize on-site groundwater resources, determine the impact of water withdrawal on surrounding groundwater users and asses the potability of the supply aquifer. The assessment also included a characterization of the native soils on the property, identifying the position of the shallow water table and an impact evaluation on the adjacent wetland.

1.1 SITE DESCRIPTION

The property is located approximately 6 kilometres east of Highway 48 in Zephyr, Ontario, in the Township of Uxbridge, as shown in Figure 1. The western portion of the property is an abandoned golf course and is accessed by Zephyr Road and Concession Road 3. The proposed development will occur wholly within the western portion of the property. This portion of the property will hereafter be referred to as the Site.

The Zephyr-Egypt Provincially Significant Wetland Complex (hereafter referred to as the PSW) occupies the eastern portion of the property (east of the Site). Residential land use surrounds the Site to the north, west and south. The Site consists of gentle rolling topography that generally slopes downwards towards the east/south and directs surface water drainage towards the PSW.

There are various structures found in the northern portion of the Site that are used for storage of equipment and other materials. There is a residence located in the north-western portion of the Site that was occupied by a tenant during the hydraulic pumping tests. The residence was provided drinking water from an on-site dug well (known as DW1). There is a second dug well located adjacent to the access road that fronts onto Zephyr Road (known as DW2). In addition, there were three (3) pre-existing drilled wells located in the northern portion of the Site that were installed as part of a previous hydrogeological assessment (known as TW1, TW2 and TW3). The previous hydrogeological assessment was completed on a 5 hectare parcel (approximate) located in the northern portion of the Site (this area is referred to as Phase 1).

The total area of the property is approximately 38.00 ha in size; however, 22.00 hectares of the property are located within the PSW. Development cannot occur within the PSW area and the 30 m setback from the PSW.

Phase 1 of the Site was also not included in this hydrogeological assessment described herein and will be treated as a separate property. The remaining usable portion of the Site is also known as Phase 2 and is approximately 11 ha. It is proposed that the usable portion of the Site be subdivided into 17 lots. A plan of the proposed development has been attached as Appendix A. The general Site orientation has been outlined in Figure 2.

2.0 METHODOLOGY

2.1 BACKGROUND INFORMATION

A thorough review of the available relevant background information was undertaken for this study, which included the following:

- Ministry of Northern Development and Mines, 1991. Quaternary Geology of Ontario, Southern Sheet, Map 2556, scale 1:1,000,000.
- Ontario Geological Survey, 1991. Bedrock Geology of Ontario, Southern Sheet, Map 2544, scale 1:1,000,000.
- Regulated Areas Mapping provided by the Lake Simcoe Region Conservation Authority (LSRCA)
- Source Protection Area Mapping provided by the Ministry of Environment, Conservation and Parks (MECP)

2.2 TEST-PIT INVESTIGATION

On August 3, 2017 a test-pit investigation was completed by Cambium to determine the shallow subsurface conditions across the property. The test-pits were excavated using a tracked excavator under the supervision of a Cambium technologist. A total of 13 test-pits, designated as TP101-17 through TP113-17, were advanced throughout the Site in the western portion of the property where the development is proposed to occur. Each soil sample was handled only by the technologist using dedicated nitrile gloves. Soil samples were logged for soil colour, texture, structure, moisture content, and consistency/compactness. Open test-pits were backfilled with the excavated soils and compacted with the backhoe bucket. The test-pit logs are provided in Appendix B. Test-pit locations have been outlined on Figure 2.

2.3 HYDRAULIC PUMPING TESTS

Three (3) test wells were installed on-site between June 14 and June 20 of 2018. The well labels and associated well record numbers have been outlined in Embedded Table 1. The wells were installed with 0.15 m diameter steel casings to depths ranging between 21.04 metres below ground surface (mBGS) and 29.57 mBGS. Upon installation of well PW1, the water level was recorded to be 6.26 mBGS, while the water levels were recorded to be 1.07 and 2.44 metres above ground surface (mAGS), for wells PW2 and PW3, respectively. Wells PW2 and PW3 were modified with 0.038 m diameter PVC pipe that extended upwards from the steel casing at a height greater than the static water level to allow the groundwater head pressure to equilibrate. The borehole logs of PW1, PW2 and PW3 have been attached in Appendix C. A summary of the installation details of wells PW1, PW2 and PW3 have been outlined below in Embedded Table 1

Embedded Table 1 Test Well Information

Well	Well Tag Number	Date Installed	Depth (mBGS)	Top of Steel Pipe Elevation (mASL)	Water Level (upon installation)	Static Water Level (July 16, 2018)	Static Water Elevation (July 16, 2018)
PW1	A222198	June 14, 2018	29.57	255.64	6.26 mBGS	9.34 mTOP	246.30 (mASL)
PW2	A222207	June 20, 2018	23.17	246.41	1.07 mAGS	0.14 mTOP	246.27 (mASL)
PW3	A222197	June 18, 2018	21.04	244.94	2.44 mAGS	1.38 mTOP	246.23 (mASL)(1)

1. *The top of PVC pipe elevation was calculated to be 247.61 metres above sea level (mASL). Water elevations were calculated from measuring water levels down from this elevation*

On July 16 and 17 of 2018 Cambium staff were on-site to complete three pumping tests (at wells PW1, PW2 and PW3), each lasting approximately six (6) hours (360 minutes). Well PW1 was tested on July 16, 2018 and wells PW2 and PW3 were tested simultaneously on July 17, 2018. During each pumping test the water levels in each well not being tested were monitored for drawdown. Solinst Level Logger pressure transducers (Loggers) were installed in each pumping well to record water levels continuously. A Logger was also used to record barometric pressure throughout the study period to allow for barometric compensation. Manual water level measurements were also collected for the duration of each test.

Well PW1 was tested at a rate of 95 L/min for the duration of the pumping test.

The water level of well PW2 had lowered below the top of the steel casing; as such a submersible pump could be installed and a pumping test completed. Well PW2 was initially pumped at a rate of 55 L/min, however the rate was reduced to 25 L/min soon after initiation of the test. It is noted that the pumping rate of well PW2 was reduced from 55 L/min to 25 L/min in an attempt to maintain piezometric pressure (and thereby the flowing conditions) at well PW3.

A tap was installed on the wellhead of PW3 during installation. To test well PW3 the tap was opened and allowed to flow freely. The tap flowed at a rate of approximately 14 L/min for the duration of the test.

The locations of the wells have been outlined on Figure 2 and Figure 3. The water elevations recorded from the test are outlined on Figure 4.

2.3.1 MONITORING WELLS

Only two (2) of the three (3) drilled wells installed in the northern portion of the Site as part of a previous hydrogeological assessment of Phase 1 were located (TW-2 and TW-3) and monitored during the pumping tests completed by Cambium. In addition, dug wells DW1 and DW2 were both included in the pumping tests. The wells which serviced the residences located at 12820 RR39, 7 Dafoe St. and 340 Zephyr Road were also included in the pumping tests. Each of the wells described above were installed with Loggers.

The locations of the wells described above have been outlined on Figure 2 and Figure 3. The water elevations recorded from the monitoring wells have been outlined on Figure 5. The depths and water levels recorded at the monitoring wells have been outlined below in Embedded Table 2.

As discussed in subsequent sections of this report, a groundwater sample was collected from the dug well that serviced 1 Foot Road. This well has been included in Embedded Table 2, but was not monitored during the pumping tests since contact could not be re-established with the home owner.

Embedded Table 2 Monitoring Well Construction Details

Well	Type of Well	Well Tag Number	Depth (mTOP)	Top of Pipe Elevation (mASL)	Static Water Level (mTOP) (July 16, 2018)	Static Water Elevation (mASL) (July 16, 2018)
TW-2	Drilled	A123254	31.78	255.74	9.53	246.21
TW-3	Drilled	A123353	29.52	252.44	6.23	246.21
DW-1	Dug	-	10.8	256.65	3.21	253.44
DW-2	Dug	-	7.16	250.74	5.88	244.86
12820 RR39	Drilled	-	19.46	254.97	4.38	250.59
7 Dafoe St.	Drilled	-	20.66	250.51	4.24	246.27
340 Zephyr Rd.	Drilled	-	5.54	238.44	2.49	235.95
1 Foot Road	Dug	-	6.96	-	-	-

2.4 PIEZOMETERS

On November 24, 2017 Cambium staff visited the Site and installed six (6) piezometers along the boundary between the PSW and the abandoned golf course. The piezometers were constructed from 0.04 m diameter steel risers and 0.61 m long screens. The piezometers were nested in pairs and driven to depth with hand tools. The locations of the piezometers have been outlined on Figure 2 and Figure 3. The water elevations recorded from the piezometers have been outlined on Figure 6. The depths, water levels and elevations of the piezometers have been outlined below in Embedded Table 3.

Embedded Table 3 Piezometer Construction Details

Piezometer	Depth (mTOP)	Stickup (m)	Depth (mBGS)	Top of Pipe Elevation (mASL)	Water Level (July 16, 2018) (mTOP)	Water Elevation (July 16, 2018) (mASL)
P1	3.20	1.23	1.97	238.01	1.79	236.22
P2	2.04	0.74	1.31	237.52	1.24	236.63
P3	2.95	1.35	1.60	237.56	1.87	235.69
P4	1.94	0.79	1.15	237.00	1.31	235.69
P5	3.18	1.45	1.73	237.43	1.89	235.54
P6	1.93	1.10	0.83	237.08	1.49	235.59

The piezometers were instrumented with loggers and monitored for the duration of the pumping tests.

On July 23, 2018 Cambium staff returned to the Site to install Loggers for long-term water level monitoring. Water levels from the piezometers were monitored between July 23, 2018 and September 18, 2018. The water elevation fluctuations reported from the piezometers over the long term have been outlined in Figure 7. The fluctuations of the vertical hydraulic gradients between each nested pair of piezometers have been outlined in Figure 8.

2.4.1 HYDRAULIC TESTING - PIEZOMETERS

On July 29, 2018 in-situ hydraulic tests (bail tests) were completed on each of the piezometers. To complete the bail tests each piezometer was purged of all groundwater and Loggers were installed to monitor recovery. The

loggers were left in the wells to monitor the recovery of the water level. On September 18, 2018 Cambium staff returned to the Site to retrieve the loggers. It is noted that the analysis methods of a bail test assume that a volume of water is instantaneously removed from the well and induces a corresponding instantaneous response of the water level response. Purging the wells dry by hand is not an instantaneous process. Due to the relatively low conductivity of the overburden soils the instantaneous removal of water would induce a similar water level response as would be induce from purging the wells dry. Therefore the bail test methodology described above is considered satisfactory.

2.5 SURVEY

Upon completion of the pumping tests Cambium staff surveyed each well and piezometer included in the testing. The survey was completed using a Topcon Real Time Kinematic (RTK) enabled HiPer II system with an FC-25 field controller.

2.6 WATER QUALITY SAMPLING

Water characterization sampling was completed on each of the three (3) test wells. The samples were tested for general organic/inorganic parameters in addition to bacteria. Each well was sampled within the final 60 minutes of each pumping test. Field analyses were completed on all samples collected, which included the temperature (°C), pH and conductivity (mS).

As part of the D-5-4 assessment groundwater samples were collected from the private well servicing the residences at 340 Zephyr Road, 1 Foot Road and 12820 RR39. These samples were analyzed for biological oxygen demand (BOD), total kjeldahl nitrogen, ammonia (total and un-ionized), nitrate, nitrite and dissolved organic carbon (DOC). The wells which serviced 340 Zephyr Road and 1 Foot Road were installed at depths of 5.54 mTOP and 6.96 mTOP, respectively. These two wells did not have associated well tags, but were interpreted to be installed in the shallow overburden based their measured depths. The well that serviced 12820 RR39 was assumed to be installed in a deeper, confined aquifer. Further discussion on these wells is outlined in the following sections.

The groundwater samples were stored in coolers with freezer packs and maintained less than 10°C during transport to the Caduceon Environmental Laboratories (Caduceon) in Ottawa, Ontario. Caduceon is accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA), for specific environmental tests listed in the scope of accreditation approved by CALA. The Certificates of Analysis are attached as Appendix D. The water quality results were compared against the Ontario Drinking Water Quality Standards (ODWQS) (Ministry of the Environment, June 2006).

2.7 AQUIFER TEST ANALYSIS

To determine aquifer properties of the water bearing units that the pumping wells and piezometers had been installed in the water level data were imported into AquiferTest Pro ™ (Version: 2011.1). The model and results of

the analysis are discussed in more detail in Section 4.3. The results of the aquifer test analysis have been included as Appendix E.

3.0 HYDROGEOLOGICAL AND GEOLOGICAL SETTING

The Site is primarily located within the physiographic region known as the Simcoe Lowlands. The Simcoe Lowlands physiographic region extends from Lake Couchiching, southward along the western edge of Lake Simcoe continuing southward toward the community of Bolton. Morphologically, this region is characterised by flat, low-lying plains composed of silts, clays and fine to medium grained sands deposited within glacial Lake Algonquin. Evidence of glacial Lake Algonquin and its successors is provided by numerous shorelines, wave-cut notches, terraces and beach ridges located throughout the study area (Chapman, L.J. and D.F. Putnam, 1984) (Lake Simcoe Region Conservation Authority, 2015).

According to Map 2556 of the Ontario Geological Survey (Barnett, P.J.,Cowan, W.R. and Henry, A.P., 1991), the Site is located in an area where the following surficial deposits are present:

- Coarse-textured glaciolacustrine deposits (sand, gravel, minor silt and clay, foreshoe and basinal deposits)
- Till (Stone-poor, sandy silt to silty sand-textured till on Paleozoic terrain)

The Site and surrounding area are characterized by one bedrock region composed of Middle Ordovician limestone, dolostone, shale, arkose, and sandstone of the Ottawa Group, Simcoe Group, and Shadow Lake Formation (Ontario Geological Survey, 1991).

3.1 TEST-PIT INVESTIGATION

The soils described in the available mapping were corroborated by the results of the test-pit investigation. Of the 13 test-pits completed at the Site, almost all exhibited similar stratigraphy. The depth of topsoil ranged from 0 metres below ground surface (mBGS) to 0.43 mBGS, underlying the topsoil was a light-brown to brown, sand and silt, some clay, some gravel, and trace cobbles. The completed depths of the test-pits ranged between 1.52 mBGS and 2.13 mBGS. Most of the test-pits were open and dry upon completion, however, test-pits TP102-17, TP110-17, and TP111-17 reported water entering the excavation, and TP112-17 exhibited saturated cave-in conditions upon completion.

In total, three (3) soil samples were collected for grain size analysis:

<u>TP101-17</u>

- This soil was described as light brown sand and gravel, some silt, moist, firm, blocky structure and extended from 1.12 – 1.80 meters below ground surface (mbgs). The soil consisted of 28% gravel, 41% sand, and 31% silt and clay.

TP104-17

- This soil was described as brown silt and sand till, some gravel, moist, stiff to soft, and extended from 0.91 – 2.00 mbgs. The soil consisted of 9% gravel, 46% sand, and 45% silt and clay.

TP107-17

- This soil was described as brown fine to medium sand, loose, moist, and extended from 0.20 – 0.89 mbgs. The soil consisted of 75% sand, and 25% silt and clay.

The grain size analyses of these soils samples have been attached in Appendix F.

3.2 WATER WELL RECORDS

To assess the hydrogeological conditions on and around the Site, well records within 500 m of the property boundary were examined. Water well records were acquired through the Ministry of Environment, Conservation and Parks (MECP) water well record database (MECP, 2018).

In total, 70 well records were examined. Of these, 44 records detailed the installation of drilled wells, 13 records detailed the installation of dug wells, 3 records detailed the installation of monitoring wells and 10 records detailed either a well abandonment or upgrade.

The drilled wells were installed to an average depth of 26.87 mBGS and groundwater was found at an average depth of 26.08 mBGS. The static water levels of the drilled wells were recorded to be on average 4.66 mBGS (some flowing conditions were also recorded). The average flow rate of the drilled wells was recorded to be 10 gallons per minute (assumed to be imperial gallons).

The dug wells were installed to an average depth of 8.07 mBGS and groundwater was found at an average depth of 5.42 mBGS. The static water levels of the dug wells were recorded to be on average 3.17 mBGS. The average flow rate of the dug wells was recorded to be 3 imperial gallons per minute (ipgm).

The details pertaining to the installation of the wells have been outline below in Embedded Table 4.

Embedded Table 4 Water Well Record Information

Count			Depth (mBGS)	Depth Water Found (mBGS)	Static Water Level (mBGS)	Flow Rate (ipgm)
Drilled Wells	44	Average	26.87	26.08	4.66	10
		Max	77.44	75.91	19.82	40
		Min	12.20	10.98	Flowing	3
Dug Wells	13	Average	8.07	5.42	3.17	3
		Max	10.67	9.15	7.01	5
		Min	4.57	2.44	1.52	1

The borehole logs indicated that the sediments in the area typically comprise of fine grained silt and clay overlying water bearing sand and gravel at depth. Some coarse grained sediments were occasionally reported at surface, overlying the fine grained materials. These conditions indicate that a confined supply aquifer is found in the region and is considered to be the same aquifer which wells PW1, PW2 and PW3 have been installed.

3.3 HYDROGEOLOGICAL CONDITIONS

A confined aquifer exists on-site and in the area of the Site. Static water levels were measured from each of the supply wells, monitoring wells TW-2, TW-3 and the supply wells that service 12820 RR39 and 7 Dafoe St. on July 16, 2018. Monitoring wells TW-2 and TW-3 have been installed in the confined aquifer (as per their water well records). There were no well tag numbers found on the wells that serviced 12820 RR39 and 7 Dafoe Street; however due to the well depths and water levels it was assumed that they have both been installed in the same confined aquifer as the other drilled monitoring wells and pumping wells. The groundwater elevation of each of these wells was calculated and the direction of groundwater flow in the confined aquifer was determined to be towards the northeast (see Figure 3).

The drilled well that serviced the residence at 340 Zephyr Rd. was installed at a shallow depth; therefore this well was interpreted to not be installed in the confined overburden aquifer.

The average depth of the fine-grained material confining layer was 26 mBGS. The underlying, confined sand and gravel aquifer was pressurized on-site since the static water levels were observed to rise a significant distance above the sand and gravel water bearing sediment (further evidenced by test wells PW2 and PW3 that exhibited flowing conditions upon installation).

A shallow overburden aquifer exists in the area, as described by the water well records for the dug wells. These wells were either installed in shallow surficial deposits of sand and gravel or fine-grained clayey material. The shallow aquifer is interpreted to be perched on top of the confining layer. The spatial continuity of the shallow overburden aquifer across the Site is not known. It was assumed that in the areas near the PSW the shallow overburden and the PSW were hydraulically connected. The direction of groundwater flow in the shallow overburden aquifer on the Site assumed to follow surficial topography (this assumption is supported by higher groundwater elevations

3.3.1 PIEZOMETER WATER ELEVATIONS AND PSW HYDROLOGY

Piezometers P1 through P6 were installed in the shallow overburden aquifer just within the boundaries of the PSW (see Embedded Table 3 for more details). The vertical hydraulic gradients reported from piezometers during the hydraulic pumping test were all downwards. The long term water level monitoring indicated that the vertical hydraulic gradients at piezometer nests P3/P4 and P5/P6 were downwards. Conversely, the vertical hydraulic gradients reported from piezometer nest P1/P2 were typically upwards during August and September.

The greatest downward hydraulic gradients were observed on July 16, 2018 and were likely caused by the rainfall event that occurred at that time. Subsequent to this event, the long term hydraulic gradients reported from the piezometers assumed generally stable patterns. The hydraulic gradients reported from piezometer nests P3/P4 and P5/P6 were always reported to be downwards and increased slightly in magnitude during the monitoring period. The vertical gradients reported from P1/P2 were generally upwards and increased slightly in magnitude during the monitoring period.

As per Figure 7, the direction of groundwater flow between the piezometers was northwards; however a portion of groundwater flow within the shallow overburden is likely directed eastwards following the downward slope in topography. All of the piezometer nests are located in areas that collect surface water runoff; however only piezometer nest P1/P2 reported upward gradients during the long term monitoring. The upward hydraulic gradients reported at piezometer nest P1/P2 are likely a result of groundwater flow from the shallow overburden aquifer pressurizing the area.

Runoff water is routed northwards from piezometer nest P1/P2 and collects in the area of piezometer nests P2/P3 and P5/P6 (as evidenced by the pond located immediately west of these two well nests). Such a scenario induces groundwater mounding in the area of piezometer nests P3/P3 and P5/P6, which generates downward gradients.

As discussed in Section 4.3, the hydraulic conductivity calculated from the deep piezometers was approximately one order of magnitude less than the shallow piezometers; therefore downward hydraulic gradients may sustained at piezometer nests P3/P3 and P5/P6 since groundwater will remain perched on sediments of lower hydraulic conductivity, but the volume of water infiltrating into the deeper sediments may be relatively low.

3.3.2 VULNERABLE AREAS

As per the MECP Source Protection Information Atlas the majority the proposed development area is mapped as a significant groundwater recharge area (SGRA) and a highly vulnerable aquifer (HVA). These two classifications are interpreted to apply to the shallow overburden aquifer that exists in the area, since the deeper supply aquifer that exists in the region is confined by a thick layer of fine grained sediments. As discussed in the previous section, there is not likely a significant amount of groundwater recharge from the shallow overburden aquifer to the deeper, confined aquifer. The deeper confined overburden aquifer is not considered to be highly vulnerable.

The property is also located within Intake Protection Zone 3 (IPZ3) of a nearby surface water intake. The proposed land use is not considered to be a land use of concern within IPZ3, therefore the surface water intake will not be influenced by the proposed development.

As discussed previously the Zephyr-Egypt Provincially Significant Wetland Complex is located east of the proposed development. The LSRCA regulation mapping and MECP Source Protection Mapping have been attached in Appendix A

4.0 HYDRAULIC PUMPING TESTS – RESULTS AND DISCUSSION

On July 16 and 17 of 2018 Cambium staff were on-site to complete three (3) pumping tests, each lasting approximately six (6) hours (360 minutes). Pumping tests were completed on wells PW1, PW2 and PW3. Well PW1 was tested on July 16, 2018 and wells PW2 and PW3 were tested simultaneously on July 17, 2018. A summary of the pumping test information have been outlined below in Embedded Table 5:

Embedded Table 5 Summary of Pumping Test Information

Well	Top of Steel Pipe Elevation (mASL)	Static Water Elevation (July 16, 2018) (mASL)	Date Started	Time Started	Time Stopped	Duration (mins)	Flow Rate (Lpm)	Total Volume of Water Pumped from Well (L)
PW1	255.64	246.30	July 16, 2018	12:30	18:37	367	95	34,865
PW2	246.41	246.27	July 17, 2018	08:47	14:48	361	25 (1)	10,525 (2)
PW3	244.94	246.23 (3)	July 17, 2018	09:16	15:16	360	14	5,040

1. *Pumping test initially commenced at 55 litres per minute (Lpm) for the initial 55 minutes, then reduced to 25 Lpm.*
2. *Total volume includes the initial pumping rate.*
3. *The top of PVC pipe elevation was calculated to be 247.61 mASL. Water elevations were calculated from measuring water levels down from this elevation*

The loggers remained installed in the pumping wells on July 16 and 17 to continuously monitoring water level fluctuations and have been plotted on Figure 4. The results of each individual pumping test at each of the test wells have been summarized in Embedded Table 6:

Embedded Table 6 Summary of Pumping Test Results

Well	Static Water Elevation (mASL)	End of Test Water Elevation (mASL)	Total Drawdown (m)	Bottom of Well Elevation (mASL)	Available Drawdown at End of Test (m)
PW1	246.30	244.48	1.82	226.07	18.41
PW2	246.27	246.37	0.36	223.24	22.67
PW3	246.23	245.99	0.26	223.90	22.07

The results of each pumping test are discussed in the following sections.

4.1 PUMPING TESTS

The pumping test of well PW1 was completed on July 16, 2018 and the pumping tests completed on wells PW2 and PW3 were completed on July 17, 2018. During each day of testing the wells not being tested were utilized as on-site monitoring wells. Additionally, the wells located in Phase 1 of the Site (TW-2 and TW-3) and those wells servicing the residences located at 12820 RR39, 7 Dafoe St. and, 340 Zephyr Rd. were monitored for drawdown responses. Each test is discussed chronologically below.

4.1.1 JULY 16, 2018 - TEST WELL: PW1 (A222198)

On July 16, 2018 Cambium Staff were on-Site and began the pumping test at PW1 at 12:30. The static water level was measured to be 9.34 mTOP (a static water elevation of 246.30 mASL).

The discharge rate was set at 95 Lpm (21 ipgm) for the pumping test. Drawdown occurred relatively quickly and within approximately 3 minutes the static water elevation dropped from 246.30 mASL to approximately 244.70 mASL. After this instance the water elevation lowered from approximately 244.70 mASL to 244.48 mASL at a steady rate for the remainder of the test. The pump was shut off at 18:37 which resulted in the test being 367 minutes (6 hours and 7 minutes) long. The flow rate of 95 Lpm was maintained during the test, resulting in a total of 34,865 L of water being pumped from the well. A total drawdown of 1.82 m was observed during the pumping test from well PW1. Steady state was not achieved during the test.

By correlating the final drawdown depths and pumping rates, it was estimated that every metre of drawdown in well PW1 would result in an additional flow rate of 52 Lpm. (It is noted that the correlations are estimates only, since steady state conditions at this wells was never achieved.)

The elevation of the bottom of well PW1 was 226.07 mASL, therefore the available drawdown at the end of the test was 18.41 m. The drawdown response recorded in well PW1 has been plotted on Figure 4. The water level in this well recovered to 100% of static at approximately 07:00 on July 17, 2018 (approximately 383 minutes after the pump had been shut off).

4.1.1.1 JULY 16, 2018 - MONITORING WELL RESPONSE

The water level fluctuations recorded at wells PW2 and PW3 during the water withdrawal from well PW1 on July 16, 2018 have been outlined on Figure 4. The water level fluctuations reported from all other monitoring wells have been outlined on Figure 5.

The water levels at wells PW2, PW3, TW2, TW3 and the well which serviced 7 Dafoe Street responded to the pumping test at well PW1. No discernable response was recorded at any of the other monitoring wells included in the test.

The static water levels/elevations and their subsequent response to water withdrawal at well PW1 have been outlined below in Embedded Table 7.

Embedded Table 7 Monitoring Well Response to Pumping at PW1

Well	Static Water Elevation (mASL)	Water Elevation at End of Test (mASL)	Drawdown (m)	Radial Distance From PW1 (m)
PW2	246.27	246.06	0.21	188.38
PW3	246.23	246.02	0.21	144.28
TW2	246.21	246.05	0.16	118.28
TW3	246.21	246.06	0.15	215.20
7 Dafoe Street	246.27	246.08	0.19	188.00

The water elevations at wells PW2 and PW3 recovered to 100% of static at approximately 06:00 and 05:00 on July 17, 2018, respectively. The water elevations recorded at 7 Dafoe St, TW2 and TW3 recovered to 100% of static at 04:30, 02:20 and 02:04 on July 17, 2018, respectively.

4.1.1.2 JULY 16, 2018 – PIEZOMETER RESPONSE

The water elevations recorded from the piezometers during the July 16, 2018 pumping test have been outlined on Figure 6. As per Figure 6, the water elevations recorded from the piezometers did not respond to water withdrawal at PW1. Conversely, the water elevations of each piezometer increased on July 16, 2018. The water elevations slowly decreased or remained elevated after the initial increase. The increase was likely caused by localized rainfall that fell in the area on July 16, 2018 just before the pumping test at PW1 commenced.

4.1.2 JULY 17, 2018 – TEST WELLS: PW2 AND PW3

On July 17, 2018 Cambium Staff were on-site to complete the pumping tests at wells PW2 and PW3. The pumping test at well PW2 started at 08:47 at a discharge rate of 55 Lpm. The discharge rate at PW2 was maintained for the initial 55 minutes of the test. After 55 minutes the discharge rate was reduced to 25 Lpm.

The pumping test at well PW3 started at 09:16. The water level at well PW3 was above the well; therefore the tap installed on the wellhead was allow to freely flow at a rate of 14 Lpm for the duration of the test. The static water elevations measured at PW2 and PW3, prior to the pumping tests, were 246.29 mASL and 246.27 mASL, respectively.

Within the first hour of pumping a significant degree of drawdown had occurred in both wells. After the first hour of pumping drawdown increased but at a much slower rate. At the end of the pumping test the water elevations of wells PW2 and PW3 were recorded to be 245.92 mASL and 246.00 mASL, respectively. The elevations correspond to drawdown depths of 0.37 m at PW2 and 0.27 m at PW3. Steady state conditions were not achieved at either well.

At PW2 the pump was shut off at 14:48 resulting in 361 minutes of pumping at this well. A total of 10,525 L of water was pumped from PW2 during the pumping test. The tap on PW3 was turned off at 15:16 resulting in 360 minutes of water flow from this well. A total of 5,040 L of water flowed from this well during the pumping test.

The elevations of the bottom of wells PW2 and PW3 were determined to be 233.24 mASL and 223.9 mASL, resulting in available drawdown depths of 22.68 m and 22.10 m, respectively.

By correlating the final drawdown depths and pumping rates, it was estimated that every metre of drawdown in well PW2 would result in additional flow of 68 Lpm. Every additional metre of drawdown in well PW3 would result in an additional 52 Lpm of flow. (It is noted that these correlations are estimates only since steady state conditions at these wells were never achieved.)

At approximately 3 hours after the pumping tests at wells PW2 and PW3 had ceased the loggers were removed and the water levels had recovered to 91% and 86% (respectively) of their static levels.

4.1.2.1 JULY 17, 2018 – MONITORING WELL RESPONSE

The water level fluctuation recorded at well PW1 during the water withdrawal at wells PW2 and PW3 on July 17, 2018 have been outlined on Figure 4. The water level fluctuations reported from all other monitoring wells have been outlined on Figure 5.

The water levels at wells PW1, TW2, TW3 and the wells which serviced 7 Dafoe Street responded to the pumping test at wells PW2 and PW3. No discernable response was recorded at any of the other monitoring wells included in the test.

The static water levels/elevations and their subsequent response to water withdrawal at wells PW2 and PW3 have been outlined below in Embedded Table 8.

Embedded Table 8 Monitoring Well Response to Pumping at PW2 and PW3

Well	Static Water Elevation (mASL)	Water Elevation at End of Test	Drawdown (m)	Radial Distance From PW2
PW1	246.32	246.44	0.09	188.38
TW2	246.27	246.21	0.07	299.66
TW3	246.29	246.22	0.07	397.21
7 Dafoe Street	246.31	246.24	0.07	376.06

The water elevations at well PW1 recovered to approximately 60% of static at 17:00, at which point the logger was removed. The water elevations recorded at 7 Dafoe St. recovered to 60% of static at approximately 18:00, and the water elevations recorded from wells TW2 and TW3 recovered to 40% of static at between 16:30 and 17:00.

4.1.2.2 PIEZOMETER RESPONSE

The water elevations recorded from the piezometers during the July 17, 2018 pumping test have been outlined on Figure 6. As per Figure 6, the water elevations recorded from the piezometers did not respond to water withdrawal at wells PW2 and PW3.

4.2 THE ZONE OF INFLUENCE

As per Procedure D-5-5, the per person requirement for a supply well is 450 L per day (Lpd). Peak demand occurs for 120 minutes a day, which is an equivalent demand rate of 3.75 Lpm for each person. The basic minimum pumping test rate is this rate multiplied by the "likely number of persons per well" which, for a single family residence, shall be the number of bedrooms plus one.

It is currently unknown how many bedrooms will be included in each residential dwelling that will be constructed at the Site. As a conservative measure the number of bedrooms was assumed to be four (therefore the number of occupants was 5). The corresponding peak demand rate was therefore determined to be 18.75 Lpm and the total daily water withdrawal rate should be 2,250 Lpd. There are proposed to be 17 dwellings constructed at the Site; as such the daily Site-wide water demand rate is estimated to be 38,250 L (i.e., 17 dwellings x 2,250 L per day).

Well PW1 was tested at a water withdrawal rate of 95 Lpm. The total volume of water withdrawn from this well during the test was 34,865 L. It was demonstrated that well PW1 can sustain pumping rates in excess of required 18.75 Lpm and the total daily water demand volume of 2,250 Lpd.

The water withdrawal from well PW1 induced a maximum drawdown of 0.21 m from the on-site wells. The 7 Dafoe Street well was the only off-site well that recorded drawdown and it was measured to be 0.19 m. The water level in these wells recovered to 100% of static well within a 24 hour time frame. The drawdown depths recorded during the PW1 pumping test are considered to be relatively insignificant. In addition, since the water levels in those wells that recorded drawdown recovered to 100% within 24 hours, surrounding groundwater users are not anticipated to be influenced from continued water withdrawal at the Site. Well PW1 was also pumped at a rate (and total daily water withdrawal volume) far in excess of what is required to prove that adequate groundwater resources are available at the Site, and still only an insignificant influence on surrounding groundwater users was recorded.

The drawdown reported from monitoring wells during the tests at wells PW2 and PW3 ranged between 0.09 m at PW1 and 0.07 m at the 7 Dafoe Street well. These results are similar to those reported during the PW1 pumping test. The total volume of water withdrawn from wells PW2 and PW3 was greater than what is prescribed in procedure D-5-5. The water levels reported at the monitoring wells were not monitored long enough to establish when recovery reached 100% of static, however it is likely that the static levels were reached well within 24 hours (as was recorded during the pumping test at PW1).

It is concluded that the daily water withdrawal associated with the proposed development will not negatively influence surrounding groundwater users since the confined aquifer has a high capacity to yield water. The actual influence that the proposed development will incur on the surrounding groundwater users will be less than what is described in this section, if any at all.

4.3 AQUIFER TEST ANALYSIS

The Theis method (Theis, 1935) was used to calculate aquifer properties transmissivity (T as m^2/s) and hydraulic conductivity (K as m/s) of wells PW1, PW2 and PW3. The drawdown and recovery period of each test was use in the analyses. The aquifer properties are described below.

- **Hydraulic Conductivity (K) of the confined aquifer:** The hydraulic conductivity is the net velocity at which water travels through a water bearing unit. It is expressed as m/s (or m/day).
- **Transmissivity (T) of the confined aquifer**: Transmissivity can be described as the amount of water that can be transmitted horizontally through a unit width by the full saturated thickness of the aquifer under a hydraulic gradient of 1. It is expressed as m^2/s (or m^2/day) and is derived from the hydraulic conductivity and the saturated thickness of the aquifer (Fetter, 2001).

The hydraulic properties of the aquifer on-site have been compiled in Embedded Table 9, below. Additionally the raw data produced from the Aquifer Test analysis has been attached as Appendix E. Also included in Embedded

Table 9 are the hydraulic conductivity results of the bail tests that were completed at the piezometers. The bail test data was processed using the Hvorslev method (Hvorslev, M.J., 1951).

Embedded Table 9 Summary of Aquifer Properties

Date of Test	Tested Data	T (m^2/s)	K (m/s)
July 16, 2018	PW1 Drawdown	4.57×10^{-2}	3.05×10^{-2}
	PW1 Recovery	2.51×10^{-2}	1.67×10^{-2}
July 17, 2018	PW2 Drawdown	2.00×10^{-2}	1.33×10^{-2}
	PW2 Recovery	1.12×10^{-1}	7.48×10^{-2}
July 17, 2018	PW3 Drawdown	1.50×10^{-2}	1.00×10^{-2}
	PW3 Recovery	1.68×10^{-1}	1.12×10^{-1}
Average		6.43×10^{-2}	4.29×10^{-2}
July 29, 2018	P1	-	2.88×10^{-7}
	P2	-	1.05×10^{-6}
	P3	-	2.88×10^{-7}
	P4	-	1.20×10^{-6}
	P5	-	5.90×10^{-6}
	P6	-	3.20×10^{-5}

Relatively well matching curves were established for each of the pumping wells during their respective test. As per Embedded Table 9 the average values for the transmissivity and hydraulic conductivity were relatively similar. The K values reported for the sand and gravel sediments that each well was installed in were characteristic of those reported in literature for those types of sediments (Fetter, 2001) (J.P.Powers, 2007).

The transmissivity of the confined aquifer is considered to be relatively high. These results are corroborated by the data discussed in the previous section which indicate that the confined aquifer has a high capacity to yield water.

The hydraulic conductivity of the sediments in which the shallow piezometers (P2, P4 and P6) were installed ranged between 1.05×10^{-6} m/s and 3.20×10^{-5} m/s. The hydraulic conductivity of the sediments in which the deep piezometers (P1, P3 and P5) were installed ranged between 2.88×10^{-7} m/s and 5.90×10^{-6} m/s. At each nest pair the hydraulic conductivity of the shallow piezometers was almost always at least one order of magnitude higher the deeper sediments. These results indicate that runoff water can more readily infiltrate in the surficial sediments in the area, while infiltration past depths of 1.6 mBGS to 2.0 mBGS (the depths of the deep piezometers) will be limited.

4.4 WATER CHARACTERIZATION RESULTS

One (1) water sample was collected from each pumping well within the final 60 minutes of each test. The Certificate of Analyses of the groundwater testing have been attached in Appendix D.

Most parameters were reported at concentrations less than their respective ODWQS criteria. Those parameters reported in excess of the ODWQS criteria have been outlined below in Embedded Table 10.

Embedded Table 10 Summary of ODWQS Exceedances

Well	Parameter	Parameter Concentration	ODWQS Critieria
PW1	Hardness	268 mg/L	80 – 100 mg/L (OG)
	Turbidity	6.4 NTU	5 NTU (AO)
	Iron	0.642 mg/L	0.3 mg/L (AO)
	Manganese	0.069 mg/L	0.05 mg/L (AO)
PW2	Hardness	241 mg/L	80 – 100 mg/L (OG)
	Turbidity	10.9 NTU	5 NTU (AO)
	Iron	0.796 mg/L	0.3 mg/L (AO)
PW3	Hardness	248 mg/L	80 – 100 mg/L (OG)
	Turbidity	9.9 NTU	5 NTU (AO)
	Iron	0.808 mg/L	0.3 mg/L (AO)
	Total Coliform	15 cfu/100 mL	0 cfu/100 mL (MAC)

Notes:

1. *"OG" is an operational objective for the specified parameter, as defined in the ODWQS.*
2. *"AG" is an aesthetic objective for the specifies parameter, as defined in the ODWQS*
3. *"MAC" is the maximum acceptable concentration. Parameters with a MAC concentration are health related and can cause illness in humans.*

The water quality reported from each pumping well was relatively similar. Each well reported similar exceedances of the ODWQS criteria, most of which were for non-health related parameters. The only ODWQS exceedance of a health related parameter was for total coliform at well PW3. The presence of total coliform at well PW3 should be confirmed as coliforms are typically not present in deep, confined aquifer systems; as such it is recommended that this well be disinfected and re-sampled.

Chloride and sodium were reported at low concentrations from each well, additionally nitrate and nitrite were reported below the record detection limit (RDL) of the laboratory instruments in each sample.

4.5 CONCLUSIONS – WATER SUPPLY

The pumping tests completed at PW1, PW2 and PW3 indicated that the confined aquifer has a high capacity to yield water. Very minor depths of drawdown occurred at the monitoring wells in relation to the water volumes withdrawn from the test wells. Further, each test well can sustain the water withdrawal rate at which they were tested at.

As discussed in Section 4.2, the peak demand rate for each well was determined to be 18.75 Lpm and the total daily water withdrawal rate was 2,250 L per day.

It was demonstrated that wells PW1 and PW2 can sustain pumping rates in excess of 18.75 Lpm; however well PW3 was only tested at a rate of 14 Lpm. Well PW3 maintained a water level above the well head for the duration of the test, and was observed to have 22.10 m of drawdown at the end of the test. It was estimated that every metre of drawdown from this well could produce an additional flow rate of 52 Lpm. As such, well PW3 can sustain a water withdrawal rate of greater than 18.75 Lpm due to the ample available drawdown and the high capacity of the well. In addition, well PW3 was not pumped during the test, it was allowed to flow freely under its own pressure. Lastly, the total volume of water discharged each of the test wells was well in excess as required by the Procedure.

It is concluded that the water withdrawal associated with the proposed development will not negatively impact surrounding groundwater users.

The groundwater quality was determined to be relatively good, however total coliform was reported at well PW3. This well should be disinfected and re-tested to confirm the presence of total coliform at this well.

4.5.1 IMPACTS ON THE ZEPHYR-EGYPT PROVINCIALLY SIGNIFICANT WETLAND COMPLEX

The water elevations reported from the piezometers did not respond to the pumping tests; therefore water withdrawal for the proposed development will not influence the PSW.

The water elevations of the piezometers did respond to a rainfall event that began just prior to the pumping test on July 16, 2018. The spatial extent of the shallow overburden aquifer is unknown; however in the area of the PSW the shallow overburden aquifer and the PSW are considered to be hydraulically connected. This is evidenced by upward gradients present in the area of piezometer nest P1/P2 which were likely caused by hydraulic pressures of the shallow overburden aquifer.

The pumping tests were completed on wells that were installed in the confined overburden aquifer, which is not hydraulically connected to the shallow overburden aquifer. As such, it is unsurprising that no response from the pumping was recorded in the piezometers.

5.0 WASTEWATER ASSESSMENT

As per Procedure D-5-4 Technical Guideline for Individual On-Site Sewage Systems: Water Quality Risk Assessment (Ministry of the Environment, 1996), an assessment was completed to determine the feasibility of utilizing on-site sewage disposal for the development.

The creation of 17 new residential lots will increase wastewater effluent loading on the overburden soils in the area and subsequently the shallow overburden aquifer that is present regionally. Within the effluent, nitrate is considered the limiting contaminant due to the human health concerns. Procedure D-5-4 requires that the effluent plume at the Site boundary to be within the ODWQS limit of 10 mg/L for nitrate to prevent contamination of adjacent properties. Although natural processes and soil interaction can result in nitrate being attenuated in the receiving aquifer system, Procedure D-5-4 states that only dilution can be used as the principal attenuation mechanism to predict future nitrate concentrations. As such, a mass balance calculation is used to determine the impact of developing residential lots on the Site.

5.1 AVAILABLE DILUTION

The total available dilution for the Site is estimated by the following equation:

$$Qi = A \times S \times I$$

Where: Qi – Volume of Available dilution water

A - Area of the Site

S – Water surplus

I – Infiltration factor

To calculate the water surplus the ten year climate normal data collected between 1981 and 2010 at the Shanty Bay weather station was used. The data was accessed through the Environment Canada website (Environment Canada, 2017). The total yearly precipitation, on average, was 968 mm.

The Thorthwaite method was used o determine the amount of evapotranspiration that will occur at the Site (S. Lawrence Dingman, 2008). The calculated depth of evapotranspiration was 545 mm/year. The evapotranspiration calculations are attached in Appendix G. Therefore the water surplus calculated to be 423 mm per year (1.16 mm/day).

To determine the fraction of surplus water that infiltrates into the soils on-site, the volume of surplus water is multiplied by an infiltration factor. The infiltration factor varies between 0 and 1 and is estimated based on topography, soils and cover (as per the Stormwater Management Planning and Design Manual, (Ministry of the Environment, June 2006)).

In addition to calculating the infiltration factor for the Site, the area of the Site was measured (via available mapping) to determine the total volume of available dilution water generated in each portion of the Site. The calculations of available dilution water for each portion of the Site have been outlined below in Embedded Table 11.

Embedded Table 11 Available Dilution Calculations

Infiltration Factor	
Topography	Rolling = 0.2
Soil	Till (silty sand) = 0.25
Cover	Grass Field = 0.1
Infiltration Factor (I)	**0.55**
Volume of Precipitation Water	
Developable Portion Area (A) (m^2)	110,000
Surplus (S) (m/day)	0.00116
Volume of Surplus Water Per Day (AxS)	**127.48 m^3/day (127,480 L/day)**
Volume of Available Dilution Water Per Day ((AxS)xI)	**70.11 m^3/day (70,110 L/day)**
Volume of Runoff Water Per Day ((AxS)x(1-I))	**57.37 m^3/day (57,370 L/day)**

5.2 PREDICTIVE ASSESSMENT

Based on Procedure D-5-4, each proposed lot is anticipated to generate an average discharge of 1,000 L/day of sewage effluent. Total nitrogen (all species) ultimately convert to nitrate through the wastewater treatment process. Nitrate is considered to be the critical contaminant in sewage effluent. A nitrate loading of 40 grams/lot/day is required to be normally used to determine the effluent loading from conventional septic systems on the receiving groundwater system.

To evaluate the impact of a septic system on a groundwater resource, a reference point or value is established to assist in determining the extent of the impact, if any. In this respect, the quality of the groundwater that is not impacted by septic system on the Site (i.e. background water quality) should be used for comparison purposes. Water quality samples were collected in three (3) surrounding wells. Two of the samples were collected from wells interpreted to be installed in the shallow overburden aquifer (i.e., the wells that serviced 1 Foot Road and 340 Zephyr Road). The well that services 12820 RR39 is considered to be installed in the deeper, confined overburden aquifer. The concentrations of nitrate reported from the well installed in the shallow overburden were less than reportable detection limit of 0.1 mg/L. The concentration of nitrate reported from the well that services 12820 RR39 was 1 mg/L. The shallow overburden aquifer will be the receiver of septic effluent; therefore the background concentration of nitrate was assumed to be 0.1 mg/L.

To determine the adequate lot density for the Site, a mass balance calculation is used to determine the sewage loading for nitrate on the property boundary. The mass balance calculations is outlined below as:

$$Q_tC_t = Q_eC_e + Q_iC_i$$

Where: Q_t = Total volume ($Q_e + Q_i$)

C_t = Total concentration of nitrate at the property boundary

Q_e = Volume of septic effluent

C_e = Concentration of nitrate in effluent (40 mg/L)

Q_i = Volume of available dilution water

C_i = Concentration of nitrate in dilution water (0.1 mg/L)

In order to determine the concentration of nitrate at the property boundary (C_t), the above mass balance equation is arranged as follows:

$$C_t = \frac{QeCe + QiCi}{Qt}$$

This equation was used for the developable portion of the Site. The results of the equation have been outlined in Embedded Table 12 below:

Embedded Table 12 Predictive Assessment of Nitrate Concentration

Variable	Value
Number of Lots in Portion	23
Volume of Sewage Effluent (Q_e)	23 Lots x 1,000 L/day = 23,000 L/day
C_e	40 mg/L
Q_i	70,110 L/day
C_i	0.1 mg/L
Q_t	93,751 L/day
C_t	**9.96 mg/L**

The number of lots included in the equation was maximized, while still maintaining a nitrate concentration at the border of the developable area of the Site of less than 10 mg/L. The maximum number of lots that can theoretically be developed on the Site (including the existing dwelling) is 23. If 17 lots are to be developed on the Site the concentration of nitrate at the Site boundary would be 7.89 mg/L.

5.3 CONCLUSIONS

The proposed development on Phase 2 includes the construction of 17 residential dwellings (including the existing dwelling). The nitrate loading calculations indicate that the concentration of nitrate at the boundary of the developable area will be 7.89 mg/L if 17 dwellings are constructed. The maximum number of lots that can be developed on the Site is 23.

6.0 PROVINCIALLY SIGNIFICANT WETLAND IMPACT ASSESSMENT

The proposed development is for 17 lots. The construction of 17 lots will alter the water balance of the developable area of the Site and may potentially impact the adjacent PSW. To determine if the proposed development will influence the PSW the water balance included in Section 5.0 was expanded upon.

The annual volume of groundwater infiltration (also referred to as available dilution water) at the Site, prior to development) was calculated to be 25,592 m³/year (70.11 m³/day). The corresponding annual volume of runoff at the Site prior to development was calculated to be 20,939 m³/year (57.37 m³/day). The total annual surplus was 46,530 m³/year (127.48 m³/day).

The area of the impervious surfaces (i.e., roofs of the dwellings, driveways and roadways) included in the development are not known; therefore they have been estimated based on similar sized developments that are found in the area of the Site. The footprint of each dwelling was assumed to be 200 m² (total area of 3,400 m²). The footprint of each driveway was assumed to be 80 m² (total area of 1,360 m²). There is approximately 503 m of roadway included in the proposed development. The width of roadway, including sidewalks, was assumed to be 15 m. The total area of the roadways was calculated to be 7,545 m². The total area of all impervious surfaces was estimated to be 12,305 m². The portion of the Site that will remain undeveloped will be reduced to 97,695 m².

Evapotranspiration does not occur from impervious surfaces described above; therefore to estimate runoff it was assumed that 10% of the precipitation that falls on impervious surfaces is lost to evaporation. The remaining 90% is converted to runoff. The water balance of the Site, including the proposed development, has been outlined below in Embedded Table 13.

Embedded Table 13 Post-Development Water Balance

Undeveloped Area		
Area (m²)	97,695	
Surplus (mm/day)	1.16	
Surplus (m/day)	0.00116	
Volume of Available Dilution Water (Infiltration) Per Year From Undeveloped Areas	**22,729 m³/year (62.27 m³/day)**	
Runoff Water Generated from Undeveloped Areas	**18,596 m³/year (50.95 m³/day)**	
Impervious Surfaces		
Surface Type	**Area**	**Runoff**
Dwellings	3,400 m²	2,963 m³/year
Driveways	1,360 m²	1,185 m³/year
Roads	7,545 m²	6,573 m³/year
Total	12,305 m²	10,720 m³/year
Total Site-Wide Runoff	**29,316 m³**	

Upon development the annual infiltration rate will be to 22,729 m³/year, which equates to a loss of 2,863 m³/year (or 0.03 L/sec of equivalent streamflow). The runoff will increase to 29,316 m³/year, which equates to an increase of 8,378 m^3/year (or 0.1 L/sec of equivalent streamflow).

6.1 AVAILABLE LOW IMPACT DESIGN MEASURES

To mitigate the loss of infiltration and increased runoff associated with the propose development the document titled Low Impact Development Stormwater Management Planning and Design Guide (Credit Valley Conservation, 2010) was reviewed (hereafter referred to as the LID Manual).

Cambium recommends that runoff generated from the rooves of each dwelling be captured and directed to soak-away pits or permeable areas (this is referred to as downspout disconnection). Roof downspout disconnections direct water away from the house to a permeable area on the property where infiltration can occur. This prevents stormwater from being converted entirely to runoff or flowing across a "connected" impervious surface, such as a driveway. Permeable areas could be lawn areas, a rain garden or infiltration trenches.

If roof downspout disconnections are installed it is reasonable to assume that the runoff generated from roofs should be reduced by approximately 90% (i.e. the infiltration factor of each roof is 0.9).

A water balance including the roof downspout disconnection LID measure has been outlined in Embedded Table 14.

Embedded Table 14 Post-Development Water Balance Including LID Measures

Undeveloped Area			
Area (m^2)	97,698		
Surplus (mm/day)	1.16		
Surplus (m/day)	0.00116		
Volume of Available Dilution Water (Infiltration) Per Year From Undeveloped Areas	**22,729 m^3/year (62.27 m^3/day)**		
Runoff Water Generated from Undeveloped Areas	**18,596 m^3/year (50.95 m^3/day)**		
Impervious Surfaces			
Surface Type	**Area**	**Runoff**	**Infiltration**
Dwellings	3,400 m^2	296 m^3/year	2,667 m^3/year
Driveways	1,360 m^2	1,185 m^3/year	-
Roads	7,545 m^2	6,573 m^3/year	-
Total Site-Wide Runoff	**25,396 m^3/year**		
Total Site-Wide Infiltration	**26,650 m^3/year**		

If downspout disconnections are implemented on the dwellings then the post-development infiltration rate will be 26,650 m^3/year; which is an increase of 1,058 m^3/year when compared to pre-development conditions (an increase in equivalent streamflow of 0.01 L/sec). The runoff generated from the Site upon development will be 25,396 m^3/year; which is an increase 4,457 m^3/year (an increase in equivalent stream flow of 0.06 L/sec).

6.2 CONCLUSIONS

The proposed development of the Site will not influence the adjacent PSW if downspout disconnections are implemented as LID measures on each dwelling. The LID measures will likely result in a minor improvement of the infiltration rate when compared to the pre-development water balance. The improvement in infiltration will reduce the concentration of nitrate at the Site boundary since the volume of available dilution water will increase. The annual runoff volumes will increase upon development of the Site, however the runoff will be collected by the

pre-existing ponds located along the eastern boundary of the developable area of the Site. The ponds will induce additional infiltration and buffer peak run-off flows.

7.0 SUMMARY

Three test-wells were installed on-Site to assess available groundwater resources. The hydraulic testing indicated that each well can sustain the daily water withdrawal demand for a four bedroom dwelling.

Minor drawdown responses were recorded during the pumping tests, however they were considered to be insignificant or not representative of actual Site conditions upon development; as such it is not anticipated that surrounding groundwater users will be negatively influenced from the proposed development. The adjacent PSW will also not be negatively influenced from the proposed development.

The water quality of each well was considered to be good. Most of the ODWQS exceedances were for non-health related parameters that can be treated using conventional methods. Total coliforms were detected in well PW3. The presence of total coliforms at well PW3 should be confirmed by disinfecting and re-sampling the well.

Nitrate loading calculations indicated that the Site can sustain the development of up to 23 residential dwellings while maintaining a boundary concentration of nitrate of less than 10 mg/L. The boundary concentration of nitrate for 17 dwellings was calculated to be 7.89 mg/L.

The pre-development infiltration rate can be sustained (and slightly improved) if downspout disconnections are implemented on the dwellings included in the development. The annual runoff volume will increase upon development of the Site; however the runoff will be directed to pre-existing ponds that will buffer the runoff discharge peak and promote additional infiltration.

REFERENCES

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Appended Figures

HYDROGEOLOGICAL ASSESSMENT

CHINA CANADA JING XIN MIN INTL.
309 Zephyr Road,
Zephyr, Ontario

LEGEND

- Highway
- Major Road
- Railroad
- Watercourse
- Water Area
- Provincial Park
- Built-Up Area
- Wooded Area

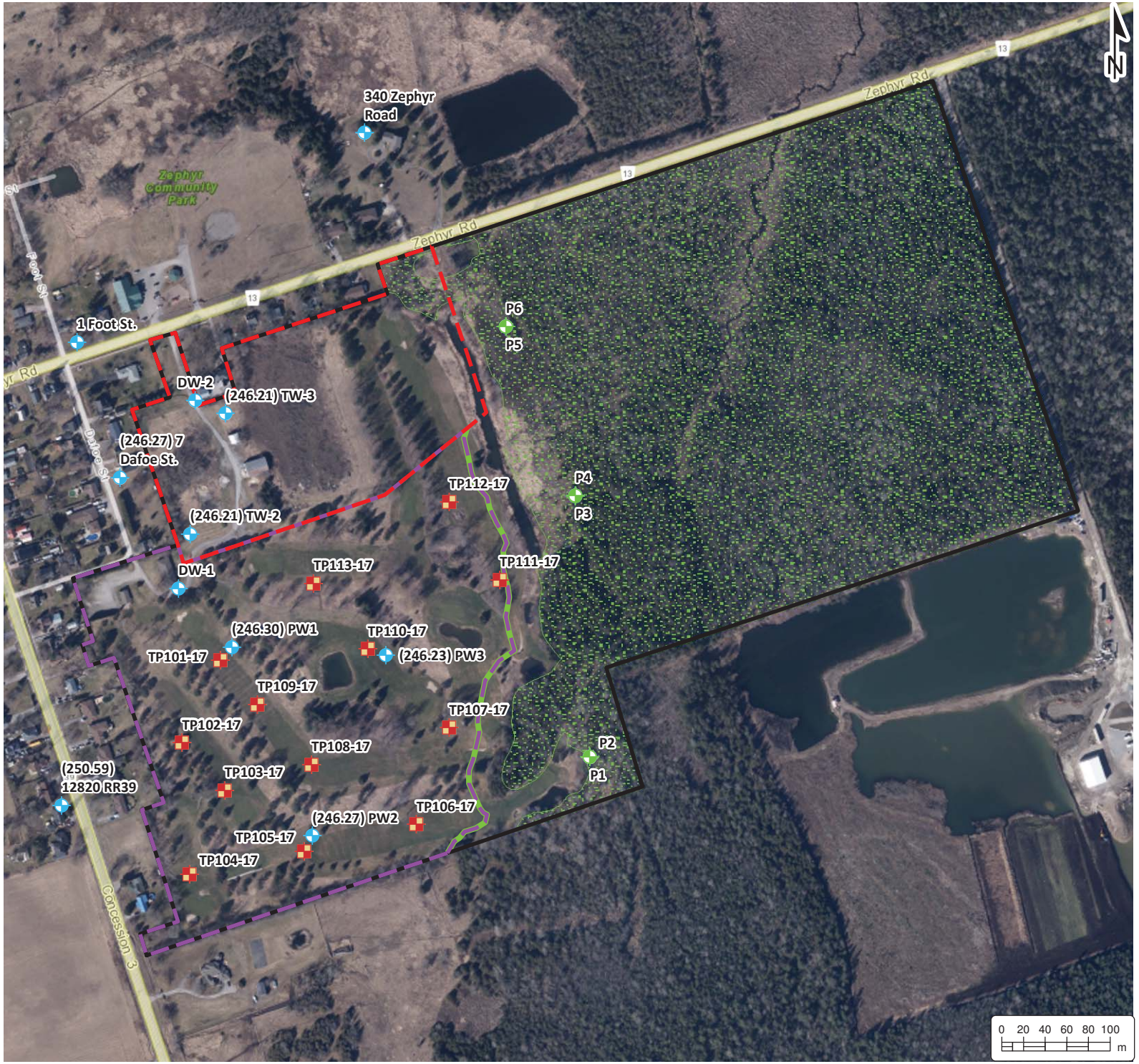
Notes:
- Base mapping features are © Queen's Printer of Ontario, 2017 (this does not constitute an endorsement by the Ministry of Natural Resources or the Ontario Government).
- Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.
- Cambium Inc. makes every effort to ensure this map is free from errors but cannot be held responsible for any damages due to error or omissions. This map should not be used for navigation or legal purposes. It is intended for general reference use only.

CAMBIUM
P.O. Box 325, 52 Hunter Street East
Peterborough, Ontario, K9H 1G5
Tel: (705) 742.7900 Fax: (705) 742.7907
www.cambium-inc.com

REGIONAL LOCATION PLAN

Project No.:	6199-001	Date:	August 2018
		Rev.:	
Scale:	1:200,000	Projection:	NAD 1983 UTM Zone 17N
Created by:	TLC	Checked by:	CM
Figure:	1		

O:\GIS\project_MXDs\6100-6199\6199-001 CCJBXMI co EcoVue - Hydrogeological Assessment, Hidden Ridge, Uxbridge\2018-08-08 FIG 1 - Regional Location Plan.mxd



HYDROGEOLOGICAL ASSESSMENT

CHINA CANADA JING XIN MIN INTL.
309 Zephyr Road,
Zephyr, Ontario

LEGEND

- Well Location (Confined Aquifer Groundwater Elevation - July 16, 2018
- Piezometer Location
- Test Pit Location
- 30m Wetland Setback
- Wetland
- Phase 1 Development
- Phase 2 Development
- Subject Property (approx.)

Notes:
- Phase 1 and 2 Subject Property is approximate and was obtained from Ecovue, Draft, Concept Sketch A, Project No:17-1672 Dated November 17, 2017.
- Wetlands and Wetland Setback were onbtained from Ecovue, Draft, Concept Sketch A, Project No:17-1672 Dated November 17, 2017.
- Base mapping features were obtained from the Durham County online GIS.
- Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.
- Cambium Inc. makes every effort to ensure this map is free from errors but cannot be held responsible for any damages due to error or omissions. This map should not be used for navigation or legal purposes. It is intended for general reference use only.

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ORIENTATION PLAN

Project No.:	6199-001	Date:	August 2018
		Rev.:	
Scale:	1:5,000	Projection:	NAD 1983 UTM Zone 17N
Created by:	TLC	Checked by:	CM
Figure:	2		

O:\GIS\project_MXDs\6100-6199\6199-001 CCJBXM\ co EcoVue - Hydrogeological Assessment, Hidden Ridge, Uxbridge\2018-08-08 FIG 2 - Orientation Plan.mxd

HYDROGEOLOGICAL ASSESSMENT

CHINA CANADA JING XIN MIN INTL.
309 Zephyr Road,
Zephyr, Ontario

LEGEND

- Well Location
- Piezometer Location
- Groundwater Contour (July 16, 2018)
- (246.30) Groundwater Elevation (July 16, 2018)
- Confined Aquifer Flow Direction (July 16, 2018)

Notes:
- Base mapping features were obtained from the Durham County online GIS.
- Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.
- Cambium Inc. makes every effort to ensure this map is free from errors but cannot be held responsible for any damages due to error or omissions. This map should not be used for navigation or legal purposes. It is intended for general reference use only.

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Peterborough, Ontario, K9H 1G5
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www.cambium-inc.com

GROUNDWATER CONTOURS

Project No.:	6199-001	Date:	August 2018
		Rev.:	
Scale:	1:5,000	Projection:	NAD 1983 UTM Zone 17N
Created by:	TLC	Checked by:	CM
Figure:	3		

O:\GIS\project_MXDs\6100-6199\6199-001 CCJBXMI co EcoVue - Hydrogeological Assessment, Hidden Ridge, Uxbridge\2018-08-08 FIG 3 - Groundwater Contours.mxd

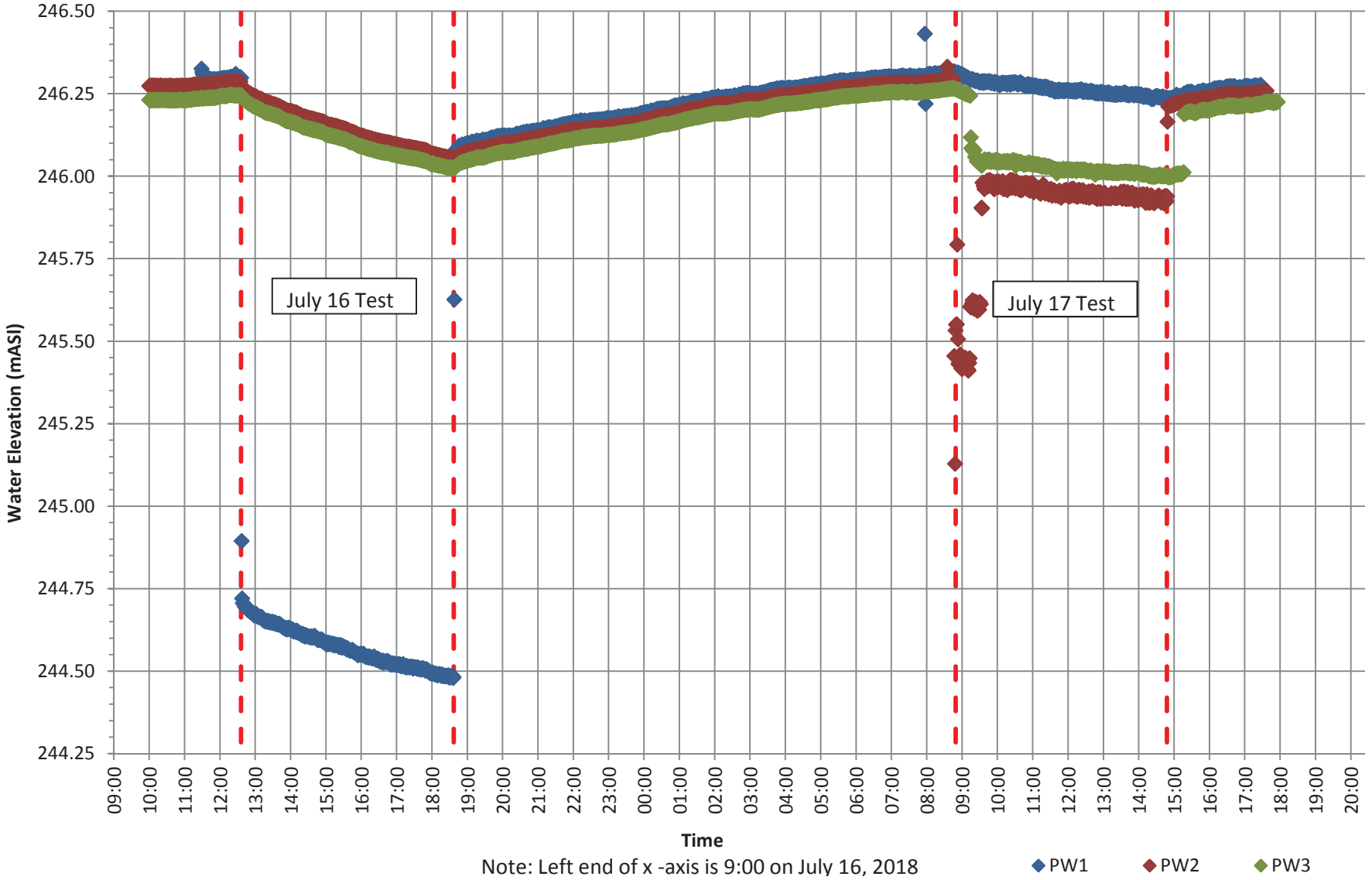


Figure 4. Groundwater Elevations - Test Wells

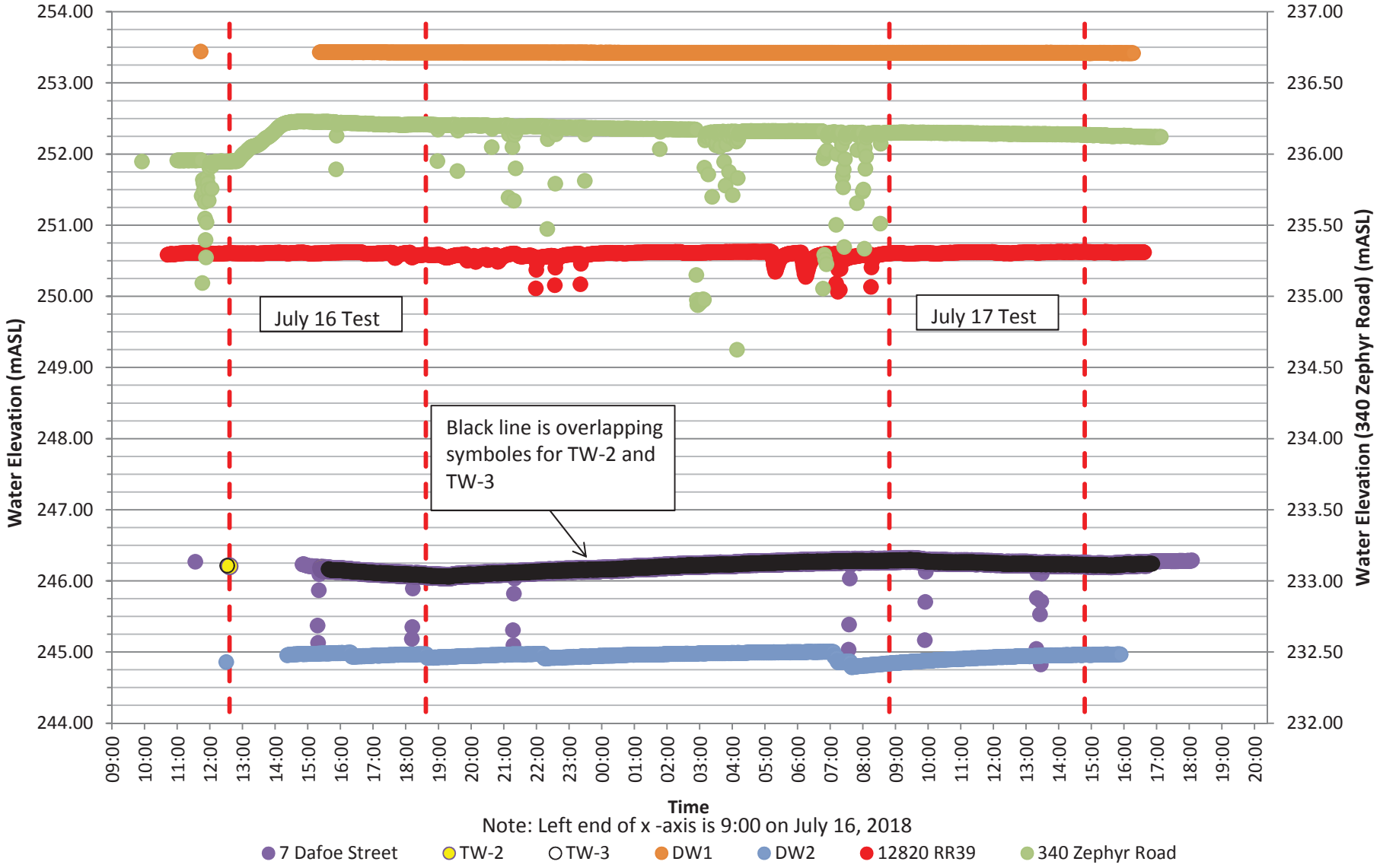


Figure 5. Groundwater Elevations - Monitoring Wells

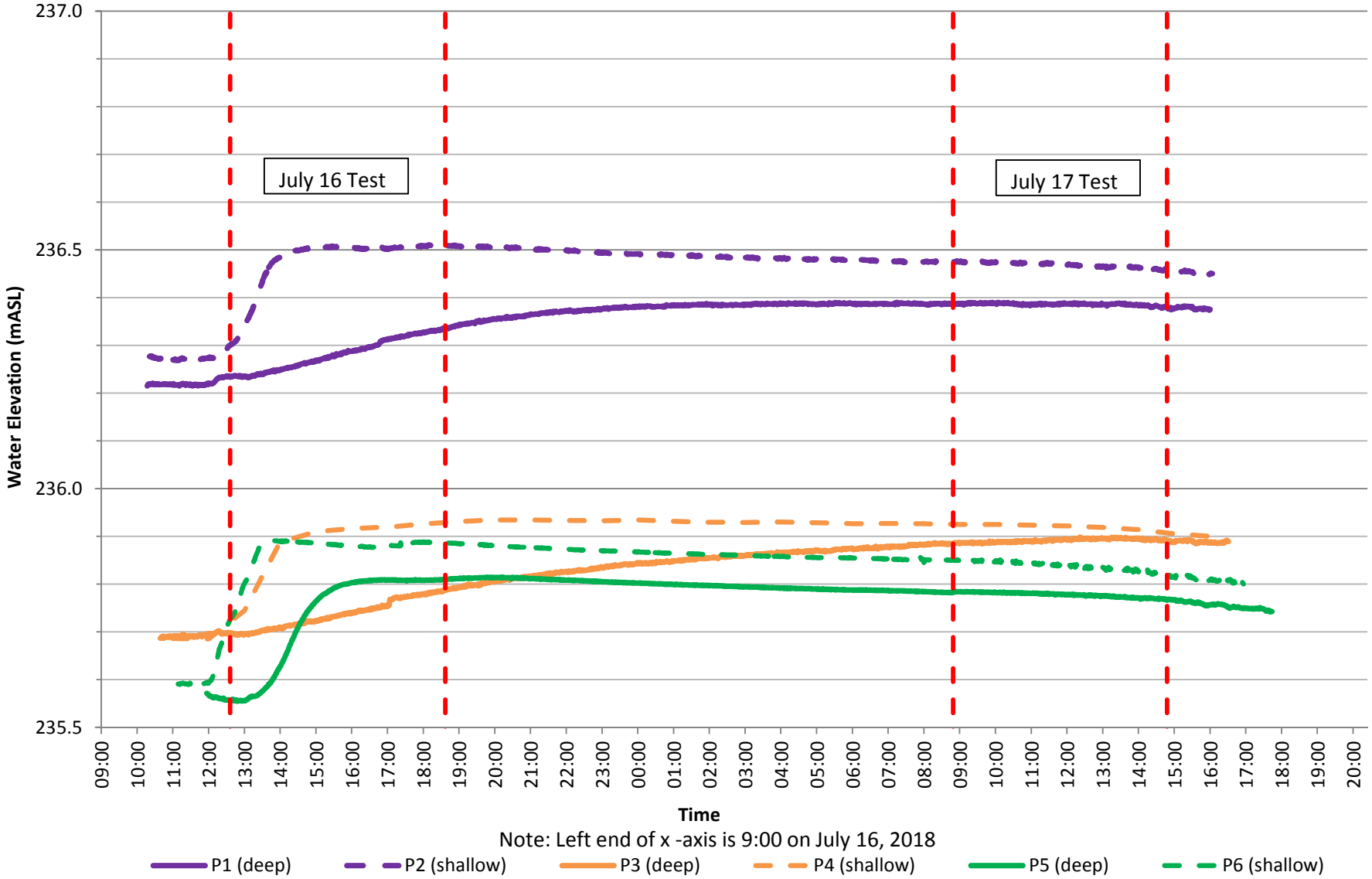


Figure 6. Groundwater Elevations - Piezometers

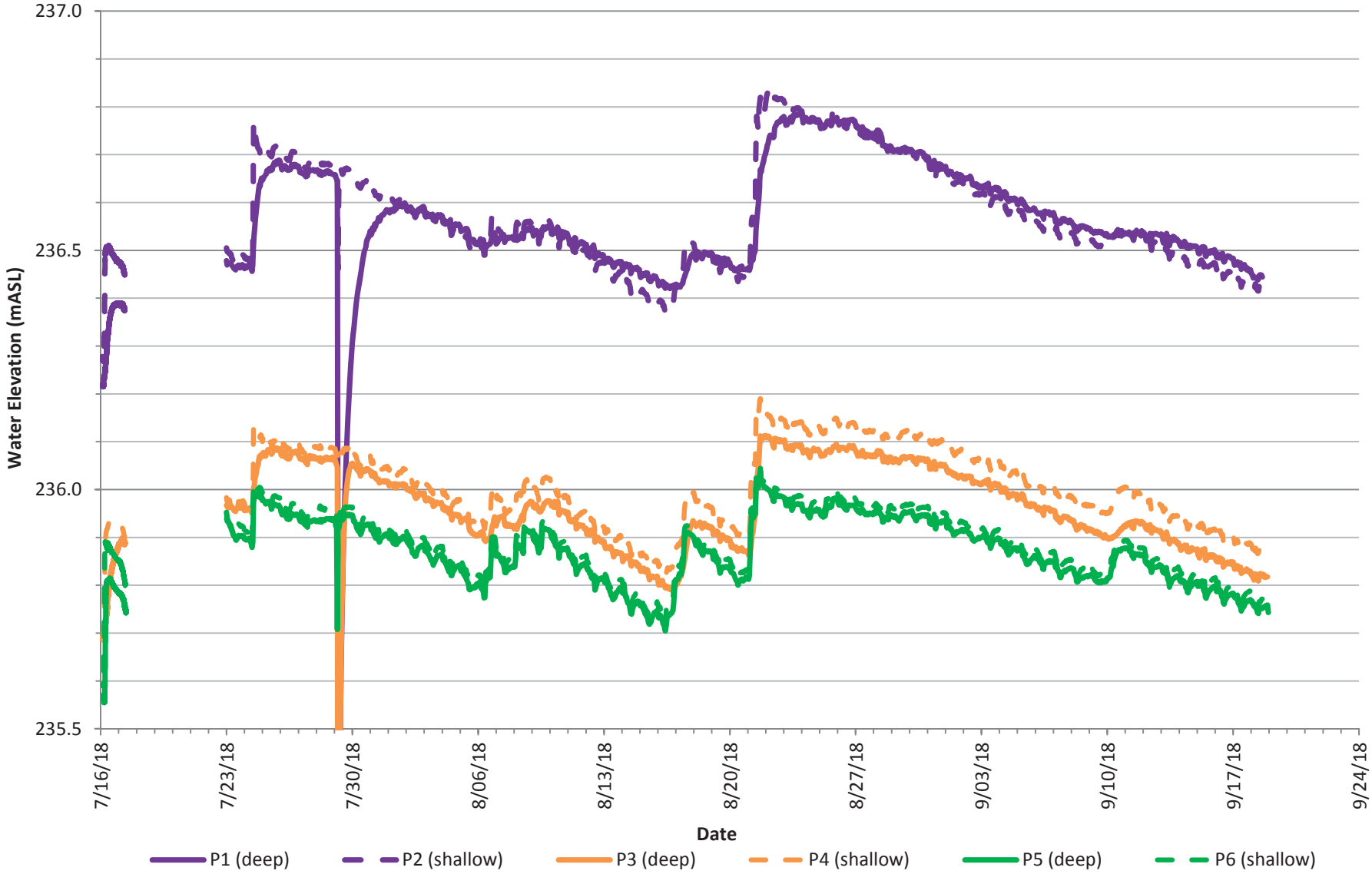
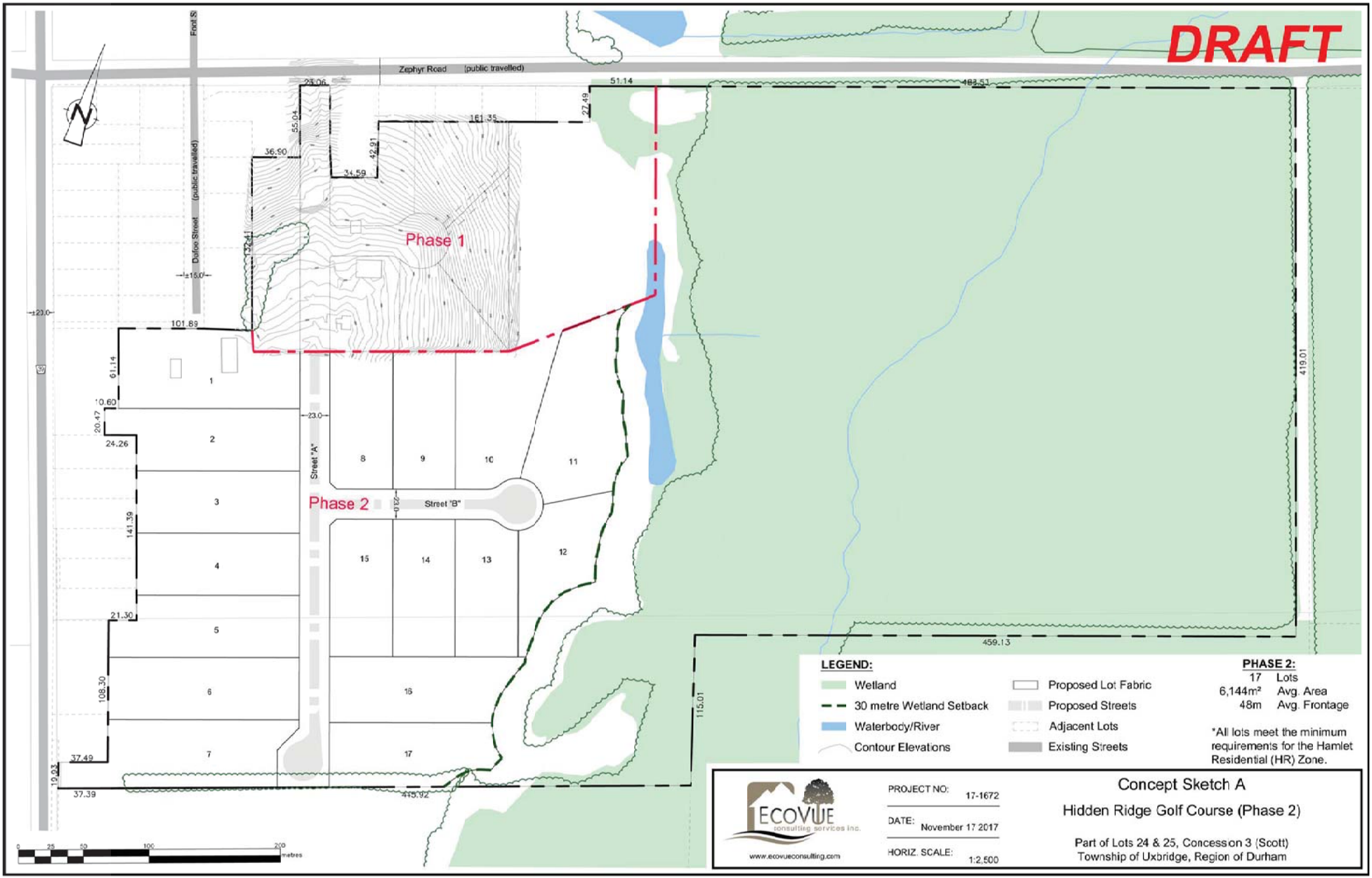


Figure 7. Long Term Groundwater Elevations - Piezometers

Figure 8: Vertical Hydraulic Gradients - Piezometers

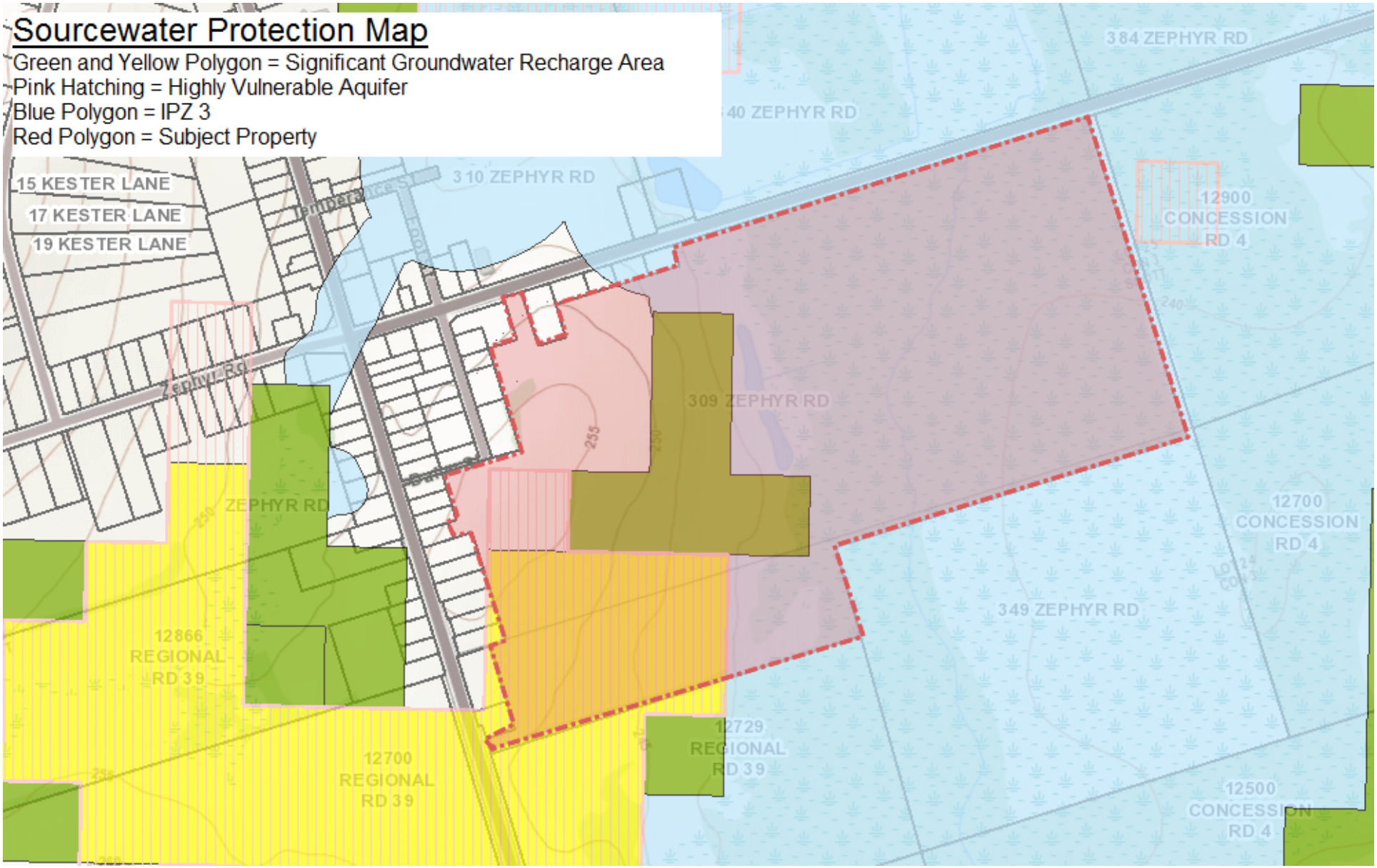
Appendix A

Proposed Development Plan and Land Information


DRAFT
Zephyr Road (public travelled)
Foot St
Dufore Street (public travelled)
Phase 1
Phase 2
Street "A"
Street "B"
LEGEND:
Wetland
30 metre Wetland Setback
Waterbody/River
Contour Elevations
Proposed Lot Fabric
Proposed Streets
Adjacent Lots
Existing Streets
PHASE 2:
17 Lots
6,144m² Avg. Area
48m Avg. Frontage
*All lots meet the minimum requirements for the Hamlet Residential (HR) Zone.
ECOVUE consulting services inc.
www.ecovueconsulting.com
PROJECT NO: 17-1672
DATE: November 17 2017
HORIZ. SCALE: 1:2,500
Concept Sketch A
Hidden Ridge Golf Course (Phase 2)
Part of Lots 24 & 25, Concession 3 (Scott)
Township of Uxbridge, Region of Durham

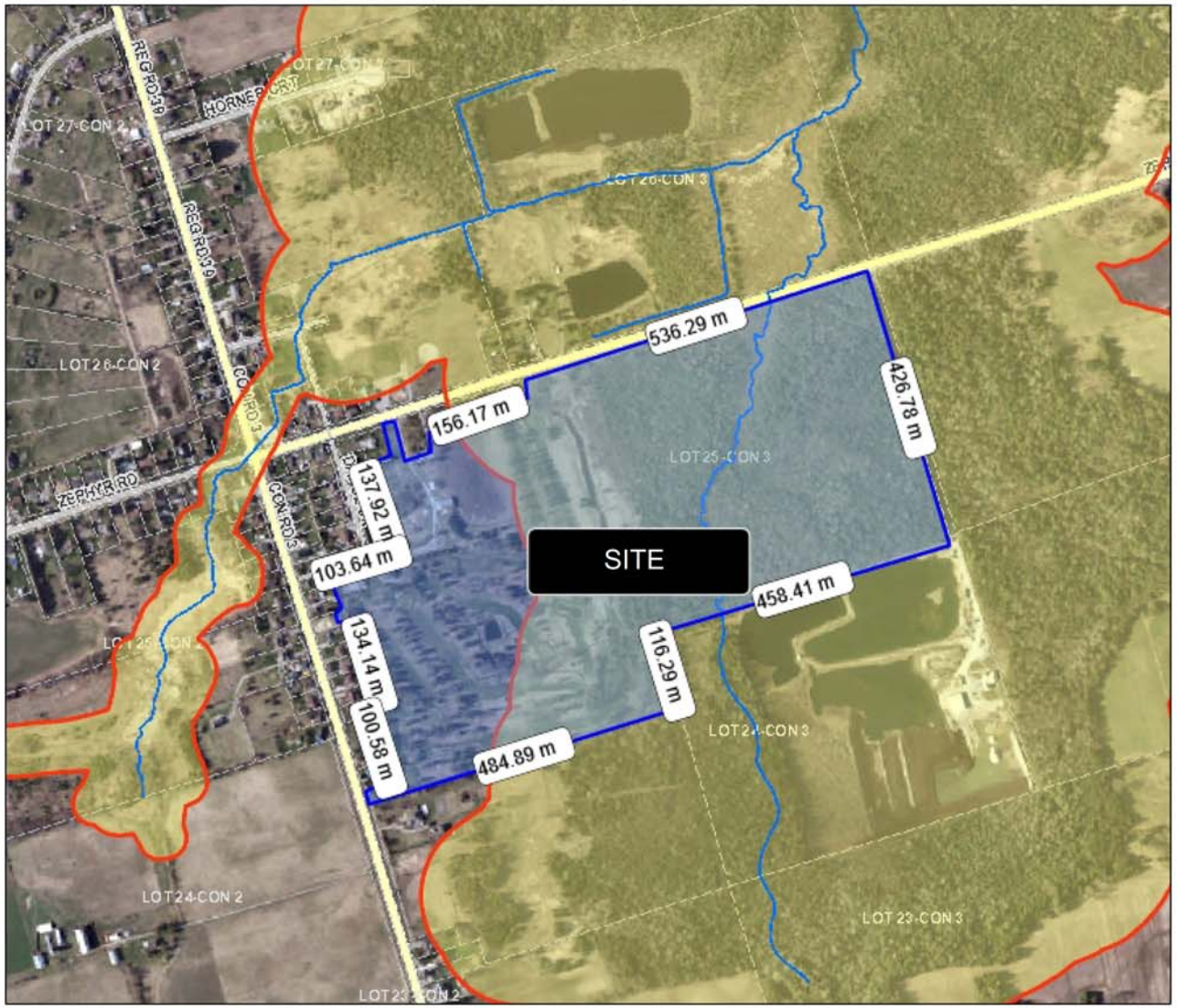
Sourcewater Protection Map

Green and Yellow Polygon = Significant Groundwater Recharge Area
Pink Hatching = Highly Vulnerable Aquifer
Blue Polygon = IPZ 3
Red Polygon = Subject Property



Lake Simcoe Region conservation authority

LSRCA Regulated Areas



Features

- Regulation Map Index
- LSRCA Watershed Boundary
- Lake Simcoe
- Watercourse
- Regulated Area Boundary
- Regulated Area
- Assessment Parcel
- Lot and Concession
- Roads
  - Hwy 400 Series
  - Highway, Arterials
  - Local Road
- Railway

Printed On:
10/19/2018

WGS_1984_Web_Mercator_Auxiliary_Sphere

Mapped By:

Scale 1: 9,160

465 0 233 465 Meters

Appendix B
Test-pit Logs

TEST PIT LOGS
309 Zephyr Rd, Zephyr, Ontario
Cambium Reference No. 6199-001

Test Pit ID	Depth (mbgs[1])	Sample Number	Material Description	UTM (Zone 17T)
TP101-17	0 - 0.20		Topsoil, dry, fine sandy organics	638877
	0.20 - 1.12	1	Light brown silt and fine sand, some gravel, stiff block structure, dry	4895421
	1.12 - 1.8	2	Silty gravelly sand, trace clay, moist, firm, blocky structure No water in hole upon completion	
TP102-17	0 - 0.25		Topsoil, fine sandy organics	
	0.25 - 0.84	1	Brown sandy silt, trace gravel, moist, soft	638842
	0.84 - 2.00	2	Brown silt and sand, some gravel, trace clay, moist, blocky structure Water entering bottom of hole	4895345
TP103-17	0 - 0.23		Topsoil, moist, fine sandy organics	
	0.23 - 0.81	1	Brown silty gravelly sand, trace clay, moist, loose to firm, variable to silt platy structure	638881 4895301
	0.81 - 2.00	2	Brown to grey silty sand, some clay, trace gravel, mostly blocky structure. No water in hole upon completion	
TP104-17	0 - 0.18		Topsoil	
	0.18 - 0.91	1	Brown silt and clay, some sand, trace gravel, soft, moist	638849
	0.91 - 2.00	2	Brown silty sand, some clay, trace gravel, moist, stiff to soft Hole open and dry upon completion	4895223
TP105-17	0 - 0.30		Topsoil	
	0.30 - 1.07	1	Variable soils - Tills, silts, sandy tills. Mostly soft. Soils appear to be disturbed from prior grading work at this location.	638954 4895245
	1.07 - 1.52	2	Brown silty sand, some clay, trace gravel, moist, soft. Hole excavated to 6'10". Open and dry.	
TP106-17	0 - 0.20		Topsoil	
	0.20 - 0.84	1	Various soils and materials: brown fine sand, dry; garbage; brown silt; cobbles and gravel, blocky.	639058
	0.84 - 1.22	2	Brown silt and clay till, moist, blocky	4895270
	1.22 - 2.13	3	Grey blue silt and clay, some sand and gravel. Cobbles approx. 25% of volume, moist, firm. Hole open and dry upon completion.	
TP107-17	0 - 0.20		Topsoil	
	0.20 - 0.89	1	Brown silty sand, trace clay, loose, moist	639088
	0.89 - 1.93	2	Grey silt and clay, soft, moist, mottled, same soil at depth, slightly more silt. Some saturated lenses at ~5 feet. Hole open and dry upon completion	4895359
TP108 -17	0 - 0.36		Topsoil, sand to silty sand	638961
	0.36 - 2.00	1	Light brown fine sandy silt, some gravel, dry, stiff, blocky structure Hole open and dry upon completion	4895325

TEST PIT LOGS
309 Zephyr Rd, Zephyr, Ontario
Cambium Reference No. 6199-001

Test Pit ID	Depth (mbgs[1])	Sample Number	Material Description	Depth (mbgs)
TP109-17	0 - 0.25		Topsoil	
	0.25 - 0.94	1	Sandy silt till, some gravel, dry, some platy structure, firm	638911
	0.94 - 2.00	2	Brown silty sand, some gravel, till, moist, loose	4895380
			Hole open and dry upon completion	
TP110-17	0 - 0.33		Topsoil, sand and silt, moist	
	0.33 - 0.76	1	Light brown silt and fine sand, trace gravel, some staining, soft, moist	639013
	0.76	2	Grey silt and clay, moist, orange mottling	4895432
	0.76 - 2.00	3	Brown silt and clay, some gravel, moist	
			Water entering bottom of hole	
TP111-17	0 - 0.43		Topsoil	
	0.43 - 0.69	1	Blue silt and clay, some fine sand, moist to saturated, soft	639135
	1.24		Water entering at 1.24m, buried organics throughout, moist to saturated	4895495
	1.24 - 2.13	2	Blue medium sand, moist to saturated, loose	
			Hole terminated at 2.13m, water entering hole	
TP112-17	0 - 0.18		Topsoil	
	0.18 - 1.52	1	Brown silty sand, trace clay, moist, soft, loose	639088
			Water entering hole at 1.5m, some red staining. Unable to excavate past 1.5m due to saturated cave-in conditions	4895568
	1.52	2	Brown silt and clay, firm, moist	
TP113-17	0 - 0.30		Topsoil	638963
	0.30 - 2.00	1	Sand and gravel till, firm, dry	4895492
			Hole open and dry upon completion	

Notes: 1. mbgs = metres below ground surface

Appendix C
Borehole Logs

Ontario

Ministry of the Environment and Climate Change

Measurements recorded in: ☐ Metric ☑ Imperial

Well Tag No. *(Place Sticker and/or Print Below)*: A222207

Well Record

Regulation 903 Ontario Water Resources Act

Page 1 of 1

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
China Canada Jing Bei xin min Intl			

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
118 Gemini Cres	Richmond Hill	ON	L4S2K7	

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
Dafoe St	Uxbridge/Scott	25	3

County/District/Municipality	City/Town/Village	Province	Postal Code
Durham	Zeph	Ontario	

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	17	639858	4859526		

Overburden and Bedrock Materials/Abandonment Sealing Record *(see instructions on the back of this form)*

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	Depth (m/ft) To
Brown	clay	silt, stones	Hard	0	10'
Grey	clay	stones	Dense	10	45'
Grey	sand	gravel	Loose	45	76'

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m^3/ft^3)
0	20'	Hole plug	7.86 ft^3

Method of Construction

☐ Cable Tool ☐ Diamond
☐ Rotary (Conventional) ☐ Jetting
☐ Rotary (Reverse) ☐ Driving
☐ Boring ☐ Digging
☐ Air percussion
☑ Other, *specify* rotary air

Well Use

☐ Public ☐ Commercial ☐ Not used
☑ Domestic ☐ Municipal ☐ Dewatering
☐ Livestock ☐ Test Hole ☐ Monitoring
☐ Irrigation ☐ Cooling & Air Conditioning
☐ Industrial
☐ Other, *specify*

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	Depth (m/ft) To
10"	Steel	.188"	0	73'

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	Depth (m/ft) To
6"	Steel	18	73	76'

Status of Well

☑ Water Supply
☐ Replacement Well
☐ Test Hole
☐ Recharge Well
☐ Dewatering Well
☐ Observation and/or Monitoring Hole
☐ Alteration (Construction)
☐ Abandoned, Insufficient Supply
☐ Abandoned, Poor Water Quality
☐ Abandoned, other, *specify*
☐ Other, *specify*

Results of Well Yield Testing

After test of well yield, water was:
☑ Clear and sand free
☐ Other, *specify*

If pumping discontinued, give reason:

Pump intake set at (m/ft): 60'

Pumping rate (l/min / GPM): 10 GPM

Duration of pumping: 1 hrs + 0 min

Final water level end of pumping (m/ft): Flow

If flowing give rate (l/min / GPM): 15 GPM

Recommended pump depth (m/ft): 60

Recommended pump rate (l/min / GPM): 20

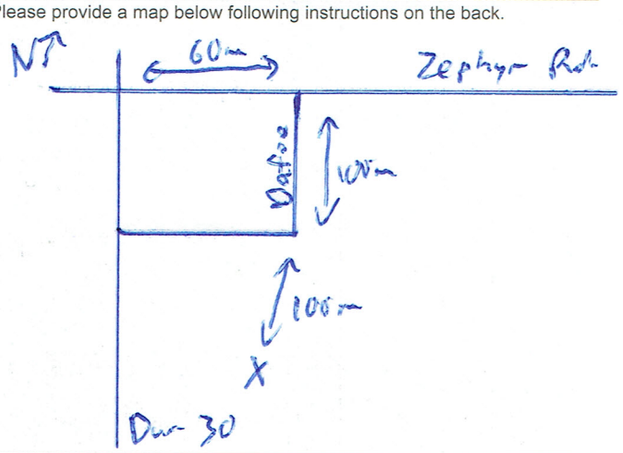
Well production (l/min / GPM): 30

Disinfected? ☑ Yes ☐ No

	Draw Down Time (min)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level	+ 3.5'			
1	Flow		1	Flow
2	Flow		2	Flow
3	Flow		3	Flow
4	Flow		4	Flow
5	Flow		5	Flow
10	Flow		10	Flow
15	Flow		15	Flow
20	Flow		20	Flow
25	Flow		25	Flow
30	Flow		30	Flow
40	Flow		40	Flow
50	Flow		50	Flow
60	Flow		60	Flow

Map of Well Location

Please provide a map below following instructions on the back.



Water Details

Water found at Depth	Kind of Water	
76' (m/ft) ☐ Gas	☑ Fresh ☐ Untested	☐ Other, *specify*
(m/ft) ☐ Gas	☐ Fresh ☐ Untested	☐ Other, *specify*
(m/ft) ☐ Gas	☐ Fresh ☐ Untested	☐ Other, *specify*

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
0	20'	10"
0	76'	6"

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
Wilsons Water Wells Ltd.	5459

Business Address (Street Number/Name)	Municipality
13787 Hwy 48	Stouffville

Province	Postal Code	Business E-mail Address
ON	L4A7X3	

Bus. Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name)
9056404369	Ferguson, Eric

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
3490		2018 06 21

Comments: Chlorinated 200ppm
Residual chlorine 50 ppm → 21 hrs

Well owner's information package delivered	Date Package Delivered	Date Work Completed
☑ Yes ☐ No	2018 06 20	2018 06 20

Ministry Use Only

Audit No. Z265420

Received

Ministry's Copy

Ontario

Ministry of the Environment and Climate Change

Measurements recorded in: ☐ Metric ☑ Imperial

W... Tag#: A 222198 ...Below)

A222198

Well Record

Regulation 903 Ontario Water Resources Act

Page 1 of 1

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
China Canada Jing	Bei xin min intl.		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
118 Gemini Crest	Richmond hill	on	L4S2M7	

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
Dafoe Street	Uxbridge/scott	25	3

County/District/Municipality	City/Town/Village	Province	Postal Code
Durham	Zephr	Ontario	

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	17	638975	4895482		

Overburden and Bedrock Materials/Abandonment Sealing Record *(see instructions on the back of this form)*

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	To
Brown	Sand	stone, silt, gravel	Hard	0	25'
Grey	Clay	stones	Dense	25	85'
Grey	Sand	gravel	Loose	85	97'

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0	20'	Bentonite slurry	7.84 ft³

Method of Construction

☐ Cable Tool ☐ Diamond
☐ Rotary (Conventional) ☐ Jetting
☐ Rotary (Reverse) ☐ Driving
☐ Boring ☐ Digging
☐ Air percussion
☑ Other, specify: Rotary air

Well Use

☐ Public ☐ Commercial ☐ Not used
☑ Domestic ☐ Municipal ☐ Dewatering
☐ Livestock ☐ Test Hole ☐ Monitoring
☐ Irrigation ☐ Cooling & Air Conditioning
☐ Industrial
☐ Other, specify

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	To
6"	Steel	.188"	0	94'

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	To
6"	Steel	14	94	97'

Status of Well

☑ Water Supply
☐ Replacement Well
☐ Test Hole
☐ Recharge Well
☐ Dewatering Well
☐ Observation and/or Monitoring Hole
☐ Alteration (Construction)
☐ Abandoned, Insufficient Supply
☐ Abandoned, Poor Water Quality
☐ Abandoned, other, specify
☐ Other, specify

Water Details

Water found at Depth (m/ft)	Gas	Kind of Water	Fresh	Untested	Other, specify
97'	☐		☑	☐	
	☐		☐	☐	
	☐		☐	☐	

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
0	20'	10"
0	97'	6"

Results of Well Yield Testing

After test of well yield, water was:
☑ Clear and sand free
☐ Other, specify

If pumping discontinued, give reason:

Pump intake set at (m/ft): 85'

Pumping rate (l/min / GPM): 12 GPM

Duration of pumping: 1 hrs + 0 min

Final water level end of pumping (m/ft): 21'4

If flowing give rate (l/min / GPM)

Recommended pump depth (m/ft): 70

Recommended pump rate (l/min / GPM): 20

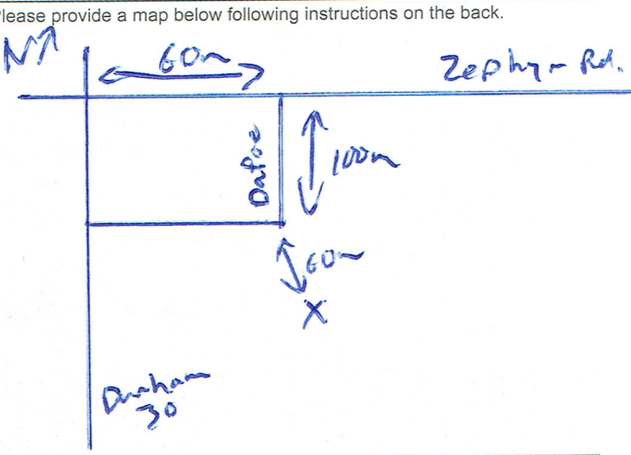
Well production (l/min / GPM): 30 +

Disinfected? ☑ Yes ☐ No

	Draw Down Time (min)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level		20'2		
1	20'4		1	20.3
2	21.3		2	20.2
3	21.4		3	20.2
4	21.4		4	20.2
5	21.4		5	20.2
10	21.4		10	20.2
15	21.4		15	20.2
20	21.4		20	20.2
25	21.4		25	20.2
30	21.4		30	20.2
40	21.4		40	20.2
50	21.4		50	20.2
60	21.4		60	20.2

Map of Well Location

Please provide a map below following instructions on the back.



Comments: Disinfected 200ppm
Residual chlorine 100ppm → 17 hrs.

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
Wilson's Water Wells Ltd.	5459

Business Address (Street Number/Name)	Municipality
13787 Hwy 48	Stouffville

Province	Postal Code	Business E-mail Address
ON	L4A7X3	

Bus. Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name)
9056404369	Ferguson, Eric

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
3490		2018061 8

Well owner's information package delivered	Date Package Delivered	Date Work Completed
☑ Yes ☐ No	2018061 8	2018061 4

Ministry Use Only

Audit No. Z265418

Received

0506E (2014/11)

Ministry's Copy

Ontario — Ministry of the Environment and Climate Change

Measurements recorded in: ☐ Metric ☑ Imperial

Tag#: A 222197 (t Below)

A 222197

Well Record

Regulation 903 Ontario Water Resources Act

Page 1 of 1

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
China Canada Jing Bei Xin Min Shall			

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
118 Gemini Cres	Richmond Hill	ON	L4S 2K7	

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
Dafoe Street	Uxbridge/Scott	25	3

County/District/Municipality	City/Town/Village	Province	Postal Code
Durham	- Beph	Ontario	

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 8 3	17	639030	4895426		

Overburden and Bedrock Materials/Abandonment Sealing Record *(see instructions on the back of this form)*

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	Depth (m/ft) To
Brown	clay	stones, silt	Hard	0	6'
Grey	clay	stones	Dense	6	50'
Grey	sand	gravel	Loose	50	69'

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0	20'	Hole plug	7.86 ft³

Method of Construction

☐ Cable Tool ☐ Diamond ☐ Rotary (Conventional) ☐ Jetting ☐ Rotary (Reverse) ☐ Driving ☐ Boring ☐ Digging ☐ Air percussion ☑ Other, specify: Rotary air

Well Use

☐ Public ☐ Commercial ☐ Not used ☑ Domestic ☐ Municipal ☐ Dewatering ☐ Livestock ☐ Test Hole ☐ Monitoring ☐ Irrigation ☐ Cooling & Air Conditioning ☐ Industrial ☐ Other, specify

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	Depth (m/ft) To
6"	Steel	.188"	0	66'

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	Depth (m/ft) To
6"	Steel	16	66	69'

Status of Well

☑ Water Supply ☐ Replacement Well ☐ Test Hole ☐ Recharge Well ☐ Dewatering Well ☐ Observation and/or Monitoring Hole ☐ Alteration (Construction) ☐ Abandoned, Insufficient Supply ☐ Abandoned, Poor Water Quality ☐ Abandoned, other, specify ☐ Other, specify

Water Details

Water found at Depth (m/ft)	Gas	Kind of Water	Fresh	Untested	Other, specify
69'	☐		☑	☐	
	☐		☐	☐	
	☐		☐	☐	

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
0	20'	10"
0	69'	6"

Results of Well Yield Testing

After test of well yield, water was: ☑ Clear and sand free ☐ Other, specify

If pumping discontinued, give reason:

Pump intake set at (m/ft): 55'

Pumping rate (l/min / GPM): 10 GPM

Duration of pumping: 1 hrs + 0 min

Final water level end of pumping (m/ft): Flowing

If flowing give rate (l/min / GPM): 20 GPM

Recommended pump depth (m/ft): 30

Recommended pump rate (l/min / GPM): 20

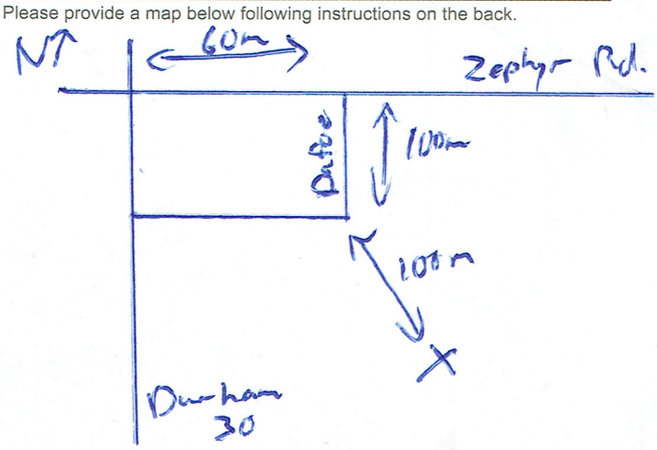
Well production (l/min / GPM): 30+

Disinfected? ☑ Yes ☐ No

Draw Down Time (min)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level	+8'		
1	Flow	1	Flow
2	Flow	2	Flow
3	Flow	3	Flow
4	Flow	4	Flow
5	Flow	5	Flow
10	Flow	10	Flow
15	Flow	15	Flow
20	Flow	20	Flow
25	Flow	25	Flow
30	Flow	30	Flow
40	Flow	40	Flow
50	Flow	50	Flow
60	Flow	60	Flow

Map of Well Location

Please provide a map below following instructions on the back.



Comments: Disinfected 200 ppm
Residual Chlorine 100 ppm → 17 hrs

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
Wilson's Water Wells Ltd.	5459

Business Address (Street Number/Name)	Municipality
13787 Hwy 48	Stouffville

Province	Postal Code	Business E-mail Address
ON	L4A 7X3	

Bus. Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name)
9056404369	Ferguson, Eric

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
3490		2015061 8

Well owner's information package delivered	Date Package Delivered	Date Work Completed
☑ Yes ☐ No	2015061 8	2015061 8

Ministry Use Only

Audit No. Z265560

Received

0506E (2014/11)

Ministry's Copy

Appendix D
Certificates of Analysis

CADUCEON ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: ---

REPORT No. B17-23016

Report To:

Cambium Environmental
PO Box 325, 52 Hunter Street East
Peterborough ON K9H 1G5 Canada
Attention: Cameron MacDougall

Caduceon Environmental Laboratories
285 Dalton Ave
Kingston Ontario K7K 6Z1
Tel: 613-544-2001
Fax: 613-544-2770

DATE RECEIVED: 11-Aug-17
DATE REPORTED: 17-Aug-17
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: 6199-001
P.O. NUMBER:
WATERWORKS NO.

	Client I.D.	340 Zephyr Rd.	1 Foot Rd.	12820 Durham Rd. 39	
	Sample I.D.	B17-23016-1	B17-23016-2	B17-23016-3	
	Date Collected	09-Aug-17	09-Aug-17	09-Aug-17	

Parameter	Units	R.L.	Reference Method	Date/Site Analyzed				
BOD(5 day)	mg/L	2	SM 5210B	11-Aug-17/K	3	< 2	< 2	
Total Kjeldahl Nitrogen	mg/L	0.1	E3199A.1	15-Aug-17/K	0.1	0.6	< 0.1	
Ammonia (N)-Total	mg/L	0.01	SM4500-NH3-H	15-Aug-17/K	0.10	0.30	0.01	
Ammonia (N)-unionized	mg/L	0.01	CALC	15-Aug-17/K	< 0.01	< 0.01	< 0.01	
Nitrite (N)	mg/L	0.1	SM4110C	14-Aug-17/O	< 0.1	< 0.1	< 0.1	
Nitrate (N)	mg/L	0.1	SM4110C	14-Aug-17/O	< 0.1	< 0.1	1.0	
Dissolved Organic Carbon	mg/L	0.2	EPA 415.1	14-Aug-17/O	0.8	2.5	0.3	

Michelle Dubien
Lab Manager

R.L. = Reporting Limit
Test methods may be modified from specified reference method unless indicated by an *
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill,B-Barrie

CADUCEON ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G39405 **REPORT No. B18-21068**

Report To:

Cambium Environmental
PO Box 325, 52 Hunter Street East
Peterborough ON K9H 1G5 Canada
Attention: Cameron MacDougall

Caduceon Environmental Laboratories
2378 Holly Lane
Ottawa Ontario K1V 7P1
Tel: 613-526-0123
Fax: 613-526-1244

DATE RECEIVED: 18-Jul-18
DATE REPORTED: 24-Jul-18
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: 6199-001
P.O. NUMBER:
WATERWORKS NO.

	Client I.D.:	PW1		ODWS	
	Sample I.D.:	B18-21068-1		Objective	Type of Objective
	Date Collected:	16-Jul-18			

Parameter	Units	R.L.	Reference Method	Date/Site Analyzed				
Hardness (as CaCO3)	mg/L	1	SM 3120	19-Jul-18/O	**268**		80-100	OG
Alkalinity(CaCO3) to pH4.5	mg/L	5	SM 2320B	18-Jul-18/O	211		30-500	OG
pH @25°C	pH Units		SM 4500H	18-Jul-18/O	8.04		6.5-8.5	OG
Conductivity @25°C	µmho/cm	1	SM 2510B	18-Jul-18/O	544			
Turbidity	NTU	0.1	SM 2130	20-Jul-18/O	**6.4**		5	AO
Total Suspended Solids	mg/L	3	SM 2540D	19-Jul-18/O	< 3			
Colour	TCU	2	SM 2120C	20-Jul-18/O	< 2		5	AO
Fluoride	mg/L	0.1	SM4110C	18-Jul-18/O	< 0.1		1.5	MAC
Chloride	mg/L	0.5	SM4110C	18-Jul-18/O	17.2		250	AO
Nitrite (N)	mg/L	0.1	SM4110C	18-Jul-18/O	< 0.1		1	MAC
Nitrate (N)	mg/L	0.1	SM4110C	18-Jul-18/O	< 0.1		10	MAC
Sulphate	mg/L	1	SM4110C	18-Jul-18/O	36		500	AO
Calcium	mg/L	0.02	SM 3120	19-Jul-18/O	79.4			
Magnesium	mg/L	0.02	SM 3120	19-Jul-18/O	16.9			
Sodium	mg/L	0.2	SM 3120	19-Jul-18/O	6.6		200,20	AO,MAC
Potassium	mg/L	0.1	SM 3120	19-Jul-18/O	1.1			
Aluminum	mg/L	0.01	SM 3120	19-Jul-18/O	0.06		0.1	OG
Antimony	mg/L	0.0001	EPA 200.8	24-Jul-18/O	0.0001		0.006,0.006	IMAC,MAC
Arsenic	mg/L	0.0001	EPA 200.8	24-Jul-18/O	0.0001		0.025,0.010	IMAC,MAC
Barium	mg/L	0.001	SM 3120	19-Jul-18/O	0.159		1	MAC
Beryllium	mg/L	0.002	SM 3120	19-Jul-18/O	< 0.002			
Bismuth	mg/L	0.02	SM 3120	19-Jul-18/O	< 0.02			
Boron	mg/L	0.005	SM 3120	19-Jul-18/O	0.007		5,5.0	IMAC,MAC
Cadmium	mg/L	0.000015	EPA 200.8	24-Jul-18/O	< 0.000015		0.005	MAC
Chromium	mg/L	0.002	SM 3120	19-Jul-18/O	< 0.002		0.05	MAC
Cobalt	mg/L	0.005	SM 3120	19-Jul-18/O	< 0.005			
Copper	mg/L	0.002	SM 3120	19-Jul-18/O	< 0.002		1	AO
Iron	mg/L	0.005	SM 3120	19-Jul-18/O	**0.642**		0.3	AO

ODWS - Ontario Drinking Water Standards
AO - Aesthetic Objectives
IMAC - Interim Maximum Acceptable Concentration
MAC - Maximum Acceptable Concentration
OG - Operational Guidelines

R.L. = Reporting Limit
Test methods may be modified from specified reference method unless indicated by an *
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill,B-Barrie

Greg Clarkin , BSc., C. Chem
Lab Manager - Ottawa District

CADUCEON ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G39405 **REPORT No. B18-21068**

Report To:

Cambium Environmental
PO Box 325, 52 Hunter Street East
Peterborough ON K9H 1G5 Canada
Attention: Cameron MacDougall

Caduceon Environmental Laboratories
2378 Holly Lane
Ottawa Ontario K1V 7P1
Tel: 613-526-0123
Fax: 613-526-1244

DATE RECEIVED: 18-Jul-18
DATE REPORTED: 24-Jul-18
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: 6199-001
P.O. NUMBER:
WATERWORKS NO.

	Client I.D.:	PW1		ODWS	
	Sample I.D.:	B18-21068-1		Objective	Type of Objective
	Date Collected:	16-Jul-18			

Parameter	Units	R.L.	Reference Method	Date/Site Analyzed				
Lead	mg/L	0.00002	EPA 200.8	24-Jul-18/O	0.00004		0.010	MAC
Manganese	mg/L	0.001	SM 3120	19-Jul-18/O	**0.069**		0.05	AO
Molybdenum	mg/L	0.01	SM 3120	19-Jul-18/O	< 0.01			
Nickel	mg/L	0.01	SM 3120	19-Jul-18/O	< 0.01			
Selenium	mg/L	0.001	EPA 200.8	24-Jul-18/O	< 0.001		0.05	MAC
Silicon	mg/L	0.01	SM 3120	19-Jul-18/O	7.46			
Silver	mg/L	0.0001	EPA 200.8	24-Jul-18/O	< 0.0001			
Strontium	mg/L	0.001	SM 3120	19-Jul-18/O	0.281			
Thallium	mg/L	0.00005	EPA 200.8	24-Jul-18/O	< 0.00005			
Tin	mg/L	0.05	SM 3120	19-Jul-18/O	< 0.05			
Titanium	mg/L	0.005	SM 3120	19-Jul-18/O	< 0.005			
Uranium	mg/L	0.00005	EPA 200.8	24-Jul-18/O	0.00014		0.020	MAC
Vanadium	mg/L	0.005	SM 3120	19-Jul-18/O	< 0.005			
Zinc	mg/L	0.005	SM 3120	19-Jul-18/O	0.005		5	AO
Ammonia (N)-Total	mg/L	0.01	SM4500-NH3-H	19-Jul-18/K	0.18			
Total Kjeldahl Nitrogen	mg/L	0.1	E3199A.1	19-Jul-18/K	0.2			
Organic Nitrogen	mg/L	0.1	E3199A.1	24-Jul-18/K	< 0.1		0.15	OG
Phosphorus-Total	mg/L	0.01	E3199A.1	19-Jul-18/K	0.05			
Phenolics	mg/L	0.001	MOEE 3179	20-Jul-18/O	< 0.001			
Tannins and Lignins	mg/L	0.5	SM5500B	23-Jul-18/K	< 0.5			
Sulphide	mg/L	0.01	SM4500-S2	20-Jul-18/K	< 0.01		0.05	AO
Dissolved Organic Carbon	mg/L	0.2	EPA 415.1	19-Jul-18/O	2.8		5	AO
Total Organic Carbon	mg/L	0.2	EPA 415.1	20-Jul-18/O	2.6			
Total Coliform	cfu/100mL	1	MOE E3407	18-Jul-18/O	0		0	MAC
E coli	cfu/100mL	1	MOE E3407	18-Jul-18/O	0		0	MAC
Heterotrophic Plate Count	cfu/mL	2	SM 9215C	18-Jul-18/O	4			
Anion Sum	meq/L		Calc.	23-Jul-18/O	5.45			

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Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill,B-Barrie

Greg Clarkin , BSc., C. Chem
Lab Manager - Ottawa District

CADUCEON ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G39405 **REPORT No. B18-21068**

Report To:

Cambium Environmental
PO Box 325, 52 Hunter Street East
Peterborough ON K9H 1G5 Canada
Attention: Cameron MacDougall

Caduceon Environmental Laboratories
2378 Holly Lane
Ottawa Ontario K1V 7P1
Tel: 613-526-0123
Fax: 613-526-1244

DATE RECEIVED: 18-Jul-18
DATE REPORTED: 24-Jul-18
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: 6199-001
P.O. NUMBER:
WATERWORKS NO.

			Client I.D.:		PW1		ODWS	
			Sample I.D.:		B18-21068-1		Objective	Type of Objective
			Date Collected:		16-Jul-18			
Parameter	**Units**	**R.L.**	**Reference Method**	**Date/Site Analyzed**				
Cation Sum	meq/L		Calc.	23-Jul-18/O	5.72			
% Difference	%		Calc.	23-Jul-18/O	2.36			
Ion Ratio	AS/CS		Calc.	23-Jul-18/O	0.954			
Sodium Adsorption Ratio	-		Calc.	23-Jul-18/O	0.174			
TDS(ion sum calc.)	mg/L	1	Calc.	23-Jul-18/O	285		500	AO
Conductivity (calc.)	µmho/cm		Calc.	23-Jul-18/O	529			
TDS(calc.)/EC(actual)	-		Calc.	23-Jul-18/O	0.524			
EC(calc.)/EC(actual)	-		Calc.	23-Jul-18/O	0.973			
Langelier Index(25°C)	S.I.		Calc.	23-Jul-18/O	0.822			
Saturation pH (25°C)	-		Calc.	23-Jul-18/O	7.22			

ODWS - Ontario Drinking Water Standards
AO - Aesthetic Objectives
IMAC - Interim Maximum Acceptable Concentration
MAC - Maximum Acceptable Concentration
OG - Operational Guidelines

R.L. = Reporting Limit
Test methods may be modified from specified reference method unless indicated by an *
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill,B-Barrie

Greg Clarkin , BSc., C. Chem
Lab Manager - Ottawa District

CADUCEON ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G78623 **REPORT No. B18-21231**

Report To:

Cambium Environmental
PO Box 325, 52 Hunter Street East
Peterborough ON K9H 1G5 Canada
Attention: Cameron MacDougall

Caduceon Environmental Laboratories
2378 Holly Lane
Ottawa Ontario K1V 7P1
Tel: 613-526-0123
Fax: 613-526-1244

DATE RECEIVED: 19-Jul-18
DATE REPORTED: 27-Jul-18
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: 6199-001
P.O. NUMBER: Zephyr
WATERWORKS NO.

			Client I.D.:		PW3	PW2	ODWS	
			Sample I.D.:		B18-21231-1	B18-21231-2	Objective	Type of Objective
			Date Collected:		17-Jul-18	17-Jul-18		
Parameter	Units	R.L.	Reference Method	Date/Site Analyzed				
Hardness (as CaCO3)	mg/L	1	SM 3120	20-Jul-18/O	241	248	80-100	OG
Alkalinity(CaCO3) to pH4.5	mg/L	5	SM 2320B	20-Jul-18/O	191	202	30-500	OG
pH @25°C	pH Units		SM 4500H	20-Jul-18/O	8.28	8.30	6.5-8.5	OG
Conductivity @25°C	µmho/cm	1	SM 2510B	20-Jul-18/O	497	517		
Turbidity	NTU	0.1	SM 2130	20-Jul-18/O	10.9	9.9	5	AO
Total Suspended Solids	mg/L	3	SM 2540D	23-Jul-18/O	< 3	< 3		
Colour	TCU	2	SM 2120C	20-Jul-18/O	< 2	< 2	5	AO
Fluoride	mg/L	0.1	SM4110C	21-Jul-18/O	< 0.1	< 0.1	1.5	MAC
Chloride	mg/L	0.5	SM4110C	21-Jul-18/O	14.5	9.5	250	AO
Nitrite (N)	mg/L	0.1	SM4110C	21-Jul-18/O	< 0.1	< 0.1	1	MAC
Nitrate (N)	mg/L	0.1	SM4110C	21-Jul-18/O	< 0.1	< 0.1	10	MAC
Sulphate	mg/L	1	SM4110C	21-Jul-18/O	44	50	500	AO
Calcium	mg/L	0.02	SM 3120	20-Jul-18/O	63.7	75.7		
Magnesium	mg/L	0.02	SM 3120	20-Jul-18/O	19.9	14.4		
Sodium	mg/L	0.2	SM 3120	20-Jul-18/O	5.4	4.7	200,20	AO,MAC
Potassium	mg/L	0.1	SM 3120	20-Jul-18/O	1.3	1.0		
Aluminum	mg/L	0.01	SM 3120	20-Jul-18/O	0.04	0.06	0.1	OG
Antimony	mg/L	0.0001	EPA 200.8	24-Jul-18/O	< 0.0001	< 0.0001	0.006,0.006	IMAC,MAC
Arsenic	mg/L	0.0001	EPA 200.8	24-Jul-18/O	0.0003	0.0003	0.025,0.010	IMAC,MAC
Barium	mg/L	0.001	SM 3120	20-Jul-18/O	0.139	0.091	1	MAC
Beryllium	mg/L	0.002	SM 3120	20-Jul-18/O	< 0.002	< 0.002		
Bismuth	mg/L	0.02	SM 3120	20-Jul-18/O	< 0.02	< 0.02		
Boron	mg/L	0.005	SM 3120	20-Jul-18/O	0.010	0.005	5,5.0	IMAC,MAC
Cadmium	mg/L	).000015	EPA 200.8	24-Jul-18/O	< 0.000015	< 0.000015	0.005	MAC
Chromium	mg/L	0.002	SM 3120	20-Jul-18/O	< 0.002	< 0.002	0.05	MAC
Cobalt	mg/L	0.005	SM 3120	20-Jul-18/O	< 0.005	< 0.005		
Copper	mg/L	0.002	SM 3120	20-Jul-18/O	< 0.002	< 0.002	1	AO
Iron	mg/L	0.005	SM 3120	20-Jul-18/O	0.796	0.808	0.3	AO

ODWS - Ontario Drinking Water Standards
AO - Aesthetic Objectives
IMAC - Interim Maximum Acceptable Concentration
MAC - Maximum Acceptable Concentration
OG - Operational Guidelines

R.L. = Reporting Limit
Test methods may be modified from specified reference method unless indicated by an *
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill,B-Barrie

Greg Clarkin , BSc., C. Chem
Lab Manager - Ottawa District

CADUCEON ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G78623 **REPORT No. B18-21231**

Report To:

Cambium Environmental
PO Box 325, 52 Hunter Street East
Peterborough ON K9H 1G5 Canada
Attention: Cameron MacDougall

Caduceon Environmental Laboratories
2378 Holly Lane
Ottawa Ontario K1V 7P1
Tel: 613-526-0123
Fax: 613-526-1244

DATE RECEIVED: 19-Jul-18
DATE REPORTED: 27-Jul-18
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: 6199-001
P.O. NUMBER: Zephyr
WATERWORKS NO.

			Client I.D.:		PW3	PW2	ODWS	
			Sample I.D.:		B18-21231-1	B18-21231-2	Objective	Type of Objective
			Date Collected:		17-Jul-18	17-Jul-18		
Parameter	**Units**	**R.L.**	**Reference Method**	**Date/Site Analyzed**				
Lead	mg/L	0.00002	EPA 200.8	24-Jul-18/O	< 0.00002	< 0.00002	0.010	MAC
Manganese	mg/L	0.001	SM 3120	20-Jul-18/O	0.050	0.048	0.05	AO
Molybdenum	mg/L	0.01	SM 3120	20-Jul-18/O	< 0.01	< 0.01		
Nickel	mg/L	0.01	SM 3120	20-Jul-18/O	< 0.01	< 0.01		
Selenium	mg/L	0.001	EPA 200.8	24-Jul-18/O	< 0.001	< 0.001	0.05	MAC
Silicon	mg/L	0.01	SM 3120	20-Jul-18/O	8.49	7.14		
Silver	mg/L	0.0001	EPA 200.8	24-Jul-18/O	< 0.0001	< 0.0001		
Strontium	mg/L	0.001	SM 3120	20-Jul-18/O	0.331	0.195		
Thallium	mg/L	0.00005	EPA 200.8	24-Jul-18/O	< 0.00005	< 0.00005		
Tin	mg/L	0.05	SM 3120	20-Jul-18/O	< 0.05	< 0.05		
Titanium	mg/L	0.005	SM 3120	20-Jul-18/O	< 0.005	< 0.005		
Uranium	mg/L	0.00005	EPA 200.8	24-Jul-18/O	0.00035	0.00011	0.020	MAC
Vanadium	mg/L	0.005	SM 3120	20-Jul-18/O	< 0.005	< 0.005		
Zinc	mg/L	0.005	SM 3120	20-Jul-18/O	< 0.005	< 0.005	5	AO
Ammonia (N)-Total	mg/L	0.01	SM4500-NH3-H	20-Jul-18/K	0.11	0.08		
Total Kjeldahl Nitrogen	mg/L	0.1	E3199A.1	20-Jul-18/K	0.2	0.1		
Organic Nitrogen	mg/L	0.10	E3199A.1	27-Jul-18/K	< 0.10	< 0.10	0.15	OG
Phosphorus-Total	mg/L	0.01	E3199A.1	20-Jul-18/K	0.02	0.02		
Phenolics	mg/L	0.001	MOEE 3179	27-Jul-18/O	< 0.001	< 0.001		
Tannins and Lignins	mg/L	0.5	SM5500B	23-Jul-18/K	< 0.5	< 0.5		
Sulphide	mg/L	0.01	SM4500-S2	20-Jul-18/K	< 0.01	< 0.01	0.05	AO
Dissolved Organic Carbon	mg/L	0.2	EPA 415.1	20-Jul-18/O	2.1	1.4	5	AO
Total Organic Carbon	mg/L	0.2	EPA 415.1	20-Jul-18/O	2.2	1.5		
Total Coliform	cfu/100mL	1	MOE E3407	19-Jul-18/O	0	**15**	0	MAC
E coli	cfu/100mL	1	MOE E3407	19-Jul-18/O	0	0	0	MAC
Heterotrophic Plate Count	cfu/mL	2	SM 9215C	19-Jul-18/O	2	6		
Anion Sum	meq/L		Calc.	23-Jul-18/O	5.14	5.35		

ODWS - Ontario Drinking Water Standards
AO - Aesthetic Objectives
IMAC - Interim Maximum Acceptable Concentration
MAC - Maximum Acceptable Concentration
OG - Operational Guidelines

R.L. = Reporting Limit
Test methods may be modified from specified reference method unless indicated by an *
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill,B-Barrie

Greg Clarkin , BSc., C. Chem
Lab Manager - Ottawa District

CADUCEON ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G78623 **REPORT No. B18-21231**

Report To:

Cambium Environmental
PO Box 325, 52 Hunter Street East
Peterborough ON K9H 1G5 Canada
Attention: Cameron MacDougall

Caduceon Environmental Laboratories
2378 Holly Lane
Ottawa Ontario K1V 7P1
Tel: 613-526-0123
Fax: 613-526-1244

DATE RECEIVED: 19-Jul-18
DATE REPORTED: 27-Jul-18
SAMPLE MATRIX: Groundwater

JOB/PROJECT NO.: 6199-001
P.O. NUMBER: Zephyr
WATERWORKS NO.

			Client I.D.:		PW3	PW2	ODWS	
			Sample I.D.:		B18-21231-1	B18-21231-2	Objective	Type of Objective
			Date Collected:		17-Jul-18	17-Jul-18		
Parameter	**Units**	**R.L.**	**Reference Method**	**Date/Site Analyzed**				
Cation Sum	meq/L		Calc.	23-Jul-18/O	5.13	5.25		
% Difference	%		Calc.	23-Jul-18/O	0.0170	0.970		
Ion Ratio	AS/CS		Calc.	23-Jul-18/O	1.00	1.02		
Sodium Adsorption Ratio	-		Calc.	23-Jul-18/O	0.151	0.131		
TDS(ion sum calc.)	mg/L	1	Calc.	23-Jul-18/O	264	277	500	AO
Conductivity (calc.)	µmho/cm		Calc.	23-Jul-18/O	489	503		
TDS(calc.)/EC(actual)	-		Calc.	23-Jul-18/O	0.531	0.537		
EC(calc.)/EC(actual)	-		Calc.	23-Jul-18/O	0.984	0.972		
Langelier Index(25°C)	S.I.		Calc.	23-Jul-18/O	0.932	1.04		

ODWS - Ontario Drinking Water Standards
AO - Aesthetic Objectives
IMAC - Interim Maximum Acceptable Concentration
MAC - Maximum Acceptable Concentration
OG - Operational Guidelines

R.L. = Reporting Limit
Test methods may be modified from specified reference method unless indicated by an *
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill,B-Barrie

Greg Clarkin , BSc., C. Chem
Lab Manager - Ottawa District

Appendix E
Aquifer Test Results

Cambium Inc.
52 Hunter St. East
Peterborough, Ontatio, Canada
K9H 1G5

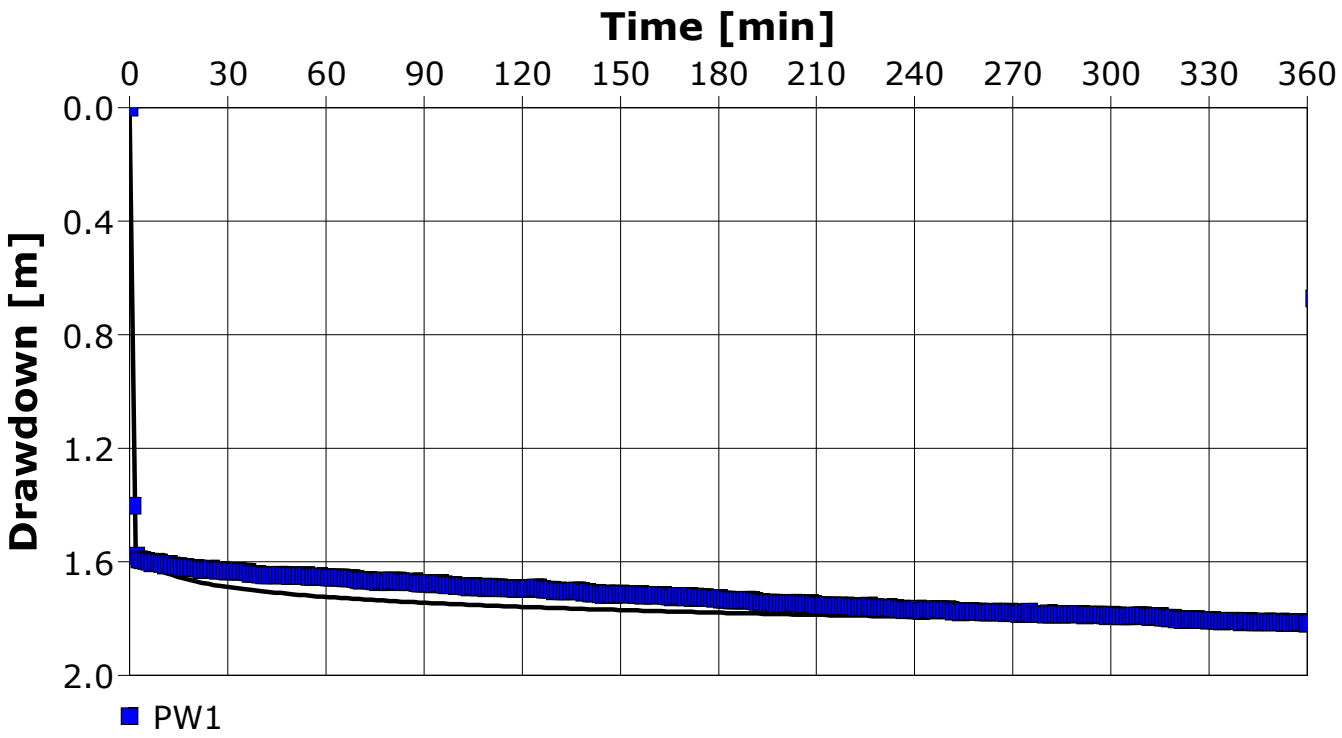
Pumping Test Analysis Report

Project: Hydrogeological Assessment

Number: 6199-001

Client: China Canada Jing Bei Xin Min Intl.

Location: Zephyr, Ontario	Pumping Test: PW1 (A222198)	Pumping Well: PW1
Test Conducted by: Jeremy Tracey		Test Date: 16/07/2018
Analysis Performed by: Cam MacDougall	PW1 Pumping Test	Analysis Date: 01/08/2018
Aquifer Thickness: 1.50 m	Discharge: variable, average rate 0.095 [m³/s]	



Calculation using Theis

Observation Well	Transmissivity [m²/s]	Hydraulic Conductivity [m/s]	Storage coefficient	Radial Distance to PW [m]	
PW1	4.57×10^{-2}	3.05×10^{-2}	7.91×10^{-11}	0.08	

Cambium Inc.
52 Hunter St. East
Peterborough, Ontatio, Canada
K9H 1G5

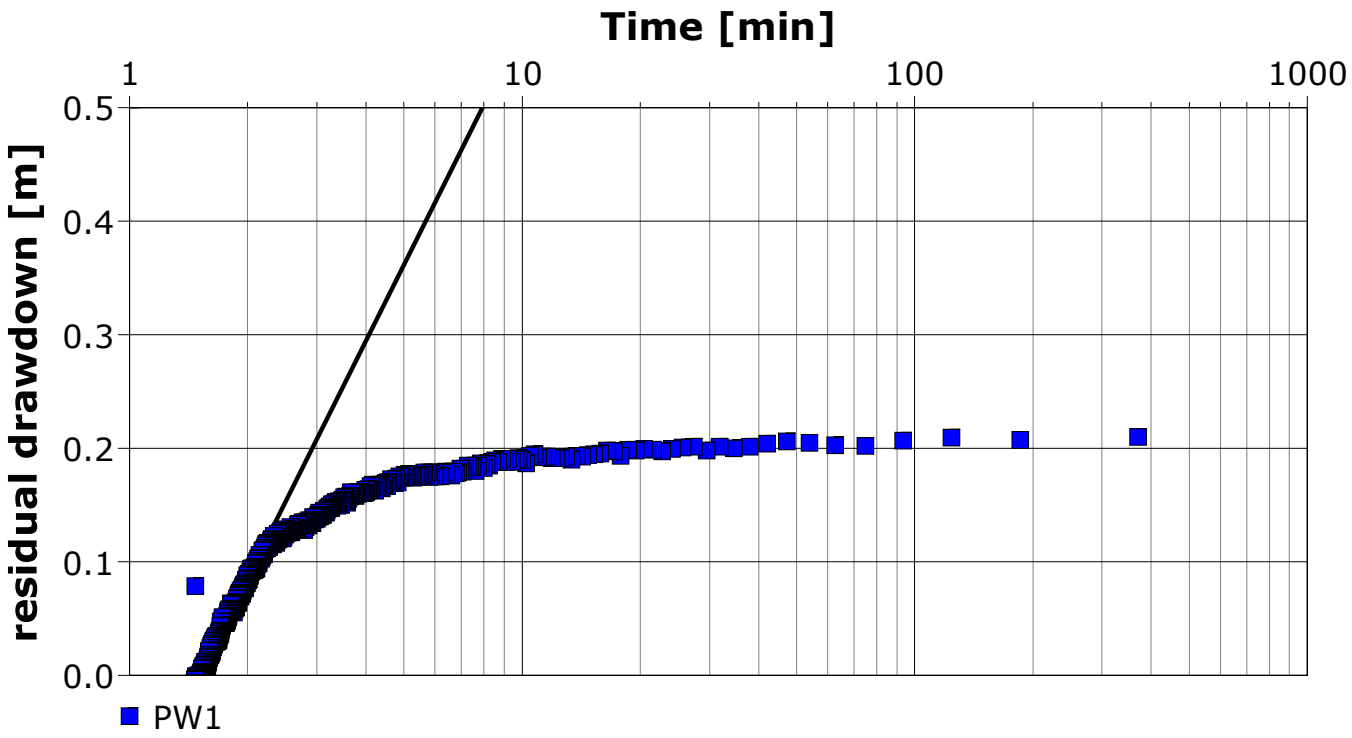
Pumping Test Analysis Report

Project: Hydrogeological Assessment

Number: 6199-001

Client: China Canada Jing Bei Xin Min Intl.

Location: Zephyr, Ontario	Pumping Test: PW1 (A222198)	Pumping Well: PW1
Test Conducted by: Jeremy Tracey		Test Date: 16/07/2018
Analysis Performed by: Cam MacDougall	PW1 Pumping Test (Recovery)	Analysis Date: 01/08/2018
Aquifer Thickness: 1.50 m	Discharge: variable, average rate 0.095 [m³/s]	



Calculation using THEIS & JACOB

Observation Well	Transmissivity [m²/s]	Hydraulic Conductivity [m/s]	Radial Distance to PW [m]	
PW1	2.51×10^{-2}	1.67×10^{-2}	0.08	

Cambium Inc.
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Peterborough, Ontatio, Canada
K9H 1G5

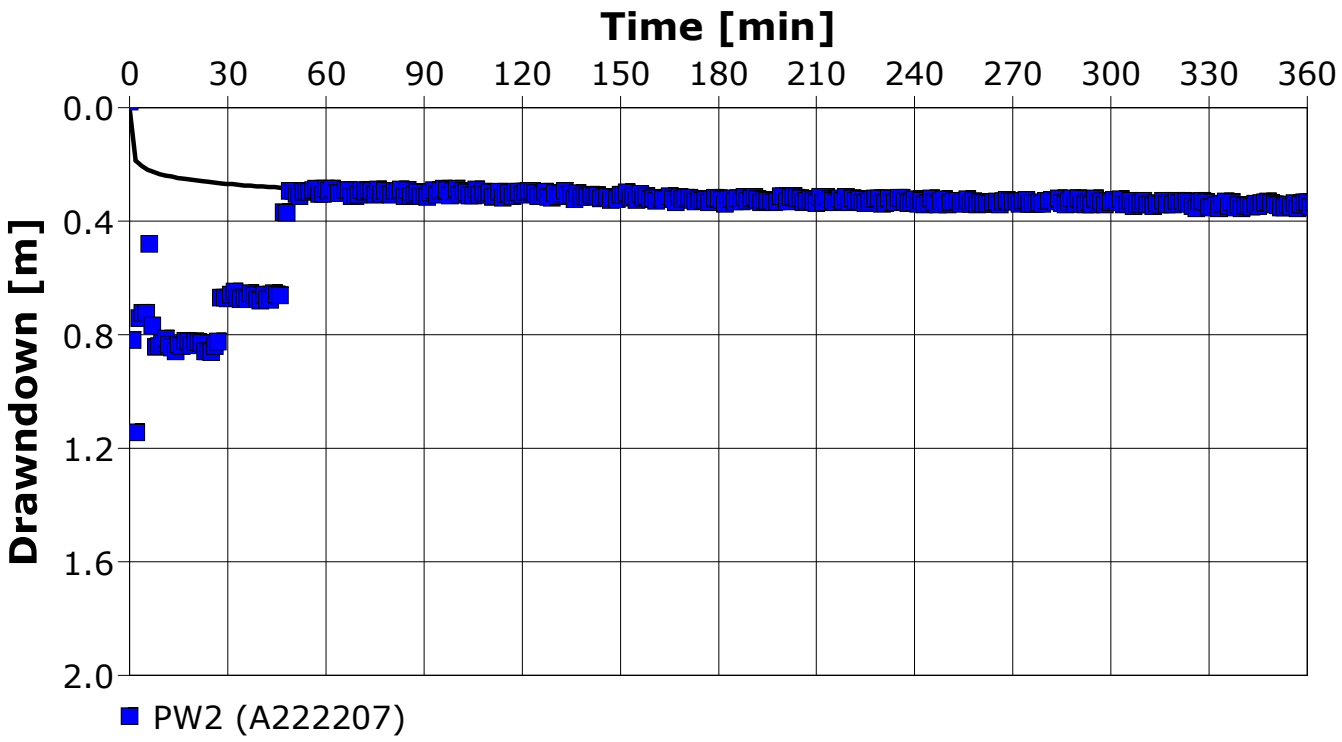
Pumping Test Analysis Report

Project: Hydrogeological Assessment

Number: 6199-001

Client: China Canada Jing Bei Xin Min Intl.

Location: Zephyr, Ontario	Pumping Test: PW2 (A222207)	Pumping Well: PW2 (A222207)
Test Conducted by: Jeremy Tracey		Test Date: 17/07/2018
Analysis Performed by: Cam MacDougall	PW2 Pumping Test	Analysis Date: 01/08/2018
Aquifer Thickness: 1.50 m	Discharge: variable, average rate 0.025 [m³/s]	



Calculation using Theis

Observation Well	Transmissivity [m²/s]	Hydraulic Conductivity [m/s]	Radial Distance to PW [m]	
PW2 (A222207)	2.00×10^{-2}	1.33×10^{-2}	0.08	

Cambium Inc.
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K9H 1G5

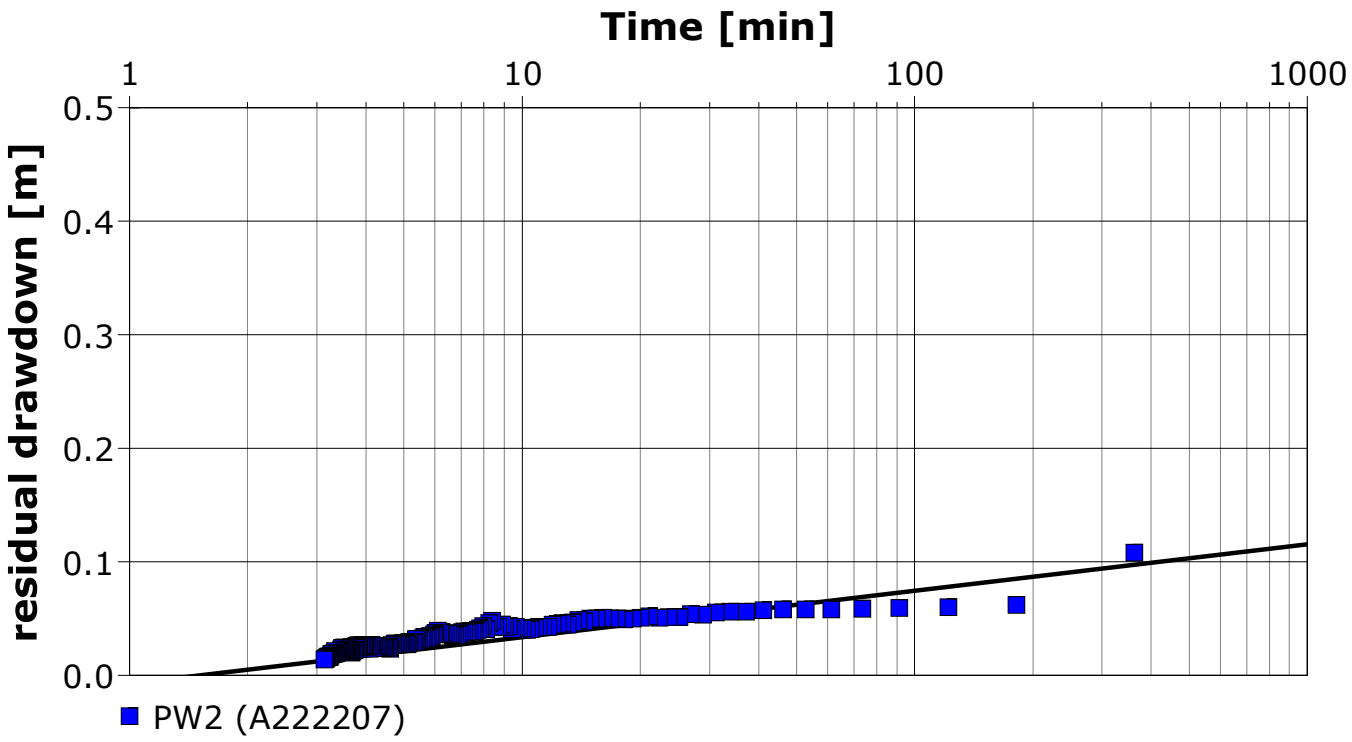
Pumping Test Analysis Report

Project: Hydrogeological Assessment

Number: 6199-001

Client: China Canada Jing Bei Xin Min Intl.

Location: Zephyr, Ontario	Pumping Test: PW2 (A222207)	Pumping Well: PW2 (A222207)
Test Conducted by: Jeremy Tracey		Test Date: 17/07/2018
Analysis Performed by: Cam MacDougall	PW2 Pumping Test (Recovery)	Analysis Date: 01/08/2018
Aquifer Thickness: 1.50 m	Discharge: variable, average rate 0.025 [m³/s]	



Calculation using THEIS & JACOB

Observation Well	Transmissivity [m²/s]	Hydraulic Conductivity [m/s]	Radial Distance to PW [m]	
PW2 (A222207)	1.12×10^{-1}	7.48×10^{-2}	0.08	

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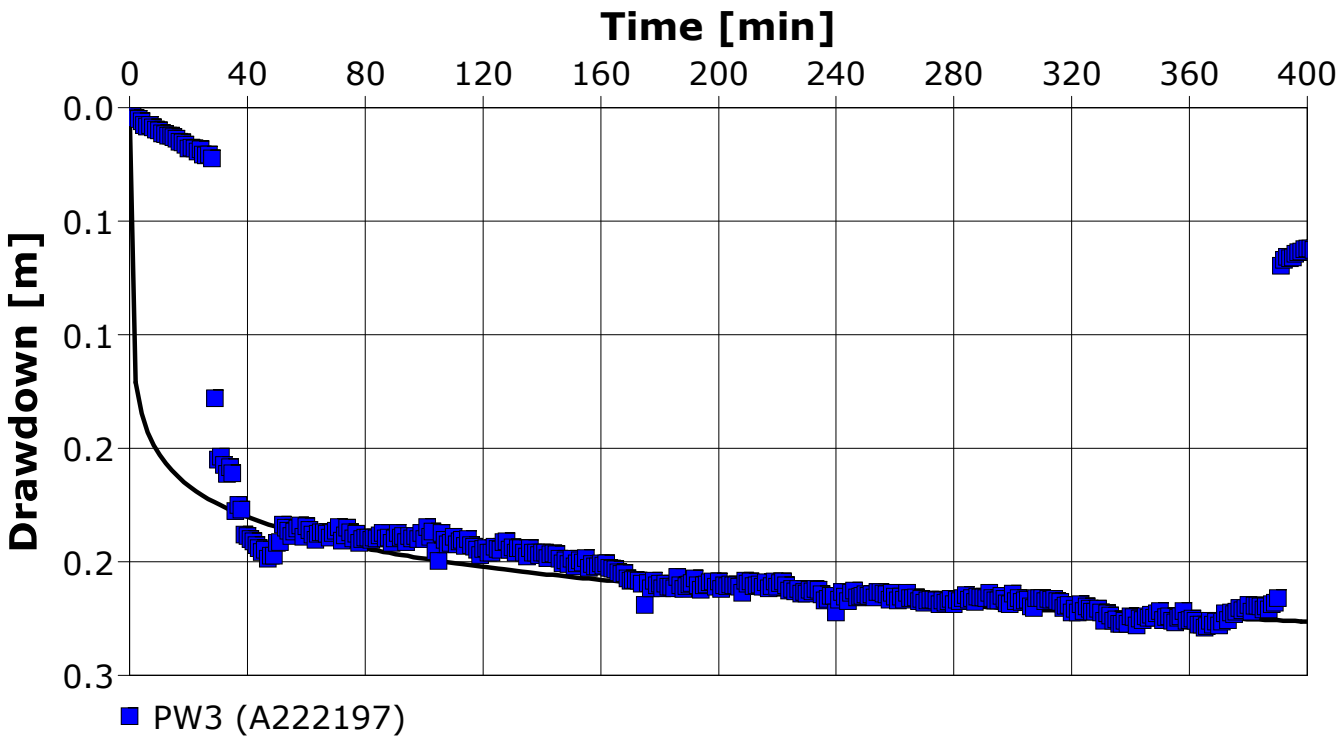
Pumping Test Analysis Report

Project: Hydrogeological Assessment

Number: 6199-001

Client: China Canada Jing Bei Xin Min Intl.

Location: Zephyr, Ontario	Pumping Test: PW3 (A222197)	Pumping Well: PW3 (A222197)
Test Conducted by: Jeremy Tracey		Test Date: 17/07/2018
Analysis Performed by: Cam MacDougall	PW3 Pumping Test	Analysis Date: 01/08/2018
Aquifer Thickness: 1.50 m	Discharge: variable, average rate 0.014 [m³/s]	



Calculation using Theis

Observation Well	Transmissivity [m²/s]	Hydraulic Conductivity [m/s]	Radial Distance to PW [m]	
PW3 (A222197)	1.50×10^{-2}	1.00×10^{-2}	0.08	

Cambium Inc.
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Peterborough, Ontatio, Canada
K9H 1G5

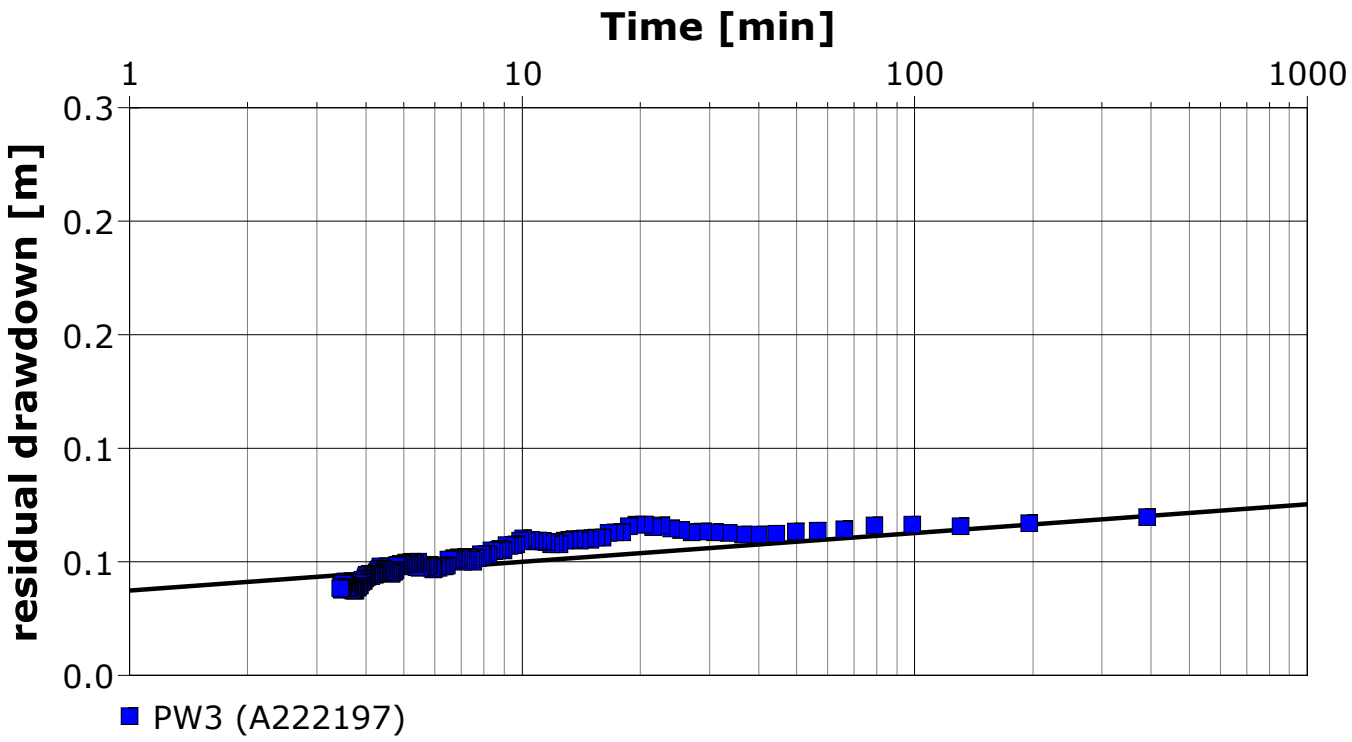
Pumping Test Analysis Report

Project: Hydrogeological Assessment

Number: 6199-001

Client: China Canada Jing Bei Xin Min Intl.

Location: Zephyr, Ontario	Pumping Test: PW3 (A222197)	Pumping Well: PW3 (A222197)
Test Conducted by: Jeremy Tracey		Test Date: 17/07/2018
Analysis Performed by: Cam MacDougall	PW3 Pumping Test (Recovery)	Analysis Date: 01/08/2018
Aquifer Thickness: 1.50 m	Discharge: variable, average rate 0.014 [m³/s]	

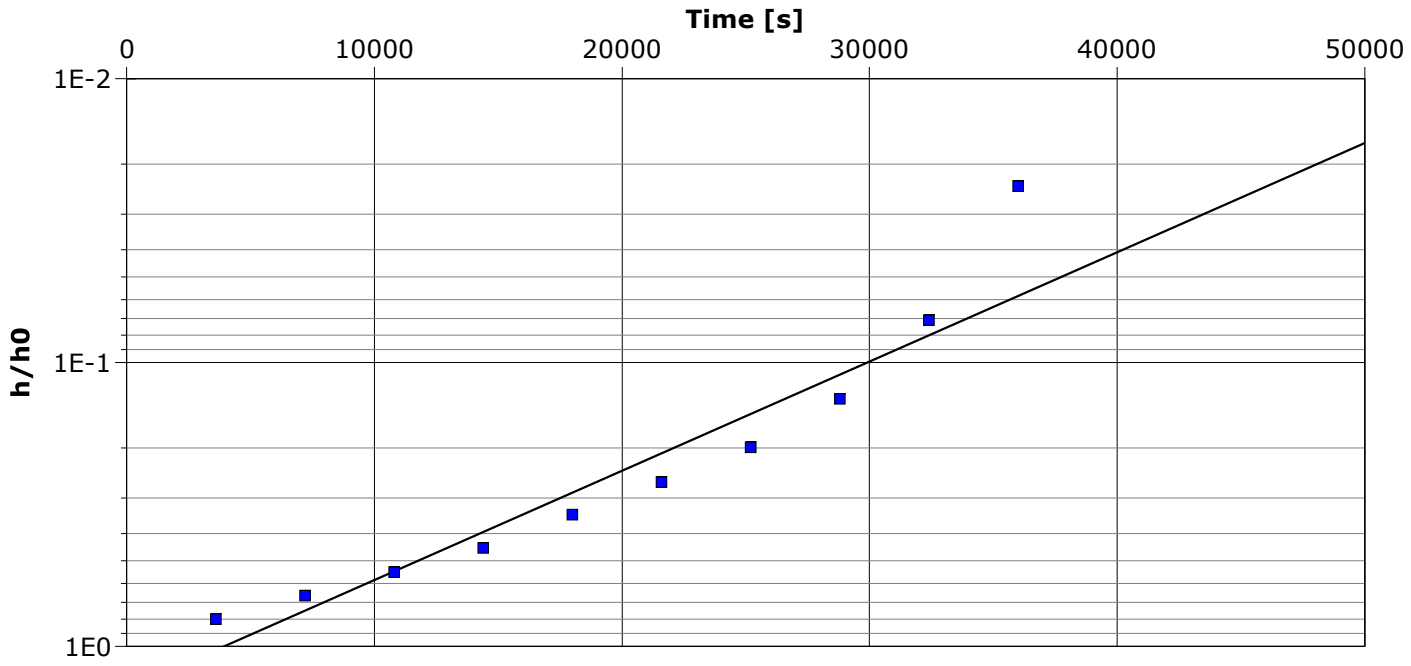


Calculation using THEIS & JACOB

Observation Well	Transmissivity [m²/s]	Hydraulic Conductivity [m/s]	Radial Distance to PW [m]	
PW3 (A222197)	1.68×10^{-1}	1.12×10^{-1}	0.08	

Cambium Inc. **52 Hunter St. East** **Peterborough, Ontatio, Canada** **K9H 1G5**	**Slug Test Analysis Report** Project: Hydrogeological Assessment Number: 6199-001 Client: China Canada Jing Bei Xin Min Intl.

Location: Zephyr, Ontairo	Slug Test: Piezometer P1	Test Well: P1
Test Conducted by: Cam MacDougall		Test Date: 7/29/18
Analysis Performed by: Cam MacDougall	P1 Slug Test	Analysis Date: 9/25/18
Aquifer Thickness: 1.84 m		



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
P1	2.88×10^{-7}	

Cambium Inc.
52 Hunter St. East
Peterborough, Ontatio, Canada
K9H 1G5

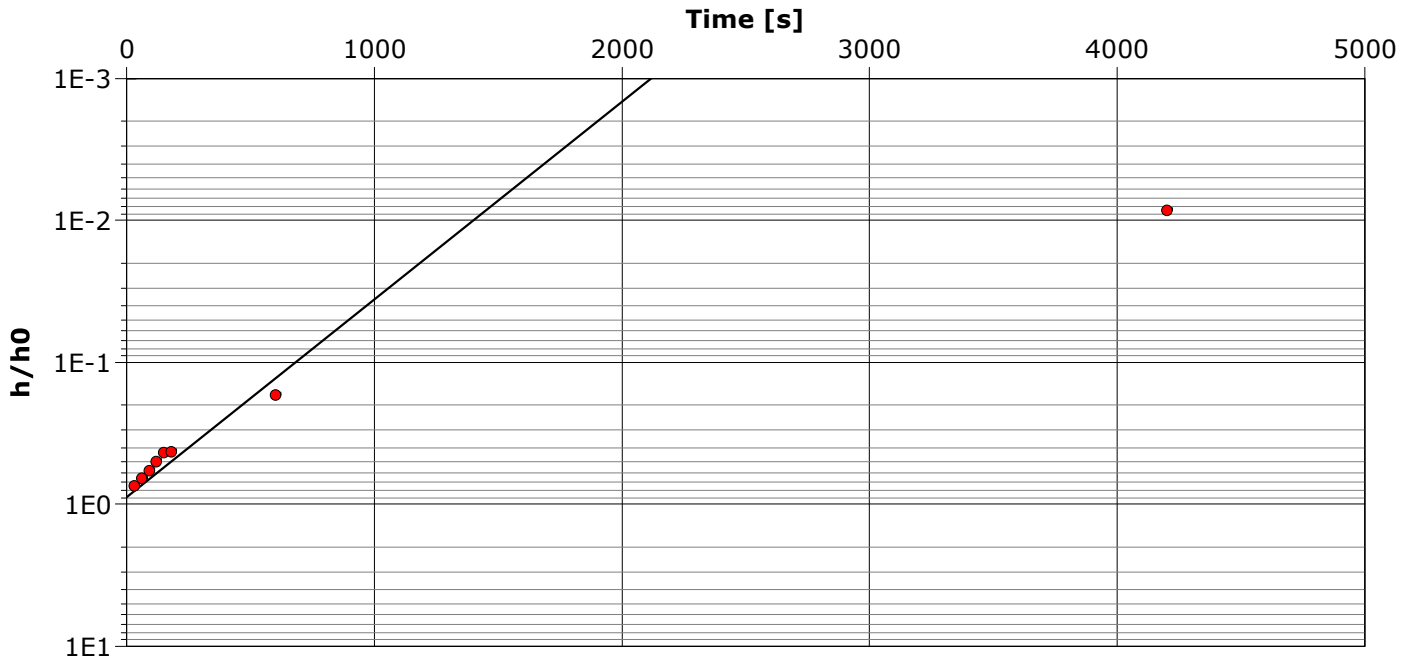
Slug Test Analysis Report

Project: Hydrogeological Assessment

Number: 6199-001

Client: China Canada Jing Bei Xin Min Intl.

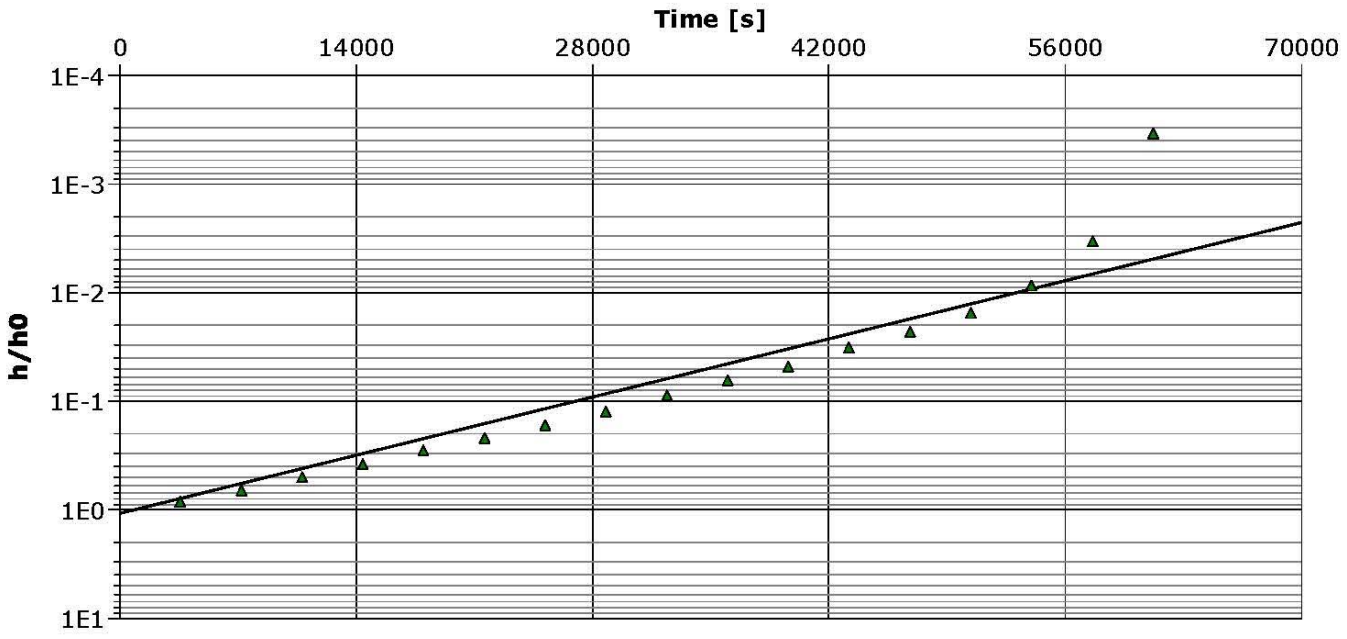
Location: Zephyr, Ontairo	Slug Test: Piezometer P2	Test Well: P2
Test Conducted by: Cam MacDougall		Test Date: 7/29/18
Analysis Performed by: Cam MacDougall	P2 Slug Test	Analysis Date: 9/25/18
Aquifer Thickness: 1.18 m		



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
P2	1.05×10^{-5}	

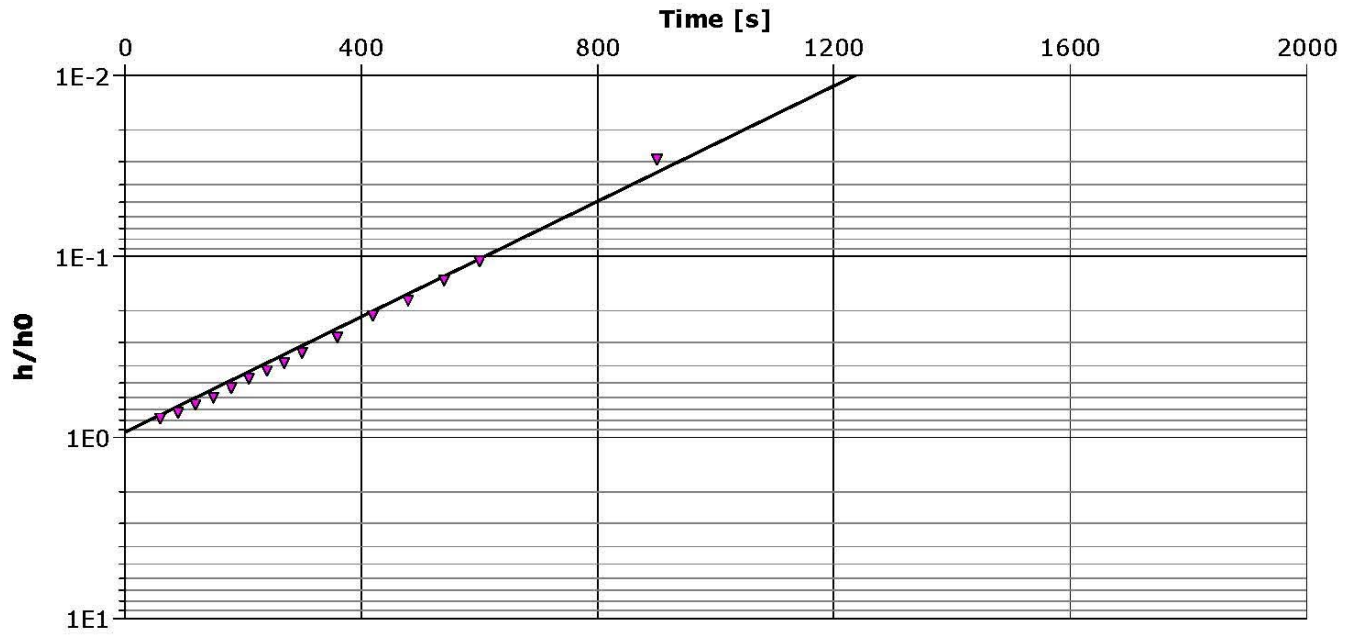
Cambium Inc. **52 Hunter St. East** **Peterborough, Ontatio, Canada** **K9H 1G5**	**Slug Test Analysis Report**	
	Project: Hydrogeological Assessment	
	Number: 6199-001	
	Client: China Canada Jing Bei Xin Min Intl.	
Location: Zephyr, Ontairo	Slug Test: Piezometer P3	Test Well: P3
Test Conducted by: Cam MacDougall		Test Date: 7/29/18
Analysis Performed by: Cam MacDougall	P3 Slug Test	Analysis Date: 9/25/18
Aquifer Thickness: 1.44 m		



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
P3	2.88×10^{-7}	

Cambium Inc. **52 Hunter St. East** **Peterborough, Ontatio, Canada** **K9H 1G5**	**Slug Test Analysis Report**	
	Project: Hydrogeological Assessment	
	Number: 6199-001	
	Client: China Canada Jing Bei Xin Min Intl.	
Location: Zephyr, Ontairo	Slug Test: Piezometer P4	Test Well: P4
Test Conducted by: Cam MacDougall		Test Date: 7/29/18
Analysis Performed by: Cam MacDougall	P4 Slug Test	Analysis Date: 9/25/18
Aquifer Thickness: 1.03 m		



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
P4	1.20×10^{-5}	

Cambium Inc.
52 Hunter St. East
Peterborough, Ontatio, Canada
K9H 1G5

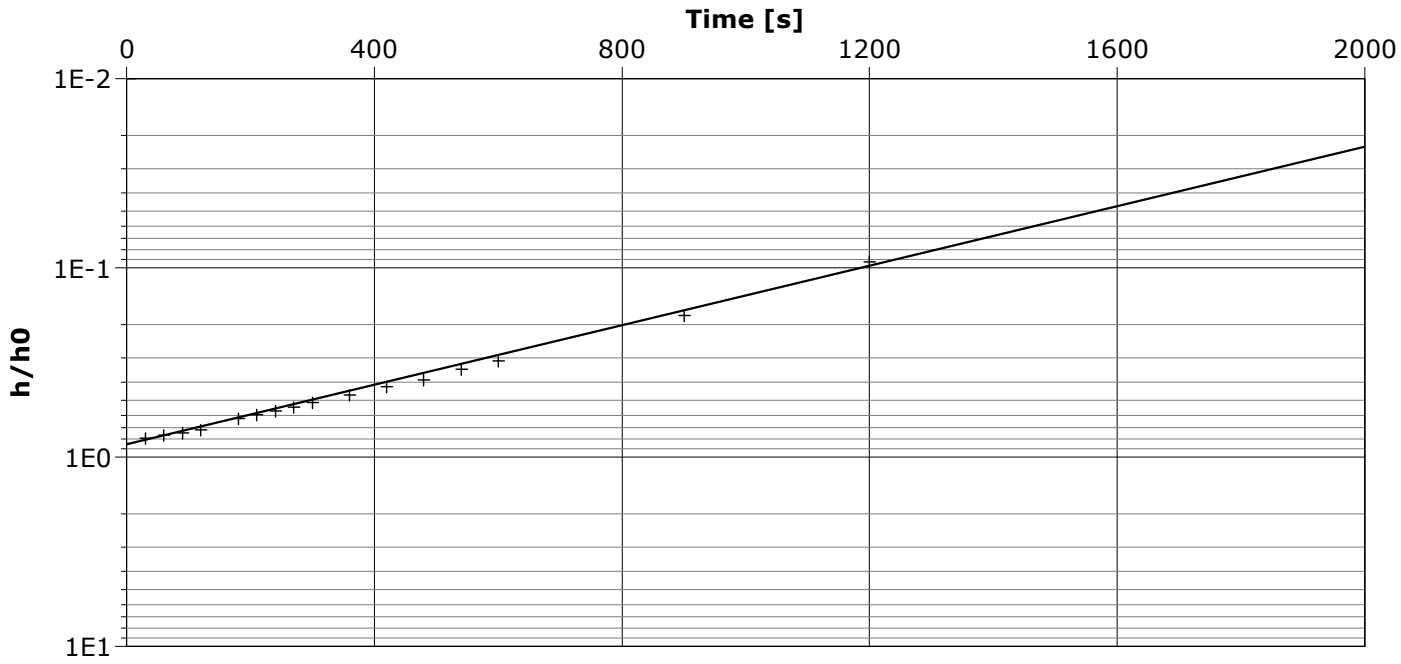
Slug Test Analysis Report

Project: Hydrogoelogical Assessment

Number: 6199-001

Client: China Canada Jing Bei Xin Min Intl.

Location: Zephyr, Ontairo	Slug Test: Piezometer P5	Test Well: P5
Test Conducted by: Cam MacDougall		Test Date: 7/29/18
Analysis Performed by: Cam MacDougall	P5 Slug Test	Analysis Date: 9/25/18
Aquifer Thickness: 1.67 m		



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
P5	5.90×10^{-6}	

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Peterborough, Ontatio, Canada
K9H 1G5

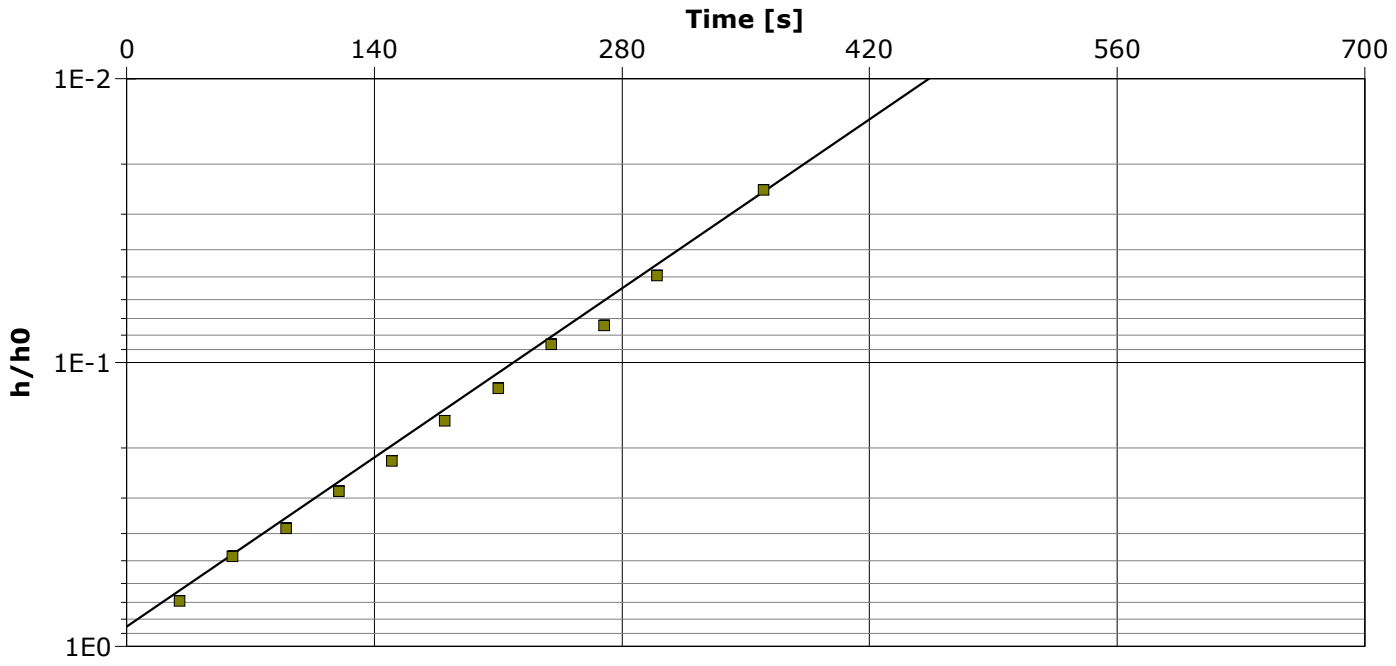
Slug Test Analysis Report

Project: Hydrogoelogical Assessment

Number: 6199-001

Client: China Canada Jing Bei Xin Min Intl.

Location: Zephyr, Ontairo	Slug Test: Piezometer P6	Test Well: P6
Test Conducted by: Cam MacDougall		Test Date: 7/29/18
Analysis Performed by: Cam MacDougall	P6 Slug Test	Analysis Date: 9/25/18
Aquifer Thickness: 1.67 m		



Calculation using Hvorslev

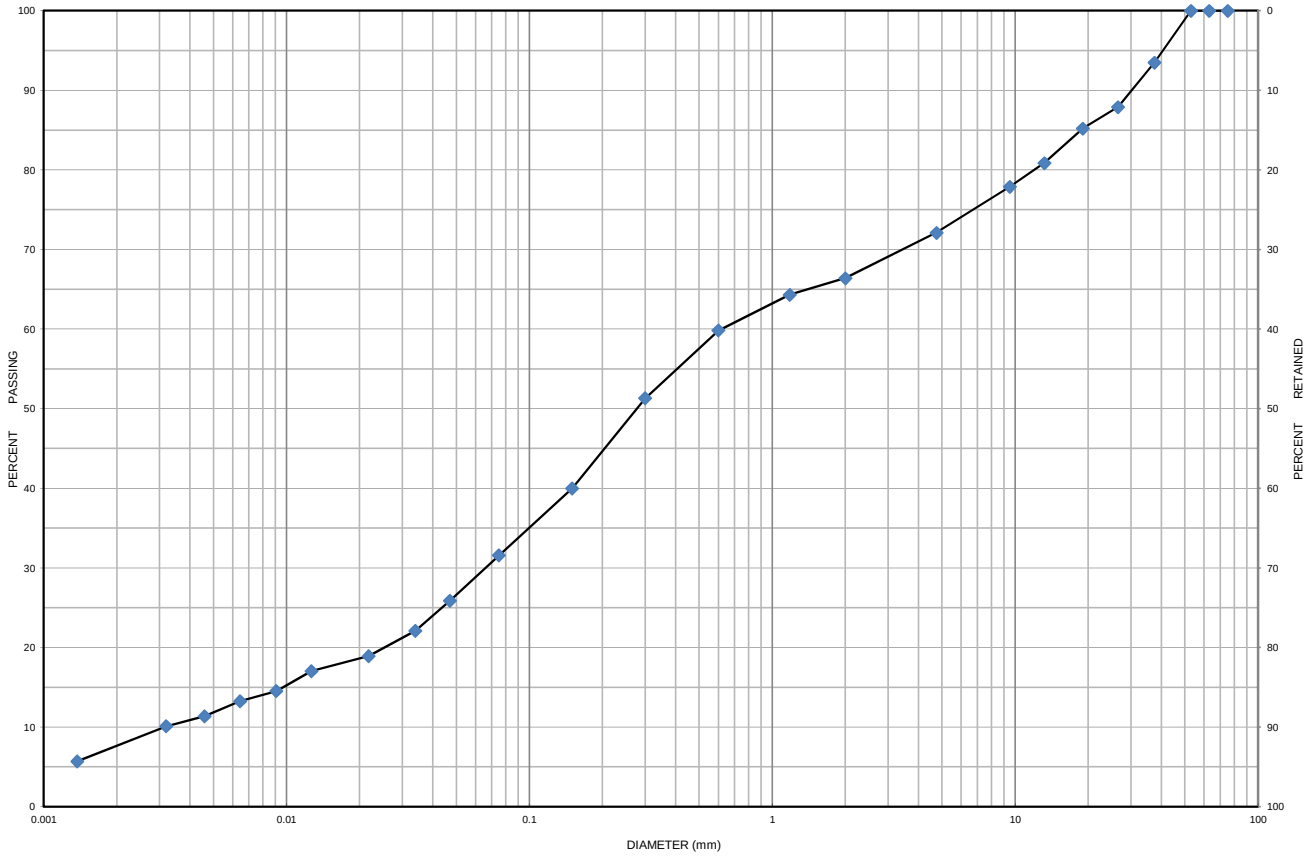
Observation Well	Hydraulic Conductivity [m/s]	
P6	3.20×10^{-5}	

Appendix F
Grain Size Analyses

Grain Size Distribution Chart

Project Number:	*6199-001*	**Client:**	*China Canada Jing Bei Xin Min Intl. c/o EcoVue Consultir*		
Project Name:	*Hidden Ridge, Uxbridge*				
Sample Date:	*August 3, 2017*	**Sampled By:**	*Cam MacDougall - Cambium Inc.*		
Location:	*TP 101 2*	**Depth:**	*1.1 m to 1.8 m*	**Lab Sample No:**	*S-17-651*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Location	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
TP 101	2	1.1 m to 1.8 m	28	41	31		5.9

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Silty Gravelly Sand trace Clay	SW	0.600	0.067	0.0032	187.50	2.34

Issued By: _____ *Date Issued:* *August 25, 2017*

(Senior Project Manager)

Cambium Inc. (Laboratory)
866.217.7900 | cambium-inc.com
701 The Queensway | Units 5-6 | Peterborough | ON | K9J 7J6

Grain Size Distribution Chart

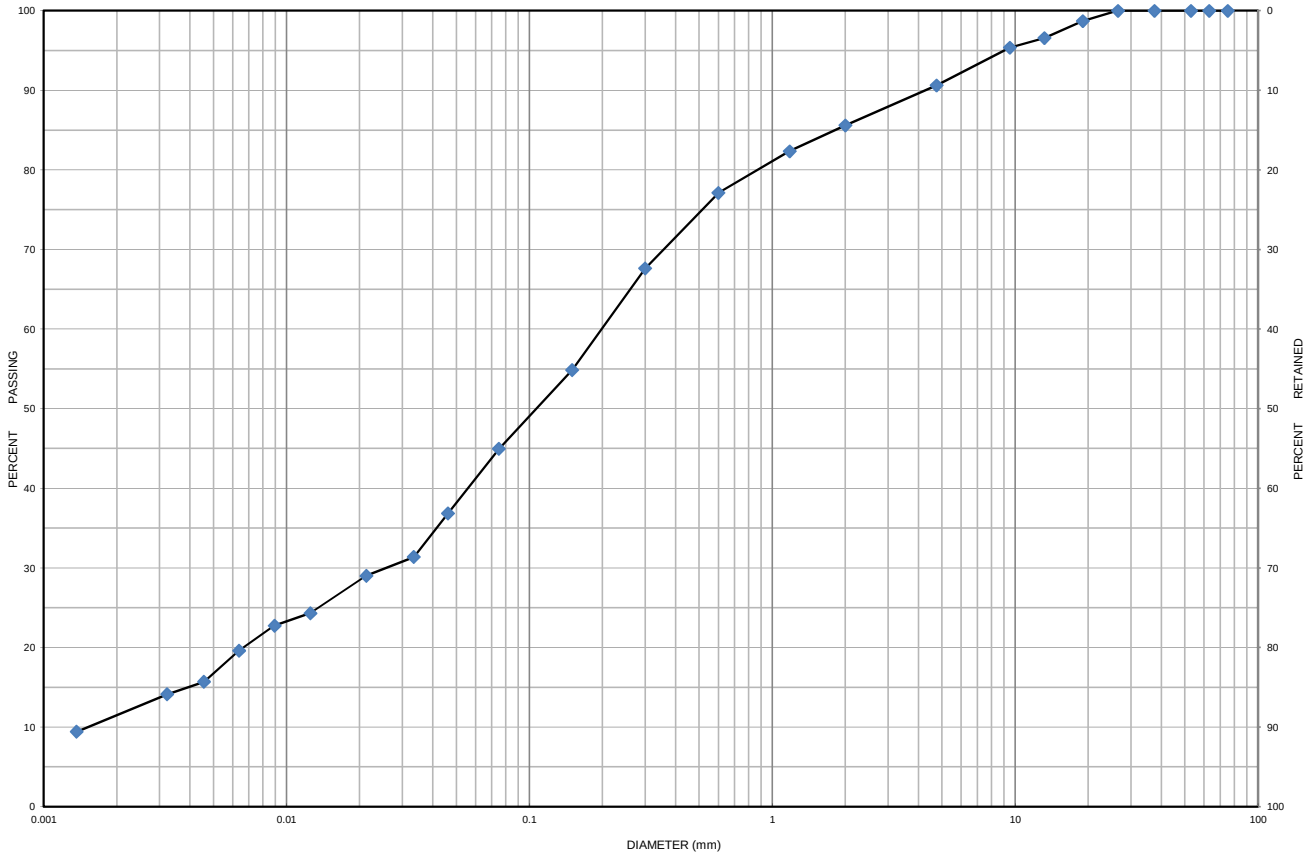
Project Number: *6199-001* **Client:** *China Canada Jing Bei Xin Min Intl. c/o EcoVue Consultir*

Project Name: *Hidden Ridge, Uxbridge*

Sample Date: *August 3, 2017* **Sampled By:** *Cam MacDougall - Cambium Inc.*

Location: *TP 104 2* **Depth:** **Lab Sample No:** *S-17-652*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Location	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
TP 104	2		9	46	45		11.2

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Silty Sand some Clay trace Gravel	SM	0.200	0.028	0.0017	117.65	2.31

Issued By: _____ *Date Issued:* *August 25, 2017*

(Senior Project Manager)

Cambium Inc. (Laboratory)
866.217.7900 | cambium-inc.com
701 The Queensway | Units 5-6 | Peterborough | ON | K9J 7J6

Grain Size Distribution Chart

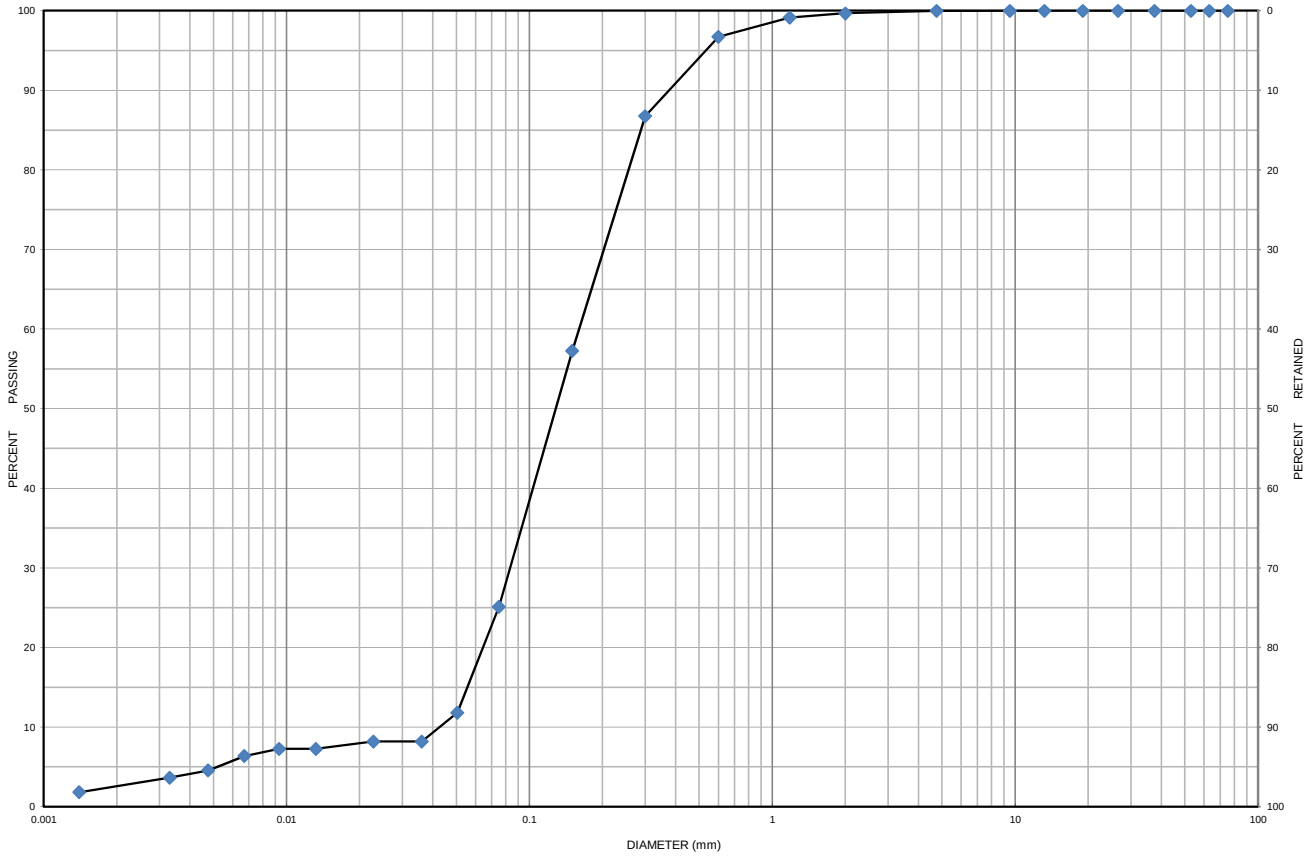
Project Number: *6199-001* **Client:** *China Canada Jing Bei Xin Min Intl. c/o EcoVue Consultir*

Project Name: *Hidden Ridge, Uxbridge*

Sample Date: *August 3, 2017* **Sampled By:** *Cam MacDougall - Cambium Inc.*

Location: *TP 107 1* **Depth:** **Lab Sample No:** *S-17-653*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Location	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
TP 107	1		0	75	25		15.9

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Silty Sand trace Clay	SM	0.160	0.084	0.042	3.81	1.05

Issued By: _____ *Date Issued:* *August 25, 2017*

(Senior Project Manager)

Cambium Inc. (Laboratory)
866.217.7900 | cambium-inc.com
701 The Queensway | Units 5-6 | Peterborough | ON | K9J 7J6

Appendix G
Evapotranspiration Calculations

THORNTHWAITE-TYPE MONTHLY WATER-BALANCE MODEL

(modified from Dingman 2001: ex. 7-13, Box 7-3 using ET model of Hamon (1963))

Input Data | Computed Values

Location: Barrie, ON | Lat. = **44.1** degree (0.77 rad) | *SOILmax* = **100** mm

	J	F	M	A	M	J	J	A	S	O	N	D
Declination (deg)	-21.3	-13.3	-2.0	9.8	18.9	23.3	21.3	13.7	3.0	-9.0	-18.6	-23.3
Declination (rad)	-0.37	-0.23	-0.03	0.17	0.33	0.41	0.37	0.24	0.05	-0.16	-0.32	-0.41
DayLength (hr)*	9.0	10.2	11.7	13.3	14.6	15.3	15.0	13.8	12.4	10.8	9.5	8.7

*For lat. > 66.5, replace #NUM! with 24 in summer; 0 in winter.

WATER BALANCE

Temperatures in C, water-balance terms in mm.

Month:	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**	**Year**
P	89	70	64	65	80	89	73	86	92	78	98	84	968
T	-8	-7	-2	5.7	12	17	20	19	15	8.7	2.6	-4	
F	0.00	0.00	0.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	0.43	0.00	
RAIN	0	0	0	62	80	89	73	86	92	78	42	0	603
SNOW	89	70	64	3	0	0	0	0	0	0	56	84	365
PACK	0	0	0	0	0	0	0	0	0	0	0	0	
MELT	0	0	0	0	0	0	0	0	0	0	0	0	0
INPUT (W_m)	0	0	0	0	0	0	0	0	0	0	0	0	0
PET	0	0	0	40	67	97	111	97	69	40	23	0	545
W - PET	0	0	0	0	0	0	0	0	0	0	0	0	
SOIL	0	0	0	0	0	0	0	0	0	0	0	0	
ΔSOIL	0	0	0	0	0	0	0	0	0	0	0	0	
ET	0	0	0	0	0	0	0	0	0	0	0	0	0
W-ET-ΔSOIL	0	0	0	0	0	0	0	0	0	0	0	0	0

Surplus **423** **mm/yr**

PET Calc

IF(T>0,924*DayLength*0.611*EXP(17.3*T/(T+237.3))/(T+273.2),0)