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# **Hydrogeological Servicing Study for a Proposed Commercial Development, Haliburton, Ontario**

*Palmer Project #*  
2006001

*Prepared For*  
LRC Campbell Ltd.

July 5, 2023

Rory Campbell  
General Manager  
Curry Chevrolet Buick GMC  
Box 30, Haliburton, Ontario  
K0M 1S0

Dear Mr. Campbell:

**Re:** Hydrogeological Servicing Study for a Proposed Commercial Development,  
Haliburton, Ontario

**Project #:** 2006001

Palmer is pleased to submit the attached report describing the results of our Hydrogeological Study to support water servicing for a proposed commercial development and five (5) lot subdivision located in Haliburton Village north of the Curry Chevrolet Buick GMC Dealership, Haliburton, Ontario (the "site").

The County of Haliburton Official Plan requires development applications with individual servicing to be accompanied by a Hydrogeological Report. The purpose of this Hydrogeological Study was to determine the available groundwater supply at the site area, ensure other water users in the area will not be adversely impacted, and to protect groundwater and surface water quality in the immediate vicinity of the site. This study is based on the Ministry of Environment, Conservation and Parks (MECP) document titled, "Technical Guideline for Private Wells: Water Supply Assessment" (Procedure D-5-5).

Based on the results of test well drilling, hydraulic testing and well monitoring, it is our opinion that the site possesses an adequate supply of potable groundwater to service the proposed commercial development. Recommended well yields range from 21 to 68 L/min, with a daily total volume ranging from 15,120 to 48,960 L/day based on 12-hours of pumping. The water quality is typical for the bedrock aquifer in the Haliburton area and generally met Ontario Drinking Water Standards. Minor exceedances can be managed with typical commercial/ residential treatment methods.

Thank you for the opportunity to work with you on this project. Please let us know if you have questions or comments on this submission.

Yours truly,  
**Palmer**

Jason Cole, M.Sc., P.Geo.  
VP, Principal Hydrogeologist

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# 1. Introduction

Palmer was retained by LRC Campbell Ltd. (the “Client”) to complete a Hydrogeological Study to support individual water servicing for a five (5) lot subdivision for a commercial development located in Haliburton Village north of the existing Curry Chevrolet Buick GMC Dealership, Haliburton, ON. The location of the site is shown on **Figure 1**. The site is bound by Mallard Road to the north, County Road 21 and the existing dealership to the south, forested land to the west, and commercial developments to the east. The site is approximately 3.67 hectares (ha) in size and the development areas for the five (5) proposed lots are 0.8 ha, 0.5 ha, 0.5 ha, 0.6 ha and 0.7 ha. A drawing showing the Proposed Draft Plan of Subdivision and Condominium Description (2023) is provided in **Appendix A**.

We understand that the proposed development will be serviced by the municipal sanitary sewer system for Haliburton, but no on-site potable water services are available. The County of Haliburton Official Plan (2019) requires a Hydrogeological Study to accompany development applications that are proposed to be serviced by individual wells. Therefore, the purpose of this Hydrogeology Study is to assess the overall availability of groundwater resources on site, determine the maximum sustainable yield for each test well, assess potential well interference effects and impacts to existing water users or the natural environment. This Hydrogeology Study was designed to generally meet the Ministry of Environment, Conservation and Parks (MECP) document titled, “Technical Guideline for Private Wells: Water Supply Assessment” (Procedure D-5-5).

To determine if groundwater resources at the site are sufficient to support the development, two test wells (PW1 and PW2) were installed within the site area (**Figure 1**). Based on a site area of 3.67 ha, the MECP requires that a pumping test must be conducted on three (3) test wells. To meet this requirement, the existing potable water well located at the adjacent Curry Dealership was used as a third test well. To determine the overall groundwater resources available in the site area, a six (6)-hour variable-rate pumping test was conducted at each test well. Manual groundwater level measurements were collected from each test well to determine the static water level and to assess interference effects during the pumping tests.

## 1.1 Scope of Work

Palmer’s Hydrogeological Study was completed through the following main tasks:

- Obtain and review applicable background information including surficial geology, bedrock geology, physiography mapping, and previous reporting;
- Assessed local water supply conditions by reviewing surrounding MECP water well records;
- Supporting the installation of test wells by providing technical guidance to water well drillers;
- Completion of a door-to-door water well survey on active water users within of the site boundary. This survey included the collection of baseline groundwater levels, installation of data loggers, and collection of groundwater chemistry samples from willing participants;
- Collection of baseline groundwater levels and installation of data loggers at all test wells;
- Planning and completion of three (3) six-hour variable-rate pumping tests;
- Collection of three (3) groundwater quality samples compared against Ontario Drinking Water Standards (ODWS), one from each test well;
- Analysis of pumping test data in order to determine hydraulic properties of the bedrock aquifer, radius of influence from each well, and potential impact to the environment/nearby water users;



- Provide technical guidance on the long-term sustainable pumping rate for each well and provide our opinion on the recommended pumping rate for each test well;
- Assess the potential for a Permit to Take Water (PTTW) from the MECP for water takings over 50,000 L/day; and,
- Produce a Hydrogeological Study Report outlining the results and recommendations from this investigation.

## 2. Existing Conditions

### 2.1 Water Bodies

The site is found within the Burnt River Watershed. The nearest water body to the site is Grass Lake, located approximately 320 m south of the site boundary. Grass Lake is approximately 0.6 km<sup>2</sup> in size and is part of a five-lake chain system. This system ultimately drains via the Drag River which flows into the Burnt River located 17 km south of the site.

### 2.2 Physiography and Geology

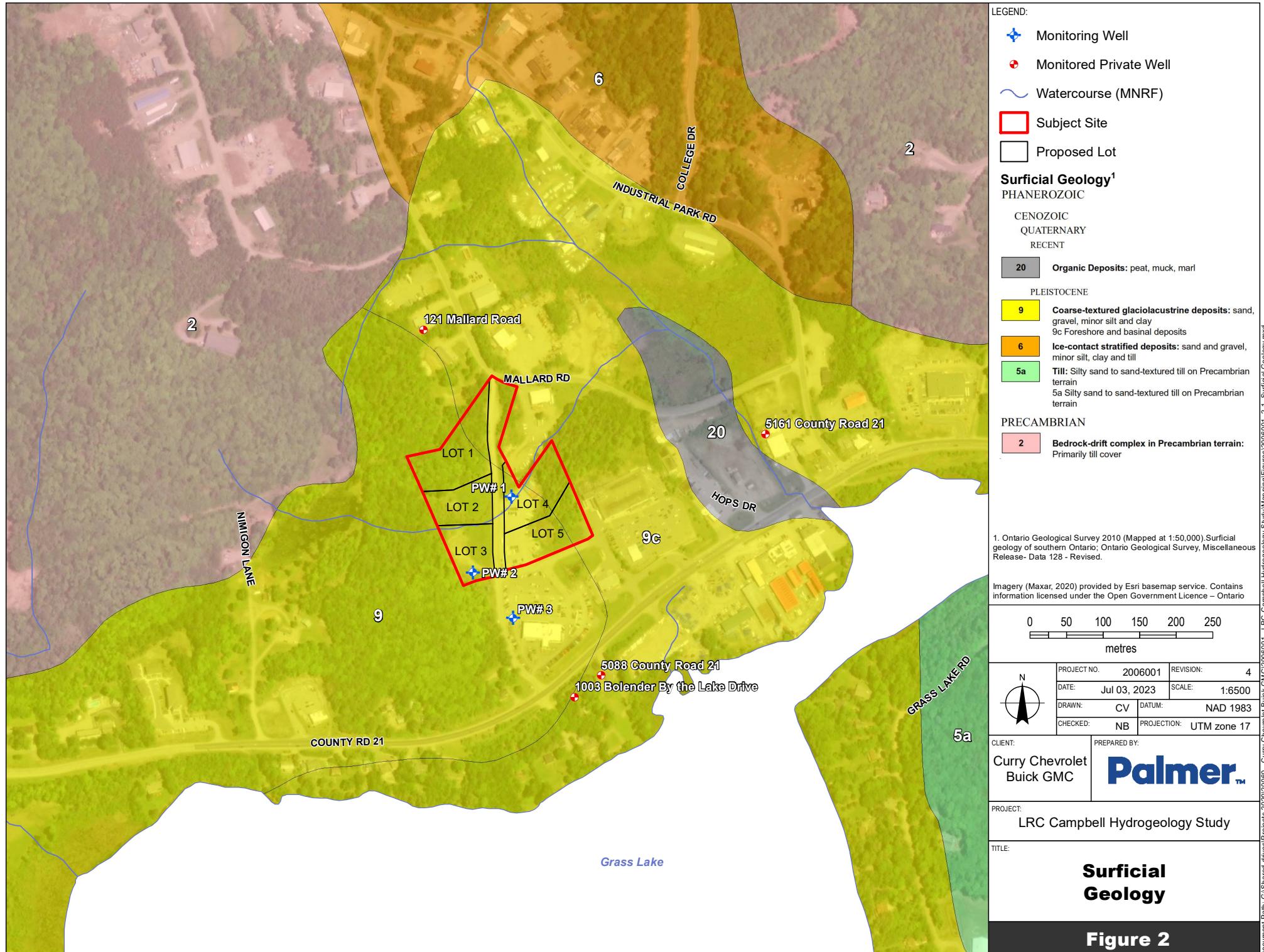
The site is situated within the Algonquin Highlands physiographic region (Chapman and Putnam, 1984). The Algonquin Highlands is broadly dome shaped, with the crown standing approximately 488 meters above sea level (masl) to 550 masl. It slopes down to 275 masl to the west and 183 masl to the east. Locally, the relief is rough with rounded knobs and ridges and frequent outcrops of bare rock that amount to 5% of the total area. Many of the valleys are floored with outwash sand and gravel. Several areas have deeper till and few rock outcrops with the surface of the till being smoothed and moulded with occasional drumlins appearing. In several areas, sandy glacial till can be found overlying Precambrian bedrock, with occasional outcrops peaking through the till.

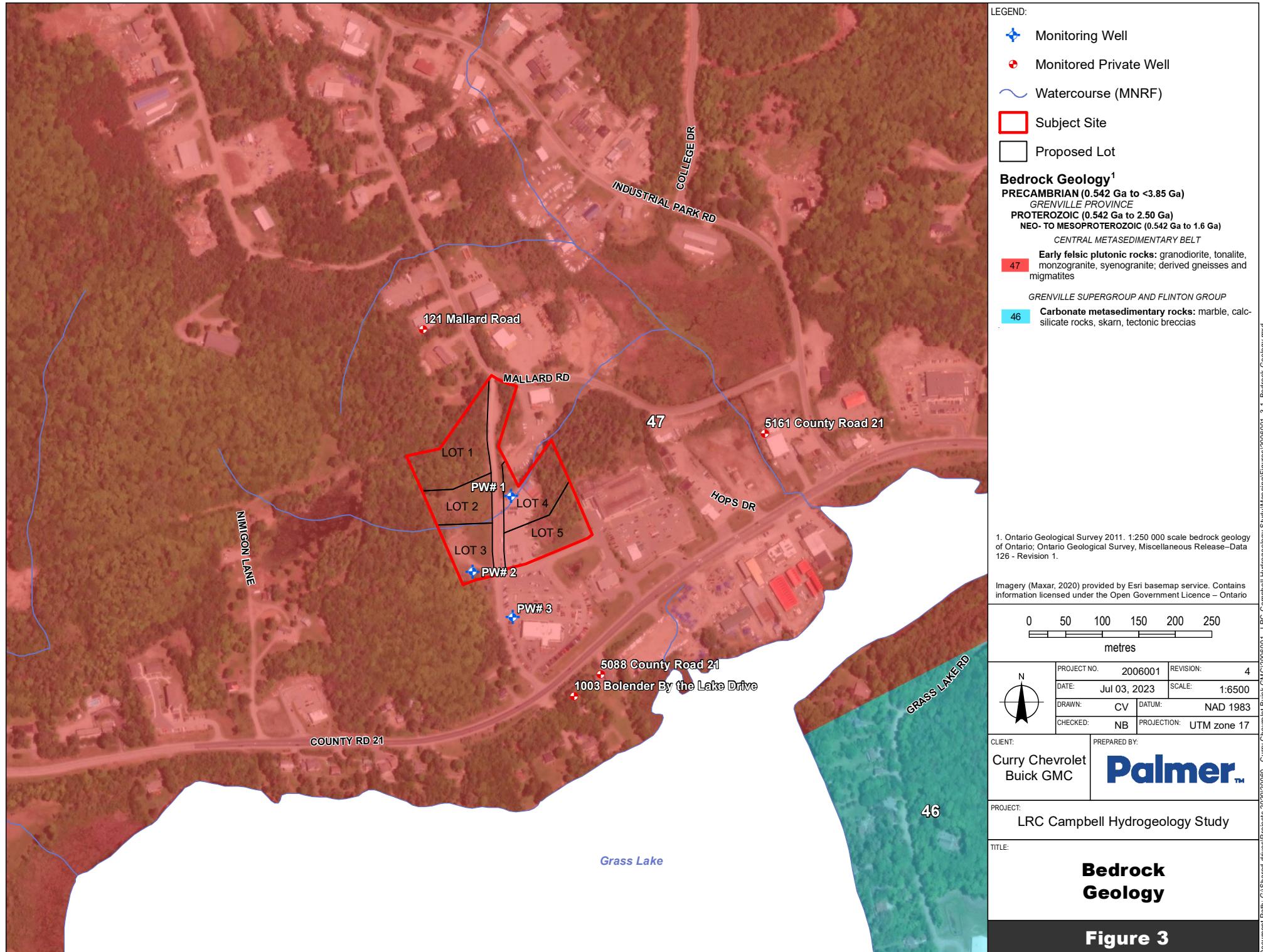
A review of available online surficial geology mapping from the Ontario Geological Survey (OGS) was used to identify the overburden materials of the site (**Figure 2**). Overlying the site are coarse-textured glaciolacustrine deposits, which consists of sand and gravel, with minor silt and clay. Bedrock geology mapping indicates that the site is underlain by Precambrian bedrock, comprised primarily of granitic rocks (**Figure 3**).

### 2.3 Hydrostratigraphic Units

Hydrostratigraphic units can be subdivided into two distinct groups based on their ability to allow groundwater movement. An aquifer is classically defined as a layer of soil that is permeable enough to permit a usable supply of water to be extracted. An aquitard is a layer of soil that inhibits groundwater movement due to its low permeability. Shallow groundwater flow within the analysis area is influenced by two (2) key hydrostratigraphic units: coarse-textured glaciolacustrine deposits and Precambrian bedrock.

**Coarse-textured glaciolacustrine** aquifer deposits were identified in OGS surficial geology mapping as being present over the study area. This unit is comprised primarily of sand and silty sand. Generally, this unit has a high permeability, estimated to range from  $10^{-4}$  to  $10^{-7}$  m/s and therefore, forms a surficial aquifer that allows for shallow horizontal groundwater flow and recharge.





**Precambrian Bedrock** was identified in OGS bedrock mapping below the coarse-textured glaciolacustrine soils. Groundwater movement in this unit is entirely dependent on the permeability created through fractures in the bedrock (i.e., secondary porosity). Precambrian bedrock may act as an aquitard if fractures are not present. However, when present, high volumes of water may pass through this unit. Many potable groundwater wells are completed in this unit and artesian head pressure is somewhat common in this area.

## 2.4 Well Water Records

Palmer reviewed the MECP Water Well database for all wells within a 500 m radius of the Site, with the summarized results provided in **Table 1** and shown on **Figure 4**. A total of fifty-six (56) wells were identified, comprised of thirty-five (35) domestic wells, eleven (11) commercial wells, two (2) mixed use (commercial and domestic), two (2) test holes and six (6) wells with unknown use. The depths of the wells ranged between 7.3 to 146.3 meters below ground surface (mbgs) and static water level between 0 (artesian) to 35.0 mbgs. The depth of bedrock was found to range from 0 to 18.9 mbgs. The recommended pumping rates (or well yield) ranged from 3.8 to 113.6 L/min, with an average yield of 21.6 L/min.

**Table 1. MECP Water Well Records**

Well ID	Date Completed	UTM	Depth (mbgs)	Depth of Bedrock (mbgs)	Water Level (mbgs)	Recommended Pumping Rate (GPM)	Usage
2700146	1962-02-05	17 693733 4991005 W	17.4	13.1	8.2	7.6	Domestic
2700147	1966-10-21	17 693926 4991086 W	25.6	5.2	2.4	3.8	Domestic
2700149	1965-08-26	17 694314 4991272 W	34.4	6.4	9.8	7.6	Domestic
2700149	1965-08-26	17 694314 4991272 W	34.4	6.4	9.8	3.8	Domestic
2700221	1964-12-16	17 693286 4991144 W	18.9	6.7	6.1	37.9	Domestic
2700222	1963-09-30	17 693701 4991122 W	7.3	1.8	1.5	7.6	Domestic
2700223	1962-08-14	17 694326 4991365 W	30.2	4.3	2.4	18.9	Commercial
2700550	1968-11-12	17 694025 4991044 W	37.8	8.2	1.5	37.9	Domestic
2700554	1968-11-26	17 694165 4991044 W	7.3	4.3	2.7	3.8	Domestic
2700563	1968-09-30	17 694015 4991644 W	21.6	5.2	1.5	15.1	Domestic
2700616	1969-09-23	17 693735 4990874 W	64	3	0	3.8	Domestic

Well ID	Date Completed	UTM	Depth (mbgs)	Depth of Bedrock (mbgs)	Water Level (mbgs)	Recommended Pumping Rate (GPM)	Usage
2700635	1969-07-10	17 693815 4990924 W	33.2	2.1	6.1	3.8	Domestic
2700635	1969-07-10	17 693815 4990924 W	33.2	2.1	6.1	-	Domestic
2700651	1969-11-22	17 694385 4990724 W	30.5	5.2	6.1	45.4	Domestic
2700651	1969-11-22	17 694385 4990724 W	30.5	5.2	6.1	3.8	Domestic
2700652	1969-10-29	17 694325 4990734 W	9.8	5.8	4.6	75.7	Domestic
2701053	1974-10-23	17 694364 4991127 W	9.1	1.5	3.7	11.4	Domestic
2701064	1969-07-20	17 694275 4991194 W	24.4	0.3	3.7	94.6	Domestic
2701216	1976-09-13	17 693415 4991024 W	32.6	18.9	0	75.7	Domestic
2701242	1976-10-29	17 694165 4991254 W	19.8	0	3	11.4	-
2701356	1977-10-19	17 694515 4990974 W	18.3	4.9	4.6	15.1	Domestic
2701374	1977-12-20	17 694165 4991574 W	16.8	5.5	4.6	11.4	Domestic
2701442	1977-10-04	17 694415 4991224 W	61	5.2	0.9	-	Commercial
2701453	1977-02-17	17 694265 4991224 W	41.5	18.6	1.8	-	Commercial / Domestic
2701453	1977-02-17	17 694265 4991224 W	41.5	18.6	1.8	113.6	Commercial / Domestic
2701819	1980-08-19	17 694015 4990774 W	38.1	1.8	4.3	22.7	Domestic
2702202	1985-02-25	17 693848 4991574 L	0	0	0	22.7	Commercial
2702305	1985-11-06	17 693472 4991416 L	36.6	3.4	10.7	22.7	Domestic
2702376	1986-08-30	17 693848 4991574 L	73.2	2.4	6.1	26.5	Commercial
2702377	1986-10-31	17 693848 4991574 L	25.3	2.4	1.8	87.1	Commercial
2702377	1986-10-31	17 693848 4991574 L	25.3	2.4	1.8	87.1	Commercial

Well ID	Date Completed	UTM	Depth (mbgs)	Depth of Bedrock (mbgs)	Water Level (mbgs)	Recommended Pumping Rate (GPM)	Usage
2702487	1986-09-27	17 693472 4991416 L	30.5	3.7	12.2	87.1	Domestic
2702487	1986-09-27	17 693472 4991416 L	30.5	3.7	12.2	113.6	Domestic
2703112	1989-03-16	17 693848 4991574 L	146.3	6.1	1.5	26.5	Commercial
2706115	2001-09-26	17 693682 4991707 W	36.6	1.5	5.5	37.9	Domestic
2706821	2004-06-30	17 693465 4990815 W	37	0.9	3	86.1	Domestic
2707036	2005-09-28	17 694021 4990905 W	49	0	35	-	Commercial
2707038	2005-09-23	17 693860 4991583 W	91	0.9	6	-	Domestic
2707318	2006-10-17	17 693913 4990725 W	91.5	2.4	9.9	-	Domestic
7131402	2009-08-03	17 693850 4991377 W	48.8	0	1.8	15.1	Domestic
7146031	2010-05-04	17 693362 4990844 W	138.7	0	3	18.9	Commercial
7154384	2010-10-20	17 693821 4990791 W	97.6	0	0	-	Domestic
7161241	2011-01-24	17 694250 4991109 W	0	0	0	18.9	-
7163613	2011-05-09	17 694250 4991109 W	0	0	0	-	-
7170914	2011-09-28	17 694338 4991331 W	0	0	0	37.9	-
7172317	2011-11-04	17 694106 4991171 W	18.3	0	0	18.9	Domestic
7176058	2011-12-05	17 693638 4990701 W	79.2	0	2.4	-	Domestic
7191122	2012-10-03	17 693848 4991766 W	24.4	0	4.6	56.8	Commercial
7203362	2013-01-13	17 694132 4991126 W	42.7	0	2.4	18.9	Commercial
7210710	2013-10-29	17 693637 4990858 W	0	0	8	7.6	-
7221288	2014-05-14	17 693550 4991502 W	48.8	0	5.7	3.8	Domestic

Well ID	Date Completed	UTM	Depth (mbgs)	Depth of Bedrock (mbgs)	Water Level (mbgs)	Recommended Pumping Rate (GPM)	Usage
7233956	2014-11-13	17 693361 4991177 W	18.3	0	4.3	7.6	Domestic
7268647	2016-07-14	17 693907 4991746 W	0	0	0	3.8	-
7269891	2016-07-04	17 693576 4990858 W	48.8	0	11	37.9	Test Hole
7269891	2016-07-04	17 693576 4990858 W	48.8	0	11	7.6	Test Hole
7275095	2016-06-04	17 693789 4991602 W	91.4	0	8.8	18.9	Domestic

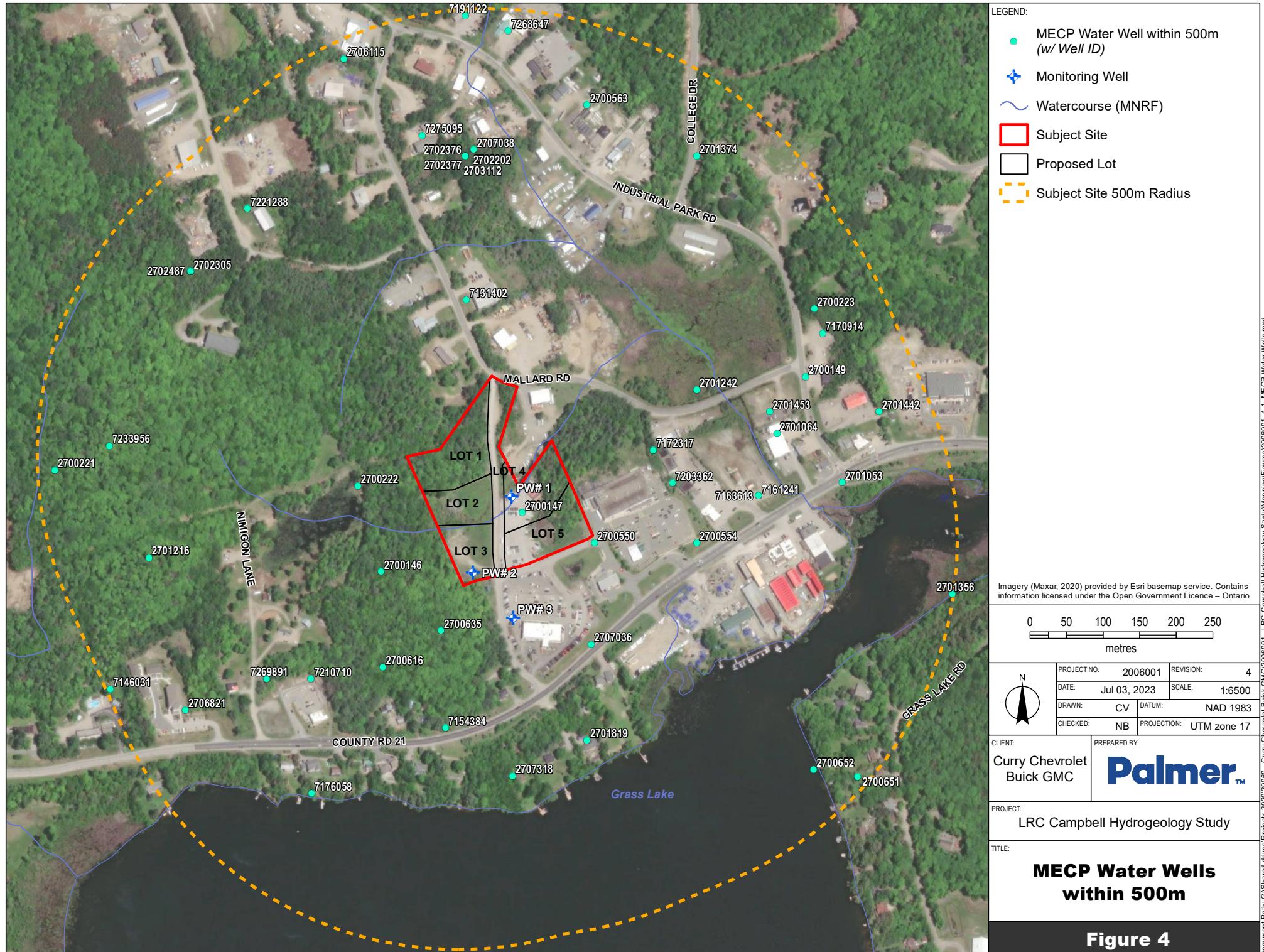
## 2.5 Private Water Well Survey

A door-to-door private water well survey was conducted within a 300 m radius of the site boundary requesting homeowners/business owners to participate in a baseline well monitoring program. The details of the wells involved in well monitoring program are provided in **Table 2**, and the location of the wells is provided on **Figure 1**. The purpose of this program was to monitor private water wells before and during the pumping tests conducted at each of the three (3) test wells to determine the potential for off-site interference effects. The well monitoring program involved the collection of a baseline water level, a baseline groundwater chemistry sample, and the installation of a datalogger to provide continuous water level measurements during the pumping tests.

*Table 2. Private Water Well Summary*

Address	Well Type	Well Depth (mbgs)	Water Level (mbtoc)
5088 County Road 21	Drilled	36.6	7.73
5161 County Road 21 (Pump Shop)	Drilled	24.4	1.21
121 Mallard Road	Drilled	>30	4.70
1003 Bolender By The Lake Drive	Drilled	>30	10.56

Water Level collected on November 10, 2020.



## 3. Hydrogeological Assessment

### 3.1 Borehole Drilling and Test Well Installations

Two (2) test wells were completed at the site on September 14, and September 15, 2020 (PW1, and PW2 - **Figure 1**) on Lots 3 and 4, respectively. The existing well located at the Curry Dealership was completed on September 28, 2005 (PW3). A summary of the test well construction details can be found in **Table 3**. Boreholes were advanced by Haliburton Artesian Well Drillers. Six (6) meters of steel casing was installed in each well and set into the bedrock. Below this, the test wells are 5" diameter open core holes. The test wells were driven until a permeable unit was identified by the well driller and Palmer staff. Detailed borehole logs can be found in **Appendix B**.

*Table 3. Test Well Construction Details*

Test Well ID	Lot	Depth (m)	Steel Casing Length (m)	Open Core Length (m)	Geology
PW1	4	36.5	6.0	30.5	Granite
PW2	3	20.1	6.0	14.1	Granite
PW3	Existing Curry Dealership	49.0	6.0	43.0	Granite

### 3.2 Test Pits

Test pitting was completed on September 9, 2020 to characterize the soils and to determine the depth to bedrock at eleven (11) locations at the site (**Figure 1**). Each test pit was completed to a maximum depth of 3 m or until bedrock was encountered. The depth to bedrock, depth to water (if encountered), and stratigraphy are summarized in **Table 4**. A photo log of the test pits is presented in **Appendix C**. The depth to bedrock ranged from 0.6 to greater than 3 m across the site.

*Table 4. Test Pit Summary*

Test Pit ID	Lot	Depth (m)	Stratigraphy	Depth to Bedrock (mbgs)	Depth of Water Seepage (mbgs)
1	5	2.9	<ul style="list-style-type: none"> <li>0 - 1 m: Sand and gravel fill, trace organics</li> <li>1 - 2.9 m: Silty sand, light brown</li> </ul>	>2.9	-
2	5	2.8	<ul style="list-style-type: none"> <li>0 - 0.3 m: Topsoil</li> <li>0.3 - 1.5 m: Sand and gravel fill, contained organics</li> <li>1.5 – 2.8 m: Sandy silt, contained cobbles, brown to grey</li> <li>Black organic layer encountered at 2.1 mbgs. Water seepage at organic layer</li> </ul>	>2.8	2.1
3	4	2.1	<ul style="list-style-type: none"> <li>0 - 0.3 m: Topsoil</li> <li>0.3 – 0.9 m: Sand and silt fill, trace organics</li> <li>0.9 – 2.1 m: Sandy silt, contained cobbles, brown to grey</li> <li>2.1 m: Bedrock</li> </ul>	2.1	1.9

Test Pit ID	Lot	Depth (m)	Stratigraphy	Depth to Bedrock (mbgs)	Depth of Water Seepage (mbgs)
			<ul style="list-style-type: none"> <li>Black organic layer encountered at 1.9 mbgs, water seepage at organic layer</li> </ul>		
4	4	2.4	<ul style="list-style-type: none"> <li>0 – 0.3 m: Topsoil</li> <li>0.3 – 0.8 m: Sand and silt fill</li> <li>0.8 – 2.4 m: Sand and silt, contained boulders (up to 1m in length), brown</li> <li>Organic layer found at 1.1 mbgs</li> <li>Water seepage at 1.4 mbgs</li> <li>2.4 m: Bedrock</li> </ul>	2.4	1.4
5	3	2.8	<ul style="list-style-type: none"> <li>0 – 0.3 m: Topsoil</li> <li>0.3 – 1.2 m: Sand and gravel fill, some silt</li> <li>1.2 – 2.8 m: Silty sand, some clay, brown</li> <li>Surface water seepage at 0.6 mbgs</li> </ul>	>2.8	0.6
6	3	2.6	<ul style="list-style-type: none"> <li>0 – 0.2 m: Topsoil</li> <li>0.2 – 1.4 m: Sand and gravel, some silt</li> <li>1.4 – 2.6 m: Silty sand, some gravel. Brown to grey transition at 2.1 m</li> <li>Water seepage at 2.4 mbgs</li> </ul>	>2.6	2.4
7	3	2.5	<ul style="list-style-type: none"> <li>0 – 0.35 m: Topsoil</li> <li>0.35 – 0.8 m: Silt, some sand and gravel</li> <li>0.8 – 2.5 m: Silt and clay, some sand, contained organics, brown</li> <li>Located adjacent to watercourse</li> <li>Water seepage at 0.7 mbgs</li> <li>Organic layer encountered at 1.4 mbgs</li> </ul>	>2.5	0.7
8	2	1.1	<ul style="list-style-type: none"> <li>0 – 0.2 m: Topsoil</li> <li>0.2 – 1.1 m: Sandy silt, some clay, brown to dark brown</li> <li>Water seepage at bedrock (1.1m)</li> <li>1.1 m: Bedrock</li> </ul>	1.1	1.1
9	2	1.5	<ul style="list-style-type: none"> <li>0 – 0.3 m: Topsoil</li> <li>0.3 – 1.5 m: Sand and silt, brown</li> <li>1.5 m: Bedrock</li> </ul>	1.5	-
10	1	3.0	<ul style="list-style-type: none"> <li>0 – 0.4 m: Topsoil</li> <li>0.4 – 1.0 m: Sand and silt till, some organics</li> <li>1.0 – 3.0 m: Sand and silt. Brown to grey transition at 1.4 m</li> </ul>	>3.0	-
11	1	0.6	<ul style="list-style-type: none"> <li>0 – 0.2 m: Topsoil</li> <li>0.2 – 0.6: Sand and silt, contained organics</li> <li>0.6 m: Bedrock</li> </ul>	0.6	-

### 3.3 Geology

The results of the borehole drilling investigations and test pitting were consistent with the regional OGS surficial geology and bedrock mapping (**Figure 2** and **3**). The stratigraphy of the site as encountered during borehole drilling is described below:

**Coarse Textured Glaciolacustrine Deposits:** Coarse textured material was encountered from surface in all test wells and test pits. This unit consisted of sand, gravel, and silt and ranged from 2.1 – 2.7 meters thick.

**Grey Granite Bedrock:** Bedrock was encountered in all test wells ranging from 2.1 – 3.0 mbgs. This unit was described as soft to hard, grey granite rock. The thickness of this unit ranged from 16.8 – 33.9 m.

**Red Granite Bedrock:** A soft red granite unit was encountered in all test wells. In PW1 and PW2, this unit was encountered below the grey granite unit at 36.0 m and 19.5 m respectively and was 0.61 m thick in both boreholes. In PW3, this unit was encountered at 3 m and was 46 m thick, however the water bearing unit (i.e., fractured zone) within the red granite was likely encountered near the bottom of the borehole. It is estimated that the water bearing fractured zone at PW3 is 0.61 m in thickness based on the results at PW1 and PW2. The fractures in the red granite bedrock are identified as the permeable unit identified during well drilling which is considered to be the bedrock aquifer for this site.

### 3.4 Groundwater Levels

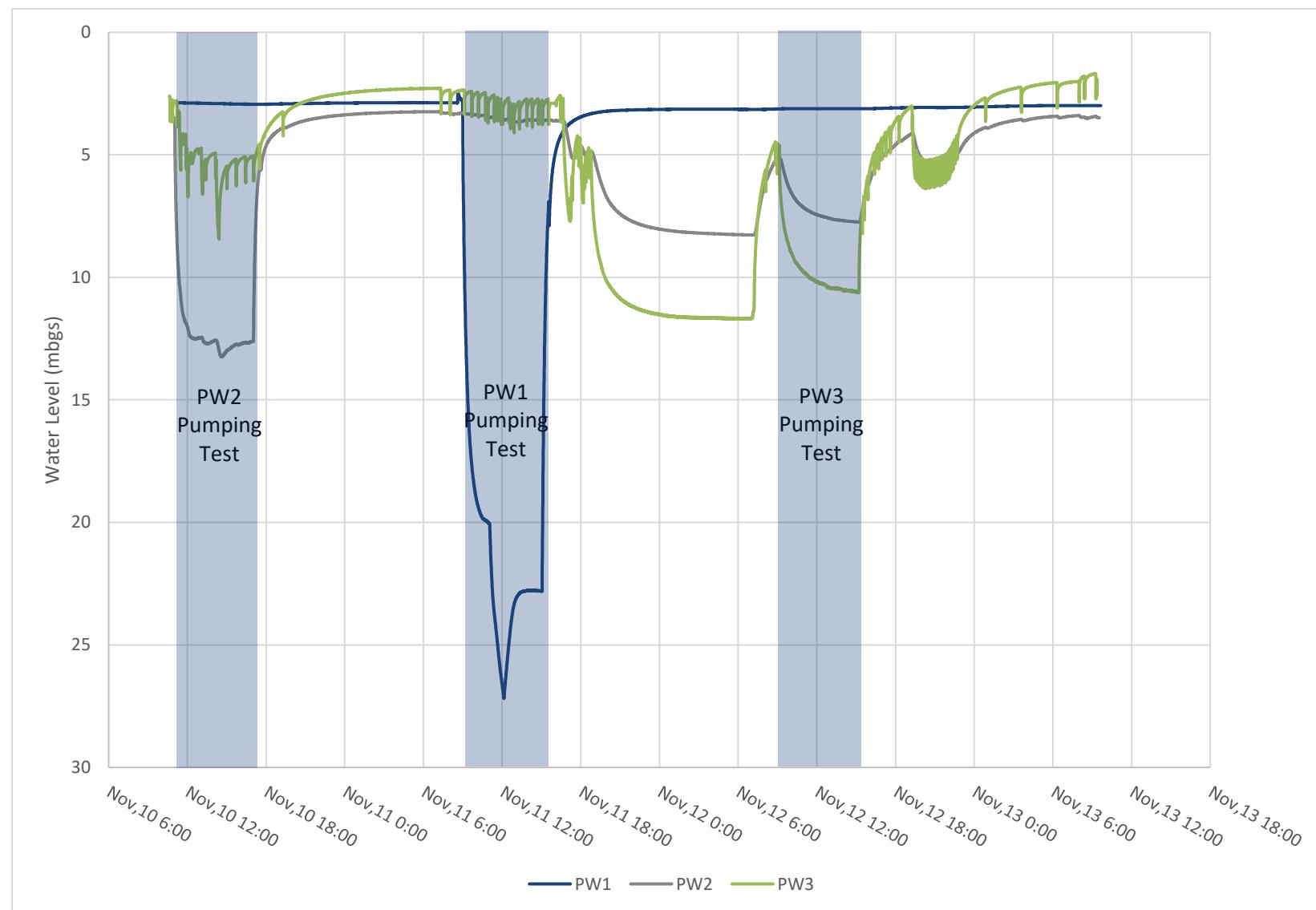
Groundwater levels were measured in the test wells on September 15, 2020, September 30, 2020, November 9, 2020, and November 13, 2020. Water levels were measured using a water level tape and recorded to the nearest centimetre. A summary of the measured water levels is provided in **Table 5**, and **Figure 5** presents continuous water level data during the week of the pumping tests between November 9 and November 13, 2020. The water levels ranged from 2.38 to 4.11 mbgs, with the seasonal low water levels being observed on September 30, 2020.

**Table 5. Test Well Groundwater Levels**

Monitoring Well ID	Stick Up (m)	Depth (m)	Groundwater Level (mbgs)			
			September 15, 2020	September 30, 2020	November 9, 2020	November 13, 2020
PW1	0.48	36.5	3.33	3.63	2.78	3.02
PW2	0.67	20.1	3.60	4.11	3.48	3.53
PW3	0.97	49.0	2.87	3.44	2.38	2.47

As observed in **Figure 5**, the pumping tests were conducted on November 10, November 11, and November 12, between approximately 9 AM and 5PM. The continuous water level data reveals PW2 and PW3 show similar drawdown trends, suggesting the wells are likely connected to the same aquifer unit.

Note that the drawdown observed at PW2 and PW3 between November 11 at 6:00 PM and November 12 at 7:00 AM is related to the water being accidentally left on at the Curry Dealership over night.

**Figure 5. Test Well Hydrograph**

## 3.5 Pumping Tests

A six-hour variable rate pumping test was conducted at each of the three (3) test wells (PW1, PW2, and PW3). The tests were conducted first using a step test followed by a constant rate pumping test. This method involves initializing the pumping test at a low rate, then incrementally increasing the rate over the first 1 – 2 hours to determine a sustainable rate for a longer term test. The purpose of these pumping tests was to determine the aquifer hydraulic conductivity (K), transmissivity (T), storativity (S), groundwater quality, and to assess groundwater interference effects and potential effects to existing water users and the natural environment. Water levels were monitored in the pumping well and at the other test wells and private water wells during each pumping test. Water levels from private wells are provided in **Figure 6**. Water levels were monitored manually and using automatic data loggers to obtain continuous water level information.

A groundwater sample was collected within the last 30-minutes of each pumping test to determine the groundwater quality at each well location. These groundwater samples were submitted to ALS and compared to the Ontario Drinking Water Quality Standards (ODWS).

Values for aquifer hydraulic conductivity and transmissivity were calculated using the displacement-time data collected from each pumping test in Aqtesolv™ software using the Papadopoulos and Cooper (1967) solution for confined aquifers. Storativity was calculated by simulating the drawdown observed during these tests using Aqtesolv™ forward solutions. The results from the Aqtesolv™ modelling are presented in **Appendix D** and described in further detail below.

### 3.5.1 PW1 Pumping Test

#### 3.5.1.1 PW1 Pumping Test Results

On November 11, 2020, test well PW1 was pumped at a starting rate of 22.71 L/min for 2 hours, then increased to 26.50 L/min for 1 hour, then reduced to 22.71 L/min for the remaining 3 hours (due to excessive drawdown) (**Figure 7**). A summary of the pumping test and the results from PW1 is found in **Table 6**.

The results of the pumping test are plotted as drawdown versus time in **Figure 7**. Based on the displacement-time data a hydraulic conductivity value of  $4.20 \times 10^{-5}$  m/s and a transmissivity value of  $2.56 \times 10^{-5}$  m/s<sup>2</sup> were calculated for PW1 assuming an aquifer thickness of 0.61 m. The aquifer storativity was estimated to be  $1.42 \times 10^{-5}$  m<sup>-1</sup> based on forward solution modelling.

After 6 hours of pumping, the drawdown was 24.4 m. This includes approximately 4 m of drawdown related to increasing the pumping rate from 22.71 to 26.50 L/min. After reducing the rate to 22.71 L/min, the well recovered by approximately 4 m and maintained drawdown at about 20 m. Within the final 30 minutes of the test, PW1 experienced 3 cm of drawdown (0.125 cm/min). This low rate of drawdown suggests PW1 was nearing steady-state conditions at the end of the pumping test. Upon completion of the test, PW1 recovered 15.7 m (79%) of the water column in 30 minutes, indicating a good well yield.

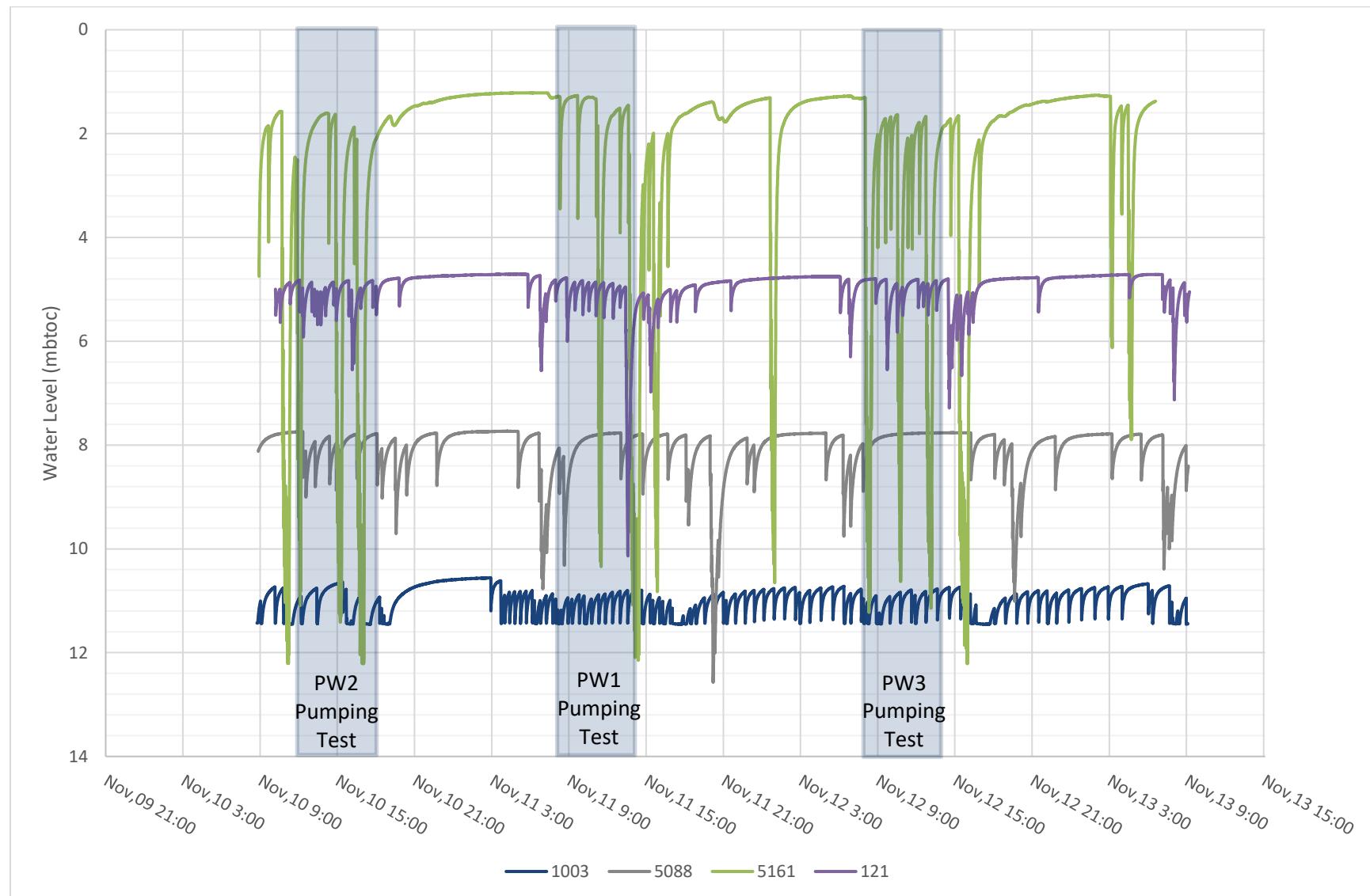
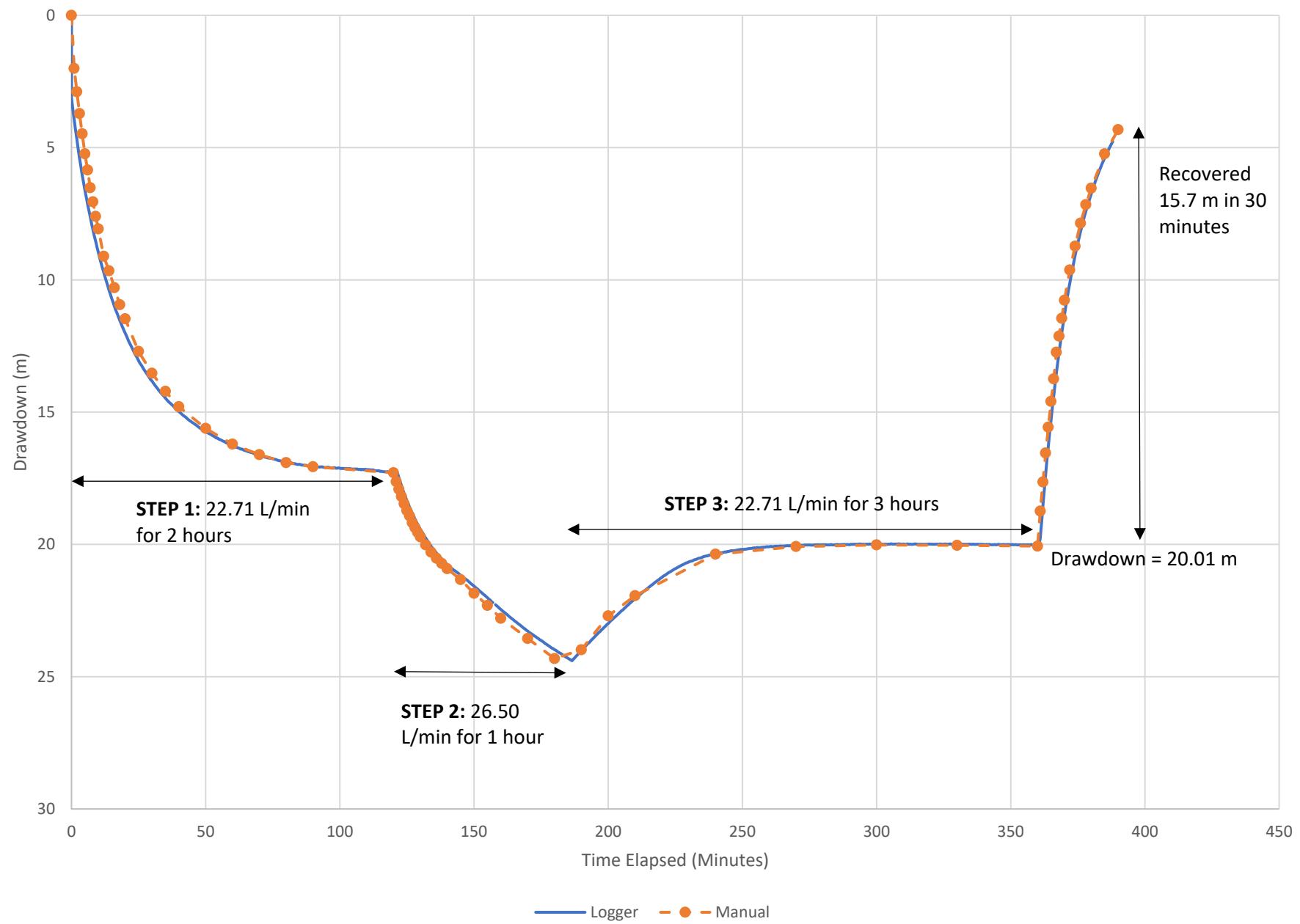
**Figure 6. Private Water Well Groundwater Levels**

Figure . PW1 Pumping Test Response



**Table 6. PW1 Pumping Test Summary**

<b>Water Level Before Test (mbgs)</b>	<b>2.78</b>
<b>Final Water Level (mbgs)</b>	<b>22.85</b>
<b>Total Drawdown (m)</b>	<b>20.01</b>
<b>Hydraulic Conductivity (m/s)</b>	<b><math>4.20 \times 10^{-5}</math></b>
<b>Aquifer Thickness (m)</b>	<b>0.61</b>
<b>Transmissivity (m/s<sup>2</sup>)</b>	<b><math>2.56 \times 10^{-5}</math></b>
<b>Step 1 Pumping Rate (L/min)</b>	<b>22.71</b>
<b>Step 2 Pumping Rate (L/min)</b>	<b>26.50</b>
<b>Step 2 Pumping Rate (L/min)</b>	<b>22.71</b>

### 3.5.1.2 PW1 Well Interference

Test wells PW2, and PW3 were monitored as observation wells during the pumping test occurring at PW1 (**Figure 5**). None of the observation wells showed a significant drawdown response during this pumping test. Based on the chemistry of the groundwater at PW1, and the lack of interference effects with PW2 and PW3, it is likely that the fracture zone encountered at PW1 is not hydraulically connected to fracture zones encountered PW2 and PW3.

The four (4) private wells included in the private well water survey were monitored during the pumping test occurring at PW1 (water levels are presented in **Figure 6**). No measurable interference was recorded at 1003 Bolender By The Lake Drive and 5088 County Road 21. Minor interference in the range of 0.10 – 0.20 m was interpreted at 5161 County Road 21 and 121 Mallard Road. These wells have depths of 24.4 and >30 mbgs respectively, and therefore the very minor interference identified will not adversely affect water quantity in these wells.

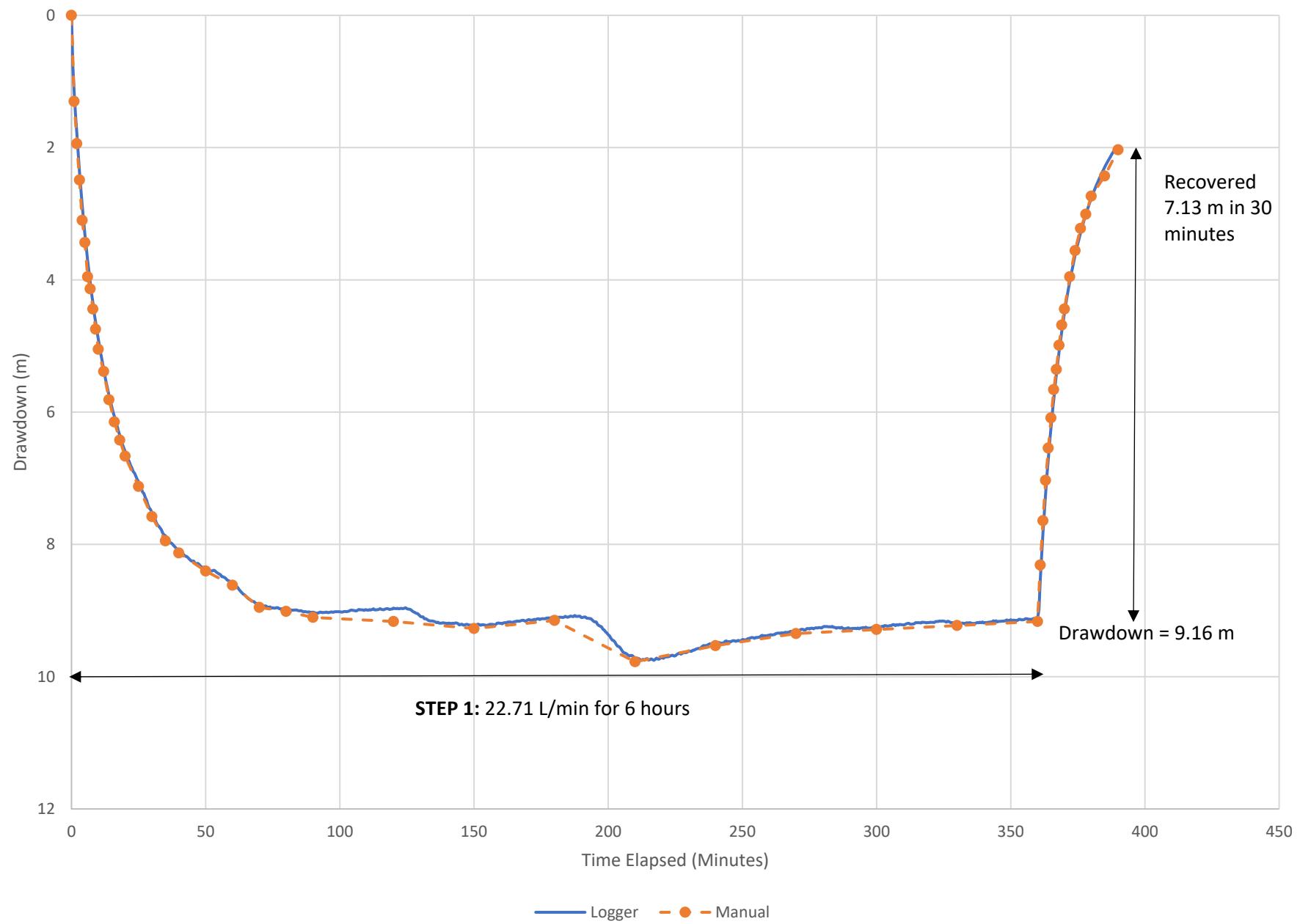
## 3.5.2 PW2 Pumping Test

### 3.5.2.1 PW2 Pumping Test Results

On November 10, 2020, test well PW2 was pumped at a starting rate of 22.71 L/min. Based on the observed drawdown, this pumping rate was determined to be sufficient for a long-term test and no additional increase in pumping rate was required (i.e., a constant rate pumping test was completed and not a step-drawdown test). A summary of the pumping test and the results from PW2 is found in **Table 7**.

The results of the pumping test were plotted as drawdown versus time in **Figure 8**. Based on the displacement-time data a hydraulic conductivity value of  $1.02 \times 10^{-4}$  m/s and a transmissivity value of  $6.24 \times 10^{-5}$  m/s<sup>2</sup> were calculated for PW2 assuming an aquifer thickness of 0.61 m. The storativity was determined to be  $1.31 \times 10^{-5}$  m<sup>-1</sup> based on drawdown observed from PW3.

Figure . PW2 Pumping Test Response



**Table 7. PW2 Pumping Test Summary**

<b>Water Level Before Test (mbgs)</b>	<b>3.48</b>
<b>Final Water Level (mbgs)</b>	<b>12.64</b>
<b>Total Drawdown (m)</b>	<b>9.16</b>
<b>Hydraulic Conductivity (m/s)</b>	<b><math>1.02 \times 10^{-4}</math></b>
<b>Aquifer Thickness (m)</b>	<b>0.61</b>
<b>Transmissivity (m/s<sup>2</sup>)</b>	<b><math>6.24 \times 10^{-5}</math></b>
<b>Step 1 Pumping Rate (L/min)</b>	<b>22.71</b>

After 6 hours of pumping, the drawdown was 9.16 m. Increased drawdown was observed throughout the pumping test at PW2 (**Figure 8**). This is interpreted to be from water usage at PW3 from the Curry GM Dealership. Continuous groundwater level data confirms that there is well interference between PW2 and PW3 (**Figure 5**). While some interference effects with PW3 were observed, the drawdown at PW2 is interpreted to have stabilized after approximately 2 hours of pumping at 9.16 m. Upon completion of the test, PW2 recovered 7.13 m (78%) in 30 minutes, indicating a good well yield.

### 3.5.2.2 PW2 Well Interference

Test wells PW1 and PW3 were monitored as observation wells for the PW2 pumping test. Based on the water level data approximately 2.49 m of well interference was observed in PW3 from pumping at PW2 (**Figure 5**). As PW3 has an available drawdown of 38.62 m, 2.49 m of interference is not expected to adversely affect the well yield at this well.

The four (4) private wells included in the private well water survey were monitored during the pumping test occurring at PW2. No measurable interference was recorded at any of the private wells (**Figure 6**).

## 3.5.3 PW3 Pumping Test

### 3.5.3.1 PW3 Pumping Test Results

On November 12, 2020, test well PW3 was pumped at a starting rate of 45.42 L/min. As this well has a pump installed with a set pumping rate, the pumping rate for the test could not be changed. A summary of the pumping test and the results from PW3 is found in **Table 8**.

The results of the pumping test are plotted as drawdown versus time in **Figure 9**. The drawdown data was used to determine a hydraulic conductivity value of  $2.77 \times 10^{-4}$  m/s, and a transmissivity value of  $1.69 \times 10^{-4}$  m/s<sup>2</sup> were calculated for PW3 assuming an aquifer thickness of 0.61 m. The storativity was determined to be  $1.25 \times 10^{-5}$  m<sup>-1</sup> based on drawdown observed at PW2.

After 6 hours of pumping, the drawdown was 4.88 m. It is important to note that PW3 had not fully recovered to static water level conditions from previous use (**Figure 5**), therefore the early drawdown rate is likely lower than anticipated. Within the final 30 minutes of the test, PW3 experienced 3 cm of drawdown (0.1 cm/min). This low rate of drawdown suggests PW3 was nearing steady-state conditions at

the end of the pumping test. Upon completion of the test, PW3 recovered 4.37 m (90%) of water column in 30 minutes. This is a very fast recovery time and suggests PW3 is highly productive.

**Table 8. PW3 Pumping Test Summary**

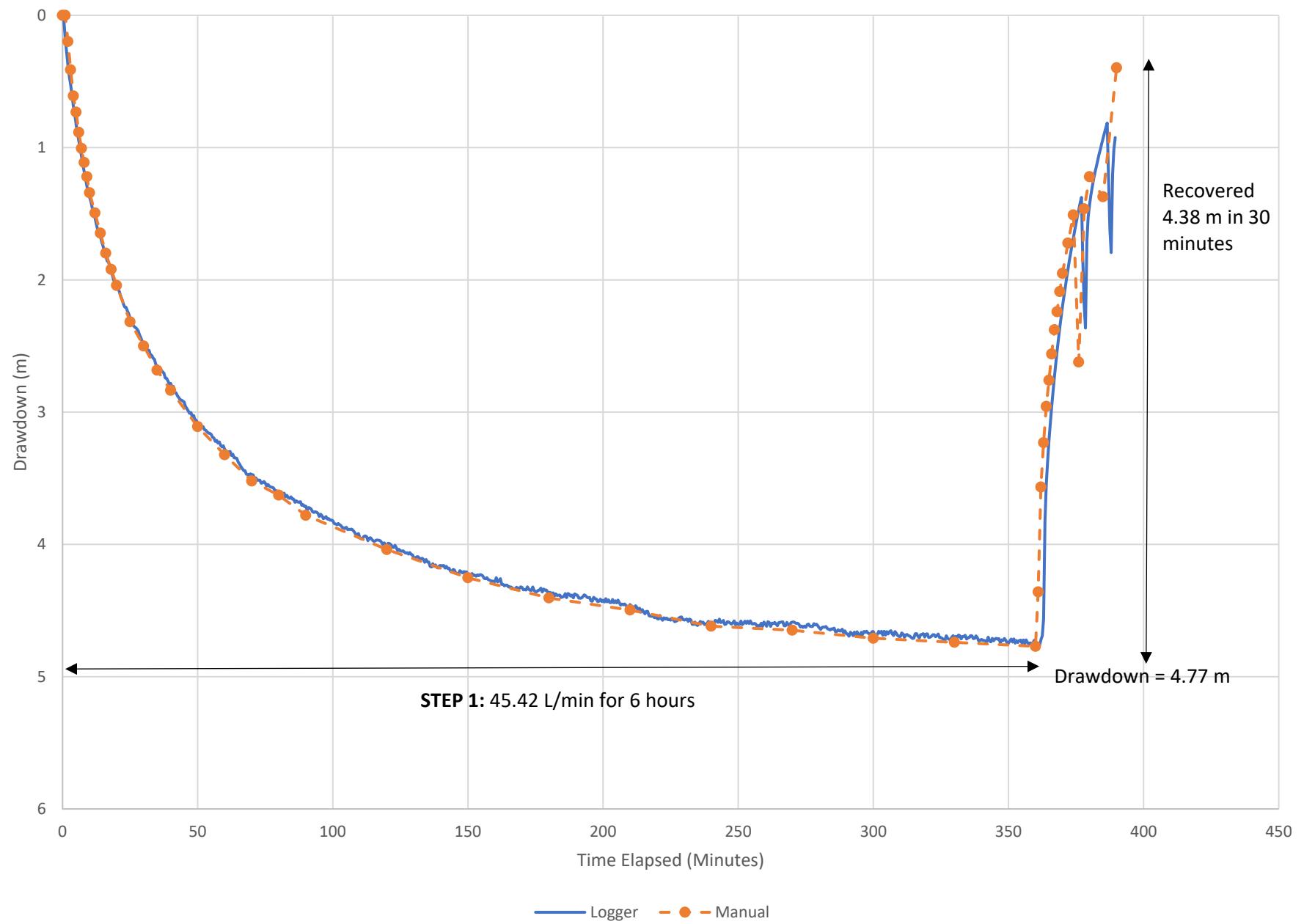
<b>Water Level Before Test (mbgs)</b>	<b>5.08</b>
<b>Final Water Level (mbgs)</b>	<b>9.96</b>
<b>Total Drawdown (m)</b>	<b>4.88</b>
<b>Hydraulic Conductivity (m/s)</b>	<b><math>2.77 \times 10^{-4}</math></b>
<b>Aquifer Thickness (m)</b>	<b>0.61</b>
<b>Transmissivity (m/s<sup>2</sup>)</b>	<b><math>1.69 \times 10^{-4}</math></b>
<b>Step 1 Pumping Rate (L/min)</b>	<b>45.42</b>

### 3.5.3.2 PW3 Well Interference

Test wells PW1 and PW2 were monitored as observation wells for the PW3 pumping test. Based on the water level data approximately 5.0 m of well interference was observed in PW2 from pumping at PW3 (**Figure 5**). As PW2 has an available drawdown of 15.99 m, 5.0 m of interference is not expected to adversely affect the well yield at this well.

The four (4) private wells included in the private well water survey were monitored during the pumping test occurring at PW3. No measurable interference was recorded at 121 Mallard Road, 5088 County Road 21, and at 1003 Bolender By The Lake Drive (**Figure 6**). Minor interference of 0.10 – 0.20 m was recorded at 5161 County Road 21. The depth of this well is 24.4 mbgs, therefore this interference will not adversely affect water quantity in this well.

Figure . PW3 Pumping Test Response



## 3.6 Pumping Rate Assessment

### 3.6.1 Long-Term Safe Yield

The long-term safe yield for the test wells was calculated by using the Farvolden Method (1961). The results of these calculations are provided in **Table 9**. This method uses the transmissivity and the available drawdown to calculate the twenty-year maximum long-term safe pumping rate ( $Q_{20}$ ). This rate presents the theoretical rate that each test well can be pumped constantly for a twenty-year period without mining the aquifer, but does not consider permitting requirements (i.e., a PTTW will be required for pumping at greater than 50,000 L/day), well interference, or off-site impacts to other water users. These considerations will be addressed in **Section 3.6.2** where a recommended pumping rate will be presented for each test well.

The Farvolden Method for the long-term safe pumping rate is outlined below:

$$Q_{20} = (0.68)(T)(H_a)(S_f)$$

Where:

$Q_{20}$	=	Twenty-year safe yield (L/day)
T	=	Transmissivity (m <sup>2</sup> /day)
$H_a$	=	Available drawdown (m) – Water level from September 30, 2020, to recommended pump setting
$S_f$	=	Safety Factor (0.7)

Based on the results of this assessment, the  $Q_{20}$  for PW1 - PW3 range from 24.01 L/min at PW1 to 219.88 L/min at PW3 (**Table 9**). PW3 has a very high transmissivity as well as a large available drawdown. PW1 has a large available drawdown but is limited by a moderate transmissivity value. PW2 has a high transmissivity value but is limited by a shallow depth and smaller amount of available drawdown.

**Table 9. Long-Term Safe Yield**

Test Well ID	T (m <sup>2</sup> /day)	$H_a$ (m)	$S_f$	Sustainable Pumping Rate ( $Q_{20}$ ) (L/min)	Sustainable Pumping Rate ( $Q_{20}$ ) (L/day)
PW1	2.21	32.87	0.7	24.01	34,577
PW2	5.39	15.99	0.7	28.49	41,024
PW3	14.60	45.56	0.7	219.88	316,621

### 3.6.2 Recommended Pumping Rate

The recommended pumping rate differs from the safe yield as it is based on a more typical maximum 12-hour/ day pumping schedule and known aquifer recharge. In addition, this analysis considers the potential off site impacts, well interference, and MECP permitting considerations. The results of this assessment may provide recommended pumping rates that are higher or lower than the long-term safe yield.

This analysis for the recommended pumping rate at each well uses a forward solution analysis in Aqtesolv™ software which are summarized in **Table 10**. The forward solution uses the Papadopoulos and Cooper (1967) method and aquifer data including the transmissivity, storativity, and aquifer thickness to model drawdown in the test well, and the drawdown cone created by pumping at specified rates and durations. Using the forward solutions, the recommended pumping rate for each well can be obtained.

**Table 10. Forward Solution Summary**

Forward Solution Parameters	PW 1	PW 2	PW 3
Water Level (mbgs)	3.63	4.11	3.44
Recommended Pump Setting (mbgs)	34.96	18.51	42.0
Transmissivity (m <sup>2</sup> /s)	2.56 x 10 <sup>-5</sup>	6.24 x 10 <sup>-5</sup>	1.69 x 10 <sup>-4</sup>
Storativity	1.42 x 10 <sup>-5</sup>	1.31 x 10 <sup>-5</sup>	1.25 x 10 <sup>-5</sup>
Available Drawdown minus 1 m (m)	30.33	13.40	37.56
Pumping Rate (L/min)	<b>30</b>	<b>21</b>	<b>68</b>
Pumping Duration (hr)	12	12	12
Modelled Drawdown (m)	26.80	8.0	10.10
Daily Yield (L/0.5 days)	21,600	15,120	48,960
Radius of Influence to 1 m drawdown (m)	310	220	390

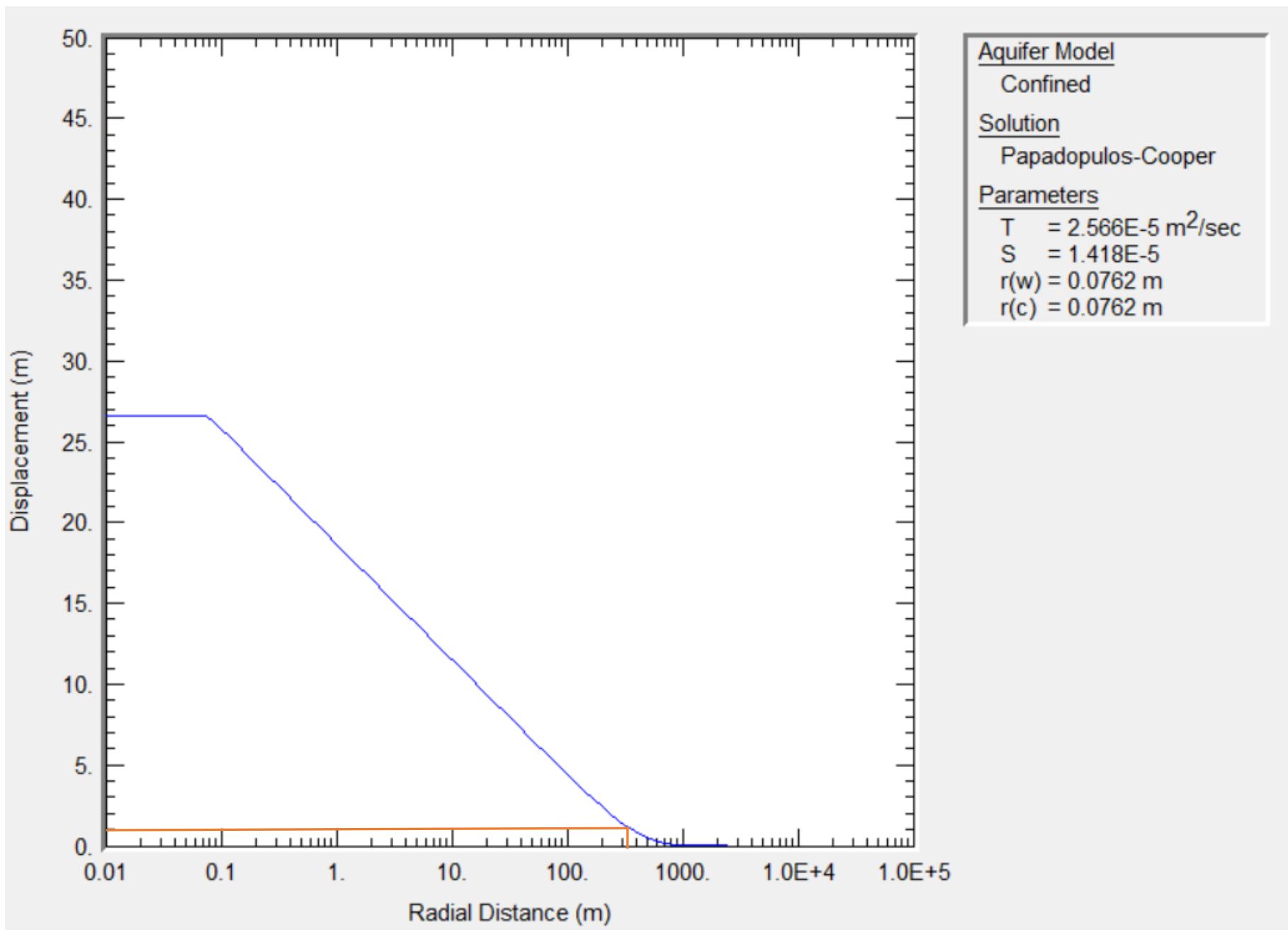
### 3.6.2.1 PW1 Recommended Pumping Rate

The Q<sub>20</sub> for PW1 was calculated to be 23.58 L/min (**Table 9**). On November 11, 2020, PW1 was pumped at 22.71 L/min for 6 hours and experienced 20.01 m of drawdown. PW1 has a good mix of a large available drawdown combined with a moderate transmissivity value. The recommended pumping rate will need to take into consideration the available drawdown minus an additional 1 m of water level fluctuation to account for seasonal low water levels over time.

A forward solution in Aqtesolv™ was completed to model a pumping rate over a 12-hour period that would limit drawdown in PW1 to 26.80 m or approximately 90% of the available drawdown. **Figure 10** displays the theoretical drawdown and drawdown cone created when pumping PW2 at 30 L/min for 12 hours. At this rate, the drawdown is limited to 26.80 m, and the volume of water for is maximized at 21,600 L/day.

Well recovery is expected to be rapid as PW1 recovered 15.7 m (79%) in 30 min following the 6-hour pumping test (**Figure 7**). As the total daily yield for the recommended pumping rate is less than 50,000 L/day, a PTTW from the MECP would not be required.

*Figure . PW1 Forward Solution*



### 3.6.2.2 PW2 Recommended Pumping Rate

The  $Q_{20}$  for PW2 was calculated to be 28.56 L/min (**Table 9**). On November 10, 2020, PW2 was pumped at 22.71 L/min for 6 hours and experienced 9.16 m of drawdown. PW2 has a high transmissivity value, but a lower available drawdown. Based on the monitoring data, from 6:00 PM on November 11 to 7:00 AM on November 12, PW2 experienced 5.03 m of drawdown related to water use from PW3 (**Figure 5**). The recommended pumping rate will need to take into consideration well interference from PW3, and the available drawdown minus an additional 1 m of water level fluctuation to account for seasonal low water levels over time.

A forward solution in Aqtesolv™ was completed to model a pumping rate over a 12-hour period that would limit drawdown in PW2 to 8.0 m or 60% of the available drawdown. **Figure 11** displays the theoretical drawdown and drawdown cone created when pumping PW2 at 21 L/min for 12 hours. At this rate, the drawdown is limited to 8.0 m, and the volume of water is maximized at 15,120 L/day. This conservative scenario leaves 5.40 m of available drawdown for well interference related to pumping at PW3. It should be noted that the 5.03 m of well interference caused from pumping at PW3 was not from regular water usage, but from the water being accidentally left on at the Curry Dealership over night (**Figure 5**).

Well recovery is expected to be rapid as PW2 recovered 7.13 m (78%) in 30 min following the 6-hour pumping test. As the total daily yield for the recommended pumping rate is less than 50,000 L/day, a PTTW from the MECP will not be required.

### 3.6.2.3 PW3 Recommended Pumping Rate

The  $Q_{20}$  for PW3 was calculated to be 191.21 L/min (**Table 9**). On November 12, 2020, PW3 was pumped at 45.42 L/min and experienced 4.88 m of drawdown. PW3 has both a high transmissivity and a large available drawdown. Based on the monitoring data, during the pumping test occurring at PW2 on November 10, 2020, PW3 experienced approximately 2.49 m of associated drawdown (**Figure 5**). The recommended pumping rate will need to take into consideration the 2.49 m of well interference with PW2, and the available drawdown minus an additional 1 m of water level fluctuation to account for seasonal low water levels over time.

A forward solution in Aqtesolv™ was completed to model a pumping rate over a 12-hour period that would limit drawdown in PW3 to 10.10 m, and limit daily yield to below 50,000 L/day. **Figure 12** displays the theoretical drawdown and drawdown cone created when pumping PW3 at 68 L/min for 12 hours. At this rate, the drawdown is limited to 10.10 m, and the volume of water is maximized at 48,960 L/day. This scenario leaves 28.52 m of available drawdown for well interference associated with pumping at PW2.

Well recovery is expected to be rapid as PW3 recovered by 4.37 m (90%) in 30 min following the 6-hour pumping test.

*Figure 1 . PW2 Forward Solution*

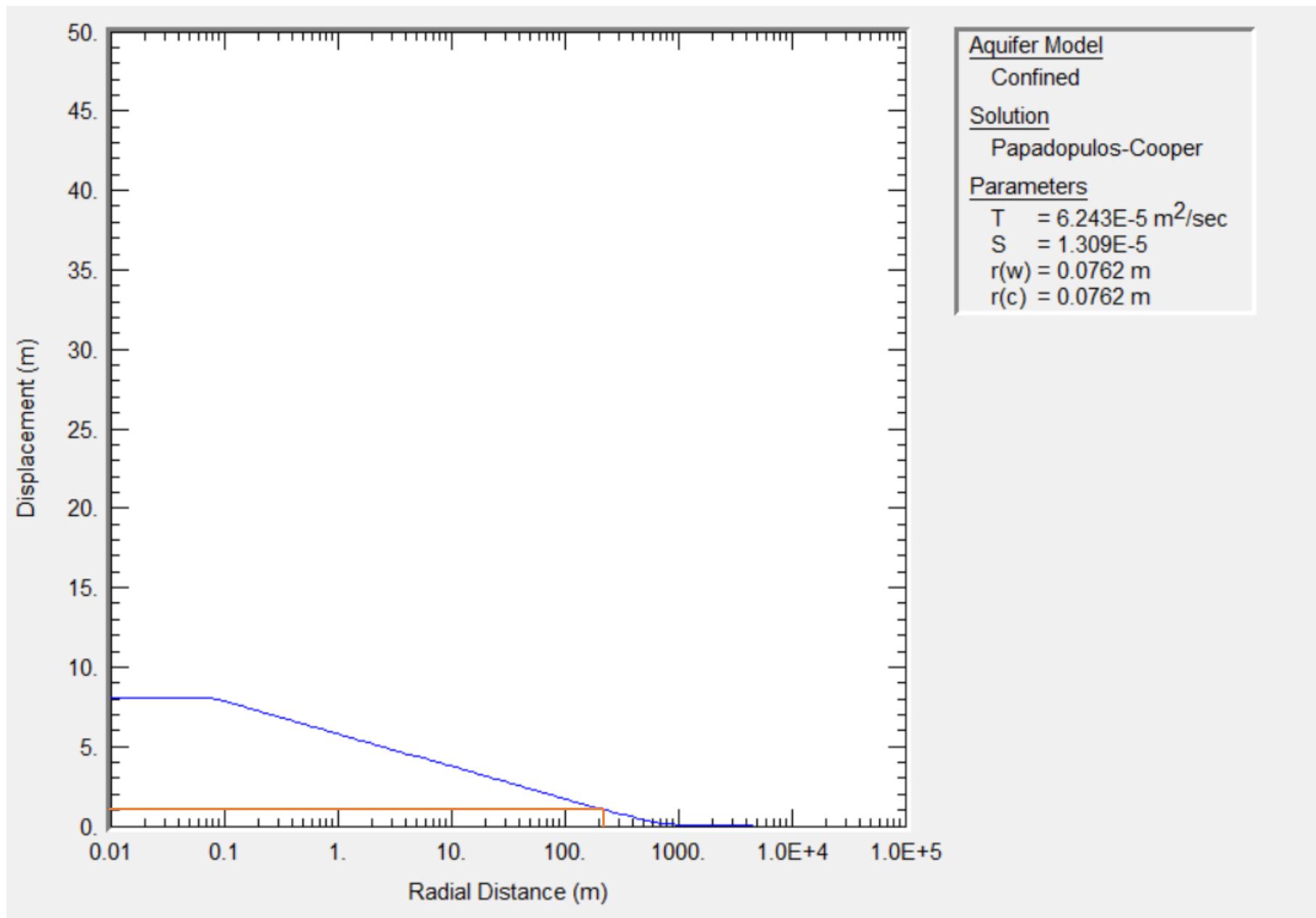
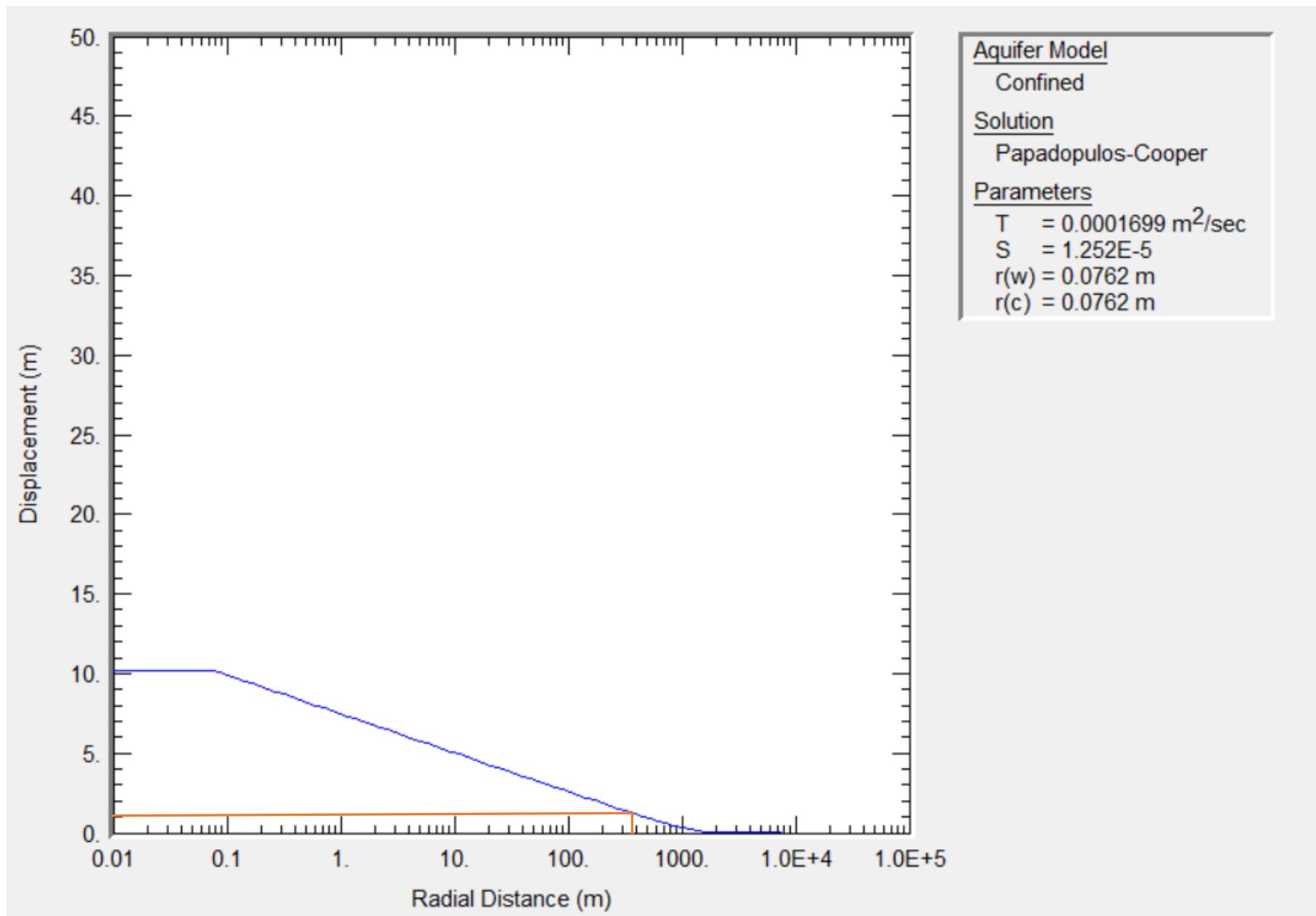


Figure 1 . PW3 Forward Solution



## 3.7 Groundwater Chemistry

Groundwater chemistry samples were collected between November 10, 2020 and November 12, 2020 from each test well 30-minutes before the end of each test. Groundwater samples were analyzed for a suite of water quality parameters including TDS, turbidity, anions, nutrients, bacteria, and metals. The summary of the groundwater chemistry samples can be found in **Table 11**. The Certificate of Analysis can be found in **Appendix E**.

The groundwater samples were compared to Ontario Drinking Water Quality Standards (ODWS). ODWS consists of Aesthetic and Operational Guidelines, and Microbiological/Chemical Standards. Aesthetic and Operational Guidelines identify non health-related parameters which may impact taste, color, and odor. Microbiological/Chemical Standards identify health-related parameters.

Overall, the groundwater quality was good and typical for the area. The following minor exceedances of OWDS standards were observed:

PW1 and PW3 exceeded the Aesthetic and Operational Guidelines guideline for hardness, and PW1 exceeded the guideline for Manganese. Hardness and Manganese exceedances are common in groundwater and are due to the dissolution of minerals in contact with groundwater. Hardness can be removed through water softening systems, while manganese can be removed through reverse osmosis filters or carbon filters.

PW2 exceeded the Microbiological /Chemical Standard for total coliforms. This exceedance is typically found in wells that are not properly sealed and have organic material present in the well. This exceedance is typically removed through UV filtration.

Groundwater should be tested again prior to servicing to confirm the groundwater quality and should be regularly checked in accordance with the Local Health Department requirements.

**Table 11. Groundwater Chemistry Summary**

Parameters	Aesthetic Ontario Drinking Water Standard	Microbiological and Chemical Ontario Drinking Water Standard	Lowest Detection Limit	Units	PW1	PW2	PW3
<b>Physical Tests (Water)</b>							
Colour, Apparent	5	-	2.0	CU	3.3	<2.0	<2.0
Conductivity	-	-	3.0	umhos/cm	359	174	224
pH	6.5 -> 8.5	-	0.10	pH units	7.52	8.22	8.01
Redox Potential	-	-	-1000	mV	320	307	320
Total Dissolved Solids	500	-	13	mg/L	208	107	132
Turbidity	5	-	0.10	NTU	0.55	0.62	1.28
<b>Anions and Nutrients (Water)</b>							
Alkalinity, Bicarbonate (as CaCO <sub>3</sub> )	-	-	2.0	mg/L	176	78.8	104
Alkalinity, Carbonate (as CaCO <sub>3</sub> )	-	-	2.0	mg/L	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as CaCO <sub>3</sub> )	-	-	2.0	mg/L	<2.0	<2.0	<2.0
Alkalinity, Total (as CaCO <sub>3</sub> )	30 -> 500	-	2.0	mg/L	176	78.8	104
Ammonia, Total (as N)	-	-	0.010	mg/L	0.013	<0.010	<0.010
Bromide (Br)	-	-	0.10	mg/L	<0.10	<0.10	<0.10
Chloride (Cl)	250	-	0.50	mg/L	3.56	0.94	1.21
Computed Conductivity	-	-	-	uS/cm	317	165	214
Conductivity % Difference	-	-	-	%	-12	-5	-5
Fluoride (F)	-	1.5	0.020	mg/L	0.067	0.149	0.176
Hardness (as CaCO <sub>3</sub> )	80 -> 100	-	-	mg/L	<b>186</b>	85.5	<b>115</b>
Ion Balance	-	-	-	%	127	121	122
Langelier Index	-	-	-	-	0	0	0
Nitrate (as N)	-	10	0.020	mg/L	0.029	0.093	0.142
Nitrite (as N)	-	1	0.010	mg/L	<0.010	<0.010	<0.010
Saturation pH	-	-	-	pH	7.39	8	7.76
Orthophosphate-Dissolved (as P)	-	-	0.0030	mg/L	<0.0030	<0.0030	<0.0030
TDS (Calculated)	-	-	-	mg/L	186	92.7	123
Sulfate (SO <sub>4</sub> )	500	-	0.30	mg/L	4.07	7.98	10.9
Anion Sum	-	-	-	me/L	3.08	1.52	2
Cation Sum	-	-	-	me/L	3.9	1.85	2.45
Cation - Anion Balance	-	-	-	%	12	10	10
<b>Inorganic Parameters (Water)</b>							
Silica	-	-	0.21	mg/L	15.9	12.6	11.3
<b>Bacteriological Tests (Water)</b>							
E. Coli	-	0	-	CFU/100mL	0	0	0
Total Coliform Background	-	-	0	CFU/100mL	0	250	0
Total Coliforms	-	0	0	CFU/100mL	0	<b>3</b>	0
<b>Metals (Water)</b>							
Sodium Adsorption Ratio	-	-	0.10	SAR	<0.10	0.1	<0.10
<b>Total Metals (Water)</b>							
Aluminum (Al)-Total	0.1	-	0.010	mg/L	<0.050	<0.050	<0.010
Antimony (Sb)-Total	-	0.006	0.00010	mg/L	<0.0010	<0.0010	<0.00010

Parameters	Aesthetic Ontario Drinking Water Standard	Microbiological and Chemical Ontario Drinking Water Standard	Lowest Detection Limit	Units	PW1	PW2	PW3
Arsenic (As)-Total	-	0.01	0.00010	mg/L	<0.0010	<0.0010	<0.00010
Barium (Ba)-Total	-	1	0.00020	mg/L	0.486	0.0750	0.0499
Beryllium (Be)-Total	-	-	0.00010	mg/L	<0.0010	<0.0010	<0.00010
Bismuth (Bi)-Total	-	-	0.000050	mg/L	<0.00050	<0.00050	<0.000050
Boron (B)-Total	-	5	0.010	mg/L	<0.10	<0.10	0.012
Cadmium (Cd)-Total	-	0.005	0.000010	mg/L	<0.000050	<0.000050	<0.000010
Calcium (Ca)-Total	-	-	0.50	mg/L	57.3	28.4	38.6
Cesium (Cs)-Total	-	-	0.000010	mg/L	<0.00010	<0.00010	<0.000010
Chromium (Cr)-Total	-	0.05	0.00050	mg/L	<0.0050	<0.0050	<0.00050
Cobalt (Co)-Total	-	-	0.00010	mg/L	<0.0010	<0.0010	<0.00010
Copper (Cu)-Total	1	-	0.0010	mg/L	<0.0050	<0.0050	0.0017
Iron (Fe)-Total	0.3	-	0.050	mg/L	<0.10	<0.10	<0.050
Lead (Pb)-Total	-	0.01	0.00010	mg/L	<0.00050	<0.00050	<0.00010
Magnesium (Mg)-Total	-	-	0.050	mg/L	10.4	3.52	4.48
Manganese (Mn)-Total	0.05	-	0.00050	mg/L	<b>0.603</b>	<0.0050	0.00056
Molybdenum (Mo)-Total	-	-	0.000050	mg/L	<0.00050	0.00165	0.00204
Nickel (Ni)-Total	-	-	0.00050	mg/L	<0.0050	<0.0050	<0.00050
Phosphorus (P)-Total	-	-	0.050	mg/L	<0.50	<0.50	<0.050
Potassium (K)-Total	-	-	0.050	mg/L	2.50	1.83	2.32
Rubidium (Rb)-Total	-	-	0.00020	mg/L	<0.0020	<0.0020	0.00026
Selenium (Se)-Total	-	0.05	0.000050	mg/L	<0.00050	<0.00050	0.000242
Silicon (Si)-Total	-	-	0.10	mg/L	7.4	5.9	5.28
Silver (Ag)-Total	-	-	0.000050	mg/L	<0.00050	<0.00050	<0.000050
Sodium (Na)-Total	200	20	0.50	mg/L	2.74	2.13	2.07
Strontium (Sr)-Total	-	-	0.0010	mg/L	0.519	0.297	0.560
Sulfur (S)-Total	-	-	0.50	mg/L	<5.0	<5.0	3.82
Tellurium (Te)-Total	-	-	0.00020	mg/L	<0.0020	<0.0020	<0.00020
Thallium (Tl)-Total	-	-	0.000010	mg/L	<0.00010	<0.00010	<0.000010
Thorium (Th)-Total	-	-	0.00010	mg/L	<0.0010	<0.0010	<0.00010
Tin (Sn)-Total	-	-	0.00010	mg/L	<0.0010	<0.0010	<0.00010
Titanium (Ti)-Total	-	-	0.00030	mg/L	<0.0030	<0.0030	<0.00030
Tungsten (W)-Total	-	-	0.00010	mg/L	<0.0010	<0.0010	<0.00010
Uranium (U)-Total	-	0.02	0.000010	mg/L	0.00825	0.00228	0.00322
Vanadium (V)-Total	-	-	0.00050	mg/L	<0.0050	<0.0050	0.00293
Zinc (Zn)-Total	5	-	0.0030	mg/L	<0.030	<0.030	<0.0030
Zirconium (Zr)-Total	-	-	0.00030	mg/L	<0.0020	<0.0020	<0.00030

**\*Aesthetic Exceedances Italic & Bold****\*Microbiological and Chemical Exceedances Bolded and Shaded**

## 4. Site Servicing Discussion

### 4.1 Water Supply

Based on the hydrogeological investigation and surrounding Ontario Well Records, this site is expected to have adequate groundwater resources to supply each of the five (5) lots with potable water through the use of individual water wells (one well per lot). Considering permitting, well interference, and off-site impacts, we estimate that these wells will produce a maximum yield within the range of 21 to 68 L/min, or 15,120 to 48,960 L/day. Ontario Well Records within 500 m of the site area support this range with the average well yield being 21 L/min. The use of underground storage tanks and filling during off peak hours may also be required to meet peak water supply demands, depending upon the nature of the commercial business on each lot.

It is important to note that the total water supply required to support a commercial development will vary based on water use of the business. Should a proposed commercial development require additional water supply beyond those described in this report, additional hydrogeological testing or permitting may be required.

Overall, groundwater chemistry at the site is typical for the bedrock aquifer in the Haliburton area. Exceedances in the ODWS Aesthetic and Operational Guidelines for Hardness and Manganese were observed. These exceedances may be removed through typical treatment methods such as water softening systems, reverse osmosis, and/or carbon filters. An exceedance in the ODWS Microbiological/Chemical Standard for Total Coliforms was observed. This exceedance may be removed using UV filtration. Groundwater should be tested again prior to servicing to confirm the groundwater quality and treatment requirements, and should be regularly checked in accordance with the Local Health Department requirements.

## 5. Effects Assessment

### 5.1 Off-Site Private Water Wells – Groundwater Levels

A private water well survey was conducted within 300 m of the site boundary. Four (4) residents/business owners participated in this survey. Baseline groundwater levels were collected from each resident's well and a groundwater sample was collected before the pumping tests to confirm baseline groundwater quality. A data logger was installed to provide continuous groundwater level measurements from each private well (**Figure 6**). The purpose of the survey was to assess potential impacts to existing water users during the pumping tests.

Based on the continuous water level data presented in **Figure 6**, no significant interference effects were identified in the off-site private water wells monitored during the pumping tests.

### 5.2 Off-Site Private Water Wells – Groundwater Chemistry

Groundwater samples were collected on November 13, 2020 from each private water well included in the private water well survey to analyze them for a suite of water quality parameters including TDS, turbidity, anions, nutrients, bacteria, and metals. The groundwater samples were compared to ODWS. The results

of groundwater quality sampling can be found in **Appendix F**. The groundwater quality from the private wells were generally good and typical of the area. No groundwater quality impacts at any private well were reported during the pumping tests.

### **5.3 On-Site Well Interference**

Pumping at PW2 and PW3 resulted in approximately 2.5 and 5.0 m of interference between the wells when pumped at the recommended rates. Based on the available drawdown for each of these wells, this value is considered reasonable and is not expected to limit the available water supply of these wells or limit the addition of up to three additional wells as part of the complete five lot subdivision. Pumping at PW1 did not result in a response to either PW2 or PW3 indicating hydraulic separation between the fractured bedrock aquifer on site.

### **5.4 Source Water Protection**

Based on available MECP Source Protection Information mapping, the site is within a Significant Groundwater Recharge Area (SGRA) (**Appendix G**). No development constraints are associated with development within a SGRA. Because all stormwater will be managed on site through direct precipitation/runoff rooftop downspouts that will be directed to pervious areas, no significant changes to groundwater recharge are expected from site development.

### **5.5 Natural Features**

An ephemeral swale that cuts across the middle of the site was identified by Palmer staff. The swale was observed dry during the site visit on September 15, 2020 and had very little flow before the pumping tests observed on November 9. No changes to the flow were observed during the pumping tests occurring between November 10 – November 12. Based on site observations and groundwater levels, this ephemeral swale is assumed to have little to no groundwater support. No adverse impacts to the function of the ephemeral swale are anticipated from pumping on site.

## 6. Summary and Conclusions

Based on the results of the Hydrogeological Servicing Study completed for a Proposed Commercial Development located in Haliburton, Ontario, the following summary and conclusions are presented:

- The geology of the site generally consists of glaciolacustrine sands and silts overlying Precambrian bedrock. The Precambrian fractured bedrock is the primary aquifer in the Haliburton Area.
- Two (2) test wells were completed on September 14, and September 15, 2020 (PW1 and PW2). The existing well located at the Curry Dealership was completed on September 28, 2005 (PW3). These test wells ranged in depths from 20.1 – 49.0 mbgs.
- A series of variable-rate pumping tests were completed at each test well in general accordance with the MECP document “Technical Guideline for Private Wells: Water Supply Assessment” (Procedure D-5-5).
- A private water well survey was completed within 300 m of the site boundary to collect well data on nearby water users. Four (4) homeowners/ business owners participated in the survey. Baseline groundwater levels were collected from each private well on November 9, 2020, and a groundwater chemistry sample was collected before the completion of the pumping tests. Data loggers were installed at each participating well to collect continuous groundwater level information before, during and after the pumping tests.
- Variable-rate pumping tests were completed between November 10, 2020, and November 12, 2020. The pumping tests occurred between 9 AM and 5 PM for a duration of 6 hours each test. Data loggers were installed in each test well before the pumping tests to collect continuous groundwater level information and assess the potential for well interference between the test wells.
- Drawdown data from the pumping tests were used to determine transmissivity and storativity values for each test well. The transmissivity and storativity values ranged from  $1.69 \times 10^{-4} \text{ m}^2/\text{s}$  –  $2.56 \times 10^{-5} \text{ m}^2/\text{s}$ , and  $1.25 \times 10^{-5} – 1.42 \times 10^{-5} \text{ m}^{-1}$  respectively.
- Groundwater chemistry samples were collected from each test well 30-minutes before the conclusion of each test and compared to ODWS. Overall, the groundwater chemistry was typical for the bedrock aquifer in the Haliburton area. PW1 exceeded the Aesthetic and Operational guidelines for Hardness and Manganese, PW2 exceeded the Microbiological/ Chemical standard for Total Coliforms, and PW3 exceeded the Aesthetic and Operational guidelines for Hardness. These exceedances are common for the area and can be readily removed through common commercial water filtration methods. Additional testing during site plan application is recommended.
- Long-term sustainable pumping rate or safe yield for each test well was determined using the Farvolden Method (1961). This method provides a theoretical rate that each test well can be

pumped constantly for a twenty-year period without mining the aquifer known as the Q<sub>20</sub>. The Q<sub>20</sub> for each well ranged from 24.0 – 219.8 L/min.

- The recommended pumping rate differs from the safe yield, as it is based on a more typical maximum 12-hour/ day pumping schedule. In addition, this analysis considers the potential off site impacts, well interference, and MECP permitting considerations. The recommended pumping rate for each well ranged from 21 – 68 L/min, with a daily yield ranging from 15,120 – 48,960 L/day.
- No significant interference effects were identified in the four (4) off-site private water wells monitored during the variable-rate pumping tests completed at PW1, PW2, and PW3.
- Pumping at PW2 and PW3 resulted in between approximately 2.5 and 5.0 m of interference between the wells when pumped at the recommended rates. Pumping at PW1 did not result in a response to either PW2 or PW3 indicating a hydraulic separation between the fractured bedrock aquifers on site. Based on the available drawdown for each of these wells, these interference effects are considered reasonable and are not expected to limit the available water supply of these wells or limit the addition of up to three additional wells as part of the complete five lot subdivision.
- Based on the results of this study, this site was found to have adequate groundwater resources to support five (5) typical commercial developments each serviced by an individual water well. Depending upon the specific commercial lands use on each site, on-site storage of potable water may be required to meet peak water demand requirements. Storage tanks could be filled during off-peak hours and be relied upon during peak water demand.

## 7. Statement of Limitations

The extent of this study was limited to the specific scope of work for which we were retained and that is described in this report. Palmer has assumed that the information provided by the client or any secondary sources of information are factual and accurate. Palmer accepts no responsibility for any deficiency, misstatement or inaccuracy contained in this report as a result of omissions, misinterpretations or negligent acts from relied upon data. Judgment has been used by Palmer in the interpretation of the information provided but subsurface physical and chemical characteristics may differ from regional scale geology mapping and vary between or beyond well/borehole locations given the inherent variability in geological conditions.

Palmer is not a guarantor of the geological or groundwater conditions at the subject site, but warrants only that its work was undertaken and its report prepared in a manner consistent with the level of skill and diligence normally exercised by competent geoscience professionals practicing in the Province of Ontario. Our findings, conclusions and recommendations should be evaluated in light of the limited scope of our work.

The information and opinions expressed in the Report are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT Palmer's WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS Palmer MAY EXPRESSLY APPROVE. Ownership in and copyright for the contents of the Report belongs to Palmer. Any use which a third party makes of the Report is the sole responsibility of such third party. Palmer accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without Palmer's express written permission. Should the project design change following issuance of the Report, Palmer must be provided the opportunity to review and revise the Report in light of such alteration or variation.

## 8. Signatures

This report was prepared and reviewed by the undersigned:

**Prepared By:**



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Nolan Boyes, M.Sc., P.Geo.  
Hydrogeologist

**Reviewed By:**



---

Jason Cole, M.Sc., P.Geo.  
VP, Principal Hydrogeologist

## 9. References

- Chapman, L.J. and D.F. Putman, 1984.  
Physiography of Southern Ontario. 1973. Special Volume No. 2. Toronto, Ontario. Ontario Geological Survey. 270 p.
- County of Haliburton, 2019. County of Haliburton Official Plan.
- Farvolden, R.N. 1961. Groundwater resources Pembina area, Alberta. Alberta Research Council, Preliminary Report 61-4, 26 p.
- MECP, 1996. Procedure D-5-5 – Technical Guideline for Private Wells: Water Supply Assessment.
- MECP, 2008. Design Guidelines for Drinking Water Systems
- The Ontario Geological Survey. 2003. Surficial Geology of Southern Ontario.

# **Appendix A – Proposed Draft Plan of Subdivision and Condominium Description (LRC Campbell, 2023)**

DRAFT PLAN OF SUBDIVISION AND COMMON ELEMENTS CONDOMINIUM DESCRIPTION

PART OF LOTS 11 & 12, CONCESSIONS 8 & 9

GEOGRAPHIC TOWNSHIP OF DYSART

UNITED TOWNSHIPS OF DYSART, DUDLEY, HARCOURT,

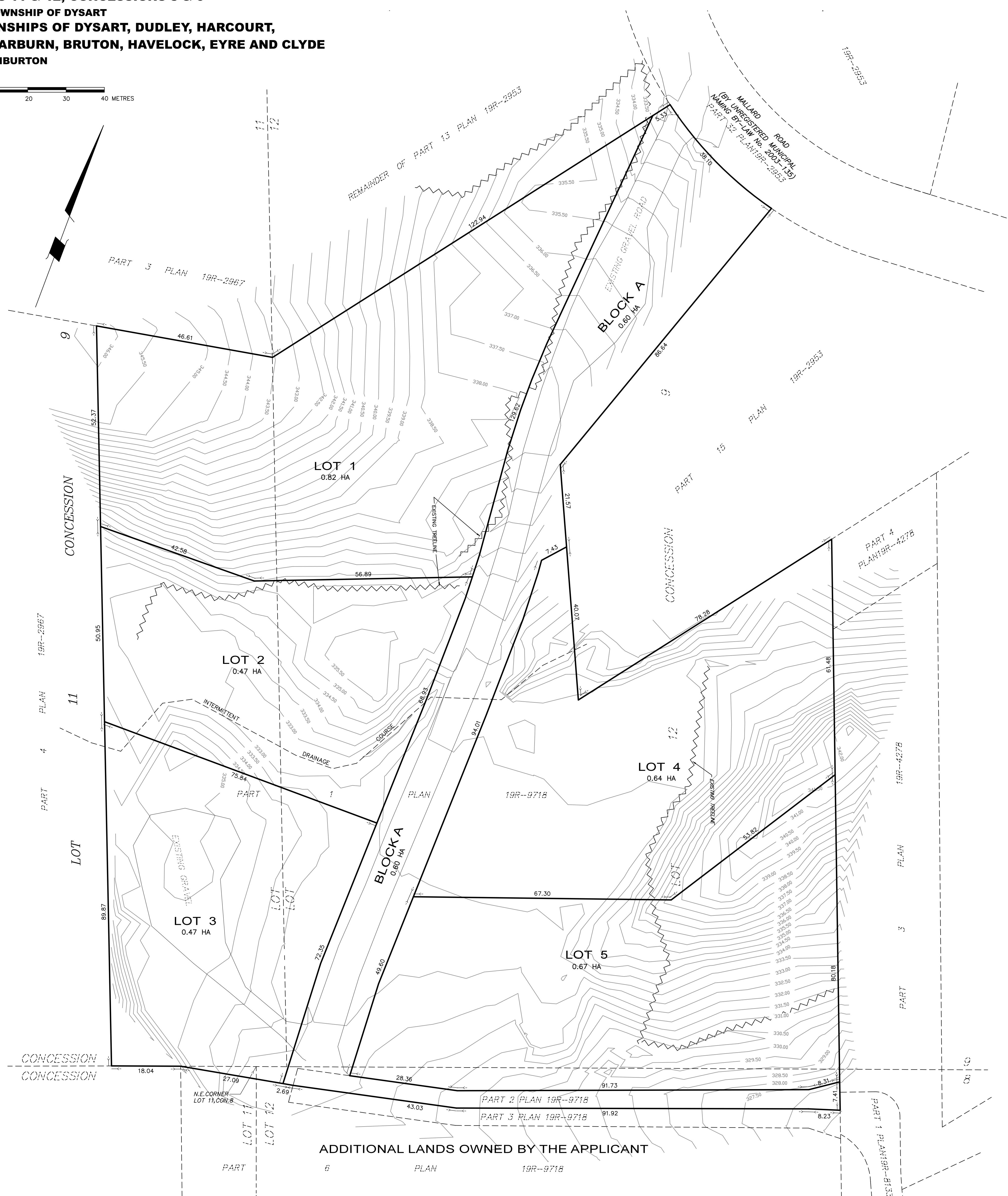
GUILFORD, HARBURN, BRUTON, HAVELOCK, EYRE AND CLYDE

COUNTY OF HALIBURTON

SCALE 1 : 500 METRIC

10 5 0 10 20 30 40 METRES  
RODNEY GEYER O.L.S.

METRIC: DISTANCES AND COORDINATES ARE IN METRES  
AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048.



**SCHEDULE**

LOT/BLOCK	PROPOSED LAND USE	AREA
SUBDIVISION LOTS 1-5	COMMERCIAL	3.07 ha. $\pm$
CONDOMINIUM BLOCK A	ACCESS ROAD	0.60 ha. $\pm$

**OWNER'S CERTIFICATE**  
I HEREBY CONSENT TO THE SUBMISSION OF THIS PLAN FOR DRAFT APPROVAL.

JANUARY 11, 2023.  
HALIBURTON, ONTARIO.

RORY CAMPBELL FOR  
LRC CAMPBELL LTD.  
I HAVE AUTHORITY TO BIND  
THE CORPORATION

**PLANNER'S CERTIFICATE**  
I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY A REGISTERED PROFESSIONAL PLANNER, WITHIN THE MEANING OF THE ONTARIO PROFESSIONAL PLANNERS INSTITUTE ACT, 1994.

JANUARY 11, 2023.  
TORONTO, ONTARIO.

Anthony Usher  
ANTHONY USHER  
REGISTERED PROFESSIONAL PLANNER

**OTHER INFORMATION**

ADDITIONAL INFORMATION REQUIRED UNDER SECTION 51 (17)  
OF THE PLANNING ACT:  
A. AS SHOWN HERON.  
B. AS SHOWN HERON.  
C. AS SHOWN HERON.  
D. COMMERCIAL.  
E. AS SHOWN HERON.  
F. AS SHOWN HERON.  
G. AS SHOWN HERON.  
H. DRILLED WELLS TO BE SOURCE OF DOMESTIC WATER SUPPLY.  
I. SAND AND SILT WITH BOULDERS.  
J. AS SHOWN HERON.  
MUNICIPAL SEWAGE SERVICES: COMMON ELEMENT CONDOMINIUM ROAD TO MALLARD ROAD; PRIVATE ROAD TO COUNTY ROAD 21 VIA PART 1, PLAN 19R-8133.  
L. SEE APPLICATION.

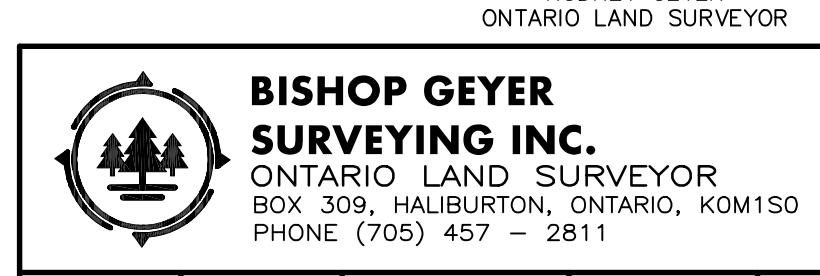
**CONTOURS:**

1. CONTOURS SUPPLIED BY PINSTONE ENGINEERING LTD.
2. CONTOUR INTERVALS ARE 0.5 METRES.

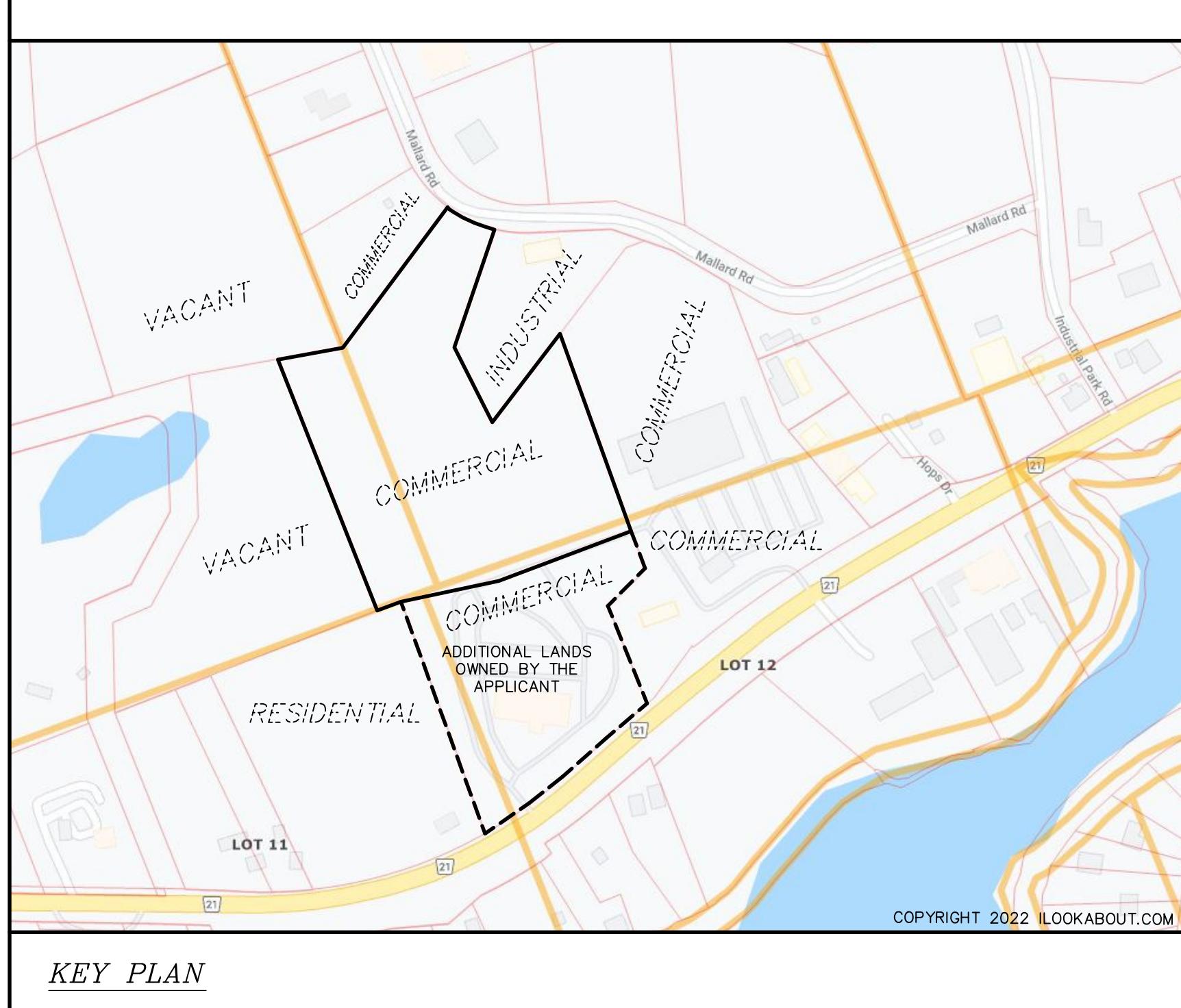
**SURVEYOR'S CERTIFICATE**  
I HEREBY CERTIFY THAT THE BOUNDARIES OF THE LANDS TO BE SUBDIVIDED ARE ACCURATELY SHOWN ON THIS PLAN.

JANUARY 11, 2023.  
HALIBURTON, ONTARIO.

RODNEY GEYER  
ONTARIO LAND SURVEYOR  
BOX 309, HALIBURTON, ONTARIO, K0M 1S0  
PHONE (705) 457 - 2811



CHECKED BY: R.H.G. DRAWN BY: C.B. REV. DATE: JANUARY 11, 2023. W.O.: 2022-00 REV. B



# **Appendix B – Borehole Logs**

## **(Haliburton Artesian Well Drillers, 2005, 2020)**

Measurements recorded in:  Metric  Imperial

Page 1 of 3

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**Well Owner's Information**

Well Owner Information  
First Name Last Name/Organization E-mail Address  
LRC CAMPBELL rory@currchevrolet.ca  
Mailing Address (Street Number/Name) Municipality Province Postal Code Telephone No. (inc. area code)  
5065 COUNTY ROAD 21 DYSART ET AL ONT K0M 1S0 7034572100

Well Location			
Address of Well Location (Street Number/Name)		Township	Lot
<u>50 MALLARD ROAD</u>		<u>HALIBURTON</u>	<u>11 + 12</u>
County/District/Municipality		City/Town/Village	Province
<u>DIXART ET AL</u>		<u>HALIBURTON</u>	<u>Ontario</u>
UTM Coordinates		Northing	Postal Code
NAD 1983		1716939.13	K0M 1S0
Zone		Easting	Municipal Plan and Sublot Number
103		4991104	Other

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

Overburden and Bedrock Materials/Abandonment Sealing Record (see instructions on the back)				Depth (m/t) From	To
General Colour	Most Common Material	Other Materials	General Description		
BROWN	GRAVEL	SAND	PACED	0	7
GREY	GRANITE	—	SOFT	7	118
RED	GRANITE	GRAVEL	HOOSIE	118	120

Annular Space			
Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m <sup>3</sup> /ft <sup>3</sup> )
0	20	BENSEAL	

Results of Well Yield Testing				
After test of well yield, water was:	Draw Down		Recovery	
	Time (min)	Water Level (m/ft)	Time (min)	Water Level (m/ft)
Clear and sand free	Static Level	12.5		70.5
<input type="checkbox"/>	1	13.6	1	64.3
<input type="checkbox"/>	2	14.7	2	58.2
Other, specify:	3	15.9	3	51.3
If pumping discontinued, give reason: <hr/>	4	17.3	4	44.7
Pump intake set at (m/ft)  <u>100</u>	5	18.4	5	38.5
Pumping rate (l/min / GPM)  <u>10</u>	10	23.7	10	32.1
Duration of pumping <u>1 hrs + 0 min</u>	15	29.4	15	25.7
Final water level end of pumping (m/ft)  <u>70.5</u>	20	33.7	20	19.6
If flowing give rate (l/min/GPM) <hr/>	25	38.6	25	14.7
Recommended pump depth (m/ft)  <u>100</u>	30	43.7	30	13.7
Recommended pump rate (l/min/GPM) <u>85</u>	40	52.1	40	12.5
Well production (l/min/GPM)  <u>8</u>	50	61.4	50	12.5
Disinfected?	60	70.5	60	12.5
<input type="checkbox"/> Yes <input type="checkbox"/> No				

Method of Construction	Well Use
<input type="checkbox"/> Cable Tool	<input type="checkbox"/> Diamond
<input checked="" type="checkbox"/> Rotary (Conventional)	<input type="checkbox"/> Jetting
<input type="checkbox"/> Rotary (Reverse)	<input type="checkbox"/> Driving
<input type="checkbox"/> Boring	<input type="checkbox"/> Digging
<input checked="" type="checkbox"/> Air percussion	
<input type="checkbox"/> Other, specify _____	
	<input checked="" type="checkbox"/> Public
	<input type="checkbox"/> Domestic
	<input type="checkbox"/> Livestock
	<input type="checkbox"/> Irrigation
	<input type="checkbox"/> Industrial
	<input type="checkbox"/> Other, specify _____
	<input type="checkbox"/> Commercial
	<input type="checkbox"/> Municipal
	<input type="checkbox"/> Test Hole
	<input type="checkbox"/> Cooling & Air Conditioning
	<input type="checkbox"/> Not used
	<input type="checkbox"/> Dewatering
	<input type="checkbox"/> Monitoring

#### Map of Well Location

Construction Record - Casing					Status of Well
Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft)		
			From	To	
6 1/4	STREL	.188	+2	20	<input checked="" type="checkbox"/> Water Supply <input type="checkbox"/> Replacement Well <input type="checkbox"/> Test Hole <input type="checkbox"/> Recharge Well <input type="checkbox"/> Dewatering Well <input checked="" type="checkbox"/> Observation and/or Monitoring Hole <input type="checkbox"/> Alteration (Construction)

#### Map of Well Location

Construction Record - Screen					Insufficient Supply <input type="checkbox"/> Abandoned, Poor Water Quality <input type="checkbox"/> Abandoned, other, specify  <input type="checkbox"/> Other, specify
Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft)		
			From	To	

Please provide a map below following instructions on the back.

Water Details		Hole Diameter	
Water found at Depth (m/ft)	Kind of Water: <input type="checkbox"/> Fresh <input type="checkbox"/> Untested <input checked="" type="checkbox"/> Gas <input type="checkbox"/> Other, specify _____	Depth (m/ft) From	Diameter (cm/in) To
119 (m/ft)	<input type="checkbox"/> Fresh <input type="checkbox"/> Untested <input checked="" type="checkbox"/> Gas <input type="checkbox"/> Other, specify _____	20	130
Water found at Depth (m/ft)	Kind of Water: <input type="checkbox"/> Fresh <input type="checkbox"/> Untested <input type="checkbox"/> Gas <input type="checkbox"/> Other, specify _____		6 1/8
Water found at Depth (m/ft)	Kind of Water: <input type="checkbox"/> Fresh <input type="checkbox"/> Untested <input type="checkbox"/> Gas <input type="checkbox"/> Other, specify _____		

1.0  
 0.6  
 0.4

\* WELL

0.6  
 0.7

**CURRY MOTORS**

Well Contractor and Well Technician Information	
Business Name of Well Contractor <b>HALIBURTON ARTISAN WELL DRILLERS</b>	Well Contractor's Licence No. <b>7672</b>
Business Address (Street Number/Name) <b>334 INDUSTRIAL PARK ROAD HALIBURTON</b>	Municipality <b>DYSART ET AL</b>

<u>County Road 21</u>	
Comments:	
Well owner's information package delivered  <input type="checkbox"/> Yes <input type="checkbox"/> No	Date Package Delivered
	<u>2020-09-14</u>
	Date Work Completed
	<u>2020-09-14</u>
Ministry Use Only	
Audit No. <u>235082</u>	
Received	

Measurements recorded in:  Metric  Imperial

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

A284563

## Well Record

Regulation 903 Ontario Water Resources Act

Page 1 of 3

## Well Owner's Information

First Name	Last Name/Organization	E-mail Address	Well Constructed by Well Owner
	LRC CAMPBELL	rory@currychewraet.ca	No
Mailing Address (Street Number/Name)	Municipality	Province	Postal Code
5065 COUNTY ROAD 21	DYSART ET AL	ONT	K0M 1S0
Well Location	Lot	Concession	Telephone No. (inc. area code)
Address of Well Location (Street Number/Name)	HALIBURTON HIGHLANDS 11+12	8 + 9	7054572100
County/District/Municipality			
UTM Coordinates	Zone	Eastng	Northing
NAD 83	17	693848	4991007

## 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	GRAVEL	ROCKS	LOOSE	0	9
GREY	GRANITE	—	HARD	9	64
RED	GRANITE	GRAVEL	LOOSE	64	66

## Annular Space

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

## Method of Construction

## Well Use

<input type="checkbox"/> Cable Tool	<input type="checkbox"/> Diamond	<input checked="" type="checkbox"/> Public	<input checked="" type="checkbox"/> Commercial	<input type="checkbox"/> Not used
<input checked="" type="checkbox"/> Rotary (Conventional)	<input type="checkbox"/> Jetting	<input type="checkbox"/> Domestic	<input type="checkbox"/> Municipal	<input type="checkbox"/> Dewatering
<input type="checkbox"/> Rotary (Reverse)	<input type="checkbox"/> Driving	<input type="checkbox"/> Livestock	<input type="checkbox"/> Test Hole	<input type="checkbox"/> Monitoring
<input type="checkbox"/> Boring	<input type="checkbox"/> Digging	<input type="checkbox"/> Irrigation	<input type="checkbox"/> Industrial	<input type="checkbox"/> Cooling & Air Conditioning
<input checked="" type="checkbox"/> Air percussion		<input type="checkbox"/> Other, specify		
<input type="checkbox"/> Other, specify				

## Construction Record - Casing

## Status of Well

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft)	From	To	<input checked="" type="checkbox"/> Water Supply
6 1/4	STEEL	.188	+2	20		<input type="checkbox"/> Replacement Well
						<input type="checkbox"/> Test Hole
						<input type="checkbox"/> Recharge Well
						<input type="checkbox"/> Dewatering Well
						<input checked="" type="checkbox"/> Observation and/or Monitoring Hole
						<input type="checkbox"/> Alteration (Construction)
						<input type="checkbox"/> Abandoned, Insufficient Supply
						<input type="checkbox"/> Abandoned, Poor Water Quality
						<input type="checkbox"/> Abandoned, other, specify
						<input type="checkbox"/> Other, specify

## Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft)	From	To	<input type="checkbox"/> Other, specify

## Water Details

## Hole Diameter

Water found at Depth (m/ft)	Kind of Water: <input type="checkbox"/> Fresh <input type="checkbox"/> Untested <input type="checkbox"/> Gas <input type="checkbox"/> Other, specify	Depth (m/ft)	Diameter (cm/in)
64.0		20	6 1/8
66			

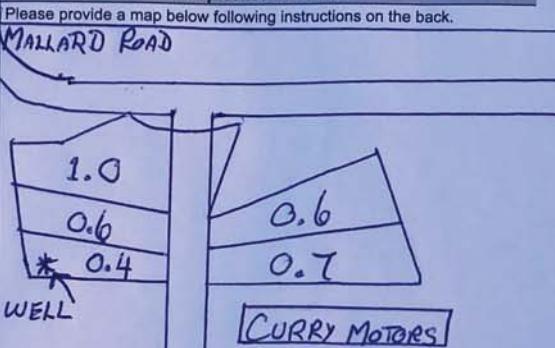
## Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
HALIBURTON ARTESIAN WELL DRILLERS	716 72
Business Address (Street Number/Name)	Municipality
334 INDUSTRIAL PARK ROAD HALIBURTON	DYSART ET AL
Province	Postal Code
Ont	K0M 1S0
Bus. Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name)
7054572686	WALKER DAVE
Well Technician's Licence No.	Signature of Technician and/or Contractor
3542	Date Submitted
3542	20200915

## Results of Well Yield Testing

After test of well yield, water was:	Draw Down	Recovery	
Time (min)	Water Level (m/ft)	Time (min)	Water Level (m/ft)
Static Level	16.2		35.2
1	16.7	1	27.1
2	17.3	2	21.3
3	17.9	3	18.6
4	19.4	4	16.5
5	19.9	5	16.2
10	22.3	10	
15	24.9	15	
20	27.3	20	
25	29.2	25	
30	31.4	30	
40	33.1	40	
50	34.3	50	
60	35.2	60	

## Map of Well Location



Comments:

Well owner's information package delivered	Date Package Delivered	Ministry Use Only
<input type="checkbox"/> Yes	20200915	Audit No. Z350830
<input type="checkbox"/> No	Date Work Completed	Received

## Instructions for Completing Form

- For use in the Province of Ontario only. This document is a permanent legal document. Please retain for future reference.
- All Sections **must** be completed in full to avoid delays in processing. Further instructions and explanations are available on the back of this form.
- Questions regarding completing this application can be directed to the Water Well Management Coordinator at 416-235-6203.
- All metre measurements shall be reported to 1/10<sup>th</sup> of a metre.**
- Please print clearly in blue or black ink only.

## Ministry Use Only

Well Owner's Information	Well Info	MUN	CON	LOT
Address of Well Location (County/District/Municipality)				
HALIBURTON		DYSART	Lot PT	Concession 8
RR# / Street Number / Name	Hwy 21	City/Town/Village	HALIBURTON	Site/Compartment/Block/Tract etc.
GPS Reading	NAD Zone	Easting	Northing	Unit Make/Model
8 3	17	694021	4990905	GARMIN
Mode of Operation: <input checked="" type="checkbox"/> Undifferentiated <input type="checkbox"/> Averaged <input type="checkbox"/> Differentiated, specify _____				

## Log of Overburden and Bedrock Materials (see instructions)

General Colour	Most common material	Other Materials	General Description		Depth	Metres
			From	To	From	To
Grey RED	ROCK FILL GRANITE		PREVIOUSLY DRILLED SOFT		0	3
					3	49

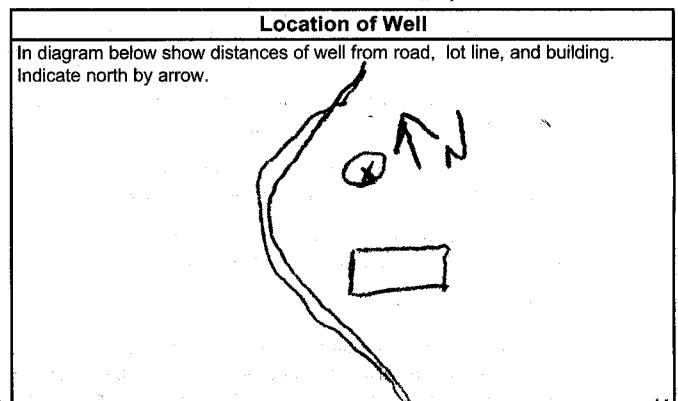
Hole Diameter		
Depth	Metres	Diameter
From	To	Centimetres

Water Record	
Water found at Metres	Kind of Water
49 m	<input checked="" type="checkbox"/> Fresh <input type="checkbox"/> Sulphur <input type="checkbox"/> Gas <input type="checkbox"/> Salty <input type="checkbox"/> Minerals <input type="checkbox"/> Other:
After test of well yield, water was	
<input checked="" type="checkbox"/> Clear and sediment free	
<input type="checkbox"/> Other, specify	
Chlorinated	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No

Construction Record					
Inside diam centimetres	Material	Wall thickness centimetres	Depth	Metres	
			From	To	
<b>Casing</b>					
15.49	<input checked="" type="checkbox"/> Steel <input type="checkbox"/> Fibreglass <input type="checkbox"/> Plastic <input type="checkbox"/> Concrete <input type="checkbox"/> Galvanized	-478	0	6	
	<input type="checkbox"/> Steel <input type="checkbox"/> Fibreglass <input type="checkbox"/> Plastic <input type="checkbox"/> Concrete <input type="checkbox"/> Galvanized				
	<input type="checkbox"/> Steel <input type="checkbox"/> Fibreglass <input type="checkbox"/> Plastic <input type="checkbox"/> Concrete <input type="checkbox"/> Galvanized				
<b>Screen</b>					
Outside diam	<input type="checkbox"/> Steel <input type="checkbox"/> Fibreglass <input type="checkbox"/> Plastic <input type="checkbox"/> Concrete <input type="checkbox"/> Galvanized	Slot No.			
	<input type="checkbox"/> Steel <input type="checkbox"/> Fibreglass <input type="checkbox"/> Plastic <input type="checkbox"/> Concrete <input type="checkbox"/> Galvanized				
	<input type="checkbox"/> Steel <input type="checkbox"/> Fibreglass <input type="checkbox"/> Plastic <input type="checkbox"/> Concrete <input type="checkbox"/> Galvanized				
<b>No Casing or Screen</b>					
<input checked="" type="checkbox"/> Open hole			6	49	

Test of Well Yield			
Pumping test method	Draw Down	Recovery	
Time min	Water Level Metres	Time min	Water Level Metres
Pump intake set at - (metres) 20	Static Level 3.5		
Pumping rate - (litres/min) 45	1 45.0	1	45.5
Duration of pumping 1 hrs + min	2 44.5	2	
Final water level end of pumping 44 metres	3 44.0	3	
Recommended pump type:	4 44.8	4	
<input type="checkbox"/> Shallow <input checked="" type="checkbox"/> Deep	5 44.5	5	
Recommended pump depth. 42 metres	10 44	10	
Recommended pump rate. 23+ (litres/min)	15 44	15	
If flowing give rate - (litres/min)	20 44	20	
If pumping discontinued, give reason.	25 44	25	
	30 44	30	
	40 44	40	
	50 44	50	
	60 44	60	45.5

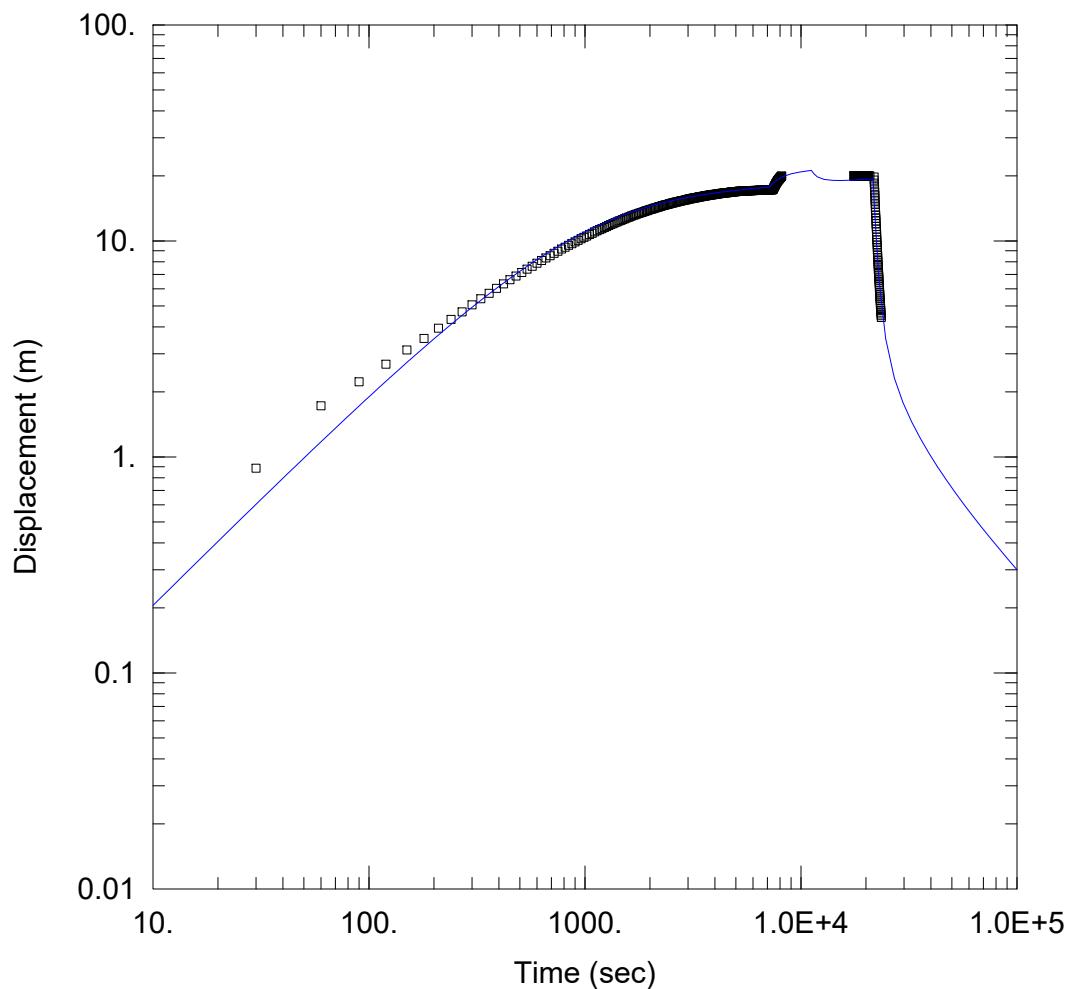
Plugging and Sealing Record		
Depth set at - Metres	Material and type (bentonite slurry, neat cement slurry) etc.	Volume Placed (cubic metres)
From	To	
0	6 BENTONITE	



Method of Construction			
Cable Tool	Rotary (air)	Diamond	Digging
Rotary (conventional)	<input checked="" type="checkbox"/> Air percussion	<input type="checkbox"/> Jetting	<input type="checkbox"/> Other
Rotary (reverse)	<input type="checkbox"/> Boring	<input type="checkbox"/> Driving	
Water Use			
Domestic	<input type="checkbox"/> Industrial	<input type="checkbox"/> Public Supply	<input type="checkbox"/> Other
Stock	<input checked="" type="checkbox"/> Commercial	<input type="checkbox"/> Not used	
Irrigation	<input type="checkbox"/> Municipal	<input type="checkbox"/> Cooling & air conditioning	
Final Status of Well			
<input checked="" type="checkbox"/> Water Supply	<input type="checkbox"/> Recharge well	<input type="checkbox"/> Unfinished	<input type="checkbox"/> Abandoned, (Other)
<input type="checkbox"/> Observation well	<input type="checkbox"/> Abandoned, insufficient supply	<input type="checkbox"/> Dewatering	
<input type="checkbox"/> Test Hole	<input type="checkbox"/> Abandoned, poor quality	<input type="checkbox"/> Replacement well	

Ministry Use Only				
Data Source	Contractor	Well Record Number		
Date Received YYYY MM DD	OCT 05 2005	6016		
Date of Inspection YYYY MM DD				
Remarks				

# **Appendix C – AQTESOLV™ Pumping Test Analysis (Palmer, 2020)**



#### WELL TEST ANALYSIS

Data Set: C:\Users\Nolan Boyes\Documents\2006001 PW1.aqt  
 Date: 12/07/20 Time: 21:16:47

#### PROJECT INFORMATION

Company: Palmer  
 Client: Curry Dealership  
 Project: 2006001  
 Test Well: PW 1  
 Test Date: Nov 11, 2020

#### AQUIFER DATA

Saturated Thickness: 0.6096 m Anisotropy Ratio (Kz/Kr): 0.01

#### WELL DATA

Pumping Wells		Observation Wells	
Well Name	X (m)	Y (m)	Well Name
PW1	0	0	□ PW1

#### SOLUTION

Aquifer Model: Confined

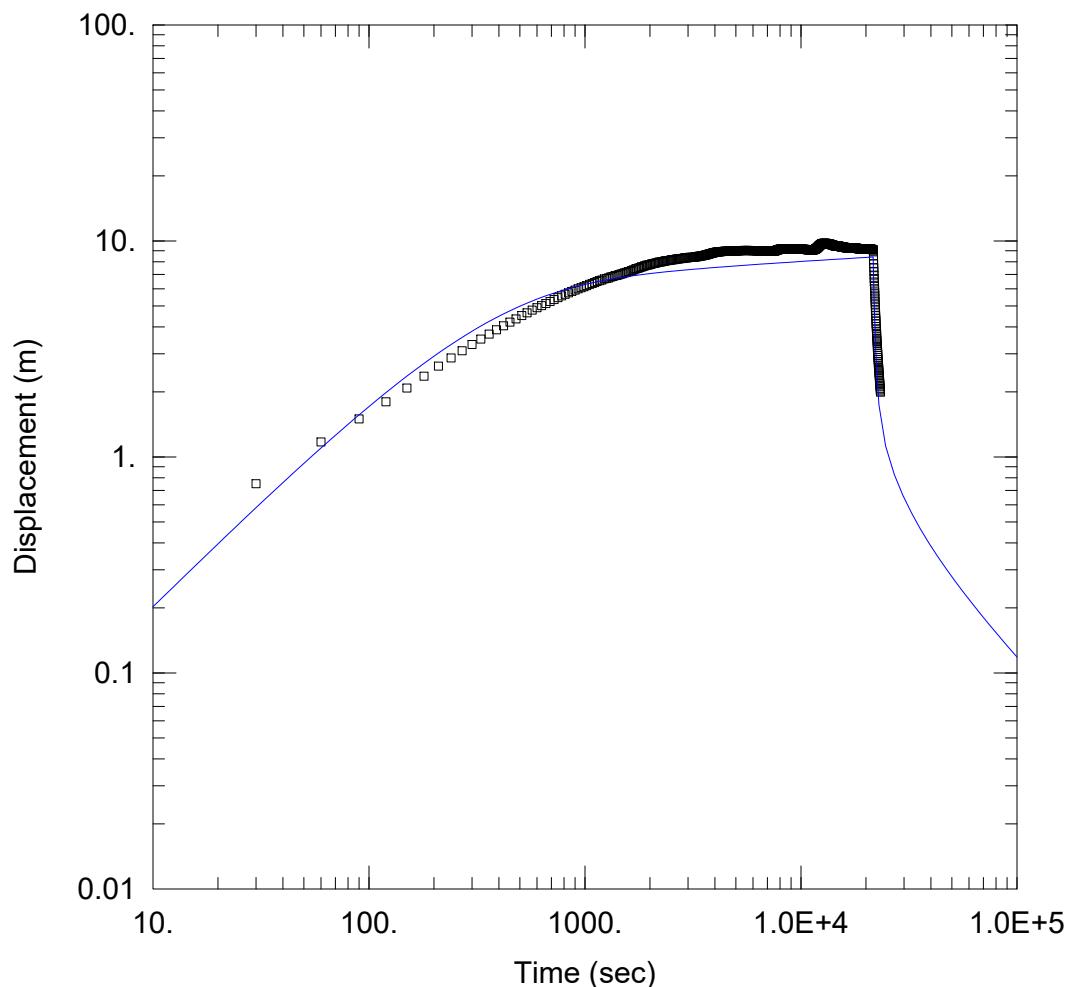
$$T = 2.566E-5 \text{ m}^2/\text{sec}$$

$$r(w) = 0.0762 \text{ m}$$

Solution Method: Papadopoulos-Cooper

$$S = 1.418E-5$$

$$r(c) = 0.0762 \text{ m}$$



#### WELL TEST ANALYSIS

Data Set: C:\Users\Nolan Boyes\Documents\2006001 PW2.aqt  
 Date: 12/07/20 Time: 21:19:07

#### PROJECT INFORMATION

Company: Palmer  
 Client: Curry Dealership  
 Project: 2006001  
 Test Well: PW 2  
 Test Date: Nov 10, 2020

#### AQUIFER DATA

Saturated Thickness: 0.6096 m Anisotropy Ratio (Kz/Kr): 0.01

#### WELL DATA

Pumping Wells		Observation Wells	
Well Name	X (m)	Y (m)	Well Name
PW2	0	0	□ PW2

#### SOLUTION

Aquifer Model: Confined

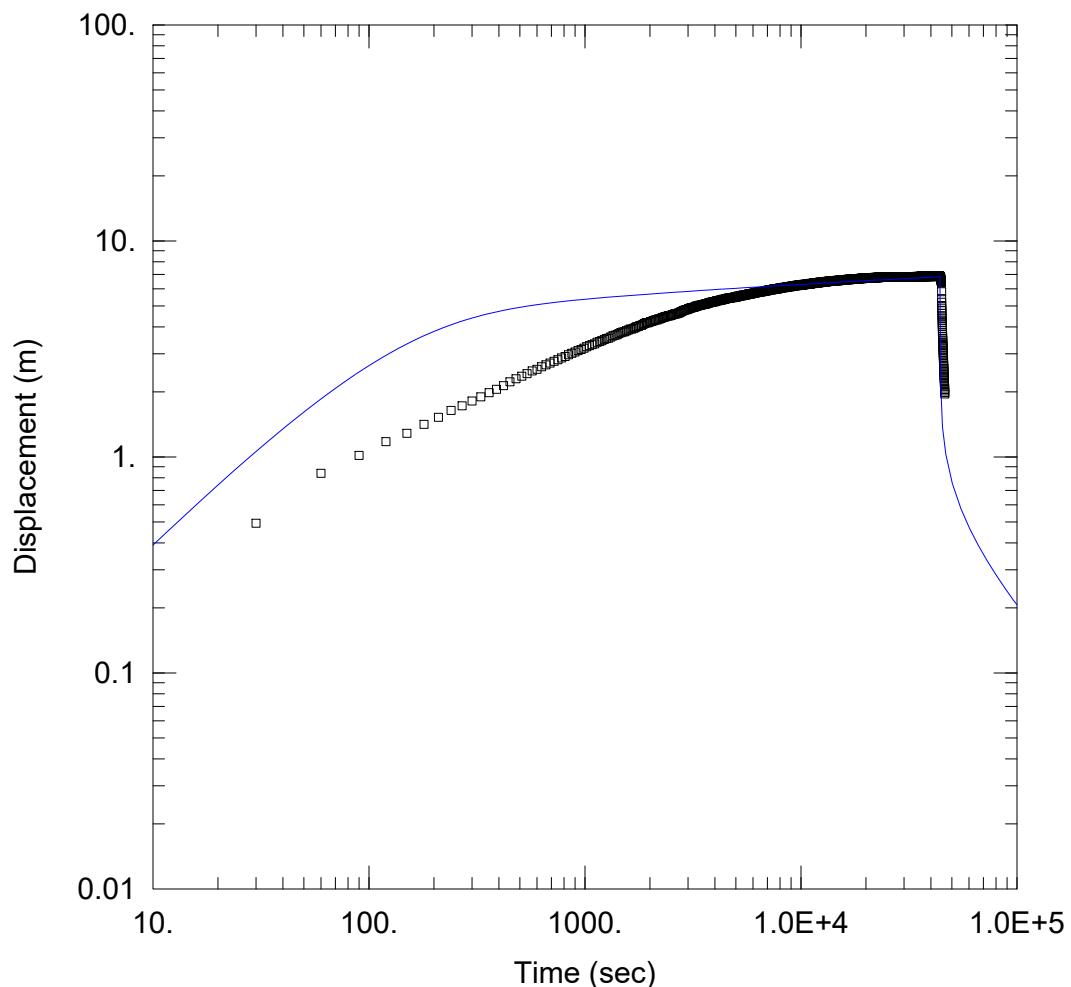
$$T = 6.243E-5 \text{ m}^2/\text{sec}$$

$$r(w) = 0.0762 \text{ m}$$

Solution Method: Papadopoulos-Cooper

$$S = 1.31E-5$$

$$r(c) = 0.0762 \text{ m}$$



#### WELL TEST ANALYSIS

Data Set: C:\Users\Nolan Boyes\Documents\2006001 PW3.aqt  
 Date: 12/07/20 Time: 21:15:00

#### PROJECT INFORMATION

Company: Palmer  
 Client: Curry Dealership  
 Project: 2006001  
 Test Well: PW 3  
 Test Date: Nov 12, 2020

#### AQUIFER DATA

Saturated Thickness: 0.6096 m Anisotropy Ratio (Kz/Kr): 0.01

#### WELL DATA

Pumping Wells		Observation Wells	
Well Name	X (m)	Y (m)	Well Name
PW3	0	0	□ PW3

#### SOLUTION

Aquifer Model: Confined  
 $T = 0.0001699 \text{ m}^2/\text{sec}$   
 $r(w) = 0.0762 \text{ m}$

Solution Method: Papadopoulos-Cooper  
 $S = 1.252E-5$   
 $r(c) = 0.0762 \text{ m}$

## **Appendix D – Test Pit Picture Log**



**Test Pit One (TP1)**



**Test Pit Two (TP2)**



**Test Pit Three (TP3)**



**Test Pit Four (TP4)**



**Test Pit Five (TP5)**



**Test Pit Six (TP6)**



**Test Pit Seven (TP7)**



**Test Pit Eight (TP8)**



**Test Pit Nine (TP9)**



**Test Pit Ten (TP10)**



**Test Pit Eleven (TP11)**

# **Appendix E – Certificate of Analysis (ALS, 2020)**

# ANALYTICAL REPORT

## Summary of Guideline Exceedances

Guideline						Guideline Limit	Unit
ALS ID	Client ID	Grouping	Analyte	Result			
<b>Ontario Drinking Water Regulation (ODWQS) JAN.1,2020 - Schedule 1 (Microbiological) and 2 (Chemical) Standards (JAN,2020)</b>							
L2528565-2	PW2	Bacteriological Tests	Total Coliforms	3	0	CFU/100mL	
<b>Ontario Drinking Water Regulation (ODWQS) JAN.1,2020 - Ontario DW Aesthetic and Operational Guidelines (June, 2006)</b>							
L2528565-1	PW1	Anions and Nutrients	Hardness (as CaCO <sub>3</sub> )	186	80-100	mg/L	
		Total Metals	Manganese (Mn)-Total	0.603	0.05	mg/L	

# ANALYTICAL REPORT

## Physical Tests - WATER

Lab ID	L2528565-1	L2528565-2
Sample Date	10-NOV-20	11-NOV-20
Sample ID	PW1	PW2

Analyte	Unit	Guide Limits		<2.0
		#1	#2	
Colour, Apparent	CU	-	5	3.3
Conductivity	umhos/cm	-	-	359
pH	pH units	-	6.5-8.5	7.52
Redox Potential	mV	-	-	320 <sup>PEHR</sup>
Total Dissolved Solids	mg/L	-	500	208 <sup>DLDS</sup>
Turbidity	NTU	-	5	0.55
				0.62

**Guide Limit #1: Schedule 1 (Microbiological) and 2 (Chemical) Standards (JAN,2020)**

**Guide Limit #2: Ontario DW Aesthetic and Operational Guidelines (June, 2006)**

  Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.

  Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

# ANALYTICAL REPORT

## Anions and Nutrients - WATER

Analyte	Unit	Guide Limits		
		#1	#2	
Alkalinity, Bicarbonate (as CaCO <sub>3</sub> )	mg/L	-	-	176      78.8
Alkalinity, Carbonate (as CaCO <sub>3</sub> )	mg/L	-	-	<2.0      <2.0
Alkalinity, Hydroxide (as CaCO <sub>3</sub> )	mg/L	-	-	<2.0      <2.0
Alkalinity, Total (as CaCO <sub>3</sub> )	mg/L	-	30-500	176      78.8
Ammonia, Total (as N)	mg/L	-	-	0.013      <0.010
Bromide (Br)	mg/L	-	-	<0.10      <0.10
Chloride (Cl)	mg/L	-	250	3.56      0.94
Computed Conductivity	µS/cm	-	-	317      165
Conductivity % Difference	%	-	-	-12      -5
Fluoride (F)	mg/L	1.5	-	0.067      0.149
Hardness (as CaCO <sub>3</sub> )	mg/L	-	80-100	186      85.5
Ion Balance	%	-	-	127      121
Langelier Index		-	-	0      0
Nitrate (as N)	mg/L	10	-	0.029      0.093
Nitrite (as N)	mg/L	1	-	<0.010      <0.010
Saturation pH	pH	-	-	7.39      8.00
Orthophosphate-Dissolved (as P)	mg/L	-	-	<0.0030      <0.0030
TDS (Calculated)	mg/L	-	-	186      92.7
Sulfate (SO <sub>4</sub> )	mg/L	-	500	4.07      7.98
Anion Sum	me/L	-	-	3.08      1.52
Cation Sum	me/L	-	-	3.90      1.85
Cation - Anion Balance	%	-	-	12      10

**Guide Limit #1: Schedule 1 (Microbiological) and 2 (Chemical) Standards (JAN,2020)**

**Guide Limit #2: Ontario DW Aesthetic and Operational Guidelines (June, 2006)**

  Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.

  Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

# ANALYTICAL REPORT

## Inorganic Parameters - WATER

Lab ID	L2528565-1	L2528565-2
Sample Date	10-NOV-20	11-NOV-20
Sample ID	PW1	PW2

Analyte	Unit	Guide Limits		
		#1	#2	
Silica	mg/L	-	-	15.9 12.6

Guide Limit #1: Schedule 1 (Microbiological) and 2 (Chemical) Standards (JAN,2020)

Guide Limit #2: Ontario DW Aesthetic and Operational Guidelines (June, 2006)

- Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
- Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

# ANALYTICAL REPORT

## Bacteriological Tests - WATER

Lab ID	L2528565-1	L2528565-2
Sample Date	10-NOV-20	11-NOV-20
Sample ID	PW1	PW2

Analyte	Unit	Guide Limits		DLM
		#1	#2	
E. Coli	CFU/100m L	0	-	0
Total Coliform Background	CFU/100m L	-	-	250
Total Coliforms	CFU/100m L	0	-	3

**Guide Limit #1: Schedule 1 (Microbiological) and 2 (Chemical) Standards (JAN,2020)**

**Guide Limit #2: Ontario DW Aesthetic and Operational Guidelines (June, 2006)**

[Yellow Box] Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.

[Red Box] Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

# ANALYTICAL REPORT

## Metals - WATER

Lab ID	L2528565-1	L2528565-2
Sample Date	10-NOV-20	11-NOV-20
Sample ID	PW1	PW2

Analyte	Unit	Guide Limits		
		#1	#2	
Sodium Adsorption Ratio	SAR	-	-	<0.10      0.10

**Guide Limit #1: Schedule 1 (Microbiological) and 2 (Chemical) Standards (JAN,2020)**

**Guide Limit #2: Ontario DW Aesthetic and Operational Guidelines (June, 2006)**

  Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.

  Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

# ANALYTICAL REPORT

## Total Metals - WATER

	Lab ID	L2528565-1	L2528565-2
Sample Date	10-NOV-20	11-NOV-20	
Sample ID	PW1	PW2	

Analyte	Unit	Guide Limits		DLHC
		#1	#2	
Aluminum (Al)-Total	mg/L	-	0.1	<0.050 <sup>DLHC</sup>
Antimony (Sb)-Total	mg/L	0.006	-	<0.0010 <sup>DLHC</sup>
Arsenic (As)-Total	mg/L	0.0100	-	<0.0010 <sup>DLHC</sup>
Barium (Ba)-Total	mg/L	1	-	0.486 <sup>DLHC</sup>
Beryllium (Be)-Total	mg/L	-	-	<0.0010 <sup>DLHC</sup>
Bismuth (Bi)-Total	mg/L	-	-	<0.00050 <sup>DLHC</sup>
Boron (B)-Total	mg/L	5	-	<0.10 <sup>DLHC</sup>
Cadmium (Cd)-Total	mg/L	0.005	-	<0.000050 <sup>DLHC</sup>
Calcium (Ca)-Total	mg/L	-	-	57.3 <sup>DLHC</sup>
Cesium (Cs)-Total	mg/L	-	-	<0.00010 <sup>DLHC</sup>
Chromium (Cr)-Total	mg/L	0.05	-	<0.0050 <sup>DLHC</sup>
Cobalt (Co)-Total	mg/L	-	-	<0.0010 <sup>DLHC</sup>
Copper (Cu)-Total	mg/L	-	1	<0.0050 <sup>DLHC</sup>
Iron (Fe)-Total	mg/L	-	0.3	<0.10 <sup>DLHC</sup>
Lead (Pb)-Total	mg/L	0.01	-	<0.00050 <sup>DLHC</sup>
Magnesium (Mg)-Total	mg/L	-	-	10.4 <sup>DLHC</sup>
Manganese (Mn)-Total	mg/L	-	0.05	0.603 <sup>DLHC</sup>
Molybdenum (Mo)-Total	mg/L	-	-	<0.00050 <sup>DLHC</sup>
Nickel (Ni)-Total	mg/L	-	-	<0.0050 <sup>DLHC</sup>
Phosphorus (P)-Total	mg/L	-	-	<0.50 <sup>DLHC</sup>
Potassium (K)-Total	mg/L	-	-	2.50 <sup>DLHC</sup>
Rubidium (Rb)-Total	mg/L	-	-	<0.0020 <sup>DLHC</sup>
Selenium (Se)-Total	mg/L	0.05	-	<0.00050 <sup>DLHC</sup>
Silicon (Si)-Total	mg/L	-	-	7.4 <sup>DLHC</sup>
Silver (Ag)-Total	mg/L	-	-	<0.00050 <sup>DLHC</sup>
Sodium (Na)-Total	mg/L	20	200	2.74 <sup>DLHC</sup>
Strontium (Sr)-Total	mg/L	-	-	0.519 <sup>DLHC</sup>
Sulfur (S)-Total	mg/L	-	-	<5.0 <sup>DLHC</sup>
Tellurium (Te)-Total	mg/L	-	-	<0.0020 <sup>DLHC</sup>
Thallium (Tl)-Total	mg/L	-	-	<0.00010 <sup>DLHC</sup>

**Guide Limit #1: Schedule 1 (Microbiological) and 2 (Chemical) Standards (JAN,2020)**

**Guide Limit #2: Ontario DW Aesthetic and Operational Guidelines (June, 2006)**

\* Please refer to the Reference Information section for an explanation of any qualifiers noted.

# ANALYTICAL REPORT

## Total Metals - WATER

Lab ID	L2528565-1	L2528565-2
Sample Date	10-NOV-20	11-NOV-20
Sample ID	PW1	PW2

Analyte	Unit	Guide Limits	
		#1	#2
Thorium (Th)-Total	mg/L	-	- <0.0010 <sup>DLHC</sup>
Tin (Sn)-Total	mg/L	-	- <0.0010 <sup>DLHC</sup>
Titanium (Ti)-Total	mg/L	-	- <0.0030 <sup>DLHC</sup>
Tungsten (W)-Total	mg/L	-	- <0.0010 <sup>DLHC</sup>
Uranium (U)-Total	mg/L	0.02	- 0.00825 <sup>DLHC</sup>
Vanadium (V)-Total	mg/L	-	- <0.0050 <sup>DLHC</sup>
Zinc (Zn)-Total	mg/L	-	5 <0.030 <sup>DLHC</sup>
Zirconium (Zr)-Total	mg/L	-	- <0.0020 <sup>DLHC</sup>
			- <0.0020 <sup>DLHC</sup>

**Guide Limit #1: Schedule 1 (Microbiological) and 2 (Chemical) Standards (JAN,2020)**

**Guide Limit #2: Ontario DW Aesthetic and Operational Guidelines (June, 2006)**

  Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.

  Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

# Reference Information

**L2528565 CONT'D....**  
**Job Reference: 2006001**  
**PAGE 10 of 12**  
**19-NOV-20 11:00 (MT)**

## Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
PEHR	Parameter Exceeded Recommended Holding Time On Receipt: Proceed With Analysis As Requested.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).

## Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
<b>ALK-SPEC-PCT-WT</b>	Water	Automated Speciated Alkalinity	APHA 2320B

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

<b>BR-IC-N-WT</b>	Water	Bromide in Water by IC	EPA 300.1 (mod)
-------------------	-------	------------------------	-----------------

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

<b>CL-IC-N-WT</b>	Water	Chloride by IC	EPA 300.1 (mod)
-------------------	-------	----------------	-----------------

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

<b>COLOUR-APPARENT-WT</b>	Water	Colour	APHA 2120
---------------------------	-------	--------	-----------

Apparent Colour is measured spectrophotometrically by comparison to platinum-cobalt standards using the single wavelength method after sample decanting. Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.

<b>EC-MF-WT</b>	Water	E. coli	SM 9222D
-----------------	-------	---------	----------

A 100 mL volume of sample is filtered through a membrane, the membrane is placed on mFC-BCIG agar and incubated at 44.5 – 0 .2 °C for 24 – 2 h. Method ID: WT-TM-1200

<b>EC-SCREEN-WT</b>	Water	Conductivity Screen (Internal Use Only)	APHA 2510
---------------------	-------	---	-----------

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

<b>EC-WT</b>	Water	Conductivity	APHA 2510 B
--------------	-------	--------------	-------------

Water samples can be measured directly by immersing the conductivity cell into the sample.

<b>ETL-SAR-CALC-WT</b>	Water	Sodium Adsorption Ratio	Calculation
------------------------	-------	-------------------------	-------------

<b>ETL-SILICA-CALC-WT</b>	Water	Calculate from SI-TOT-WT	EPA 200.8
---------------------------	-------	--------------------------	-----------

<b>F-IC-N-WT</b>	Water	Fluoride in Water by IC	EPA 300.1 (mod)
------------------	-------	-------------------------	-----------------

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

<b>IONBALANCE-OP03-WT</b>	Water	Detailed Ion Balance Calculation	APHA 1030E, 2330B, 2510A
---------------------------	-------	----------------------------------	--------------------------

<b>MET-T-CCMS-WT</b>	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)
----------------------	-------	------------------------------------	-----------------------

# Reference Information

L2528565 CONT'D....  
Job Reference: 2006001  
PAGE 11 of 12  
19-NOV-20 11:00 (MT)

## Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).			
<b>NH3-F-WT</b>	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
<b>NO2-IC-WT</b>	Water	Nitrite in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
<b>NO3-IC-WT</b>	Water	Nitrate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
<b>PH-WT</b>	Water	pH	APHA 4500 H-Electrode
Water samples are analyzed directly by a calibrated pH meter.			
Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011). Holdtime for samples under this regulation is 28 days			
<b>PO4-DO-COL-WT</b>	Water	Diss. Orthophosphate in Water by Colour	APHA 4500-P PHOSPHORUS
This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.			
<b>REDOX-POTENTIAL-WT</b>	Water	Redox Potential	APHA 2580
This analysis is carried out in accordance with the procedure described in the "APHA" method 2580 "Oxidation-Reduction Potential" 2012. Results are reported as observed oxidation-reduction potential of the platinum metal-reference electrode employed, in mV.			
It is recommended that this analysis be conducted in the field.			
<b>SO4-IC-N-WT</b>	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
<b>SOLIDS-TDS-WT</b>	Water	Total Dissolved Solids	APHA 2540C
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.			
<b>TC-MF-WT</b>	Water	Total Coliforms	SM 9222B
A 100mL volume of sample is filtered through a membrane, the membrane is placed on mENDO LES agar and incubated at 35–0.5°C for 24–2h. Method ID: WT-TM-1200			
<b>TCB-MF-WT</b>	Water	Total Coliform Background	SM 9222B

# Reference Information

L2528565 CONT'D....  
Job Reference: 2006001  
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19-NOV-20 11:00 (MT)

## Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
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A 100mL volume of sample is filtered through a membrane, the membrane is placed on mENDO LES agar and incubated at 35–0.5°C for 24–2h. Method ID: WT-TM-1200.

**TURBIDITY-WT** Water Turbidity APHA 2130 B

Sample result is based on a comparison of the intensity of the light scattered by the sample under defined conditions with the intensity of light scattered by a standard reference suspension under the same conditions. Sample readings are obtained from a Nephelometer.

\*\*ALS test methods may incorporate modifications from specified reference methods to improve performance.

## Chain of Custody Numbers:

17-794263

*The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:*

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

## GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.

mg/kg - milligrams per kilogram based on dry weight of sample

mg/kg wwt - milligrams per kilogram based on wet weight of sample

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight

mg/L - unit of concentration based on volume, parts per million.

< - Less than.

D.L. - The reporting limit.

N/A - Result not available. Refer to qualifier code and definition for explanation.

*Test results reported relate only to the samples as received by the laboratory.*

*UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.*

*Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.*

*Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guideline limits are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.*

## Quality Control Report

Workorder: L2528565

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**Client:** PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)  
 74 Berkeley Street  
 Toronto ON M5V 1E3

**Contact:** Nolan Boyes

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
<b>ALK-SPEC-PCT-WT</b>	<b>Water</b>							
<b>Batch</b>	<b>R5285948</b>							
<b>WG3444994-4 DUP</b>		<b>WG3444994-3</b>						
Alkalinity, Total (as CaCO <sub>3</sub> )	551	533			mg/L	3.2	20	14-NOV-20
Alkalinity, Bicarbonate (as CaCO <sub>3</sub> )	551	533			mg/L	3.2	20	14-NOV-20
Alkalinity, Carbonate (as CaCO <sub>3</sub> )	<2.0	<2.0	RPD-NA		mg/L	N/A	20	14-NOV-20
Alkalinity, Hydroxide (as CaCO <sub>3</sub> )	<2.0	<2.0	RPD-NA		mg/L	N/A	20	14-NOV-20
<b>WG3444994-2 LCS</b>								
Alkalinity, Total (as CaCO <sub>3</sub> )		101.1			%		85-115	14-NOV-20
<b>WG3444994-1 MB</b>								
Alkalinity, Total (as CaCO <sub>3</sub> )		<2.0			mg/L		2	14-NOV-20
Alkalinity, Bicarbonate (as CaCO <sub>3</sub> )		<2.0			mg/L		2	14-NOV-20
Alkalinity, Carbonate (as CaCO <sub>3</sub> )		<2.0			mg/L		2	14-NOV-20
Alkalinity, Hydroxide (as CaCO <sub>3</sub> )		<2.0			mg/L		2	14-NOV-20
<b>Batch</b>	<b>R5285953</b>							
<b>WG3445158-4 DUP</b>		<b>WG3445158-3</b>						
Alkalinity, Total (as CaCO <sub>3</sub> )	135	135			mg/L	0.1	20	14-NOV-20
Alkalinity, Bicarbonate (as CaCO <sub>3</sub> )	135	135			mg/L	0.1	20	14-NOV-20
Alkalinity, Carbonate (as CaCO <sub>3</sub> )	<2.0	<2.0	RPD-NA		mg/L	N/A	20	14-NOV-20
Alkalinity, Hydroxide (as CaCO <sub>3</sub> )	<2.0	<2.0	RPD-NA		mg/L	N/A	20	14-NOV-20
<b>WG3445158-2 LCS</b>								
Alkalinity, Total (as CaCO <sub>3</sub> )		99.5			%		85-115	14-NOV-20
<b>WG3445158-1 MB</b>								
Alkalinity, Total (as CaCO <sub>3</sub> )		<2.0			mg/L		2	14-NOV-20
Alkalinity, Bicarbonate (as CaCO <sub>3</sub> )		<2.0			mg/L		2	14-NOV-20
Alkalinity, Carbonate (as CaCO <sub>3</sub> )		<2.0			mg/L		2	14-NOV-20
Alkalinity, Hydroxide (as CaCO <sub>3</sub> )		<2.0			mg/L		2	14-NOV-20
<b>BR-IC-N-WT</b>	<b>Water</b>							
<b>Batch</b>	<b>R5286023</b>							
<b>WG3444518-15 DUP</b>		<b>WG3444518-13</b>						
Bromide (Br)	<0.10	<0.10	RPD-NA		mg/L	N/A	20	13-NOV-20
<b>WG3444518-12 LCS</b>								
Bromide (Br)		100.4			%		85-115	13-NOV-20
<b>WG3444518-11 MB</b>								
Bromide (Br)		<0.10			mg/L		0.1	13-NOV-20
<b>WG3444518-14 MS</b>		<b>WG3444518-13</b>						
Bromide (Br)		95.4			%		75-125	13-NOV-20
<b>CL-IC-N-WT</b>	<b>Water</b>							

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**Client:** PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)  
 74 Berkeley Street  
 Toronto ON M5V 1E3

**Contact:** Nolan Boyes

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CL-IC-N-WT	Water							
Batch R5286023								
WG3444518-15 DUP	Chloride (Cl)	WG3444518-13	0.94	0.88	mg/L	6.3	20	13-NOV-20
WG3444518-12 LCS	Chloride (Cl)		100.1		%		90-110	13-NOV-20
WG3444518-11 MB	Chloride (Cl)		<0.50		mg/L		0.5	13-NOV-20
WG3444518-14 MS	Chloride (Cl)	WG3444518-13	101.3		%		75-125	13-NOV-20
COLOUR-APPARENT-WT	Water							
Batch R5284635								
WG3444082-2 LCS	Colour, Apparent		96.1		%		85-115	12-NOV-20
WG3444082-1 MB	Colour, Apparent		<2.0		CU		2	12-NOV-20
EC-MF-WT	Water							
Batch R5285198								
WG3443875-1 MB	E. Coli		0		CFU/100mL		1	12-NOV-20
EC-WT	Water							
Batch R5285948								
WG3444994-4 DUP	Conductivity	WG3444994-3	2180	2220	umhos/cm	1.8	10	14-NOV-20
WG3444994-2 LCS	Conductivity		103.0		%		90-110	14-NOV-20
WG3444994-1 MB	Conductivity		<3.0		umhos/cm		3	14-NOV-20
Batch R5285953								
WG3445158-4 DUP	Conductivity	WG3445158-3	847	846	umhos/cm	0.1	10	14-NOV-20
WG3445158-2 LCS	Conductivity		101.2		%		90-110	14-NOV-20
WG3445158-1 MB	Conductivity		<3.0		umhos/cm		3	14-NOV-20
F-IC-N-WT	Water							

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Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)  
 74 Berkeley Street  
 Toronto ON M5V 1E3

Contact: Nolan Boyes

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed	
<b>F-IC-N-WT</b>	<b>Water</b>								
Batch	R5286023								
WG3444518-15 DUP	Fluoride (F)	WG3444518-13	0.150	0.150	mg/L	0.1	20	13-NOV-20	
WG3444518-12 LCS	Fluoride (F)		103.1		%		90-110	13-NOV-20	
WG3444518-11 MB	Fluoride (F)		<0.020		mg/L		0.02	13-NOV-20	
WG3444518-14 MS	Fluoride (F)	WG3444518-13	103.8		%		75-125	13-NOV-20	
<b>MET-T-CCMS-WT</b>	<b>Water</b>								
Batch	R5285205								
WG3444179-4 DUP	Aluminum (Al)-Total	WG3444179-3	<0.050	<0.050	RPD-NA	mg/L	N/A	20	13-NOV-20
	Antimony (Sb)-Total		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	13-NOV-20
	Arsenic (As)-Total		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	13-NOV-20
	Barium (Ba)-Total		0.132	0.132		mg/L	0.2	20	13-NOV-20
	Beryllium (Be)-Total		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	13-NOV-20
	Bismuth (Bi)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	13-NOV-20
	Boron (B)-Total		0.14	0.14		mg/L	0.8	20	13-NOV-20
	Cadmium (Cd)-Total		0.000051	0.000058		mg/L	11	20	13-NOV-20
	Calcium (Ca)-Total		164	165		mg/L	1.1	20	13-NOV-20
	Chromium (Cr)-Total		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	13-NOV-20
	Cesium (Cs)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	13-NOV-20
	Cobalt (Co)-Total		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	13-NOV-20
	Copper (Cu)-Total		0.0104	0.0097		mg/L	6.8	20	13-NOV-20
	Iron (Fe)-Total		0.15	0.14		mg/L	0.5	20	13-NOV-20
	Lead (Pb)-Total		0.00293	0.00293		mg/L	0.0	20	13-NOV-20
	Magnesium (Mg)-Total		48.0	48.7		mg/L	1.3	20	13-NOV-20
	Manganese (Mn)-Total		0.0267	0.0261		mg/L	2.3	20	13-NOV-20
	Molybdenum (Mo)-Total		0.00751	0.00742		mg/L	1.3	20	13-NOV-20
	Nickel (Ni)-Total		0.0063	0.0067		mg/L	5.1	20	13-NOV-20
	Phosphorus (P)-Total		<0.50	<0.50	RPD-NA	mg/L	N/A	20	13-NOV-20
	Potassium (K)-Total		18.7	18.5		mg/L	1.0	20	13-NOV-20
	Rubidium (Rb)-Total		0.0144	0.0144		mg/L	0.2	20	13-NOV-20
	Selenium (Se)-Total		0.00130	0.00129		mg/L	1.0	20	13-NOV-20
	Silicon (Si)-Total		8.1	7.9		mg/L	1.4	20	13-NOV-20

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Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)  
 74 Berkeley Street  
 Toronto ON M5V 1E3

Contact: Nolan Boyes

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT	Water							
Batch	R5285205							
WG3444179-4 DUP	WG3444179-3							
Silver (Ag)-Total	<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	13-NOV-20	
Sodium (Na)-Total	340	336		mg/L	1.2	20	13-NOV-20	
Strontium (Sr)-Total	3.86	3.90		mg/L	0.9	20	13-NOV-20	
Sulfur (S)-Total	61.5	60.5		mg/L	1.7	25	13-NOV-20	
Thallium (Tl)-Total	<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	13-NOV-20	
Tellurium (Te)-Total	<0.0020	<0.0020	RPD-NA	mg/L	N/A	20	13-NOV-20	
Thorium (Th)-Total	<0.0010	<0.0010	RPD-NA	mg/L	N/A	25	13-NOV-20	
Tin (Sn)-Total	<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	13-NOV-20	
Titanium (Ti)-Total	<0.0030	<0.0030	RPD-NA	mg/L	N/A	20	13-NOV-20	
Tungsten (W)-Total	<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	13-NOV-20	
Uranium (U)-Total	0.00278	0.00284		mg/L	2.1	20	13-NOV-20	
Vanadium (V)-Total	<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	13-NOV-20	
Zinc (Zn)-Total	0.081	0.085		mg/L	4.5	20	13-NOV-20	
Zirconium (Zr)-Total	<0.0020	<0.0020	RPD-NA	mg/L	N/A	20	13-NOV-20	
WG3444179-2 LCS								
Aluminum (Al)-Total	107.0			%	80-120	13-NOV-20		
Antimony (Sb)-Total	105.1			%	80-120	13-NOV-20		
Arsenic (As)-Total	104.8			%	80-120	13-NOV-20		
Barium (Ba)-Total	107.0			%	80-120	13-NOV-20		
Beryllium (Be)-Total	104.3			%	80-120	13-NOV-20		
Bismuth (Bi)-Total	105.4			%	80-120	13-NOV-20		
Boron (B)-Total	98.4			%	80-120	13-NOV-20		
Cadmium (Cd)-Total	104.7			%	80-120	13-NOV-20		
Calcium (Ca)-Total	104.4			%	80-120	13-NOV-20		
Chromium (Cr)-Total	103.1			%	80-120	13-NOV-20		
Cesium (Cs)-Total	106.8			%	80-120	13-NOV-20		
Cobalt (Co)-Total	102.0			%	80-120	13-NOV-20		
Copper (Cu)-Total	101.0			%	80-120	13-NOV-20		
Iron (Fe)-Total	101.9			%	80-120	13-NOV-20		
Lead (Pb)-Total	106.4			%	80-120	13-NOV-20		
Magnesium (Mg)-Total	103.4			%	80-120	13-NOV-20		
Manganese (Mn)-Total	103.8			%	80-120	13-NOV-20		
Molybdenum (Mo)-Total	105.4			%	80-120	13-NOV-20		

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Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)  
 74 Berkeley Street  
 Toronto ON M5V 1E3

Contact: Nolan Boyes

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
<b>MET-T-CCMS-WT</b>		Water						
<b>Batch R5285205</b>								
<b>WG3444179-2 LCS</b>								
Nickel (Ni)-Total			101.5		%	80-120	13-NOV-20	
Phosphorus (P)-Total			105.3		%	70-130	13-NOV-20	
Potassium (K)-Total			101.4		%	80-120	13-NOV-20	
Rubidium (Rb)-Total			106.3		%	80-120	13-NOV-20	
Selenium (Se)-Total			98.9		%	80-120	13-NOV-20	
Silicon (Si)-Total			101.1		%	60-140	13-NOV-20	
Silver (Ag)-Total			104.3		%	80-120	13-NOV-20	
Sodium (Na)-Total			105.4		%	80-120	13-NOV-20	
Strontium (Sr)-Total			111.0		%	80-120	13-NOV-20	
Sulfur (S)-Total			100.4		%	80-120	13-NOV-20	
Thallium (Tl)-Total			105.5		%	80-120	13-NOV-20	
Tellurium (Te)-Total			102.5		%	80-120	13-NOV-20	
Thorium (Th)-Total			108.7		%	70-130	13-NOV-20	
Tin (Sn)-Total			100.5		%	80-120	13-NOV-20	
Titanium (Ti)-Total			102.2		%	80-120	13-NOV-20	
Tungsten (W)-Total			103.4		%	80-120	13-NOV-20	
Uranium (U)-Total			109.9		%	80-120	13-NOV-20	
Vanadium (V)-Total			104.0		%	80-120	13-NOV-20	
Zinc (Zn)-Total			102.2		%	80-120	13-NOV-20	
Zirconium (Zr)-Total			102.8		%	80-120	13-NOV-20	
<b>WG3444179-1 MB</b>								
Aluminum (Al)-Total			<0.0050		mg/L	0.005	13-NOV-20	
Antimony (Sb)-Total			<0.00010		mg/L	0.0001	13-NOV-20	
Arsenic (As)-Total			<0.00010		mg/L	0.0001	13-NOV-20	
Barium (Ba)-Total			<0.00010		mg/L	0.0001	13-NOV-20	
Beryllium (Be)-Total			<0.00010		mg/L	0.0001	13-NOV-20	
Bismuth (Bi)-Total			<0.000050		mg/L	0.00005	13-NOV-20	
Boron (B)-Total			<0.010		mg/L	0.01	13-NOV-20	
Cadmium (Cd)-Total			<0.0000050		mg/L	0.000005	13-NOV-20	
Calcium (Ca)-Total			<0.050		mg/L	0.05	13-NOV-20	
Chromium (Cr)-Total			<0.00050		mg/L	0.0005	13-NOV-20	
Cesium (Cs)-Total			<0.000010		mg/L	0.00001	13-NOV-20	
Cobalt (Co)-Total			<0.00010		mg/L	0.0001	13-NOV-20	
Copper (Cu)-Total			<0.00050		mg/L	0.0005	13-NOV-20	

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Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)  
 74 Berkeley Street  
 Toronto ON M5V 1E3

Contact: Nolan Boyes

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT	Water							
Batch	R5285205							
WG3444179-1	MB							
Iron (Fe)-Total			<0.010		mg/L	0.01	13-NOV-20	
Lead (Pb)-Total			<0.000050		mg/L	0.00005	13-NOV-20	
Magnesium (Mg)-Total			<0.0050		mg/L	0.005	13-NOV-20	
Manganese (Mn)-Total			<0.00050		mg/L	0.0005	13-NOV-20	
Molybdenum (Mo)-Total			<0.000050		mg/L	0.00005	13-NOV-20	
Nickel (Ni)-Total			<0.00050		mg/L	0.0005	13-NOV-20	
Phosphorus (P)-Total			<0.050		mg/L	0.05	13-NOV-20	
Potassium (K)-Total			<0.050		mg/L	0.05	13-NOV-20	
Rubidium (Rb)-Total			<0.00020		mg/L	0.0002	13-NOV-20	
Selenium (Se)-Total			<0.000050		mg/L	0.00005	13-NOV-20	
Silicon (Si)-Total			<0.10		mg/L	0.1	13-NOV-20	
Silver (Ag)-Total			<0.000050		mg/L	0.00005	13-NOV-20	
Sodium (Na)-Total			<0.050		mg/L	0.05	13-NOV-20	
Strontium (Sr)-Total			<0.0010		mg/L	0.001	13-NOV-20	
Sulfur (S)-Total			<0.50		mg/L	0.5	13-NOV-20	
Thallium (Tl)-Total			<0.000010		mg/L	0.00001	13-NOV-20	
Tellurium (Te)-Total			<0.00020		mg/L	0.0002	13-NOV-20	
Thorium (Th)-Total			<0.00010		mg/L	0.0001	13-NOV-20	
Tin (Sn)-Total			<0.00010		mg/L	0.0001	13-NOV-20	
Titanium (Ti)-Total			<0.00030		mg/L	0.0003	13-NOV-20	
Tungsten (W)-Total			<0.00010		mg/L	0.0001	13-NOV-20	
Uranium (U)-Total			<0.000010		mg/L	0.00001	13-NOV-20	
Vanadium (V)-Total			<0.00050		mg/L	0.0005	13-NOV-20	
Zinc (Zn)-Total			<0.0030		mg/L	0.003	13-NOV-20	
Zirconium (Zr)-Total			<0.00020		mg/L	0.0002	13-NOV-20	
WG3444179-5	MS	WG3444179-3						
Aluminum (Al)-Total			95.2		%	70-130	13-NOV-20	
Antimony (Sb)-Total			104.5		%	70-130	13-NOV-20	
Arsenic (As)-Total			105.8		%	70-130	13-NOV-20	
Barium (Ba)-Total			N/A	MS-B	%	-	13-NOV-20	
Beryllium (Be)-Total			101.3		%	70-130	13-NOV-20	
Bismuth (Bi)-Total			104.4		%	70-130	13-NOV-20	
Boron (B)-Total			N/A	MS-B	%	-	13-NOV-20	
Cadmium (Cd)-Total			107.6		%	70-130	13-NOV-20	



## Quality Control Report

Workorder: L2528565

Report Date: 19-NOV-20

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Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)  
 74 Berkeley Street  
 Toronto ON M5V 1E3

Contact: Nolan Boyes

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
<b>NH3-F-WT</b>	Water							
Batch	R5285900							
WG3444247-2	LCS							
Ammonia, Total (as N)			105.6		%		85-115	13-NOV-20
WG3444247-1	MB							
Ammonia, Total (as N)			<0.010		mg/L		0.01	13-NOV-20
WG3444247-4	MS	L2528352-1						
Ammonia, Total (as N)			N/A	MS-B	%		-	13-NOV-20
<b>NO2-IC-WT</b>	Water							
Batch	R5286023							
WG3444518-15	DUP	WG3444518-13						
Nitrite (as N)			<0.010	<0.010	RPD-NA	mg/L	N/A	20
WG3444518-12	LCS							
Nitrite (as N)			100.3		%		90-110	13-NOV-20
WG3444518-11	MB							
Nitrite (as N)			<0.010		mg/L		0.01	13-NOV-20
WG3444518-14	MS	WG3444518-13						
Nitrite (as N)			101.5		%		75-125	13-NOV-20
<b>NO3-IC-WT</b>	Water							
Batch	R5286023							
WG3444518-15	DUP	WG3444518-13						
Nitrate (as N)			0.093	0.089	mg/L	3.8	20	13-NOV-20
WG3444518-12	LCS							
Nitrate (as N)			99.1		%		90-110	13-NOV-20
WG3444518-11	MB							
Nitrate (as N)			<0.020		mg/L		0.02	13-NOV-20
WG3444518-14	MS	WG3444518-13						
Nitrate (as N)			100.0		%		75-125	13-NOV-20
<b>PH-WT</b>	Water							
Batch	R5285948							
WG3444994-4	DUP	WG3444994-3						
pH			8.03	8.03	J	pH units	0.00	0.2
WG3444994-2	LCS							
pH			7.02		pH units		6.9-7.1	14-NOV-20
Batch	R5285953							
WG3445158-4	DUP	WG3445158-3						
pH			8.16	8.16	J	pH units	0.00	0.2
WG3445158-2	LCS							
pH			7.00		pH units		6.9-7.1	14-NOV-20

# Quality Control Report

Workorder: L2528565

Report Date: 19-NOV-20

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**Client:** PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)  
74 Berkeley Street  
Toronto ON M5V 1E3

Contact: Nolan Boyes

## Quality Control Report

Workorder: L2528565

Report Date: 19-NOV-20

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**Client:** PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)  
 74 Berkeley Street  
 Toronto ON M5V 1E3

**Contact:** Nolan Boyes

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
<b>TC-MF-WT</b>	<b>Water</b>							
Batch	R5285196							
WG3443885-1	MB							
Total Coliforms			0		CFU/100mL		1	12-NOV-20
<b>TCB-MF-WT</b>	<b>Water</b>							
Batch	R5285196							
WG3443885-1	MB							
Total Coliform Background			0		CFU/100mL		1	12-NOV-20
<b>TURBIDITY-WT</b>	<b>Water</b>							
Batch	R5285250							
WG3444720-3	DUP	WG3444720-4						
Turbidity		50.8	51.2		NTU	0.8	15	13-NOV-20
WG3444720-2	LCS							
Turbidity			102.5		%		85-115	13-NOV-20
WG3444720-1	MB							
Turbidity			<0.10		NTU		0.1	13-NOV-20

# Quality Control Report

Workorder: L2528565

Report Date: 19-NOV-20

Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)  
74 Berkeley Street  
Toronto ON M5V 1E3

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Contact: Nolan Boyes

## Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

## Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

# Quality Control Report

Workorder: L2528565

Report Date: 19-NOV-20

Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)  
74 Berkeley Street  
Toronto ON M5V 1E3

Contact: Nolan Boyes

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## Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
<b>Physical Tests</b>							
Colour	1	10-NOV-20 17:00	12-NOV-20 19:00	48	50	hours	EHTL
Redox Potential	1	10-NOV-20 17:00	19-NOV-20 00:00	0.25	199	hours	EHTR-FM
	2	11-NOV-20 14:30	19-NOV-20 00:00	0.25	178	hours	EHTR-FM
Turbidity	1	10-NOV-20 17:00	13-NOV-20 15:59	48	71	hours	EHTL

## Legend & Qualifier Definitions:

EHTR-FM: Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.

EHTR: Exceeded ALS recommended hold time prior to sample receipt.

EHTL: Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.

EHT: Exceeded ALS recommended hold time prior to analysis.

Rec. HT: ALS recommended hold time (see units).

## Notes\*:

Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.

Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L2528565 were received on 12-NOV-20 10:45.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.



Chain of Custody (COC) / Analytic  
Request Form



COC Number: 17 - 794263

Page \_\_\_\_\_ of \_\_\_\_\_

Canada Toll Free: 1 800 668 9878

L2528565-COFC

Report To		Contact and company name below will appear on the final report		Report Format / Distribution		Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)																												
Company:	Palmer Environmental Consulting Group Inc.			Select Report Format:	<input checked="" type="checkbox"/> PDF <input checked="" type="checkbox"/> EXCEL <input type="checkbox"/> EDD (DIGITAL)	Quality Control (QC) Report with Report	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	<table border="1"> <tr> <td rowspan="3">PRIORITY (Business Days)</td> <td colspan="2">Regular [R] <input checked="" type="checkbox"/></td> <td colspan="2">Standard TAT if received by 3 pm - business days - no surcharges apply</td> </tr> <tr> <td colspan="2">4 day [P4-20%] <input type="checkbox"/></td> <td colspan="2">1 Business day [E - 100%] <input type="checkbox"/></td> </tr> <tr> <td colspan="2">3 day [P3-25%] <input type="checkbox"/></td> <td colspan="2">Same Day, Weekend or Statutory holiday [E2 - 200%] <input type="checkbox"/></td> </tr> <tr> <td colspan="2">2 day [P2-50%] <input type="checkbox"/></td> <td colspan="2">(Laboratory opening fees may apply) <input type="checkbox"/></td> </tr> </table>										PRIORITY (Business Days)	Regular [R] <input checked="" type="checkbox"/>		Standard TAT if received by 3 pm - business days - no surcharges apply		4 day [P4-20%] <input type="checkbox"/>		1 Business day [E - 100%] <input type="checkbox"/>		3 day [P3-25%] <input type="checkbox"/>		Same Day, Weekend or Statutory holiday [E2 - 200%] <input type="checkbox"/>		2 day [P2-50%] <input type="checkbox"/>		(Laboratory opening fees may apply) <input type="checkbox"/>	
PRIORITY (Business Days)	Regular [R] <input checked="" type="checkbox"/>		Standard TAT if received by 3 pm - business days - no surcharges apply																															
	4 day [P4-20%] <input type="checkbox"/>		1 Business day [E - 100%] <input type="checkbox"/>																															
	3 day [P3-25%] <input type="checkbox"/>		Same Day, Weekend or Statutory holiday [E2 - 200%] <input type="checkbox"/>																															
2 day [P2-50%] <input type="checkbox"/>		(Laboratory opening fees may apply) <input type="checkbox"/>																																
Contact:	647-745-8153			Date and Time Required for all E&P TATs: dd-mm-yy hh:mm																														
Phone:				For tests that can not be performed according to the service level selected, you will be contacted.																														
Company address below will appear on the final report		Select Distribution:		<input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX	Analysis Request																													
Street:	74 Bentle, St			Email 1 or Fax	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below																													
City/Province:	Toronto / ON			Email 2																														
Postal Code:	M5A 2W7			Email 3																														
Invoice To	Same as Report To <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		Invoice Distribution																															
	Copy of Invoice with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX																															
Company:	Email 1 or Fax																																	
Contact:	Email 2																																	
Project Information		Oil and Gas Required Fields (client use)																																
ALS Account # / Quote #:	2006001 2440c		AFE/Cost Center:		PO#																													
Job #:	2006001		Major/Minor Code:		Routing Code:																													
PO / AFE:	Requisitioner:																																	
LSD:	Location:																																	
ALS Lab Work Order # (lab use only): L2528565 AP		ALS Contact:		Sampler:																														
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)			Date (dd-mm-yy)	Time (hh:mm)	NUMBER OF CONTAINERS																												
	PW 1			10-Nov-20	5:00 PM	P/C 6/4																												
	PW 2			11-Nov-20	2:30 PM	✓																												
Drinking Water (DW) Samples <sup>1</sup> (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)																																
Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO		Compare to Micro/Aesthetic OWS																																
Are samples for human consumption/ use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO																																		
SHIPMENT RELEASE (client use)					INITIAL SHIPMENT RECEPTION (lab use only)					FINAL SHIPMENT RECEPTION (lab use only)																								
Released by: Supriya Singh	Date: 2020/11/11	Time: 7:00	Received by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:																							
REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION																																		
WHITE - LABORATORY COPY      YELLOW - CLIENT COPY																																		

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



PALMER ENVIRONMENTAL CONSULTING  
GROUP INC. (Richmond Hill)  
ATTN: Nolan Boyes  
74 Berkeley Street  
Toronto ON M5V 1E3

Date Received: 13-NOV-20  
Report Date: 20-NOV-20 07:20 (MT)  
Version: FINAL

Client Phone: 647-795-8153

## Certificate of Analysis

Lab Work Order #: L2529340  
Project P.O. #: NOT SUBMITTED  
Job Reference: 2006001  
C of C Numbers: 17-730090  
Legal Site Desc:

A handwritten signature in black ink that reads "Jennifer Barkshire-Paterson".

Jennifer Barkshire-Paterson  
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 95 West Beaver Creek Road, Unit 1, Richmond Hill, ON L4B 1H2 Canada | Phone: +1 905 881 9887 | Fax: +1 905 881 8062  
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

# ANALYTICAL REPORT

L2529340 CONT'D....

Job Reference: 2006001

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20-NOV-20 07:20 (MT)

## WATER - [Combined] - Ontario PWQO + ODWS

	ALS ID Sampled Date Sampled Time Sample ID	L2529340-1 12-NOV-20 15:00 PW3	L2529340-2 12-NOV-20 16:00 5088	L2529340-3 12-NOV-20 16:00 121	L2529340-4 12-NOV-20 16:30 5161	L2529340-5 12-NOV-20 16:30 1003
Grouping	Analyte	Unit				
<b>Physical Tests</b>						
	Colour, Apparent	CU	<2.0	2.8	<2.0	<2.0
	Conductivity	umhos/cm	224	1910	192	846
	pH	pH units	8.01	7.67	7.58	7.95
	Redox Potential	mV	320	PEHR 304	PEHR 311	PEHR 295
	Total Dissolved Solids	mg/L	132	DLDS 1220	DLDS 100	DLDS 591
	Turbidity	NTU	1.28	1.33	1.02	1.18
<b>Anions and Nutrients</b>						
	Alkalinity, Bicarbonate (as CaCO <sub>3</sub> )	mg/L	104	168	87.5	135
	Alkalinity, Carbonate (as CaCO <sub>3</sub> )	mg/L	<2.0	<2.0	<2.0	<2.0
	Alkalinity, Hydroxide (as CaCO <sub>3</sub> )	mg/L	<2.0	<2.0	<2.0	<2.0
	Alkalinity, Total (as CaCO <sub>3</sub> )	mg/L	104	168	87.5	135
	Ammonia, Total (as N)	mg/L	<0.010	<0.010	0.022	<0.010
	Bromide (Br)	mg/L	<0.10	DLDS <0.50	<0.10	<0.10
	Chloride (Cl)	mg/L	1.21	DLDS 507	1.44	76.4
	Computed Conductivity	uS/cm	214	1720	180	858
	Conductivity % Difference	%	-5	-10	-6	1
	Fluoride (F)	mg/L	0.176	DLDS <0.10	0.095	1.02
	Hardness (as CaCO <sub>3</sub> )	mg/L	115	622	94.1	377
	Ion Balance	%	122	107	120	102
	Langelier Index		0	1	0	0
	Nitrate (as N)	mg/L	0.142	DLDS 0.57	0.120	0.043
	Nitrite (as N)	mg/L	<0.010	DLDS <0.050	<0.010	<0.010
	Saturation pH	pH	7.76	7.01	7.92	7.21
	Orthophosphate-Dissolved (as P)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030
	TDS (Calculated)	mg/L	123	1020	103	524
						675

■ Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.

■ Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

\* Please refer to the Reference Information section for an explanation of any qualifiers noted.

# ANALYTICAL REPORT

## WATER - [Combined] - Ontario PWQO + ODWS

		ALS ID	L2529340-1	L2529340-2	L2529340-3	L2529340-4	L2529340-5
Grouping	Analyte	Sampled Date	12-NOV-20	12-NOV-20	12-NOV-20	12-NOV-20	12-NOV-20
		Sampled Time	15:00	16:00	16:00	16:30	16:30
		Sample ID	PW3	5088	121	5161	1003
<b>Anions and Nutrients</b>	Sulfate (SO4)	mg/L	10.9	24.2	9.63	193	26.3
	Anion Sum	me/L	2.00	17.6	1.69	8.44	11.6
	Cation Sum	me/L	2.45	18.9	2.03	8.60	12.0
	Cation - Anion Balance	%	10	3	9	1	2
<b>Inorganic Parameters</b>	Silica	mg/L	11.3	10.2	12.2	11.6	8.60
<b>Bacteriological Tests</b>	E. Coli	CFU/100 mL	0	0	0	0	0
	Total Coliform Background	CFU/100 mL	0	0	0	0	37
	Total Coliforms	CFU/100 mL	0	0	0	0	0
<b>Metals</b>	Sodium Adsorption Ratio	SAR	<0.10	2.50	0.11	0.51	3.71
<b>Total Metals</b>	Aluminum (Al)-Total	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010
	Antimony (Sb)-Total	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total	mg/L	<0.00010	0.00013	<0.00010	<0.00010	0.00016
	Barium (Ba)-Total	mg/L	0.0499	0.262	0.0250	0.0296	0.198
	Beryllium (Be)-Total	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)-Total	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total	mg/L	0.012	0.016	<0.010	0.112	0.021
	Cadmium (Cd)-Total	mg/L	<0.000010	0.000031	<0.000010	<0.000010	<0.000010
	Calcium (Ca)-Total	mg/L	38.6	208	31.3	141	94.6
	Cesium (Cs)-Total	mg/L	<0.000010	0.000038	<0.000010	<0.000010	0.000016
	Chromium (Cr)-Total	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	0.000067
	Cobalt (Co)-Total	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Copper (Cu)-Total	mg/L	0.0017	0.0735	0.0813	0.0065	0.0667
	Iron (Fe)-Total	mg/L	<0.050	<0.050	0.063	<0.050	<0.050
	Lead (Pb)-Total	mg/L	<0.000010	0.00264	0.00042	0.00210	0.00011

\* Please refer to the Reference Information section for an explanation of any qualifiers noted.

# ANALYTICAL REPORT

## WATER - [Combined] - Ontario PWQO + ODWS

	ALS ID Sampled Date Sampled Time Sample ID	L2529340-1 12-NOV-20 15:00 PW3	L2529340-2 12-NOV-20 16:00 5088	L2529340-3 12-NOV-20 16:00 121	L2529340-4 12-NOV-20 16:30 5161	L2529340-5 12-NOV-20 16:30 1003
Grouping	Analyte	Unit				
<b>Total Metals</b>	Magnesium (Mg)-Total	mg/L	4.48	24.7	3.90	6.01
	Manganese (Mn)-Total	mg/L	0.00056	0.0313	0.00469	0.0536
	Molybdenum (Mo)-Total	mg/L	0.00204	0.00214	0.00179	0.00423
	Nickel (Ni)-Total	mg/L	<0.00050	0.00158	<0.00050	<0.00050
	Phosphorus (P)-Total	mg/L	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Total	mg/L	2.32	8.30	1.55	3.40
	Rubidium (Rb)-Total	mg/L	0.00026	0.00595	0.00094	0.00296
	Selenium (Se)-Total	mg/L	0.000242	0.000430	0.000159	0.000133
	Silicon (Si)-Total	mg/L	5.28	4.76	5.71	5.44
	Silver (Ag)-Total	mg/L	<0.000050	<0.000050	<0.000050	<0.000050
	Sodium (Na)-Total	mg/L	2.07	143	2.42	22.6
	Strontium (Sr)-Total	mg/L	0.560	2.29	0.217	4.31
	Sulfur (S)-Total	mg/L	3.82	8.84	3.09	67.5
	Tellurium (Te)-Total	mg/L	<0.00020	0.00023	<0.00020	0.00046
	Thallium (Tl)-Total	mg/L	<0.000010	0.000019	<0.000010	<0.000010
	Thorium (Th)-Total	mg/L	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total	mg/L	<0.000010	0.000014	0.000011	0.000044
	Titanium (Ti)-Total	mg/L	<0.000030	<0.000030	<0.000030	<0.000030
	Tungsten (W)-Total	mg/L	<0.000010	<0.000010	<0.000010	0.000029
	Uranium (U)-Total	mg/L	0.00322	0.0312	0.00315	0.00907
	Vanadium (V)-Total	mg/L	0.00293	0.00135	0.00075	0.00184
	Zinc (Zn)-Total	mg/L	<0.0030	0.0992	0.0035	0.0399
	Zirconium (Zr)-Total	mg/L	<0.00030	<0.00030	<0.00030	<0.00030

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.

Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

# ANALYTICAL REPORT

L2529340 CONT'D....

Job Reference: 2006001

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20-NOV-20 07:20 (MT)

**Summary of Guideline Exceedances: [Combined] - Ontario PWQO + ODWS**

Guideline			Analyte	Result	Guideline Limit	Unit
ALS ID	Client ID	Grouping				
<b>Surface Water PWQO</b>						
L2529340-1	(No parameter exceedances)	Total Metals	Copper (Cu)-Total	0.0017	0.001	mg/L
			Phosphorus (P)-Total	<0.050	0.01	mg/L
L2529340-2	5088	Total Metals	Copper (Cu)-Total	0.0735	0.001	mg/L
			Lead (Pb)-Total	0.00264	0.001	mg/L
			Phosphorus (P)-Total	<0.050	0.01	mg/L
			Uranium (U)-Total	0.0312	0.005	mg/L
			Zinc (Zn)-Total	0.0992	0.02	mg/L
L2529340-3	121	Total Metals	Copper (Cu)-Total	0.0813	0.001	mg/L
			Phosphorus (P)-Total	<0.050	0.01	mg/L
L2529340-4	5161	Total Metals	Copper (Cu)-Total	0.0065	0.001	mg/L
			Lead (Pb)-Total	0.00210	0.001	mg/L
			Phosphorus (P)-Total	<0.050	0.01	mg/L
			Uranium (U)-Total	0.00907	0.005	mg/L
			Zinc (Zn)-Total	0.0399	0.02	mg/L
L2529340-5	1003	Total Metals	Copper (Cu)-Total	0.0667	0.001	mg/L
			Phosphorus (P)-Total	<0.050	0.01	mg/L
			Uranium (U)-Total	0.0158	0.005	mg/L
<b>Ontario DW Aesthetic and Operational Guidelines</b>						
L2529340-1	PW3	Anions and Nutrients	Hardness (as CaCO <sub>3</sub> )	115	80-100	mg/L
L2529340-2	5088	Physical Tests	Total Dissolved Solids	1220	500	mg/L
		Anions and Nutrients	Chloride (Cl)	507	250	mg/L
			Hardness (as CaCO <sub>3</sub> )	622	80-100	mg/L
L2529340-4	5161	Physical Tests	Total Dissolved Solids	591	500	mg/L
		Anions and Nutrients	Hardness (as CaCO <sub>3</sub> )	377	80-100	mg/L
			Manganese (Mn)-Total	0.0536	0.05	mg/L
L2529340-5	1003	Total Metals	Total Dissolved Solids	786	500	mg/L
		Physical Tests	Chloride (Cl)	308	250	mg/L
		Anions and Nutrients	Hardness (as CaCO <sub>3</sub> )	282	80-100	mg/L
<b>Schedule 1 (Microbiological) and 2 (Chemical) Standards (JAN,2017)</b>						
L2529340-2	5088	Total Metals	Sodium (Na)-Total	143	20	mg/L
			Uranium (U)-Total	0.0312	0.02	mg/L
L2529340-4	5161	Total Metals	Sodium (Na)-Total	22.6	20	mg/L
L2529340-5	1003	Total Metals	Sodium (Na)-Total	143	20	mg/L

\* Please refer to the Reference Information section for an explanation of any qualifiers noted.

# Reference Information

**L2529340 CONT'D....**  
**Job Reference: 2006001**  
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## Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
PEHR	Parameter Exceeded Recommended Holding Time On Receipt: Proceed With Analysis As Requested.
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).

## Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
<b>ALK-SPEC-PCT-WT</b>	Water	Automated Speciated Alkalinity	APHA 2320B

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

<b>BR-IC-N-WT</b>	Water	Bromide in Water by IC	EPA 300.1 (mod)
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Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

<b>CL-IC-N-WT</b>	Water	Chloride by IC	EPA 300.1 (mod)
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Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

<b>COLOUR-APPARENT-WT</b>	Water	Colour	APHA 2120
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Apparent Colour is measured spectrophotometrically by comparison to platinum-cobalt standards using the single wavelength method after sample decanting. Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.

<b>EC-MF-WT</b>	Water	E. coli	SM 9222D
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A 100 mL volume of sample is filtered through a membrane, the membrane is placed on mFC-BCIG agar and incubated at 44.5 – 0 .2 °C for 24 – 2 h. Method ID: WT-TM-1200

<b>EC-SCREEN-WT</b>	Water	Conductivity Screen (Internal Use Only)	APHA 2510
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Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

<b>EC-WT</b>	Water	Conductivity	APHA 2510 B
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Water samples can be measured directly by immersing the conductivity cell into the sample.

<b>ETL-SAR-CALC-WT</b>	Water	Sodium Adsorption Ratio	Calculation
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<b>ETL-SILICA-CALC-WT</b>	Water	Calculate from SI-TOT-WT	EPA 200.8
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<b>F-IC-N-WT</b>	Water	Fluoride in Water by IC	EPA 300.1 (mod)
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Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

<b>IONBALANCE-OP03-WT</b>	Water	Detailed Ion Balance Calculation	APHA 1030E, 2330B, 2510A
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<b>MET-T-CCMS-WT</b>	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)
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Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

# Reference Information

L2529340 CONT'D....  
Job Reference: 2006001  
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## Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).			
NH3-F-WT	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NO2-IC-WT	Water	Nitrite in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-IC-WT	Water	Nitrate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
PH-WT	Water	pH	APHA 4500 H-Electrode
Water samples are analyzed directly by a calibrated pH meter.			
Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011). Holdtime for samples under this regulation is 28 days			
PO4-DO-COL-WT	Water	Diss. Orthophosphate in Water by Colour	APHA 4500-P PHOSPHORUS
This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.			
REDOX-POTENTIAL-WT	Water	Redox Potential	APHA 2580
This analysis is carried out in accordance with the procedure described in the "APHA" method 2580 "Oxidation-Reduction Potential" 2012. Results are reported as observed oxidation-reduction potential of the platinum metal-reference electrode employed, in mV.			
It is recommended that this analysis be conducted in the field.			
SO4-IC-N-WT	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
SOLIDS-TDS-WT	Water	Total Dissolved Solids	APHA 2540C
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.			
TC-MF-WT	Water	Total Coliforms	SM 9222B
A 100mL volume of sample is filtered through a membrane, the membrane is placed on mENDO LES agar and incubated at 35–0.5°C for 24–2h. Method ID: WT-TM-1200			
TCB-MF-WT	Water	Total Coliform Background	SM 9222B
A 100mL volume of sample is filtered through a membrane, the membrane is placed on mENDO LES agar and incubated at 35–0.5°C for 24–2h. Method ID: WT-TM-1200.			
TURBIDITY-WT	Water	Turbidity	APHA 2130 B

# Reference Information

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Job Reference: 2006001  
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## Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
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Sample result is based on a comparison of the intensity of the light scattered by the sample under defined conditions with the intensity of light scattered by a standard reference suspension under the same conditions. Sample readings are obtained from a Nephelometer.

\*\*ALS test methods may incorporate modifications from specified reference methods to improve performance.

## Chain of Custody Numbers:

17-730090

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

## GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.

mg/kg - milligrams per kilogram based on dry weight of sample

mg/kg wwt - milligrams per kilogram based on wet weight of sample

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight

mg/L - unit of concentration based on volume, parts per million.

< - Less than.

D.L. - The reporting limit.

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guideline limits are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.



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**Client:** PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)  
74 Berkeley Street  
Toronto ON M5V 1E3

Contact: Nolan Boyes

## Quality Control Report

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Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)  
 74 Berkeley Street  
 Toronto ON M5V 1E3

Contact: Nolan Boyes

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
<b>BR-IC-N-WT</b>	<b>Water</b>							
Batch	R5286675							
WG3445932-11	MB							
Bromide (Br)			<0.10		mg/L		0.1	16-NOV-20
WG3445932-6	MB							
Bromide (Br)			<0.10		mg/L		0.1	16-NOV-20
WG3445932-10	MS	L2528970-1						
Bromide (Br)			103.5		%		75-125	16-NOV-20
WG3445932-15	MS	WG3445932-13						
Bromide (Br)			99.2		%		75-125	16-NOV-20
<b>CL-IC-N-WT</b>	<b>Water</b>							
Batch	R5286675							
WG3445932-14	DUP	WG3445932-13						
Chloride (Cl)			38.8	38.9	mg/L	0.2	20	16-NOV-20
WG3445932-9	DUP	L2528970-1						
Chloride (Cl)			5.56	5.57	mg/L	0.3	20	16-NOV-20
WG3445932-12	LCS							
Chloride (Cl)			99.9		%		90-110	16-NOV-20
WG3445932-7	LCS							
Chloride (Cl)			99.9		%		90-110	16-NOV-20
WG3445932-11	MB							
Chloride (Cl)			<0.50		mg/L		0.5	16-NOV-20
WG3445932-6	MB							
Chloride (Cl)			<0.50		mg/L		0.5	16-NOV-20
WG3445932-10	MS	L2528970-1						
Chloride (Cl)			101.4		%		75-125	16-NOV-20
WG3445932-15	MS	WG3445932-13						
Chloride (Cl)			102.4		%		75-125	16-NOV-20
<b>COLOUR-APPARENT-WT</b>	<b>Water</b>							
Batch	R5285431							
WG3444961-3	DUP	L2529532-1						
Colour, Apparent			2.4	2.8	CU	17	20	13-NOV-20
WG3444961-2	LCS							
Colour, Apparent			100.1		%		85-115	13-NOV-20
WG3444961-1	MB							
Colour, Apparent			<2.0		CU		2	13-NOV-20
<b>EC-MF-WT</b>	<b>Water</b>							

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**Client:** PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)  
 74 Berkeley Street  
 Toronto ON M5V 1E3

**Contact:** Nolan Boyes

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
<b>EC-MF-WT</b>	<b>Water</b>							
Batch	R5285726							
WG3445046-1	MB							
E. Coli			0		CFU/100mL		1	14-NOV-20
<b>EC-WT</b>	<b>Water</b>							
Batch	R5286532							
WG3445755-4	DUP	WG3445755-3						
Conductivity		751	754		umhos/cm	0.4	10	16-NOV-20
WG3445755-2	LCS							
Conductivity			103.3		%		90-110	16-NOV-20
WG3445755-1	MB							
Conductivity			<3.0		umhos/cm		3	16-NOV-20
Batch	R5286534							
WG3445757-4	DUP	WG3445757-3						
Conductivity		465	469		umhos/cm	0.9	10	16-NOV-20
WG3445757-2	LCS							
Conductivity			100.7		%		90-110	16-NOV-20
WG3445757-1	MB							
Conductivity			<3.0		umhos/cm		3	16-NOV-20
<b>F-IC-N-WT</b>	<b>Water</b>							
Batch	R5286675							
WG3445932-14	DUP	WG3445932-13						
Fluoride (F)		0.060	0.060		mg/L	0.6	20	16-NOV-20
WG3445932-9	DUP	L2528970-1						
Fluoride (F)		0.054	0.054		mg/L	0.0	20	16-NOV-20
WG3445932-12	LCS							
Fluoride (F)			103.0		%		90-110	16-NOV-20
WG3445932-7	LCS							
Fluoride (F)			102.9		%		90-110	16-NOV-20
WG3445932-11	MB							
Fluoride (F)			<0.020		mg/L		0.02	16-NOV-20
WG3445932-6	MB							
Fluoride (F)			<0.020		mg/L		0.02	16-NOV-20
WG3445932-10	MS	L2528970-1						
Fluoride (F)			100.9		%		75-125	16-NOV-20
WG3445932-15	MS	WG3445932-13						
Fluoride (F)			101.2		%		75-125	16-NOV-20
<b>MET-T-CCMS-WT</b>	<b>Water</b>							

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Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)  
 74 Berkeley Street  
 Toronto ON M5V 1E3

Contact: Nolan Boyes

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT	Water							
Batch	R5285965							
WG3445336-4	DUP	WG3445336-3						
Aluminum (Al)-Total	0.0078	0.0078			mg/L	0.2	20	16-NOV-20
Antimony (Sb)-Total	0.00011	0.00011			mg/L	2.2	20	16-NOV-20
Arsenic (As)-Total	0.00017	0.00015			mg/L	8.4	20	16-NOV-20
Barium (Ba)-Total	0.0574	0.0598			mg/L	4.2	20	16-NOV-20
Beryllium (Be)-Total	<0.00010	<0.00010	RPD-NA		mg/L	N/A	20	16-NOV-20
Bismuth (Bi)-Total	<0.000050	<0.000050	RPD-NA		mg/L	N/A	20	16-NOV-20
Boron (B)-Total	0.037	0.037			mg/L	0.0	20	16-NOV-20
Cadmium (Cd)-Total	0.0000109	0.0000140	J		mg/L	0.0000031	0.00001	16-NOV-20
Calcium (Ca)-Total	125	119			mg/L	4.3	20	16-NOV-20
Chromium (Cr)-Total	<0.00050	<0.00050	RPD-NA		mg/L	N/A	20	16-NOV-20
Cesium (Cs)-Total	0.000010	<0.000010	RPD-NA		mg/L	N/A	20	16-NOV-20
Cobalt (Co)-Total	<0.00010	<0.00010	RPD-NA		mg/L	N/A	20	16-NOV-20
Copper (Cu)-Total	0.00066	0.00068			mg/L	1.5	20	16-NOV-20
Iron (Fe)-Total	<0.010	<0.010	RPD-NA		mg/L	N/A	20	16-NOV-20
Lead (Pb)-Total	<0.000050	<0.000050	RPD-NA		mg/L	N/A	20	16-NOV-20
Magnesium (Mg)-Total	14.5	14.7			mg/L	1.1	20	16-NOV-20
Manganese (Mn)-Total	0.00052	0.00057			mg/L	8.0	20	16-NOV-20
Molybdenum (Mo)-Total	0.000740	0.000787			mg/L	6.1	20	16-NOV-20
Nickel (Ni)-Total	<0.00050	<0.00050	RPD-NA		mg/L	N/A	20	16-NOV-20
Phosphorus (P)-Total	<0.050	<0.050	RPD-NA		mg/L	N/A	20	16-NOV-20
Potassium (K)-Total	2.30	2.28			mg/L	0.7	20	16-NOV-20
Rubidium (Rb)-Total	0.00151	0.00147			mg/L	2.3	20	16-NOV-20
Selenium (Se)-Total	0.000162	0.000168			mg/L	3.2	20	16-NOV-20
Silicon (Si)-Total	4.22	4.16			mg/L	1.4	20	16-NOV-20
Silver (Ag)-Total	<0.000050	<0.000050	RPD-NA		mg/L	N/A	20	16-NOV-20
Sodium (Na)-Total	30.5	30.5			mg/L	0.0	20	16-NOV-20
Strontium (Sr)-Total	0.480	0.480			mg/L	0.1	20	16-NOV-20
Sulfur (S)-Total	34.2	33.7			mg/L	1.3	25	16-NOV-20
Thallium (Tl)-Total	0.000016	0.000014			mg/L	12	20	16-NOV-20
Tellurium (Te)-Total	<0.00020	<0.00020	RPD-NA		mg/L	N/A	20	16-NOV-20
Thorium (Th)-Total	<0.00010	<0.00010	RPD-NA		mg/L	N/A	25	16-NOV-20
Tin (Sn)-Total	<0.00010	<0.00010	RPD-NA		mg/L	N/A	20	16-NOV-20
Titanium (Ti)-Total	<0.00030	0.00034			mg/L			16-NOV-20

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Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)  
 74 Berkeley Street  
 Toronto ON M5V 1E3

Contact: Nolan Boyes

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT	Water							
Batch	R5285965							
WG3445336-4 DUP	WG3445336-3							
Titanium (Ti)-Total	<0.00030	0.00034	RPD-NA	mg/L	N/A	20	16-NOV-20	
Tungsten (W)-Total	<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	16-NOV-20	
Uranium (U)-Total	0.000540	0.000531		mg/L	1.7	20	16-NOV-20	
Vanadium (V)-Total	<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	16-NOV-20	
Zinc (Zn)-Total	<0.0030	<0.0030	RPD-NA	mg/L	N/A	20	16-NOV-20	
Zirconium (Zr)-Total	<0.00020	<0.00020	RPD-NA	mg/L	N/A	20	16-NOV-20	
WG3445336-2 LCS								
Aluminum (Al)-Total	105.3		%		80-120	16-NOV-20		
Antimony (Sb)-Total	103.1		%		80-120	16-NOV-20		
Arsenic (As)-Total	102.1		%		80-120	16-NOV-20		
Barium (Ba)-Total	104.1		%		80-120	16-NOV-20		
Beryllium (Be)-Total	97.3		%		80-120	16-NOV-20		
Bismuth (Bi)-Total	106.7		%		80-120	16-NOV-20		
Boron (B)-Total	95.7		%		80-120	16-NOV-20		
Cadmium (Cd)-Total	102.0		%		80-120	16-NOV-20		
Calcium (Ca)-Total	101.3		%		80-120	16-NOV-20		
Chromium (Cr)-Total	104.4		%		80-120	16-NOV-20		
Cesium (Cs)-Total	100.9		%		80-120	16-NOV-20		
Cobalt (Co)-Total	97.5		%		80-120	16-NOV-20		
Copper (Cu)-Total	102.5		%		80-120	16-NOV-20		
Iron (Fe)-Total	100.5		%		80-120	16-NOV-20		
Lead (Pb)-Total	107.9		%		80-120	16-NOV-20		
Magnesium (Mg)-Total	110.6		%		80-120	16-NOV-20		
Manganese (Mn)-Total	104.4		%		80-120	16-NOV-20		
Molybdenum (Mo)-Total	102.5		%		80-120	16-NOV-20		
Nickel (Ni)-Total	101.0		%		80-120	16-NOV-20		
Phosphorus (P)-Total	105.2		%		70-130	16-NOV-20		
Potassium (K)-Total	105.5		%		80-120	16-NOV-20		
Rubidium (Rb)-Total	102.7		%		80-120	16-NOV-20		
Selenium (Se)-Total	101.5		%		80-120	16-NOV-20		
Silicon (Si)-Total	104.6		%		60-140	16-NOV-20		
Silver (Ag)-Total	99.3		%		80-120	16-NOV-20		
Sodium (Na)-Total	106.7		%		80-120	16-NOV-20		

## Quality Control Report

Workorder: L2529340

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Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)  
 74 Berkeley Street  
 Toronto ON M5V 1E3

Contact: Nolan Boyes

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
<b>MET-T-CCMS-WT</b>		Water						
<b>Batch R5285965</b>								
WG3445336-2	LCS							
Strontium (Sr)-Total			104.4		%	80-120	16-NOV-20	
Sulfur (S)-Total			103.3		%	80-120	16-NOV-20	
Thallium (Tl)-Total			105.3		%	80-120	16-NOV-20	
Tellurium (Te)-Total			95.2		%	80-120	16-NOV-20	
Thorium (Th)-Total			105.0		%	70-130	16-NOV-20	
Tin (Sn)-Total			101.8		%	80-120	16-NOV-20	
Titanium (Ti)-Total			99.3		%	80-120	16-NOV-20	
Tungsten (W)-Total			102.3		%	80-120	16-NOV-20	
Uranium (U)-Total			106.4		%	80-120	16-NOV-20	
Vanadium (V)-Total			104.3		%	80-120	16-NOV-20	
Zinc (Zn)-Total			100.2		%	80-120	16-NOV-20	
Zirconium (Zr)-Total			96.6		%	80-120	16-NOV-20	
WG3445336-1	MB							
Aluminum (Al)-Total			<0.0050		mg/L	0.005	16-NOV-20	
Antimony (Sb)-Total			<0.00010		mg/L	0.0001	16-NOV-20	
Arsenic (As)-Total			<0.00010		mg/L	0.0001	16-NOV-20	
Barium (Ba)-Total			<0.00010		mg/L	0.0001	16-NOV-20	
Beryllium (Be)-Total			<0.00010		mg/L	0.0001	16-NOV-20	
Bismuth (Bi)-Total			<0.000050		mg/L	0.00005	16-NOV-20	
Boron (B)-Total			<0.010		mg/L	0.01	16-NOV-20	
Cadmium (Cd)-Total			<0.0000050		mg/L	0.000005	16-NOV-20	
Calcium (Ca)-Total			<0.050		mg/L	0.05	16-NOV-20	
Chromium (Cr)-Total			<0.00050		mg/L	0.0005	16-NOV-20	
Cesium (Cs)-Total			<0.000010		mg/L	0.00001	16-NOV-20	
Cobalt (Co)-Total			<0.00010		mg/L	0.0001	16-NOV-20	
Copper (Cu)-Total			<0.00050		mg/L	0.0005	16-NOV-20	
Iron (Fe)-Total			<0.010		mg/L	0.01	16-NOV-20	
Lead (Pb)-Total			<0.000050		mg/L	0.00005	16-NOV-20	
Magnesium (Mg)-Total			<0.0050		mg/L	0.005	16-NOV-20	
Manganese (Mn)-Total			<0.00050		mg/L	0.0005	16-NOV-20	
Molybdenum (Mo)-Total			<0.000050		mg/L	0.00005	16-NOV-20	
Nickel (Ni)-Total			<0.00050		mg/L	0.0005	16-NOV-20	
Phosphorus (P)-Total			<0.050		mg/L	0.05	16-NOV-20	
Potassium (K)-Total			<0.050		mg/L	0.05	16-NOV-20	

## Quality Control Report

Workorder: L2529340

Report Date: 20-NOV-20

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Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)  
 74 Berkeley Street  
 Toronto ON M5V 1E3

Contact: Nolan Boyes

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT	Water							
Batch	R5285965							
WG3445336-1	MB							
Rubidium (Rb)-Total			<0.00020		mg/L	0.0002	16-NOV-20	
Selenium (Se)-Total			<0.000050		mg/L	0.00005	16-NOV-20	
Silicon (Si)-Total			<0.10		mg/L	0.1	16-NOV-20	
Silver (Ag)-Total			<0.000050		mg/L	0.00005	16-NOV-20	
Sodium (Na)-Total			<0.050		mg/L	0.05	16-NOV-20	
Strontium (Sr)-Total			<0.0010		mg/L	0.001	16-NOV-20	
Sulfur (S)-Total			<0.50		mg/L	0.5	16-NOV-20	
Thallium (Tl)-Total			<0.000010		mg/L	0.00001	16-NOV-20	
Tellurium (Te)-Total			<0.00020		mg/L	0.0002	16-NOV-20	
Thorium (Th)-Total			<0.00010		mg/L	0.0001	16-NOV-20	
Tin (Sn)-Total			<0.00010		mg/L	0.0001	16-NOV-20	
Titanium (Ti)-Total			<0.00030		mg/L	0.0003	16-NOV-20	
Tungsten (W)-Total			<0.00010		mg/L	0.0001	16-NOV-20	
Uranium (U)-Total			<0.000010		mg/L	0.00001	16-NOV-20	
Vanadium (V)-Total			<0.00050		mg/L	0.0005	16-NOV-20	
Zinc (Zn)-Total			<0.0030		mg/L	0.003	16-NOV-20	
Zirconium (Zr)-Total			<0.00020		mg/L	0.0002	16-NOV-20	
WG3445336-5	MS	WG3445336-6						
Aluminum (Al)-Total			102.4		%	70-130	16-NOV-20	
Antimony (Sb)-Total			99.9		%	70-130	16-NOV-20	
Arsenic (As)-Total			99.4		%	70-130	16-NOV-20	
Barium (Ba)-Total		N/A	MS-B		%	-	16-NOV-20	
Beryllium (Be)-Total			97.8		%	70-130	16-NOV-20	
Bismuth (Bi)-Total			95.1		%	70-130	16-NOV-20	
Boron (B)-Total			98.6		%	70-130	16-NOV-20	
Cadmium (Cd)-Total			100.9		%	70-130	16-NOV-20	
Calcium (Ca)-Total		N/A	MS-B		%	-	16-NOV-20	
Chromium (Cr)-Total			99.3		%	70-130	16-NOV-20	
Cesium (Cs)-Total			97.7		%	70-130	16-NOV-20	
Cobalt (Co)-Total			93.0		%	70-130	16-NOV-20	
Copper (Cu)-Total			93.2		%	70-130	16-NOV-20	
Iron (Fe)-Total			95.0		%	70-130	16-NOV-20	
Lead (Pb)-Total			99.8		%	70-130	16-NOV-20	
Magnesium (Mg)-Total		N/A	MS-B		%	-	16-NOV-20	

## Quality Control Report

Workorder: L2529340

Report Date: 20-NOV-20

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Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)  
 74 Berkeley Street  
 Toronto ON M5V 1E3

Contact: Nolan Boyes

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
<b>MET-T-CCMS-WT</b>	<b>Water</b>							
<b>Batch</b>	<b>R5285965</b>							
<b>WG3445336-5 MS</b>		<b>WG3445336-6</b>						
Manganese (Mn)-Total			98.7		%		70-130	16-NOV-20
Molybdenum (Mo)-Total			101.5		%		70-130	16-NOV-20
Nickel (Ni)-Total			95.2		%		70-130	16-NOV-20
Phosphorus (P)-Total			101.2		%		70-130	16-NOV-20
Potassium (K)-Total			N/A	MS-B	%		-	16-NOV-20
Rubidium (Rb)-Total			98.6		%		70-130	16-NOV-20
Selenium (Se)-Total			101.9		%		70-130	16-NOV-20
Silicon (Si)-Total			N/A	MS-B	%		-	16-NOV-20
Silver (Ag)-Total			93.7		%		70-130	16-NOV-20
Sodium (Na)-Total			N/A	MS-B	%		-	16-NOV-20
Strontium (Sr)-Total			N/A	MS-B	%		-	16-NOV-20
Sulfur (S)-Total			N/A	MS-B	%		-	16-NOV-20
Thallium (Tl)-Total			98.1		%		70-130	16-NOV-20
Tellurium (Te)-Total			95.1		%		70-130	16-NOV-20
Thorium (Th)-Total			101.6		%		70-130	16-NOV-20
Tin (Sn)-Total			99.8		%		70-130	16-NOV-20
Titanium (Ti)-Total			99.5		%		70-130	16-NOV-20
Tungsten (W)-Total			99.1		%		70-130	16-NOV-20
Uranium (U)-Total			N/A	MS-B	%		-	16-NOV-20
Vanadium (V)-Total			100.9		%		70-130	16-NOV-20
Zinc (Zn)-Total			91.8		%		70-130	16-NOV-20
Zirconium (Zr)-Total			96.3		%		70-130	16-NOV-20
<b>NH3-F-WT</b>	<b>Water</b>							
<b>Batch</b>	<b>R5286522</b>							
<b>WG3444943-3 DUP</b>		<b>WG3444943-5</b>						
Ammonia, Total (as N)			<0.010		<0.010		RPD-NA	mg/L
							N/A	20
								16-NOV-20
<b>WG3444943-2 LCS</b>								
Ammonia, Total (as N)								85-115
								16-NOV-20
<b>WG3444943-1 MB</b>								
Ammonia, Total (as N)								0.01
								16-NOV-20
<b>WG3444943-4 MS</b>		<b>WG3444943-5</b>						
Ammonia, Total (as N)								75-125
								16-NOV-20
<b>NO2-IC-WT</b>	<b>Water</b>							

## Quality Control Report

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Report Date: 20-NOV-20

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Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)  
 74 Berkeley Street  
 Toronto ON M5V 1E3

Contact: Nolan Boyes

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
<b>NO2-IC-WT</b>	Water							
Batch	R5286675							
WG3445932-14	DUP	<b>WG3445932-13</b>						
Nitrite (as N)		<0.010	<0.010	RPD-NA	mg/L	N/A	20	16-NOV-20
WG3445932-9	DUP	<b>L2528970-1</b>						
Nitrite (as N)		<0.010	<0.010	RPD-NA	mg/L	N/A	20	16-NOV-20
WG3445932-12	LCS							
Nitrite (as N)		99.95			%		90-110	16-NOV-20
WG3445932-7	LCS							
Nitrite (as N)		100.1			%		90-110	16-NOV-20
WG3445932-11	MB							
Nitrite (as N)		<0.010			mg/L		0.01	16-NOV-20
WG3445932-6	MB							
Nitrite (as N)		<0.010			mg/L		0.01	16-NOV-20
WG3445932-10	MS	<b>L2528970-1</b>						
Nitrite (as N)		101.1			%		75-125	16-NOV-20
WG3445932-15	MS	<b>WG3445932-13</b>						
Nitrite (as N)		102.6			%		75-125	16-NOV-20
<b>NO3-IC-WT</b>	Water							
Batch	R5286675							
WG3445932-14	DUP	<b>WG3445932-13</b>						
Nitrate (as N)		1.11	1.11		mg/L	0.0	20	16-NOV-20
WG3445932-9	DUP	<b>L2528970-1</b>						
Nitrate (as N)		<0.020	<0.020	RPD-NA	mg/L	N/A	20	16-NOV-20
WG3445932-12	LCS							
Nitrate (as N)		99.2			%		90-110	16-NOV-20
WG3445932-7	LCS							
Nitrate (as N)		99.2			%		90-110	16-NOV-20
WG3445932-11	MB							
Nitrate (as N)		<0.020			mg/L		0.02	16-NOV-20
WG3445932-6	MB							
Nitrate (as N)		<0.020			mg/L		0.02	16-NOV-20
WG3445932-10	MS	<b>L2528970-1</b>						
Nitrate (as N)		98.7			%		75-125	16-NOV-20
WG3445932-15	MS	<b>WG3445932-13</b>						
Nitrate (as N)		101.9			%		75-125	16-NOV-20
<b>PH-WT</b>	Water							

## Quality Control Report

Workorder: L2529340

Report Date: 20-NOV-20

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**Client:** PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)  
 74 Berkeley Street  
 Toronto ON M5V 1E3

**Contact:** Nolan Boyes

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PH-WT	Water							
Batch	R5286532							
WG3445755-4	DUP	WG3445755-3						
pH		7.54	7.55	J	pH units	0.01	0.2	16-NOV-20
WG3445755-2	LCS							
pH			7.00		pH units		6.9-7.1	16-NOV-20
Batch	R5286534							
WG3445757-4	DUP	WG3445757-3						
pH		7.92	7.93	J	pH units	0.01	0.2	16-NOV-20
WG3445757-2	LCS							
pH			7.00		pH units		6.9-7.1	16-NOV-20
PO4-DO-COL-WT	Water							
Batch	R5287491							
WG3446133-3	DUP	WG3446133-5						
Orthophosphate-Dissolved (as P)		<0.0030	<0.0030	RPD-NA	mg/L	N/A	20	18-NOV-20
WG3446133-2	LCS				%		80-120	18-NOV-20
Orthophosphate-Dissolved (as P)			93.1					
WG3446133-1	MB							
Orthophosphate-Dissolved (as P)			<0.0030		mg/L		0.003	18-NOV-20
WG3446133-4	MS	WG3446133-5						
Orthophosphate-Dissolved (as P)			98.9		%		70-130	18-NOV-20
REDOX-POTENTIAL-WT	Water							
Batch	R5289959							
WG3448319-1	CRM	WT-REDOX						
Redox Potential			101.5		%		80-120	19-NOV-20
WG3448319-2	DUP	L2529532-3						
Redox Potential		320	311		mV	2.9	25	19-NOV-20
SO4-IC-N-WT	Water							
Batch	R5286675							
WG3445932-14	DUP	WG3445932-13						
Sulfate (SO4)		24.1	24.1		mg/L	0.0	20	16-NOV-20
WG3445932-9	DUP	L2528970-1						
Sulfate (SO4)		41.5	41.5		mg/L	0.0	20	16-NOV-20
WG3445932-12	LCS							
Sulfate (SO4)			100.9		%		90-110	16-NOV-20
WG3445932-7	LCS							
Sulfate (SO4)			100.9		%		90-110	16-NOV-20
WG3445932-11	MB							
Sulfate (SO4)			<0.30		mg/L		0.3	16-NOV-20

## Quality Control Report

Workorder: L2529340

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**Client:** PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)  
 74 Berkeley Street  
 Toronto ON M5V 1E3

**Contact:** Nolan Boyes

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
<b>SO4-IC-N-WT</b>	Water							
Batch	R5286675							
WG3445932-6	MB							
Sulfate (SO4)			<0.30		mg/L	0.3	16-NOV-20	
WG3445932-10	MS	L2528970-1						
Sulfate (SO4)			102.5		%	75-125	16-NOV-20	
WG3445932-15	MS	WG3445932-13						
Sulfate (SO4)			104.2		%	75-125	16-NOV-20	
<b>SOLIDS-TDS-WT</b>	Water							
Batch	R5287668							
WG3446488-3	DUP	WG3446488-4						
Total Dissolved Solids			256	257	mg/L	0.6	20	17-NOV-20
WG3446488-2	LCS							
Total Dissolved Solids			85.1		%	85-115	17-NOV-20	
WG3446488-1	MB							
Total Dissolved Solids			<10		mg/L	10	17-NOV-20	
<b>TC-MF-WT</b>	Water							
Batch	R5285724							
WG3445048-1	MB							
Total Coliforms			0		CFU/100mL	1	14-NOV-20	
<b>TCB-MF-WT</b>	Water							
Batch	R5285724							
WG3445048-1	MB							
Total Coliform Background			0		CFU/100mL	1	14-NOV-20	
<b>TURBIDITY-WT</b>	Water							
Batch	R5285537							
WG3444999-3	DUP	L2529534-1						
Turbidity			54.2	53.8	NTU	0.7	15	14-NOV-20
WG3444999-2	LCS							
Turbidity			101.5		%	85-115	14-NOV-20	
WG3444999-1	MB							
Turbidity			<0.10		NTU	0.1	14-NOV-20	

# Quality Control Report

Workorder: L2529340

Report Date: 20-NOV-20

Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)  
74 Berkeley Street  
Toronto ON M5V 1E3

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Contact: Nolan Boyes

## Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

## Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

# Quality Control Report

Workorder: L2529340

Report Date: 20-NOV-20

Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)  
74 Berkeley Street  
Toronto ON M5V 1E3

Contact: Nolan Boyes

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**Hold Time Exceedances:**

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
<b>Physical Tests</b>							
Redox Potential	1	12-NOV-20 15:00	19-NOV-20 00:00	0.25	153	hours	EHTR-FM
	2	12-NOV-20 16:00	19-NOV-20 00:00	0.25	152	hours	EHTR-FM
	3	12-NOV-20 16:00	19-NOV-20 00:00	0.25	152	hours	EHTR-FM
	4	12-NOV-20 16:30	19-NOV-20 00:00	0.25	151	hours	EHTR-FM
	5	12-NOV-20 16:30	19-NOV-20 00:00	0.25	151	hours	EHTR-FM

**Legend & Qualifier Definitions:**

EHTR-FM: Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.

EHTR: Exceeded ALS recommended hold time prior to sample receipt.

EHTL: Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.

EHT: Exceeded ALS recommended hold time prior to analysis.

Rec. HT: ALS recommended hold time (see units).

**Notes\*:**

Where actual sampling date is not provided to ALS, the date (&amp; time) of receipt is used for calculation purposes.

Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (&amp; date) of receipt is used for calculation purposes. Samples for L2529340 were received on 13-NOV-20 12:56.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.



**ALS Environmental**  
www.alsglobal.com

**Chain of Custody (COC) / Analytical  
Request Form**

Canada Toll Free: 1 800 668 9878



C Number: 17 - 730090

Page \_\_\_\_\_ of \_\_\_\_\_

Report To		Contact and company name below will appear on the final report		Report Format / Distribution		Select Service Level Below - Contact your AM to confirm all E&P TATS (surcharges may apply)									
Company:	Palmer Environmental Consulting Ltd.		Select Report Format:	<input checked="" type="checkbox"/> PDF <input checked="" type="checkbox"/> EXCEL <input type="checkbox"/> EDD (DIGITAL)	Quality Control (QC) Report with Report	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO	Regular [R]		<input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply						
Contact:			<input type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked				4 day [P4-20%]		<input type="checkbox"/>	1 Business day [E-100%]					
Phone:	647 - 795 - 8153						3 day [P3-25%]		<input type="checkbox"/>	Same Day, Weekend or Statutory holiday [E2-200%]					
Company address below will appear on the final report						2 day [P2-50%]		<input type="checkbox"/>	Laboratory opening fees may apply)						
Street:	741 Bloor St.		Email 1 or Fax	nolan.bryce@pecg.ca		Data and Time Required for all E&P TATS:									
City/Province:	Toronto, ON		Email 2			For tests that can not be performed according to the service level selected, you will be contacted.									
Postal Code:	M5A 2W7		Email 3			Analysis Request									
Invoice To	Same as Report To <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		Invoice Distribution		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below										
	Copy of Invoice with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		Select Invoice Distribution:	<input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX											
Company:			Email 1 or Fax												
Contact:			Email 2												
Project Information								Potability							
ALS Account # / Quote #:	2006001		AFE/Cost Center:	PO#											
Job #:			Major/Minor Code:	Routing Code:											
PO / AFE:			Requisitioner:												
LSD:			Location:												
ALS Lab Work Order # (lab use only): LQ529340 RD			ALS Contact:	Sampler:											
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)			Date (dd-mmm-yy)	Time (hh:mm)	Sample Type						SAMPLES ON HOLD			
	PW3			12-Nov-20	3:20PM	W ✓						Sample is hazardous (please provide further details)			
	SO88			12-Nov-20	4:00PM	W ✓						NUMBER OF CONTAINERS			
	121			12-Nov-20	4:00PM	W ✓									
	5161			12-Nov-20	4:30PM	W ✓									
	1003			12-Nov-20	4:30PM	W ✓									
Drinking Water (DW) Samples <sup>1</sup> (client use)			Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)						SAMPLE CONDITION AS RECEIVED (lab use only)						
Are samples taken from a Regulated DW System?			Compare to micro / aestheticic ODWS						Frozen <input type="checkbox"/>	SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/>					
<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO									Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/>						
Are samples for human consumption/ use?									Cooling Initiated <input type="checkbox"/>	INITIAL COOLER TEMPERATURES °C		FINAL COOLER TEMPERATURES °C			
<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO									5.3			5.4			
SHIPMENT RELEASE (client use)						INITIAL SHIPMENT RECEIPTION (lab use only)						FINAL SHIPMENT RECEIPTION (lab use only)			
Released by: <i>M. Bryce</i>	Date: Nov 13, 2020	Time: 12:53	Received by: <i>Karen Hartley</i>	Date: 13/2020	Time: 12:56	Received by: <i>M</i>	Date: Nov 13/20	Time: 17:00							

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

## **Appendix F – Private Groundwater Chemistry (Palmer, 2020)**

*Appendix 7. Private Well Groundwater Chemistry*

Parameters	5088 County Road 21	5161 County Road 21	121 Mallard Road	1003 Bolender By The Lake Avenue	Aesthetic Ontario Drinking Water Standard	Microbiological and Chemical Ontario Drinking Water Standard	Lowest Detection Limit	Units
<b>Physical Tests (Water)</b>								
Colour, Apparent	2.8	<2.0	<2.0	2.3	5	-	2.0	CU
Conductivity	1910	846	192	1300	-	-	3.0	umhos/cm
pH	7.67	7.95	7.58	7.67	6.5 -> 8.5	-	0.10	pH units
Redox Potential	304	295	311	305	-	-	-1000	mV
Total Dissolved Solids	1220	591	100	786	500	-	13	mg/L
Turbidity	1.33	1.18	1.02	0.84	5	-	0.10	NTU
<b>Anions and Nutrients (Water)</b>								
Alkalinity, Bicarbonate (as CaCO <sub>3</sub> )	168	135	87.5	137	-	-	2.0	mg/L
Alkalinity, Carbonate (as CaCO <sub>3</sub> )	<2.0	<2.0	<2.0	<2.0	-	-	2.0	mg/L
Alkalinity, Hydroxide (as CaCO <sub>3</sub> )	<2.0	<2.0	<2.0	<2.0	-	-	2.0	mg/L
Alkalinity, Total (as CaCO <sub>3</sub> )	168	135	87.5	137	30 -> 500	-	2.0	mg/L
Ammonia, Total (as N)	<0.010	<0.010	0.022	<0.010	-	-	0.010	mg/L
Bromide (Br)	<0.50	<0.10	<0.10	<0.50	-	-	0.10	mg/L
Chloride (Cl)	507	76.4	1.44	308	250	-	0.50	mg/L
Computed Conductivity	1720	858	180	1150	-	-		uS/cm
Conductivity % Difference	-10	1	-6	-12	-	-		%
Fluoride (F)	<0.10	1.02	0.095	0.42	-	1.5	0.020	mg/L
Hardness (as CaCO <sub>3</sub> )	622	377	94.1	282	80 -> 100	-		mg/L
Ion Balance	107	102	120	104	-	-		%
Langelier Index	1	1	0	0	-	-		-
Nitrate (as N)	0.57	0.043	0.120	0.87	-	10	0.020	mg/L
Nitrite (as N)	<0.050	<0.010	<0.010	<0.050	-	1	0.010	mg/L
Saturation pH	7.01	7.21	7.92	7.38	-	-		pH
Orthophosphate-Dissolved (as P)	<0.0030	<0.0030	<0.0030	<0.0030	-	-	0.0030	mg/L
TDS (Calculated)	1020	524	103	675	-	-		mg/L
Sulfate (SO <sub>4</sub> )	24.2	193	9.63	26.3	500	-	0.30	mg/L
Anion Sum	17.6	8.44	1.69	11.6	-	-		me/L
Cation Sum	18.9	8.6	2.03	12	-	-		me/L
Cation - Anion Balance	3	1	9	2	-	-		%
<b>Inorganic Parameters (Water)</b>								
Silica	10.2	11.6	12.2	8.6	-	-	0.21	mg/L
<b>Bacteriological Tests (Water)</b>								
E. Coli	0	0	0	0	-	0		CFU/100 mL
Total Coliform Background	0	0	0	37	-	-	0	CFU/100 mL
Total Coliforms	0	0	0	0	-	0	0	CFU/100 mL
<b>Metals (Water)</b>								
Sodium Adsorption Ratio	2.5	0.51	0.11	3.71	-	-	0.10	SAR
<b>Total Metals (Water)</b>								
Aluminum (Al)-Total	<0.010	<0.010	<0.010	<0.010	0.1	-	0.010	mg/L
Antimony (Sb)-Total	<0.00010	<0.00010	<0.00010	<0.00010	-	0.006	0.00010	mg/L
Arsenic (As)-Total	0.00013	<0.00010	<0.00010	0.00016	-	0.01	0.00010	mg/L
Barium (Ba)-Total	0.262	0.0296	0.0250	0.198	-	1	0.00020	mg/L
Beryllium (Be)-Total	<0.00010	<0.00010	<0.00010	<0.00010	-	-	0.00010	mg/L
Bismuth (Bi)-Total	<0.000050	<0.000050	<0.000050	<0.000050	-	-	0.000050	mg/L

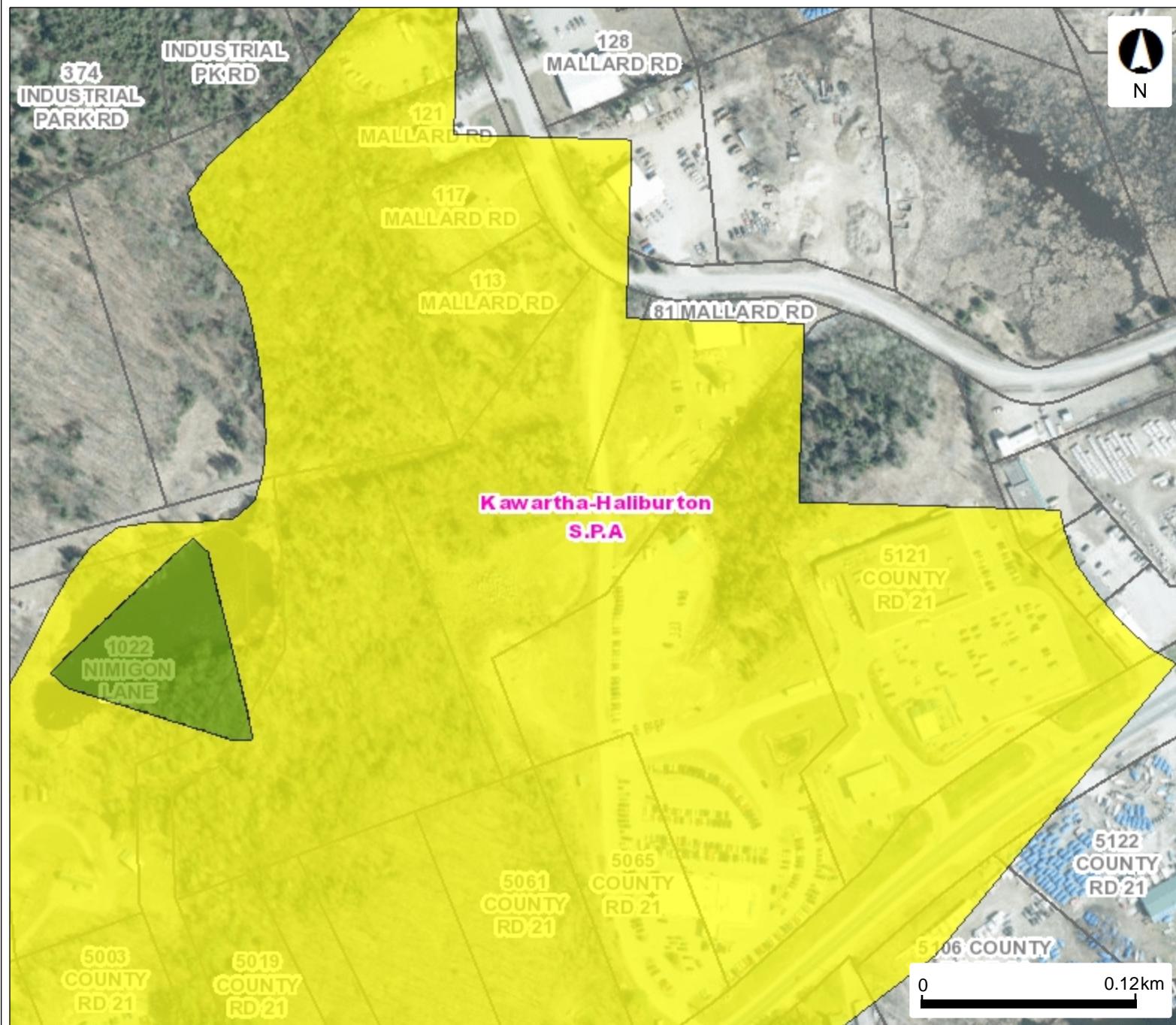
<b>Boron (B)-Total</b>	0.016	0.112	<0.010	0.021	-	5	0.010	mg/L
<b>Cadmium (Cd)-Total</b>	0.000031	<0.000010	<0.000010	<0.000010	-	0.005	0.000010	mg/L
<b>Calcium (Ca)-Total</b>	208	141	31.3	94.6	-	-	0.50	mg/L
<b>Cesium (Cs)-Total</b>	0.000038	<0.000010	<0.000010	0.000016	-	-	0.000010	mg/L
<b>Chromium (Cr)-Total</b>	<0.00050	<0.00050	<0.00050	0.00067	-	0.05	0.00050	mg/L
<b>Cobalt (Co)-Total</b>	<0.00010	<0.00010	<0.00010	<0.00010	-	-	0.00010	mg/L
<b>Copper (Cu)-Total</b>	0.0735	0.0065	0.0813	0.0667	1	-	0.0010	mg/L
<b>Iron (Fe)-Total</b>	<0.050	<0.050	0.063	<0.050	0.3	-	0.050	mg/L
<b>Lead (Pb)-Total</b>	0.00264	0.00210	0.00042	0.00011	-	0.01	0.00010	mg/L
<b>Magnesium (Mg)-Total</b>	24.7	6.01	3.90	11.2	-	-	0.050	mg/L
<b>Manganese (Mn)-Total</b>	0.0313	0.0536	0.00469	0.00750	0.05	-	0.00050	mg/L
<b>Molybdenum (Mo)-Total</b>	0.00214	0.00423	0.00179	0.00393	-	-	0.000050	mg/L
<b>Nickel (Ni)-Total</b>	0.00158	<0.00050	<0.00050	0.00063	-	-	0.00050	mg/L
<b>Phosphorus (P)-Total</b>	<0.050	<0.050	<0.050	<0.050	-	-	0.050	mg/L
<b>Potassium (K)-Total</b>	8.30	3.40	1.55	5.03	-	-	0.050	mg/L
<b>Rubidium (Rb)-Total</b>	0.00595	0.00296	0.00094	0.00448	-	-	0.00020	mg/L
<b>Selenium (Se)-Total</b>	0.000430	0.000133	0.000159	0.000115	-	0.05	0.000050	mg/L
<b>Silicon (Si)-Total</b>	4.76	5.44	5.71	4.02	-	-	0.10	mg/L
<b>Silver (Ag)-Total</b>	<0.000050	<0.000050	<0.000050	<0.000050	-	-	0.000050	mg/L
<b>Sodium (Na)-Total</b>	<b>143</b>	<b>22.6</b>	2.42	<b>143</b>	200	20	0.50	mg/L
<b>Strontium (Sr)-Total</b>	2.29	4.31	0.217	1.33	-	-	0.0010	mg/L
<b>Sulfur (S)-Total</b>	8.84	67.5	3.09	9.01	-	-	0.50	mg/L
<b>Tellurium (Te)-Total</b>	0.00023	0.00046	<0.00020	<0.00020	-	-	0.00020	mg/L
<b>Thallium (Tl)-Total</b>	0.000019	<0.000010	<0.000010	<0.000010	-	-	0.000010	mg/L
<b>Thorium (Th)-Total</b>	<0.00010	<0.00010	<0.00010	<0.00010	-	-	0.00010	mg/L
<b>Tin (Sn)-Total</b>	0.00014	0.00044	0.00011	<0.00010	-	-	0.00010	mg/L
<b>Titanium (Ti)-Total</b>	<0.00030	<0.00030	<0.00030	<0.00030	-	-	0.00030	mg/L
<b>Tungsten (W)-Total</b>	<0.00010	0.00029	<0.00010	0.00013	-	-	0.00010	mg/L
<b>Uranium (U)-Total</b>	<b>0.0312</b>	0.00907	0.00315	0.0158	-	0.02	0.000010	mg/L
<b>Vanadium (V)-Total</b>	0.00135	0.00184	0.00075	<0.00050	-	-	0.00050	mg/L
<b>Zinc (Zn)-Total</b>	0.0992	0.0399	0.0035	0.0097	5	-	0.0030	mg/L
<b>Zirconium (Zr)-Total</b>	<0.00030	<0.00030	<0.00030	<0.00030	-	-	0.00030	mg/L

\*Aesthetic Exceedances Italicized

\*Microbiological and Chemical Exceedances Bolded

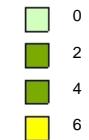
# **Appendix G – Source Water Protection**

# Source Water Protection



**Legend**

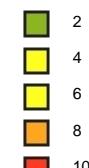
- Source Protection Areas  
Significant Groundwater Recharge Area



Wellhead Protection Area



Vulnerable Scoring Area - Groundwater



Assessment Parcel

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