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**2025 Biennial Groundwater Monitoring
Report - Maryhill Well Field (MH1, MH2)**

The Region of Waterloo



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Report - Maryhill Well Field
(MH1, MH2)**

The Region of Waterloo

**R.J. Burnside & Associates Limited
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**June 2026
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Distribution List

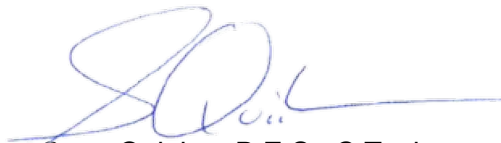
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R.J. Burnside & Associates Limited

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1.0 Introduction

The Regional Municipality of Waterloo (the Region) is unique in Ontario in that it is the largest urban municipality to rely almost exclusively on groundwater supplies for its drinking-water (Region of Waterloo, 2015). Figure 1 shows the location of municipal well fields within the Region.

The Permit to Take Water (PTTW 2613-BBKR76) for the Maryhill Well Field, requires submission of a well field specific biennial report to the Ministry of Environment, Conservation and Parks (MECP) which documents production well pumping volumes and water levels in specific monitoring wells during 2024 and 2025. This report has been prepared to meet the reporting condition of the PTTW for 2024 and 2025. A copy of the PTTW is included in Appendix A.

The location of the Maryhill Well Field is shown in Figure 1 and the production wells in Woolwich are shown in Figure 2 with the monitoring network for MH1 and MH2 shown in Figure 3. Well records for the production and monitoring wells are found in Appendix B.

1.1 Scope of Work

The Region records water levels on a regular basis within a network of monitoring wells to satisfy the requirements of their PTTW and to confirm that water taking is sustainable in the long term. The monitoring wells are concentrated near the production wells. The data from these wells and regular measurements of pumping volume obtained from the production wells are used to evaluate the impact of Region pumping on aquifers and potential impacts to private wells, other water takers and the natural environment.

The Region has developed a monitoring program for the Maryhill Well Field (MH1 and MH2) in accordance with PTTW 2613-BBKR76 which consists of the following activities:

- Measuring the daily volume pumped from the MH1 and MH2 production wells (Condition 4.1 of the PTTW);
- Measuring the water levels in monitoring wells WH-MH-OW01-09-AB (Condition 4.2 of the PTTW);
- Review of precipitation data from the nearest GRCA / Environment Canada weather station (Condition 4.3 of the PTTW); and
- Completion of a biennial report (every 2 years) that presents data in compliance with condition 4.3 of the PTTW

The Monitoring data (pumped volumes and hydrographs) are found in Appendix C with precipitation data in Appendix D. The monitoring program procedures and methodology are included in Appendix E.

2.0 Site Setting

2.1 Well Field Description

The Maryhill Well Field is located in the southeast portion of the Township of Woolwich. Wells MH1 and MH2 are southeast of the intersection of Maryhill Road and St. Charles Street. The closest municipal well field is the Maryhill Heights Well Field (MH3, MH4A and MH5), located approximately 1 km to the north (Figure 2). The closest surface water feature to the MH1 and MH2 site is Hopewell Creek, a tributary of the Grand River, located 315 m to the east (Figure 3).

2.1.1 Pumping Wells

Well records for the production wells are found in Appendix B.

A summary of the production well construction details is provided in Table 1 below.

Table 1: Production Well Construction Details

Well Name	Year Built	Casing Diameter (mm)	Open Hole Diameter (mm)	Open Hole interval (mbgs)	Aquifer
MH1	1968	200	125	37.2 to 44.3	Guelph Formation
MH2	1974	203	203*	18.5 to 19.9	AFD1*

Note: *MH2 is screened in overburden. Aquifer interpretation is based on borehole log information and does not necessarily match aquifer model representation shown on cross-sections (Figures 5 and 6).

The water taking volumes for the Maryhill MH1 and MH2 Well Field are regulated by Condition 3.2 of the PTTW and are summarized in Table 2 below.

Table 2: Annual Water Taking 2024 / 2025

Well	PTTW Details	2024			2025		
		Avg. Daily Water Taking (m ³)	Max Taken per Day (m ³)	Total Volume Pumped (m ³)	Avg. Daily Water Taking (m ³)	Max Taken per Day (m ³)	Total Volume Pumped (m ³)
MH1	157.1	0	0	0	0.05	14	17
MH2	157.1	30	61	10,905	0.3	27	111
Combined	157.1*	30	61	10,905	0.35	27	128

*the Permit Holder shall not exceed the maximum rate and amount of taking of 109 L/ min and 157,110 L/ day from any well or both wells.

Production well MH2 was the primary pumping well during 2024 and 2025 with MH1 off-line for most of 2024 / 2025. The pumping volumes are based on the total daily volumes as recorded by the Region's SCADA system and are presented in Appendix C as total monthly volumes. Pumping in the Maryhill Well Field (MH1 and MH2) was reduced from November 2024 through 2025 due to a facility upgrade project, while pumping increased at the Maryhill Heights Well Field (MH4A and MH5). Pumping volumes from the Maryhill well field ranged from 0 m³/month to 1,316 m³/month in 2024, and from 0 m³/month to 68 m³/month in 2025. In total, 10,905 m³ was produced at this well field in 2024 and 128 m³ was produced in 2025. The 2025 total volume is the lowest in the last five years, and below the permitted volume of 57,345 m³ per year (Table C-1).

2.1.2 Monitoring Wells

Observation wells WH-MH-OW01-09-A and WH-MH-OW01-09-B are located approximately 410 m north of wells MH1 and MH2 (Figure 3). WH-MH-OW01-09-A is a bedrock well and WH-MH-OW01-09-B is an overburden monitoring well, both of which were constructed to monitor water levels near the production wells.

Construction and monitoring details of WH-MH-OW01-09-A and WH-MH-OW01-B are described in Table 3 below. Well records for the monitoring wells are provided in Appendix B.

Table 3: Monitoring Well Construction Details

Monitoring Well ID	Year Built	Screened Depth (mbgs)	Screened Formation	Distance to MH1 (m)	Distance to MH2A (m)
WH-MH-OW01-09-A	2009	44.5	Guelph Formation	412	409
WH-MH-OW01-09-B	2009	29.6	AFD1	412	409

2.2 Regional Geology and Hydrostratigraphy

The following sections provide a brief overview of the regional geology and hydrogeology of the Maryhill Well Field. The surficial geology based on regional OGS mapping is provided in Figure 4. Representative cross-sections showing the stratigraphy in the vicinity of the Maryhill Well Field (MH1, MH2) are included as Figures 5 and 6. The cross-section locations are provided in Figure 3.

Note that the cross-sections are provided as a visual aid and do not necessarily contain all wells in the monitoring program for the Maryhill Well Field (MH1, MH2). The layers displayed were generated from results of the Hydrogeological Characterization and Conceptual Model Tier 3 Assessment Update Project (Aqua Insight et al, 2023) and associated hydrogeological modelling work..

2.2.1 Surficial Geology and Conceptual Hydrostratigraphy

The surficial geology of the study area has been mapped and described by the Ontario Geological Survey (2003) and updated in Bajc and Shirota (2007). The surficial geology of the Maryhill Well Field is characterized primarily by glaciofluvial gravelly deposits (Figure 4). Modern Alluvial and outwash deposits are present along Hopewell Creek. The thickness of the overburden deposits is about 35 m in this area.

The Quaternary units typically present in the Maryhill Well Field area are briefly described below, in order from youngest to oldest.

Aquitard ATA1 – Whittlesey Clay

This silt and clay unit is present at surface across the section and corresponds to glaciolacustrine Whittlesey clay (Bajc and Shirota, 2007). This unit forms a laterally extensive, low-permeability aquitard that restricts infiltration and provides partial confinement to the underlying aquifer.

Aquifer AFA1 - Whittlesey Sand

This very fine to coarse sand unit is interpreted as glaciolacustrine Whittlesey sand (Bajc and Shirota, 2007) and is encountered immediately below ATA1 across the section. AFA1 is continuous aquifer that facilitates groundwater flow within the upper overburden sequence.

Aquitard ATB1 – Upper Maryhill / Port Stanley Till

The Upper Maryhill Till is a silty to clayey till, with occasional stony texture, that is predominantly found along the flanks of the Waterloo Moraine. The Upper Maryhill Till was deposited by ice advancing from the Erie-Ontario ice lobe. In other parts of the Region, Bajc and Shirota (2007) have also used unit ATB1 to represent Tavistock, Mornington, and Port Stanley Till. This unit is considered an aquitard and, where present, acts to restrict recharge to the lower aquifers.

Aquifer AFB1 / ATB2 / AFB2 – Upper Waterloo Moraine Stratified Sediments and Equivalent

Aquifer AFB1 / AFB2 represents the main water supply aquifer in the core areas of the Waterloo Moraine. These units are generally comprised of layered silt and fine sand to coarse sand and gravel. Throughout the core areas of the Moraine (Figure 5), the unit typically exceeds 45 m in thickness. In some areas, the Upper Waterloo Moraine is interpreted to be bisected by the middle Maryhill Till (ATB2), effectively separating the aquifer into two units, AFB1 and AFB2. This aquifer is the most prolific aquifer in the Waterloo Region due to its high hydraulic conductivity and transmissivity, lateral extent, and high recharge rate.

Aquitard ATB3 – Lower Maryhill Till

The Lower Maryhill Till is described as a clayey silt to silty clay till. This unit represents one of the primary regional aquitards due to its strong influence on the groundwater flow system within the Waterloo Moraine. This unit is extensive within the core area of the Waterloo Moraine, and along the eastern flank tends to be thin, discontinuous, or re-worked and re-deposited as glaciofluvial sediments. This unit is generally less than 10 m thick in the Maryhill area.

Aquifer AFB3 – Catfish Creek Outwash Deposits

This unit consists of stratified gravels, sands, or silts and is discontinuous in the Maryhill area. It occurs as isolated patches throughout the Region with no apparent linear trends (Bajc and Shirota, 2007).

Aquitard ATC1 / ATC2 – Catfish Creek Till

The Catfish Creek Till was deposited by a major glacial advance from the north to northeast that covered all of southern Ontario. It is a dense, stony, sandy silt to silty sand till with little clay content. The hydrogeologic properties of the Catfish Creek Till are variable, ranging from a good aquitard to a poor aquifer, depending on local lithology, degree of compaction, and the presence of overlying aquitard units. This unit is approximately 3 m thick in the Maryhill area.

Aquifer AFD1 – Pre-Catfish Creek Sand and Gravel

Pre-Catfish Creek Till aquifer corresponds to sands and gravel re-worked from Catfish Creek and Pre-Catfish Creek Tills and represents the main supply aquifer in several production wells in the Cities of Kitchener and Waterloo. This unit is spatially discontinuous throughout much of the core areas of the Waterloo Moraine, and pinches out beneath Alder Creek. This unit is about 10m thick in the Maryhill area.

Aquitard ATE1 – Canning Drift

The Canning Drift is comprised of till and associated fine-textured lake deposits. It is typically found at depths of greater than 70 mbgs in the Waterloo Moraine area and is identified to be discontinuous and limited in lateral extent and thickness. Where it is absent, a hydraulic connection is present between the deep overburden aquifers and the underlying bedrock.

2.2.2 Bedrock Geology

The Paleozoic bedrock in the area consists of the Guelph Formation.

2.3 Local Geology

Figure 3 displays the Maryhill Well Field well plan and cross-section locations. Representative cross-sections are included as Figures 5 and 6 to visualize the stratigraphy described in this section.

The description of the local geology is taken from the detailed borehole log for WH-MH-OW1-09-AB.

Upper Maryhill / Port Stanley Till (ATB1) – This unit was encountered at or near surface (below topsoil / fill) at each of the drilling locations in the Maryhill Well Field. This sandy silt to clayey silt till material was documented to be 5.5 m thick at WH-MH-OW1-09-AB.

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Lower Maryhill Till (ATB3) – Clay and silty clay till deposits consistent with ATB3 were encountered at each of the wells in the Maryhill Well Field. ATB3 was 7.0 m thick at WH-MH-OW1-09-AB.

Catfish Creek Till (ATC1 / AFC1 / ATC2) – WH-MH-OW1-09-AB documents clayey silt till with some gravel and sand layers which are interpreted as Catfish Creek Till. This unit was observed to be 6.3 m thick at WH-MH-OW1-09-AB.

Pre-Catfish Creek Aquifers (AFD1) – This unit was documented in each of the borehole logs within the Maryhill Well Field. Production well MH2 and monitoring well WH-MH-OW1-09-B are screened within AFD1. Deposits described as sand and gravel were encountered from 18.8 to 30.1 mbgs at WH-MH-OW1-09-AB and from 17.4 to greater than 26.2 mbgs at MH2.

Canning Drift (ATE1) – Deposits described as clayey silt till were documented from 30.1 to 35.1 mbgs at WH-MH-OW1-09-AB.

Borehole records for WH-MH-OW1-09-AB indicate bedrock was encountered at a depth of 35.1 mbgs. No further description of the bedrock was provided. WH-MH-OW1-09-A is screened in bedrock from 41.45 to 44.5 mbgs. Production well MH1 is completed as an open hole in "grey rock" from 37.2 to 44.3 mbgs.

3.0 2024 / 2025 Results

3.1 Precipitation and Temperature

Longer term precipitation trends can have an impact on water levels in the supply aquifer. To assess the potential influence, monthly precipitation is plotted for comparison to water levels and pumping and presented in Appendix C.

Since variations in precipitation totals can occur throughout the Region due to localized events, monthly precipitation data from the GRCA and Environment Canada station located closest to the production wells are used. The closest GRCA weather station relative to the Maryhill Heights Well Field is the Laurel Dam station located 16.4 km to the southwest. The closest Environment Canada station is Waterloo International Airport (WIA) located about 8 km south from the well field. The locations of the meteorological stations are shown on Figure 1. Annual precipitation data from the past 10 years for all stations are compared with long term averages in Table D.1, Appendix D. Monthly precipitation data for the past 10 years at Shades Mills Dam are shown on Figure D.1, Appendix D. At the Laurel Dam station, the long-term average was calculated from when measurements started until the end of 2025. The Region of Waterloo International Airport (WIA) has "Climate Normals" calculated by Environment Canada for 1991 to 2020.

Annual 2024 / 2025 precipitation data for the GRCA and Environment Canada meteorological station closest to the Maryhill Well Field are presented in Table 4 below. WIA was missing 6 days of data in 2024 and 6 days in 2025. As a result, the precipitation totals may be under reported at this location.

Table 4: Summary of Precipitation Data

Station	2024 Precipitation (mm)	2024 Deviation (mm)	Long-Term Average (mm)	2025 Precipitation (mm)	2025 Deviation (mm)
Region of Waterloo International Airport ⁽¹⁾	874	+23	851 ^(A)	723	-128
Laurel Dam ⁽²⁾	907	-31	938 ^(B)	894	-44

Sources: Environment Canada (1), GRCA (2),
^A 1991 to 2020 Normal ^B Average annual precipitation since monitoring began to the end of 2025

Water levels typically follow a seasonal trend with highest levels occurring in the spring with the depth and water content of the snowpack having a significant influence on water levels. Lowest levels occurring in July / August. Widespread synoptic rainfall events can also result in Region-wide water level responses. Summer thunderstorms tend to be short lived and occur over a smaller area resulting in short term, localized water level rises not typically seen in the monitoring wells.

The 2024 total precipitation at Laurel Dam station was 907 mm, which is 31 mm below the long-term average. The 2024 total precipitation at WIA station was 874 mm, which is 23 mm above the long-term average. The March 1 GRCA snow survey indicated a snowpack across the Region that was low compared to normal.

In 2025, the total precipitation was 894 mm, which is 44 mm below the long-term average. Similarly, the total precipitation at the WIA station was 128 mm below the long-term average, indicating 2025 was a drier-than-average year. However, WIA was missing 12 days of data in 2024 / 2025 and as a result, precipitation totals may be under reported. The snow survey conducted by the GRCA on March 15, 2025, showed that the stations in the Region had a high to very high measured snow water equivalent.

3.2 Monitoring Results

Hydrographs showing the results of water level monitoring over the past 10 years are provided in Appendix C. The method used to collect the water levels (manual or electronic) is indicated on the graphs in Appendix C.

WH-MH-OW01-09-AB

Observation wells WH-MH-OW01-09-AB are located approximately 410 m north of wells MH1 and MH2. Monthly manual water levels were measured in the A and B screens. The A screen is installed within the Guelph Formation and the B screen is installed in AFD1. Water levels in both wells show seasonal trends consistent with other monitoring wells in the Region with highest water levels occurring in the spring and lowest water levels occurring in late summer. The seasonal variation in water levels was approximately 1.1 m in 2024 and 1.3 m 2025. Water levels during 2024 and 2025 were within the historical range. The decrease in pumping in 2025 does not appear to have measurably influenced groundwater levels.

4.0 Impact Assessment

4.1 Well Interference

PTTW Condition 5.1 states, "The Permit Holder shall immediately notify the local District Office of any complaint arising from the taking of water authorized under this Permit and shall report any action which has been taken or is proposed with regard to such complaint. The Permit Holder shall immediately notify the local District Office if the taking of water is observed to have any significant impact on the surrounding waters. After hours, calls shall be directed to the Ministry's Spills Action Centre at 1-800-268-6060."

PTTW Condition 5.2 states, "For Groundwater Takings - if the taking of water is observed to cause any negative impact to other water supplies obtained from any adequate sources that were in use prior to initial issuance of a Permit for this water taking, the Permit Holder shall take such action necessary to make available to those affected, a supply of water equivalent in quantity and quality to their normal takings, or shall compensate such persons for their reasonable costs of so doing, or shall reduce the rate and amount of taking to prevent or alleviate the observed negative impact. Pending permanent restoration of the affected supplies, the Permit Holder shall provide, to those affected, temporary water supplies adequate to meet their normal requirements or shall compensate such persons for their reasonable costs of doing so. If permanent interference is caused by the water taking, the Permit Holder shall restore the water supplies of those permanently affected."

When a well interference complaint is received, the Region has a Well Interference Policy in place. A copy of the policy is presented in Appendix F of the 2019 Biennial Groundwater Monitoring Report – Multiple Well Fields (Burnside, 2020). There were no well interference complaints related to pumping of MH3 (abandoned), MH4A and MH5 received in 2024 and 2025.

There are no private serviced properties for water supply within 2 km of MH4A and MH5. Registered groundwater takings within 2 km of the well field are identified in Figure 3 and summarized in Table 5; PTTW 1746-BBWLJR applies to the Maryhill Heights wells (MH4A and MH5).

Table 5: PTTWs (Groundwater) in Vicinity of Maryhill Well Field (MH1, MH2)

Permit Number	Permit Holder	Purpose	Max Liters per Day	Distance (km) from MH1 and MH2 Supply Wells	Expiry Date
1746-BBWLJR	The Regional Municipality of Waterloo	Municipal Water Supply	2,232,000	840	May 1, 2029

4.2 Aquifer Impacts to Pumping and Precipitation

PTTW Condition 4.3 states: " The Permit Holder shall prepare and submit a report every two years by June 30, that presents the results of the well field water level monitoring for the two preceding calendar years, assesses changes in water levels in the supply aquifer(s) in relation to precipitation and water taking from the aquifer(s)".

Based on monitoring results, the water levels in the Guelph Formation do not respond to pumping at wells MH1 and MH2. Water levels in the Guelph Formation followed seasonal patterns with highest levels in the spring and declined during summer months. Water levels are recorded monthly, and as a result, responses to individual precipitation or storm events are not evident.

Based on monitoring results, the water levels in AFD1 did not show a response to pumping. Water levels in the overburden followed seasonal patterns with highest levels in the spring and declining levels during summer months.

5.0 Conclusions

Impacts from pumping the municipal wells at the Maryhill Well Field (MH1, MH2) were evaluated through implementation of the Groundwater Monitoring Program. Based on the information contained in the report, Burnside offers the following conclusions:

- The information presented in this report satisfies condition 4.3 of PTTW 2613-BBKR76;
- 2024 and 2025 pumping volumes were within the permitted range;
- There were no reported well interference complaints arising from water taking at the Maryhill (MH1 and MH2) Well Field;

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June 2026

- The Guelph formation and ADF1 did not respond to pumping at the production wells;
and
- Water levels in the Guelph Formation and AFD1 followed seasonal patterns.

6.0 References

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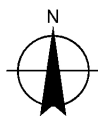
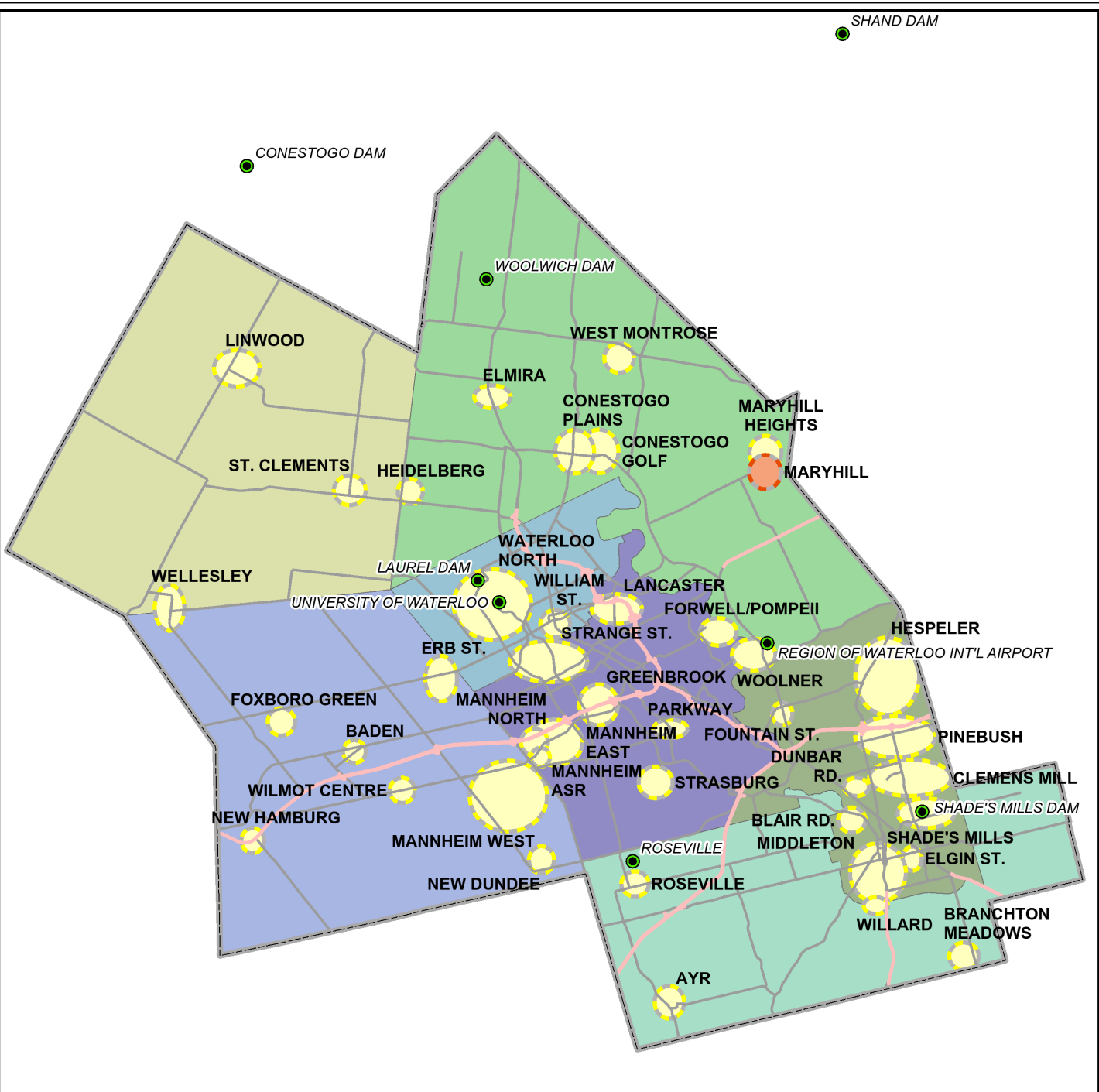


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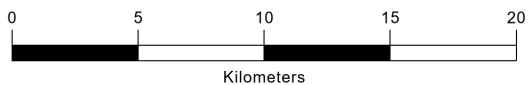
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Figures



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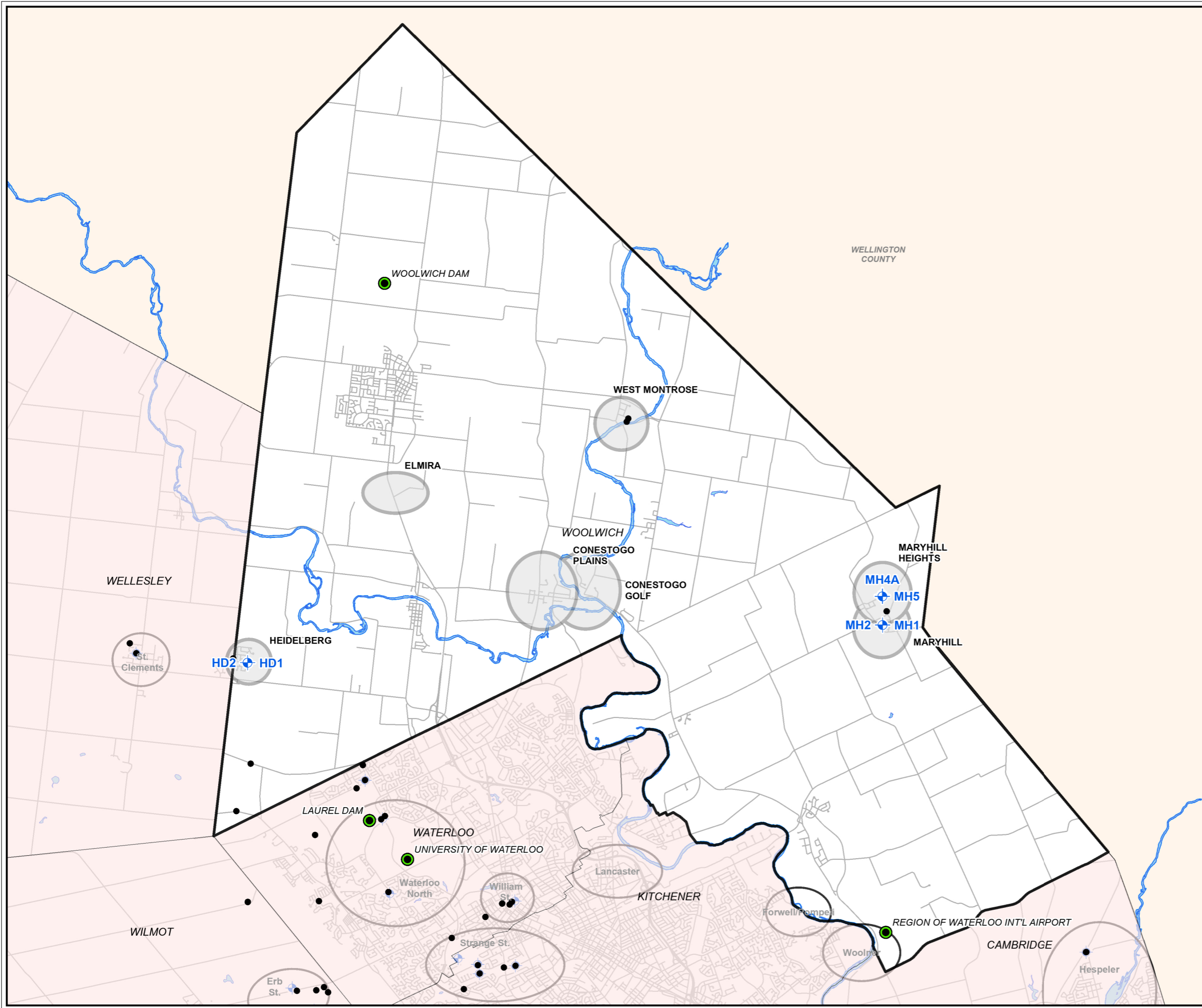
- Well Field Location
- Well Fields
- Regional Municipal Boundaries
- City of Cambridge
- City of Kitchener
- City of Waterloo
- Township of North Dumfries
- Township of Wellesley
- Township of Wilmot
- Township of Woolwich
- Meteorological Monitoring Locations



Map Title
2025 GROUNDWATER MONITORING REPORT - MARYHILL WELL FIELD
WELL FIELD LOCATION MAP

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Drawn	Checked	Date	Figure No. 1
HN	SQ	February 2026	
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LEGEND

- Production Well Location
- Monitoring Well Location
- Woolwich Municipal Boundary
- Well Fields
- Meteorological Monitoring Locations

Sources:

1. Ministry of Natural Resources, © Queen's Printer for Ontario
2. Natural Resources Canada © Her Majesty the Queen in Right of Canada.

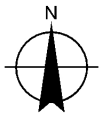
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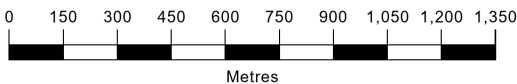
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Figure Title
2025 GROUNDWATER MONITORING REPORT - MARYHILL WELL FIELD
WOOLWICH WELL FIELDS AND MONITORING NETWORK

Drawn	Checked	Date	Figure No. 2
HN	SQ	April 2026	
Scale	Project No.		
1:110,000		HA0464020	



Data Source:
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 Natural Resources, © Queen's Printer for Ontario; Natural
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- PTTW Monitoring Well Location
- Nearby Monitoring Well Location
- Nearby Production Well Location
- Decommissioned Production Well Location
- Cross Section Orientation
- Intermittent Creek
- Creek
- Provincially Significant Wetland (MNR)
- Regional Road
- Local Road
- Private / Other Road
- Region of Waterloo Boundary

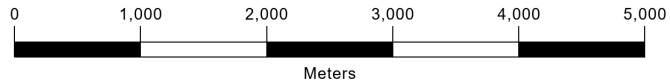
Map Title
2025 GROUNDWATER MONITORING REPORT - MARYHILL WELL FIELD
 WELL LOCATION MAP

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Drawn	Checked	Date	Figure No. 3
HN	SQ	April 2026	
Scale	Project No.		
1:21,000		HA0464020	



Data Source:
 1. Ontario Geological Survey 2003. Surficial Geology of Southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 128.
 2. Region of Waterloo GIS



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|--|--|
| <ul style="list-style-type: none"> RMOW Supply Well Watercourse Waterbody Surficial Geology 5b: Stone-poor, carbonate-derived silty to sandy till (ATA2/ATB1 - Aquitard) 5d: Glaciolacustrine-derived silty to clayey till (ATB1 - Aquitard) 6: Ice-contact stratified deposits (AFB1 - Aquifer) 7a: Glaciofluvial deposits: Sandy deposits (AFA2 - Aquifer) 7b: Glaciofluvial deposits: Gravelly deposits (AFA2 - Aquifer) 19: Modern alluvial deposits 20: Organic deposits Sand and Gravel Pit Crevasse Filling | <ul style="list-style-type: none"> Esker: Direction of Flow Known Terrace Drumlin or drumlinoid ridges (point) Glacial flute Sample Location Hummocky Topography Unit Contact Boundary |
|--|--|



Map Title
2025 GROUNDWATER MONITORING REPORT - MARYHILL WELL FIELD

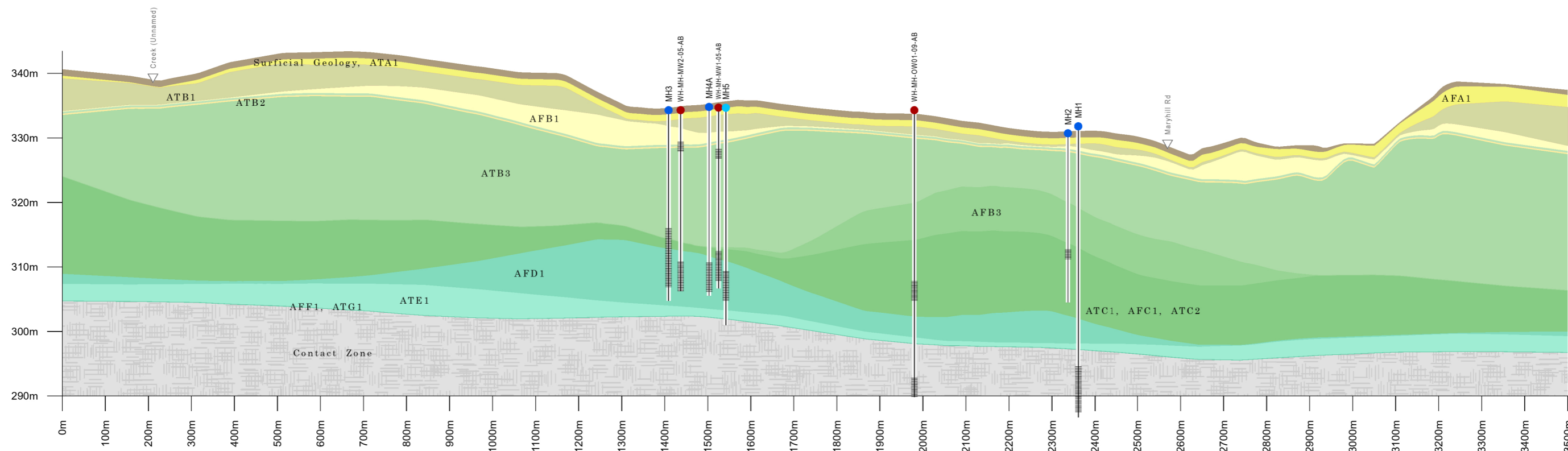
SURFICIAL GEOLOGY

Client
REGION OF WATERLOO

Drawn	Checked	Date	Figure No.
HN	SQ	February 2026	
Scale	Project No.		4
1:60,000	HA0464020		

A

A'

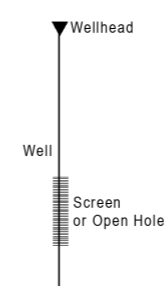


Wells

- Production Well (Active)
- Production Well (Inactive)
- Monitoring Well

Moraine Model 2026

Surficial Geology, Whittlesey Clay (ATA1)	Upper Waterloo Moraine Stratified Sediments & Equivalents (AFB1)	Lower Maryhill Till & Stratified Equivalents (ATB3)	Pre-Catfish Creek Coarse-Grained Glaciofluvial/Lacustrine Deposits (AFD1)	Weathered Bedrock
Whittlesey Sand (AFA1)	Middle Maryhill Till & Equivalents (ATB2)	Lower Waterloo Moraine Stratified Sediments or Catfish Creek Till Outwash (AFB3)	Canning Drift, Till & Fine Textured Glaciolacustrine Deposits (ATE1)	
Upper Maryhill, Port Stanley, Tavistock, Mornington, & Stratford Tills (ATB1)	Middle Waterloo Moraine Stratified Sediments & Equivalents (AFB2)	Upper/Main Catfish Creek Till (ATC1), Middle Catfish Creek Stratified Deposits (AFC1), Lower Catfish Creek Till (ATC2)	Pre-Canning Coarse Textured Glaciofluvial / Glaciolacustrine Deposits (AFF1), Pre-Canning Coarse Textured Till (ATG1)	

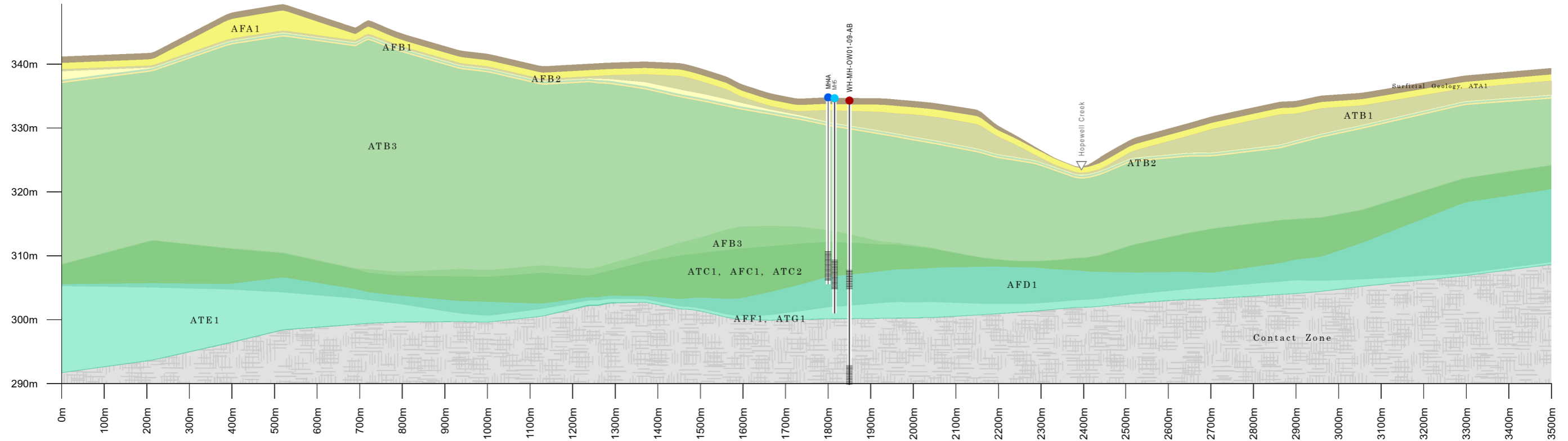


Client
REGION OF WATERLOO

Figure Title GEOLOGIC CROSS SECTION REGION OF WATERLOO Maryhill Cross Section A - A'			
Drawn PS	Checked DH	Date 2026/06/01	Figure No. 5
Horizontal Scale 1:10,000		Project No. HA046402	
Vertical Ex.:15x			

B

B'

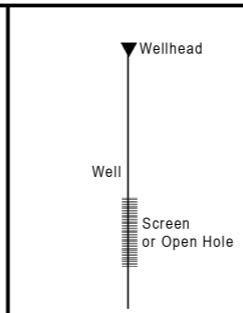


Wells

- Production Well (Active)
- Production Well (Inactive)
- Monitoring Well

Moraine Model 2026

Surficial Geology, Whittlesey Clay (ATA1)	Upper Waterloo Moraine Stratified Sediments & Equivalents (AFB1)	Lower Maryhill Till & Stratified Equivalents (ATB3)	Pre-Catfish Creek Coarse-Grained Glaciofluvial/Lacustrine Deposits (AFD1)	Weathered Bedrock
Whittlesey Sand (AFA1)	Middle Maryhill Till & Equivalents (ATB2)	Lower Waterloo Moraine Stratified Sediments or Catfish Creek Till Outwash (AFB3)	Canning Drift, Till & Fine Textured Glaciolacustrine Deposits (ATE1)	
Upper Maryhill, Port Stanley, Tavistock, Mornington, & Stratford Tills (ATB1)	Middle Waterloo Moraine Stratified Sediments & Equivalents (AFB2)	Upper/Main Catfish Creek Till (ATC1), Middle Catfish Creek Stratified Deposits (AFC1), Lower Catfish Creek Till (ATC2)	Pre-Canning Coarse Textured Glaciofluvial / Glaciolacustrine Deposits (AFF1), Pre-Canning Coarse Textured Till (ATG1)	



BURNSIDE

Client
REGION OF WATERLOO

Figure Title GEOLOGIC CROSS SECTION REGION OF WATERLOO Maryhill Cross Section B - B'			
Drawn PS	Checked DH	Date 2026/06/01	Figure No. 6
Horizontal Scale 1:10,000		Project No. HA046402	
Vertical Ex.:15x			



BURNSIDE

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Appendix A

Permit To Take Water

Appendix A

PERMIT TO TAKE WATER
Ground Water
NUMBER 2613-BBKR76

Pursuant to Section 34.1 of the Ontario Water Resources Act, R.S.O. 1990 this Permit To Take Water is hereby issued to:

The Regional Municipality of Waterloo
150 Frederick St
Kitchener, Ontario
N2G 4J3

For the water taking from: Two Wells (MH1 and MH2)

Located at: Lot 81, Concession German Company Tract, Geographic Township of Waterloo
Woolwich, Regional Municipality of Waterloo

For the purposes of this Permit, and the terms and conditions specified below, the following definitions apply:

DEFINITIONS

- (a) "Director" means any person appointed in writing as a Director pursuant to section 5 of the OWRA for the purposes of section 34.1, OWRA.
- (b) "Provincial Officer" means any person designated in writing by the Minister as a Provincial Officer pursuant to section 5 of the OWRA.
- (c) "Ministry" means Ontario Ministry of the Environment, Conservation and Parks.
- (d) "District Office" means the Guelph District Office.
- (e) "Permit" means this Permit to Take Water No. 2613-BBKR76 including its Schedules, if any, issued in accordance with Section 34.1 of the OWRA.
- (f) "Permit Holder" means The Regional Municipality of Waterloo.
- (g) "OWRA " means the *Ontario Water Resources Act*, R.S.O. 1990, c. O. 40, as amended.

You are hereby notified that this Permit is issued subject to the terms and conditions outlined below:

TERMS AND CONDITIONS

1. Compliance with Permit

- 1.1 Except where modified by this Permit, the water taking shall be in accordance with the application for this Permit To Take Water, dated January 30, 2019 and signed by Richard Wootton, and all Schedules included in this Permit.
- 1.2 The Permit Holder shall ensure that any person authorized by the Permit Holder to take water under this Permit is provided with a copy of this Permit and shall take all reasonable measures to ensure that any such person complies with the conditions of this Permit.
- 1.3 Any person authorized by the Permit Holder to take water under this Permit shall comply with the conditions of this Permit.
- 1.4 This Permit is not transferable to another person.
- 1.5 This Permit provides the Permit Holder with permission to take water in accordance with the conditions of this Permit, up to the date of the expiry of this Permit. This Permit does not constitute a legal right, vested or otherwise, to a water allocation, and the issuance of this Permit does not guarantee that, upon its expiry, it will be renewed.
- 1.6 The Permit Holder shall keep this Permit available at all times at or near the site of the taking, and shall produce this Permit immediately for inspection by a Provincial Officer upon his or her request.
- 1.7 The Permit Holder shall report any changes of address to the Director within thirty days of any such change. The Permit Holder shall report any change of ownership of the property for which this Permit is issued within thirty days of any such change. A change in ownership in the property shall cause this Permit to be cancelled.

2. General Conditions and Interpretation

2.1 Inspections

The Permit Holder must forthwith, upon presentation of credentials, permit a Provincial Officer to carry out any and all inspections authorized by the OWRA, the *Environmental Protection Act*, R.S.O. 1990, the *Pesticides Act*, R.S.O. 1990, or the *Safe Drinking Water Act*, S. O. 2002.

2.2 Other Approvals

The issuance of, and compliance with this Permit, does not:

- (a) relieve the Permit Holder or any other person from any obligation to comply with any other applicable legal requirements, including the provisions of the *Ontario Water Resources Act*, and the *Environmental Protection Act*, and any regulations made thereunder; or
- (b) limit in any way any authority of the Ministry, a Director, or a Provincial Officer, including the authority to require certain steps be taken or to require the Permit Holder to furnish any further information related to this Permit.

2.3 Information

The receipt of any information by the Ministry, the failure of the Ministry to take any action or require any person to take any action in relation to the information, or the failure of a Provincial Officer to prosecute any person in relation to the information, shall not be construed as:

- (a) an approval, waiver or justification by the Ministry of any act or omission of any person that contravenes this Permit or other legal requirement; or
- (b) acceptance by the Ministry of the information's completeness or accuracy.

2.4 Rights of Action

The issuance of, and compliance with this Permit shall not be construed as precluding or limiting any legal claims or rights of action that any person, including the Crown in right of Ontario or any agency thereof, has or may have against the Permit Holder, its officers, employees, agents, and contractors.

2.5 Severability

The requirements of this Permit are severable. If any requirements of this Permit, or the application of any requirements of this Permit to any circumstance, is held invalid or unenforceable, the application of such requirements to other circumstances and the remainder of this Permit shall not be affected thereby.

2.6 Conflicts

Where there is a conflict between a provision of any submitted document referred to in this Permit, including its Schedules, and the conditions of this Permit, the conditions in this Permit shall take precedence.

3. Water Takings Authorized by This Permit

3.1 Expiry

This Permit expires on **April 30, 2029**. No water shall be taken under authority of this Permit after the expiry date.

3.2 Amounts of Taking Permitted

The Permit Holder shall only take water from the source, during the periods and at the rates and amounts of taking specified in Table A. Water takings are authorized only for the purposes specified in Table A.

Table A

	Source Name / Description:	Source Type:	Taking Specific Purpose:	Taking Major Category:	Max. Taken per Minute (litres):	Max. Num. of Hrs Taken per Day:	Max. Taken per Day (litres):	Max. Num. of Days Taken per Year:	Zone/ Easting/ Northing:
1	MH1	Well Drilled	Municipal	Water Supply	109	24	157,110	365	17 549457 4820230
2	MH2	Well Drilled	Municipal	Water Supply	109	24	157,110	365	17 549454 4820234
Total							157,110		

3.3 Notwithstanding Table A, the Permit Holder shall not exceed the maximum rate and amount of taking of 109 L/ min and 157,110 L/ day from any well or both wells.

4. Monitoring

4.1 Under section 9 of O. Reg. 387/04, and as authorized by subsection 34(6) of the *Ontario Water Resources Act*, the Permit Holder shall, on each day water is taken under the authorization of this Permit, record the date, the volume of water taken on that date and the rate at which it was taken. The daily volume of water taken shall be measured by a flow meter or calculated in accordance with the method described in the application for this Permit, or as otherwise accepted by the Director. A separate record shall be maintained for each source. The Permit Holder shall keep all records required by this condition current and available at or near the site of the taking and shall produce the records for inspection by a Provincial Officer upon his or her request. The Permit Holder, unless otherwise required by the Director, shall submit, on or before March 31st in every year, the records required by this condition to the ministry's Water Taking Reporting System.

4.2 The Permit Holder shall measure and record water levels once a month in the following monitoring well:

WH-MH-OW01-09-A
WH-MH-OW01-09-B

4.3 The Permit Holder shall prepare and submit an electronic copy of a report every two years by June 30. The report shall present the results of the well field water level monitoring for the two preceding calendar years, assess changes in water levels in the supply aquifer(s) in relation to precipitation and water taking from the aquifer(s), and provide a summary for all interference complaints received by the Permit Holder related to this permit and reported in the District Office in accordance with Condition 5.1 and the manner in which the Permit Holder has dealt with the complaint. Any application for an amendment or renewal shall be accompanied by the most recent biennial report.

5. Impacts of the Water Taking

5.1 Notification

The Permit Holder shall immediately notify the local District Office of any complaint arising from the taking of water authorized under this Permit and shall report any action which has been taken or is proposed with regard to such complaint. The Permit Holder shall immediately notify the local District Office if the taking of water is observed to have any significant impact on the surrounding waters. After hours, calls shall be directed to the Ministry's Spills Action Centre at 1-800-268-6060.

5.2 For Groundwater Takings

If the taking of water is observed to cause any negative impact to other water supplies obtained from any adequate sources that were in use prior to initial issuance of a Permit for this water taking, the Permit Holder shall take such action necessary to make available to those affected, a supply of water equivalent in quantity and quality to their normal takings, or shall compensate

such persons for their reasonable costs of so doing, or shall reduce the rate and amount of taking to prevent or alleviate the observed negative impact. Pending permanent restoration of the affected supplies, the Permit Holder shall provide, to those affected, temporary water supplies adequate to meet their normal requirements, or shall compensate such persons for their reasonable costs of doing so.

If permanent interference is caused by the water taking, the Permit Holder shall restore the water supplies of those permanently affected.

6. Director May Amend Permit

The Director may amend this Permit by letter requiring the Permit Holder to suspend or reduce the taking to an amount or threshold specified by the Director in the letter. The suspension or reduction in taking shall be effective immediately and may be revoked at any time upon notification by the Director. This condition does not affect your right to appeal the suspension or reduction in taking to the Environmental Review Tribunal under the *Ontario Water Resources Act*, Section 100 (4).

The reasons for the imposition of these terms and conditions are as follows:

1. Condition 1 is included to ensure that the conditions in this Permit are complied with and can be enforced.
2. Condition 2 is included to clarify the legal interpretation of aspects of this Permit.
3. Conditions 3 through 6 are included to protect the quality of the natural environment so as to safeguard the ecosystem and human health and foster efficient use and conservation of waters. These conditions allow for the beneficial use of waters while ensuring the fair sharing, conservation and sustainable use of the waters of Ontario. The conditions also specify the water takings that are authorized by this Permit and the scope of this Permit.

In accordance with Section 100 of the Ontario Water Resources Act, R.S.O. 1990, you may by written Notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 101 of the Ontario Water Resources Act, R.S.O. 1990, as amended, provides that the Notice requiring the hearing shall state:

1. The portions of the Permit or each term or condition in the Permit in respect of which the hearing is required, and;
2. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

In addition to these legal requirements, the Notice should also include:

- a. The name of the appellant;
- b. The address of the appellant;
- c. The Permit to Take Water number;
- d. The date of the Permit to Take Water;
- e. The name of the Director;
- f. The municipality within which the works are located;

This notice must be served upon:

*The Secretary
Environmental Review Tribunal
655 Bay Street, 15th Floor
Toronto ON
M5G 1E5
Fax: (416) 326-5370
Email: ERTTribunalsecretary@ontario.ca*

AND

*The Director, Section 34.1,
Ministry of the Environment, Conservation
and Parks
12th Floor
119 King St W
Hamilton ON L8P 4Y7
Fax: (905) 521-7820*

Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal:

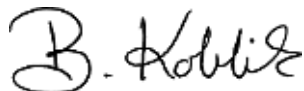
by Telephone at
(416) 212-6349
Toll Free 1(866) 448-2248

by Fax at
(416) 326-5370
Toll Free 1(844) 213-3474

by e-mail at
www.ert.gov.on.ca

This Permit cancels and replaces Permit Number 2876-837JDT, issued on 2010/03/24.

Dated at Hamilton this 2nd day of May, 2019.



Belinda Koblik
Director, Section 34.1
Ontario Water Resources Act , R.S.O. 1990

Schedule A

This Schedule "A" forms part of Permit To Take Water 2613-BBKR76, dated May 2, 2019.



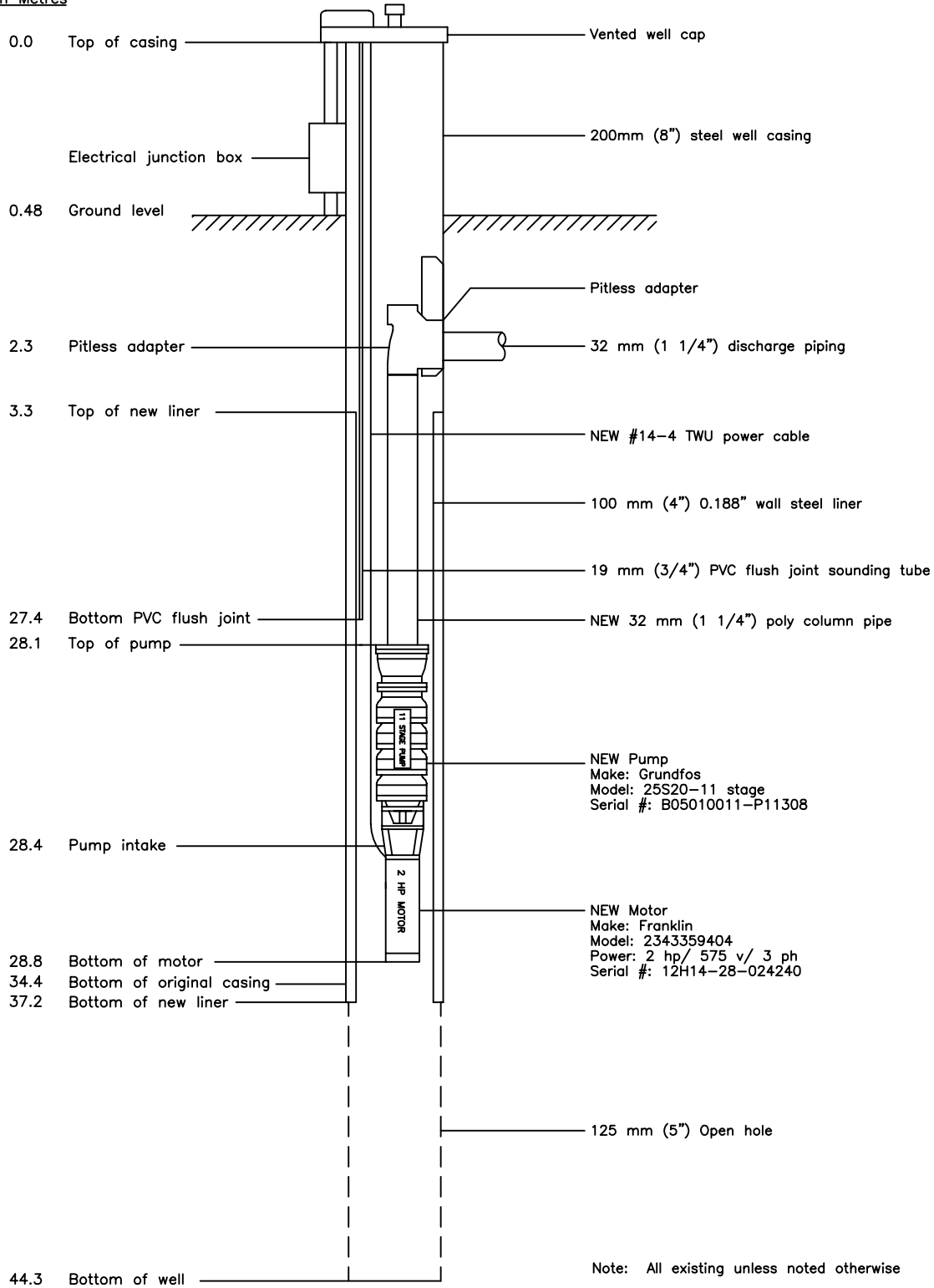
BURNSIDE

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Appendix B

Well Records

Depths
in Metres



Note: All existing unless noted otherwise



CLIENT
REGIONAL MUNICIPALITY OF WATERLOO

TITLE
Maryhill Well 1 (MH1)
Pump and Liner Installation Drawing

PROJECT No. 006-282		G:\Lotowater Projects\006 Region of Waterloo\282 Maryhill Well 1\7. Technical\Pump & Liner Install.dwg		FIGURE 2
DESIGN		REVISION No. 2013/06/27	SCALE N.T.S.	
DRAWN	EH 2011/08/18			
CHECKED				

Measurements recorded in: Metric Imperial

A 054417

Page 1 of 3

Well Owner's Information

First Name: REGIONAL MUNICIPALITY OF WATERLOO
 Last Name (Organization): WATERLOO
 E-mail Address: sfrank@region.waterloo.on.ca
 Mailing Address (Street Number/Name): 150 FREDERICK STREET
 Municipality: WATERLOO
 Province: ONTARIO
 Postal Code: N2G4J3
 Telephone No. (inc. area code): 519 571 6206

Well Location

Address of Well Location (Street Number/Name): 54 ISLEY DRIVE
 Township: WOOLWICH
 Lot: 81
 Concession: GERMAN CO. TRACT
 County/District/Municipality: MUNICIPALITY OF WATERLOO
 City/Town/Village: MARYHILL
 Province: Ontario
 Postal Code: [] [] [] [] [] []
 UTM Coordinates: Zone Easting Northing: NAD 83 17 5494604 820202
 Municipal Plan and Sublot Number: [] [] [] [] [] []
 Other: [] [] [] [] [] []

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
			THIS WELL IS KNOWN AS MARYHILL #1 (MH1)	
			A NEW STEEL LINER WAS INSTALLED TO A DEPTH OF 37.2 m. SEE ATTACHED AS-BUILT DRAWING	
			ORIGINAL WELL RECORD ATTACHED	

Annular Space

Depth Set at (m/ft) From To	Type of Sealant Used (Material and Type)	Volume Placed (m ³ /ft ³)
3.3 37.2	THIXTROPIC GROUT IN ANNULUS BETWEEN EXISTING 175 mm WELL CASING AND NEW LINER	0.63

Results of Well Yield Testing

After test of well yield, water was: <input type="checkbox"/> Clear and sand free <input type="checkbox"/> Other, specify	Draw Down		Recovery	
	Time (min)	Water Level (m/ft)	Time (min)	Water Level (m/ft)
If pumping discontinued, give reason: Pump intake set at (m/ft) Pumping rate (l/min / GPM) 100 Duration of pumping 1 hrs + 0 min Final water level end of pumping (m/ft) 24.95 If flowing give rate (l/min / GPM) Recommended pump depth (m/ft) 28.4 Recommended pump rate (l/min / GPM) Well production (l/min / GPM) Disinfected? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Static Level	8.68		
	1		1	
	2		2	
	3		3	
	4		4	
	5		5	
10		10		
15		15		
20		20		
25		25		
30		30		
40		40		
50		50		
60		60		

Method of Construction

Cable Tool Diamond Public Commercial Not used
 Rotary (Conventional) Jetting Domestic Municipal Dewatering
 Rotary (Reverse) Driving Livestock Test Hole Monitoring
 Boring Digging Irrigation Cooling & Air Conditioning
 Air percussion Industrial
 Other, specify

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft)		Status of Well
			From	To	
20.0	STEEL	0.48	0.48	3.3	<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 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
10.0	STEEL	0.48	3.3	37.2	
12.5	OPEN HOLE		37.2	44.3	

Construction Record - Screen

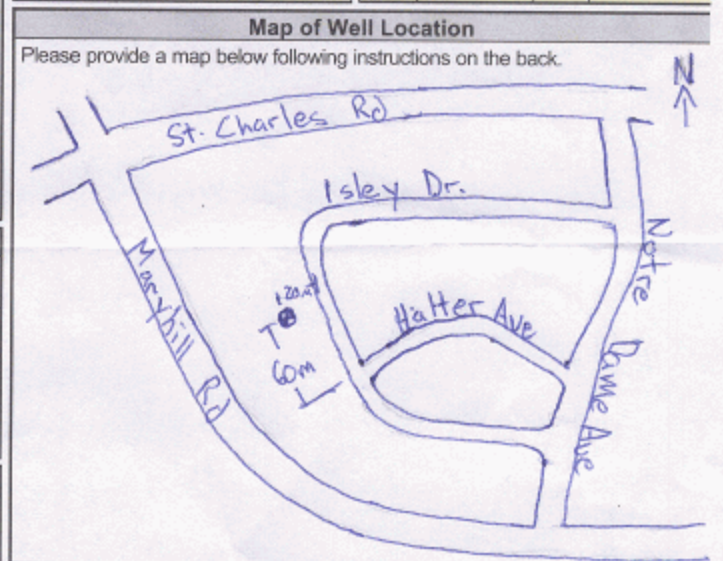
Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft)	
			From	To

Water Details

Water found at Depth (m/ft)	Kind of Water: <input type="checkbox"/> Fresh <input type="checkbox"/> Untested	Hole Diameter
	<input type="checkbox"/> Gas <input type="checkbox"/> Other, specify	Depth (m/ft) From To Diameter (cm/in)
	<input type="checkbox"/> Gas <input type="checkbox"/> Other, specify	
	<input type="checkbox"/> Gas <input type="checkbox"/> Other, specify	

Well Contractor and Well Technician Information

Business Name of Well Contractor: LOTOWATER TECHNICAL SERVICES
 Well Contractor's Licence No.: 3428
 Business Address (Street Number/Name): 92 SCOTT AVENUE
 Municipality: PARIS
 Province: ONTARIO
 Postal Code: N3L3R1
 Business E-mail Address: cmitchell@lotowater.com
 Name of Well Technician (Last Name, First Name): MITCHELL, CORY
 Signature of Technician and/or Contractor: [Signature]
 Date Submitted: 2011/08/19



Comments:

Well owner's information package delivered: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Date Package Delivered: YYY Y MM DD: 2011 08 19	Ministry Use Only Audit No.: 2138128 Date: OCT 06 2011
Date Work Completed: 2011 08 19		



MINISTRY OF THE ENVIRONMENT
The Ontario Water Resources Act
WATER WELL RECORD

M.1

6502947

COUNTY OR DISTRICT: **WATERLOO** | TOWN: **MARYHILL** | LOT: **GERMAN CO TRACT** | PAGE: **21**
 OWNER (SURNAMES FIRST): **MUNICIPALITY OF WATERLOO (REGIONAL)** | ADDRESS: **MARSLAND CENTRE, WATERLOO** | DATE COMPLETED: **NOV 23, 1975**

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUMENT)

GENERAL COLOUR	COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH (FEET)	
				FROM	TO
	8" DRILLED WELL			0	98
GREY	GRAVEL	HARDPAN	LOOSE	98	107
"	CLAY	"	LAYERED	107	113
	SHALE	ROCK	SOFT	113	118
GREY	ROCK		HARD	118	148

RECEIVED
JUL 13 1978
COMM. OF ENGRS.

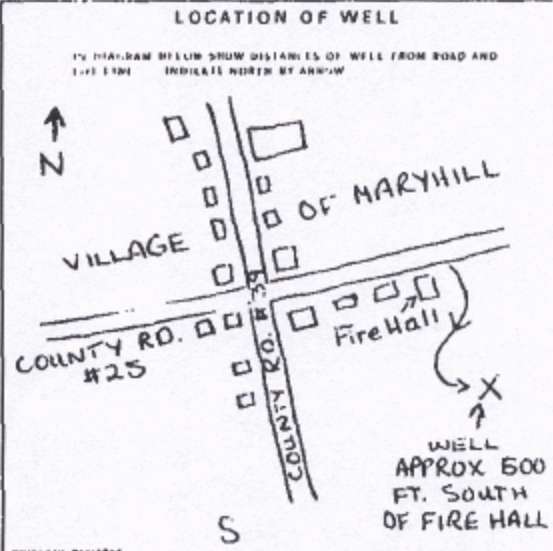
WATER RECORD WATER TABLE AT FEET: 125' 148'	ROAD OF WATER FRESH, SALTY, MINERAL, etc.	CASING & OPEN HOLE RECORD		SCREEN MATERIAL AND SIZE DEPTH TO TOP OF SCREEN
		WATERGATE 6 3/8"	DEPTH 23' 0" 113' 113' 125' 125' 148'	

PUMPING TEST

WATER LEVEL (FEET) vs. TIME (MINUTES)

Time (min)	Water Level (ft)
0	25.52
17	87
28	20
18	18
117	17

RECOMMENDED PUMP RATE: **90 MGD**



FINAL STATUS OF WELL

WATER USE

METHOD OF DRILLING

CONTRACTOR

NAME OF WELL CONTRACTOR: **MCLAUGHLIN WATER WELLS** | LICENSE NUMBER: **3518**
 ADDRESS: **BRESLAU ONT.**
 NAME OF DRILLER OR BORER: **BRYAN CAREY**
 SIGNATURE OF CONTRACTOR: *R. McLaughlin* | DATE: **9 OCT 1975**

C-3428
2138128

OCT 06 2011

1172 ST 4913161 Job # 4812019310 2181



63029474

APL
NOV 3 1968
WOOLWICH
(Waterloo Township)

lev. 5R 11985
The Ontario Water Resources Commission Act
WATER WELL RECORD
County or District Waterloo County Township, Village, Town or City Waterloo Township
Con. German Co. Tract Lot Parts 81 & 98 Date completed 2 November 1968
Owner MARYHILL DEVELOPMENTS LTD. Address C/O Mr. Gus Ruder, 642 Edna Street
(print in block letters) Kitchener, Ont.

HH1
ORIGINAL
MH2
Deepened in
1973
info on next
log

Casing and Screen Record		Pumping Test	
Inside diameter of casing	8.171"	Static level	7'
Total length of casing	100'	Test-pumping rate	30 G.P.M.
Type of screen	Johnson Stainless Steel 8"x7"	Pumping level	90'
Length of screen	7 ft. with 7"x3' top extension	Duration of test pumping	12 hrs.
Depth to top of screen	97'	Water clear or cloudy at end of test	clear
Diameter of finished hole	Screen ext. 6.375"	Recommended pumping rate	30 G.P.M.
		with pump setting of	90 feet below ground surface

Well Log	Water Record			
	From ft.	To ft.	Depth(s) at which water(s) found	Kind of water (fresh, salty, sulphur)
Overburden and Bedrock Record				
Clay & boulders	0	8		
Clay	8	25		
Gravel	25	50		
Clay, sand & gravel	50	57		
Clay	57	72		
Gravel	72	75		
Clay	75	80		
Sandy clay	80	83		
Clay	83	98		
Gravel & sand	98	105	98 - 105	Fresh

For what purpose(s) is the water to be used? Community supply

Is well on upland, in valley, or on hillside? upland

Drilling or Boring Firm COBALTA DRILLING LTD.

Address P.O. Box 1114, 2210 - King St., E., Kitchener, Ont.

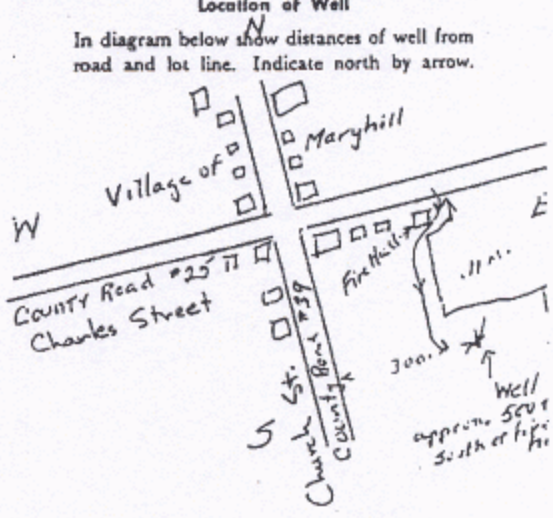
Licence Number 3160

Name of Driller or Borer Vic Pidgeon

Address #1 Cadillac Motel, Kitchener, Ont.

Date Nov. 2, 1968

Vic Pidgeon
(Signature of Licensed Drilling or Boring Contractor)



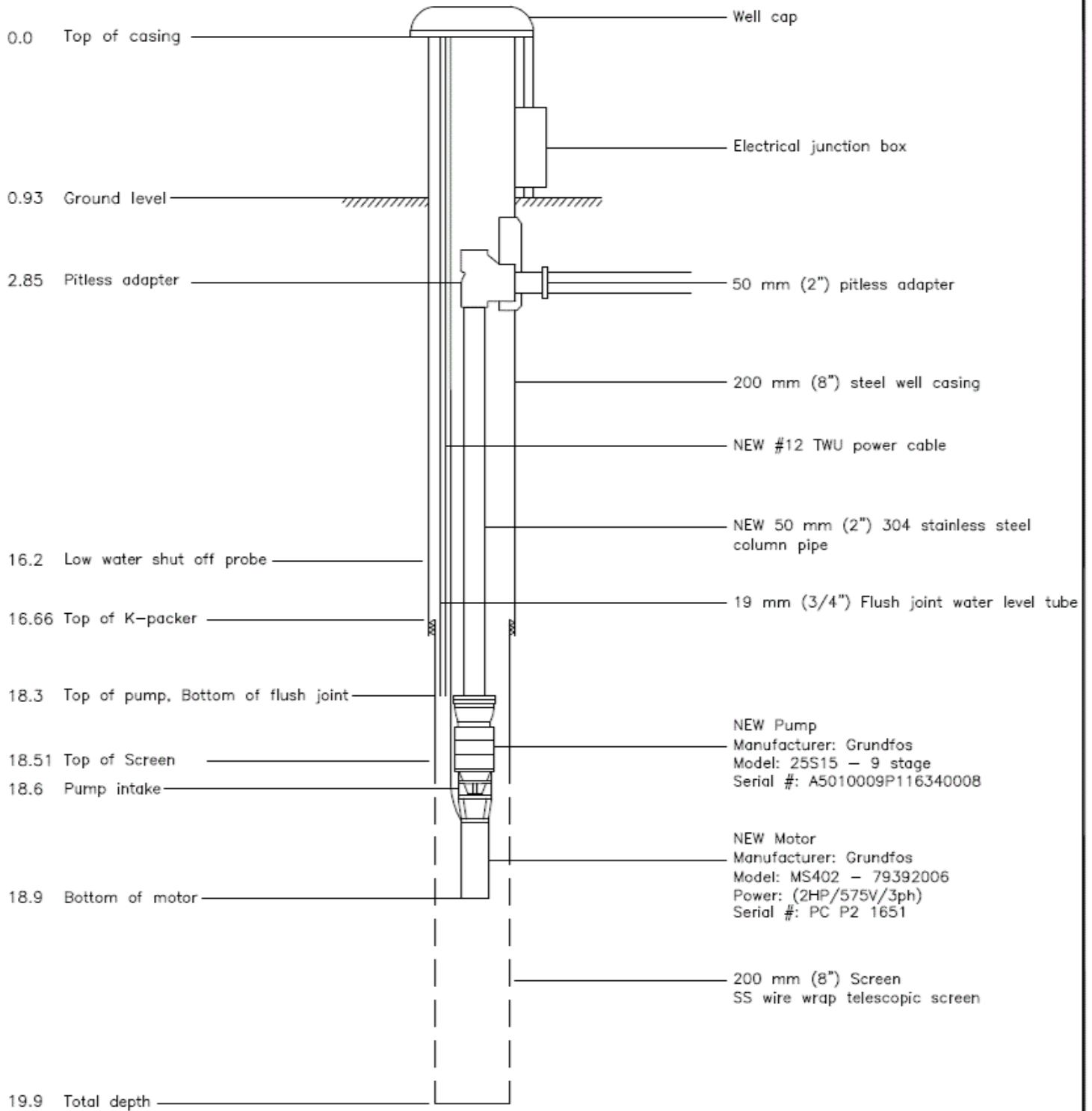
Form 1
OWRC COPY

OCT 06 2011

C-3408
213808

Depths
in metres

MH2



CLIENT
Regional Municipality of Waterloo

TITLE
Maryhill Well MH2
Pump Installation Drawing

PROJECT No. 006-391		G:\Lotowater Projects\006 Region of Waterloo\391 Maryhill Well MH2\Pump Install.dwg		FIGURE 1
DESIGN		REVISION No. 2017/05/11	SCALE N.T.S.	
DRAWN	EH 2017/04/04			
CHECKED				

1. PRINT ONLY IN SPACES PROVIDED
2. CHECK CORRECT BOX WHERE APPLICABLE

6505181
MUNICIPALITY: 65,907
CONTRACTOR: 647

COUNTY OR DISTRICT WATERLOO	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE MARY HILL	CON., BLOCK, TRACT, SURVEY, ETC. GERMAN CO. TRACT	LOT 081
OWNER (SURNAME FIRST) MUNICIPALITY OF WATERLOO	ADDRESS MARSLAND CENTRE, WATERLOO	DATE COMPLETED 12-18-74	DAY 18 NO. DEC YR. 74

U.S. ZONE EASTING NORTHING
 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100
 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100
 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)				
GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	DEPTH - FEET	
			FROM	TO
	Clay	Boulders	0	8'
	Clay		8	25
	Gravel		25	50
	Clay	Sand & Gravel	50	57
	Sand & Gravel		57	64
* Log Taken from Record No 652947				

31 0008 05/13 0027 05 0050 11 0057 05/28/11 0064 28/11

32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
10-13	1 <input type="checkbox"/> FRESH 3 <input type="checkbox"/> SULPHUR 2 <input type="checkbox"/> SALTY 4 <input type="checkbox"/> MINERAL
15-18	1 <input type="checkbox"/> FRESH 3 <input type="checkbox"/> SULPHUR 2 <input type="checkbox"/> SALTY 4 <input type="checkbox"/> MINERAL
20-23	1 <input type="checkbox"/> FRESH 3 <input type="checkbox"/> SULPHUR 2 <input type="checkbox"/> SALTY 4 <input type="checkbox"/> MINERAL
25-28	1 <input type="checkbox"/> FRESH 3 <input type="checkbox"/> SULPHUR 2 <input type="checkbox"/> SALTY 4 <input type="checkbox"/> MINERAL
30-33	1 <input type="checkbox"/> FRESH 3 <input type="checkbox"/> SULPHUR 2 <input type="checkbox"/> SALTY 4 <input type="checkbox"/> MINERAL

51 CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET
			FROM TO
10-11	1 <input checked="" type="checkbox"/> STEEL 2 <input type="checkbox"/> GALVANIZED 3 <input type="checkbox"/> CONCRETE 4 <input type="checkbox"/> OPEN HOLE		0 0059
17-18	1 <input type="checkbox"/> STEEL 2 <input type="checkbox"/> GALVANIZED 3 <input type="checkbox"/> CONCRETE 4 <input type="checkbox"/> OPEN HOLE		20-23
24-25	1 <input type="checkbox"/> STEEL 2 <input type="checkbox"/> GALVANIZED 3 <input type="checkbox"/> CONCRETE 4 <input type="checkbox"/> OPEN HOLE		27-30

SCREEN

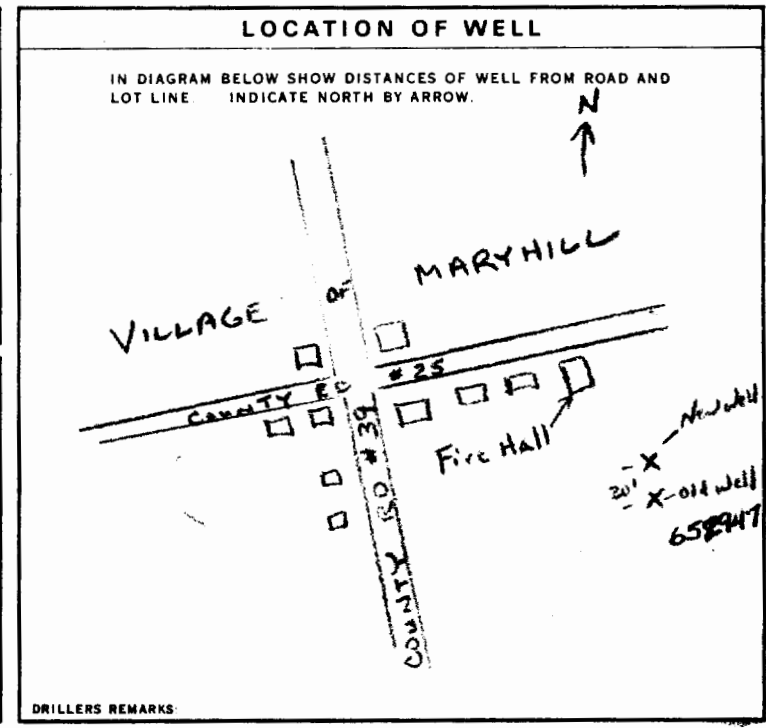
SIZE(S) OF OPENING (SLOT NO.)	DIAMETER	LENGTH
	68000 INCHES	05 FEET
MATERIAL AND TYPE	DEPTH TO TOP OF SCREEN	
	0059 FEET	

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET	MATERIAL AND TYPE	(CEMENT GROUT, LEAD PACKER, ETC.)
FROM TO		
10-13	14-17	
18-21	22-25	
26-29	30-33	

71 PUMPING TEST

PUMPING TEST METHOD 1 <input type="checkbox"/> PUMP 2 <input checked="" type="checkbox"/> BAILER	PUMPING RATE 0022 GPM	DURATION OF PUMPING 15-16 HOURS 17-18 MINS
STATIC LEVEL Present 010' FEET	WATER LEVEL END OF PUMPING 22-24 FEET	WATER LEVELS DURING 15 MINUTES 26-28 FEET 30 MINUTES 29-31 FEET 45 MINUTES 32-34 FEET 60 MINUTES 35-37 FEET
IF FLOWING, GIVE RATE GPM	PUMP INTAKE SET AT FEET	WATER AT END OF TEST 1 <input type="checkbox"/> CLEAR 2 <input type="checkbox"/> CLOUDY
RECOMMENDED PUMP TYPE <input type="checkbox"/> SHALLOW <input type="checkbox"/> DEEP	RECOMMENDED PUMP SETTING 040' FEET	RECOMMENDED PUMPING RATE GPM



84 FINAL STATUS OF WELL

1 <input checked="" type="checkbox"/> WATER SUPPLY	5 <input type="checkbox"/> ABANDONED, INSUFFICIENT SUPPLY
2 <input type="checkbox"/> OBSERVATION WELL	6 <input type="checkbox"/> ABANDONED, POOR QUALITY
3 <input type="checkbox"/> TEST HOLE	7 <input type="checkbox"/> UNFINISHED
4 <input type="checkbox"/> RECHARGE WELL	

85-86 WATER USE

1 <input type="checkbox"/> DOMESTIC	5 <input type="checkbox"/> COMMERCIAL
2 <input type="checkbox"/> STOCK	6 <input checked="" type="checkbox"/> MUNICIPAL
3 <input type="checkbox"/> IRRIGATION	7 <input type="checkbox"/> PUBLIC SUPPLY
4 <input type="checkbox"/> INDUSTRIAL	8 <input type="checkbox"/> COOLING OR AIR CONDITIONING
<input type="checkbox"/> OTHER	9 <input type="checkbox"/> NOT USED

87 METHOD OF DRILLING

1 <input checked="" type="checkbox"/> CABLE TOOL	6 <input type="checkbox"/> BORING
2 <input type="checkbox"/> ROTARY (CONVENTIONAL)	7 <input type="checkbox"/> DIAMOND
3 <input type="checkbox"/> ROTARY (REVERSE)	8 <input type="checkbox"/> JETTING
4 <input type="checkbox"/> ROTARY (AIR)	9 <input type="checkbox"/> DRIVING
5 <input type="checkbox"/> AIR PERCUSSION	

CONTRACTOR

NAME OF WELL CONTRACTOR KEN KERR	LICENCE NUMBER 3133
ADDRESS BADEN ONTARIO	
NAME OF DRILLER OR BORER	LICENCE NUMBER
SIGNATURE OF CONTRACTOR	SUBMISSION DATE DAY _____ MO _____ YR _____

OFFICE USE ONLY

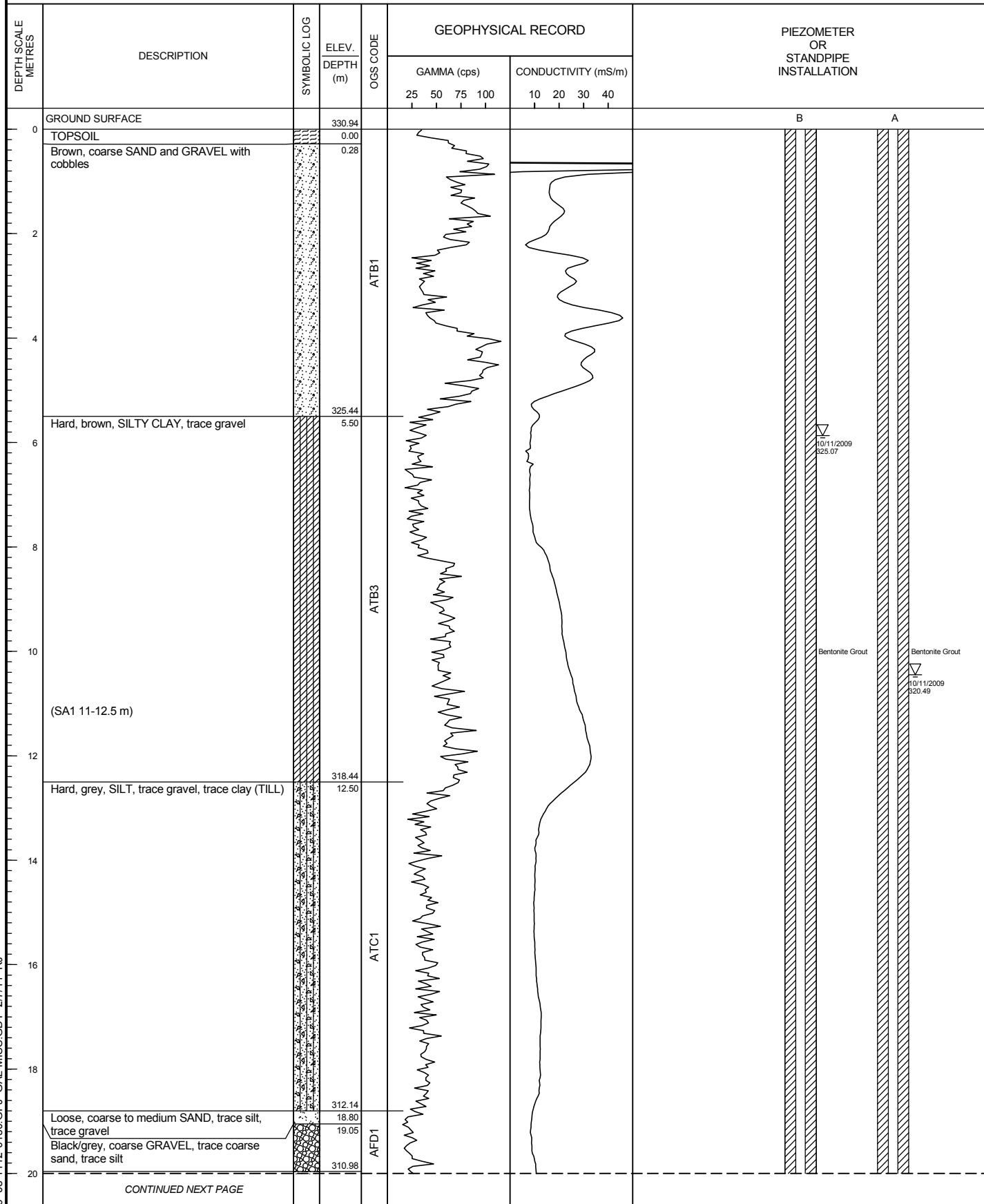
DATA SOURCE 1	CONTRACTOR 3133	DATE OF INSPECTION 06 10 87
REMARKS: - requires no.		INSPECTOR CSS.S8

PROJECT: 08-1112-0150
 LOCATION: N 4820625.0 ; E 549575.0

BOREHOLE LOG OF: WH-MH-OW01AB-09

SHEET 1 OF 3
 DATUM: NAD83

DRILLING DATE: October 9-20, 2009
 DRILL RIG: PQ Coring
 DRILLING CONTRACTOR: Procore Drilling



CONTINUED NEXT PAGE

MIS-HYD 009 08-1112-0150.GPJ GAL-MASS.GDT 2/7/11 RJ

DEPTH SCALE
 1 : 100



LOGGED: BH
 CHECKED: DN

PROJECT: 08-1112-0150

RECORD OF BOREHOLE: WH-MH-OW01AB-09

SHEET 1 OF 1

LOCATION: N 4820625.0 ; E 549575.0

DRILLING DATE: October 9-20, 2009

DATUM: NAD83

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: PQ Coring

DRILLING CONTRACTOR: Procure Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (min/m)	FLUSH	RECOVERY	R.Q.D. %	FRACT. INDEX PER 0.3 m	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.					
											TOTAL CORE %	SOLID CORE %	B Angle	DIP w.r.t. CORE AXIS				TYPE AND SURFACE DESCRIPTION		Ur	Ja	In
																		UN	ST			
		BEDROCK SURFACE		295.81																		
36		Blue grey to light grey, DOLOSTONE, fine grained, porous, small vugs - thin shale layer at 36.07 m		35.13																		
				25																		
				26																		
				27																		
38		- porosity increased at 38.48-38.73 m - porous, calcite filled vugs		28																		
				29																		
		- small porous section from 40.61-40.64 m - calcite filled vugs, medium to large in size, at 41.35-42.39 m		289.49																		
		Blue grey, calcite interbedded DOLOSTONE, medium to large vugs		41.45																		
42		Light brown/grey, DOLOSTONE, porous		288.55																		
				42.39																		
		- brown dolostone beds at 43.23-43.59 m and at 44.35-44.50 m - large vugs near 43.59 m and 43.89 m		31																		
44				286.44																		
		END OF BOREHOLE		44.50																		
46																						
48																						
50																						
52																						
54																						

MIS-RCK 004 08-1112-0150.GPJ GAL-MISS.GDT 2/7/11 RJ

DEPTH SCALE

1 : 100



LOGGED: BH

CHECKED: DN

Measurements recorded in: Metric Imperial

A090678

Page _____ of _____

Well Owner's Information

First Name _____ Last Name **REGIONAL MUNICIPALITY OF WATERLOO** E-mail Address _____ Well Constructed by Well Owner

Mailing Address (Street Number/Name) **150 Frederick Street** Municipality **KITCHENER** Province **ON** Postal Code **N2G4J3** Telephone No. (inc. area code) **519 575 4433**

Well Location

Address of Well Location (Street Number/Name) **St. Charles Street - Maryhill Community Centre** Township **Woolwich (Waterloo)** Lot **Pf. 80** Concession **BUB Upper Block**

County/District/Municipality **REGION OF WATERLOO** City/Town/Village **MARYHILL** Province **Ontario** Postal Code _____

UTM Coordinates Zone **17** Easting **549560** Northing **4820610** Municipal Plan and Sublot Number _____ Other _____

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
	Topsoil			0'	1'
	Gravel			1'	10'
Grey	Clay	Cobbles		10'	72'
	Gravel		Coarse	72'	75'
	Clay	Boulders		75'	85'
	Boulders	Gravel		85'	95'

Annular Space

Depth Set at (m/ft)	Type of Sealant Used (Material and Type)	Volume Placed (m ³ /ft ³)
95' - 85'	Sand	3 bgs.
85' - 75'	Holeplug	2 bgs.
75' - 0'	Grout	4 bgs.

Results of Well Yield Testing

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

If pumping discontinued, give reason: _____

Pump intake set at (m/ft) _____

Pumping rate (l/min / GPM) _____

Duration of pumping _____ hrs + _____ min

Final water level end of pumping (m/ft) _____

If flowing give rate (l/min / GPM) _____

Recommended pump depth (m/ft) _____

Recommended pump rate (l/min / GPM) _____

Well production (l/min / GPM) _____

Disinfected? Yes No

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

Method of Construction

Cable Tool Diamond Public Commercial Not used

Rotary (Conventional) Jetting Domestic Municipal Dewatering

Rotary (Reverse) Driving Livestock Test Hole Monitoring

Boring Digging Irrigation Cooling & Air Conditioning

Air percussion Industrial

Other, specify _____ Other, specify _____

Construction Record - Casing

Inside Diameter (mm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft)		Status of Well
			From	To	
2"	Plastic	Sch. 40	0'	95'	<input 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) <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 (mm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft)	
			From	To
2"	PVC Sch. 40	10	95'	85'

Water Details

Water found at Depth **85'-95'** Kind of Water: Fresh Untested Gas Other, specify _____

Water found at Depth _____ Kind of Water: Fresh Untested Gas Other, specify _____

Water found at Depth _____ Kind of Water: Fresh Untested Gas Other, specify _____

Hole Diameter

Depth (m/ft)	Diameter (mm/in)
0' - 95'	6"

Well Contractor and Well Technician Information

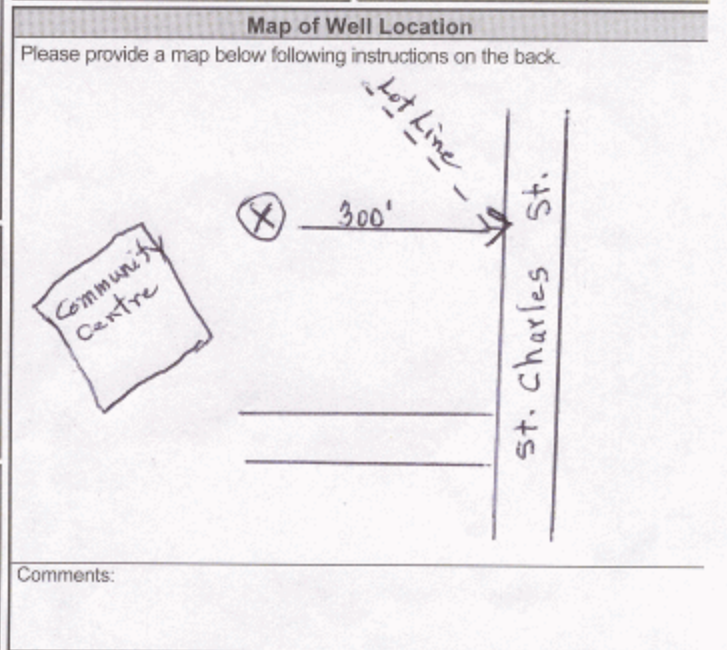
Business Name of Well Contractor **Davidson Well Drilling Limited** Well Contractor's Licence No. **1737**

Business Address (Street Number/Name) **147 North Street W.** Municipality **WINGHAM**

Province **ON** Postal Code **N0G2W0** Business E-mail Address **info@dauidsondrilling.com**

Bus. Telephone No. (inc. area code) **519 357 1960** Name of Well Technician (Last Name, First Name) **REAVIE GARY**

Well Technician's Licence No. **T1156** Signature of Technician and/or Contractor **G.C. Davidson** Date Submitted **2009/11/04**



Comments: _____

Well owner's information package delivered Yes No

Date Package Delivered **Y Y Y Y M M D D**
2009 11 04

Date Work Completed **2009 11 04**

Ministry Use Only

Audit No. **Z 109939**

MAR 29 2010

Received _____



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Appendix C

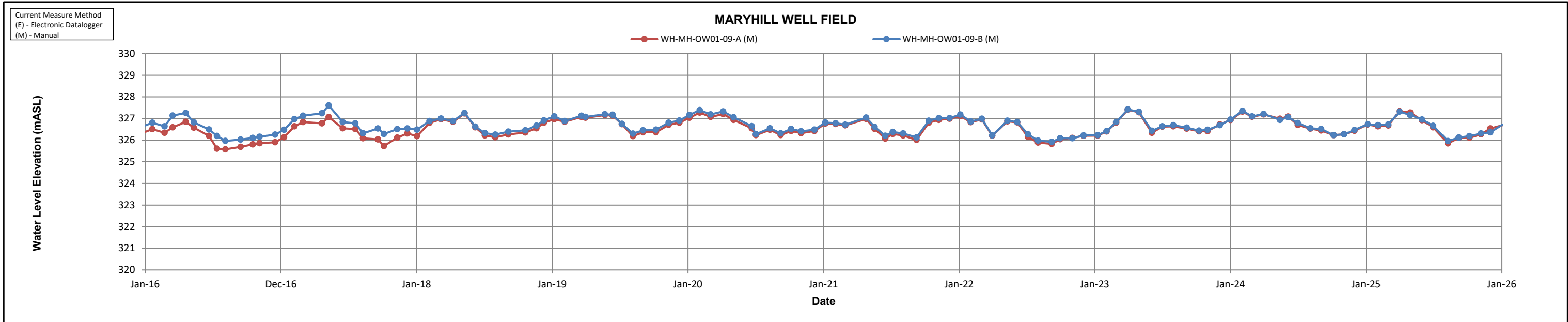
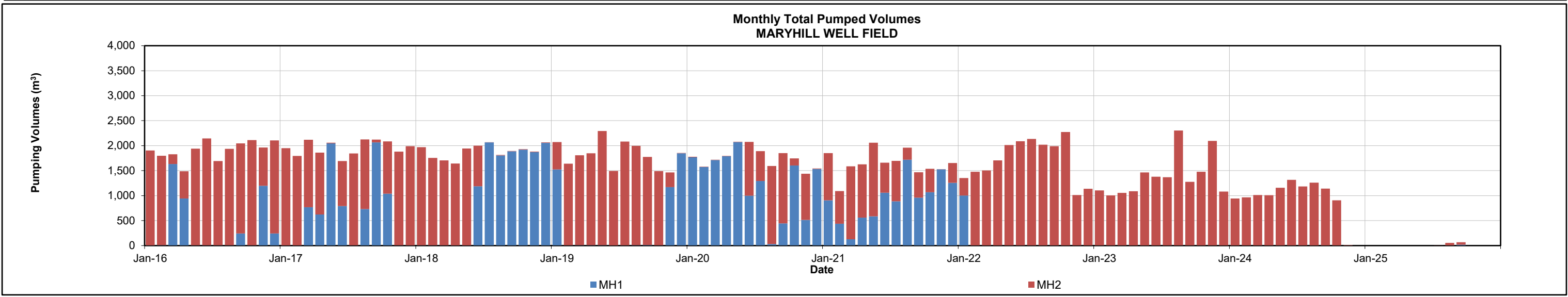
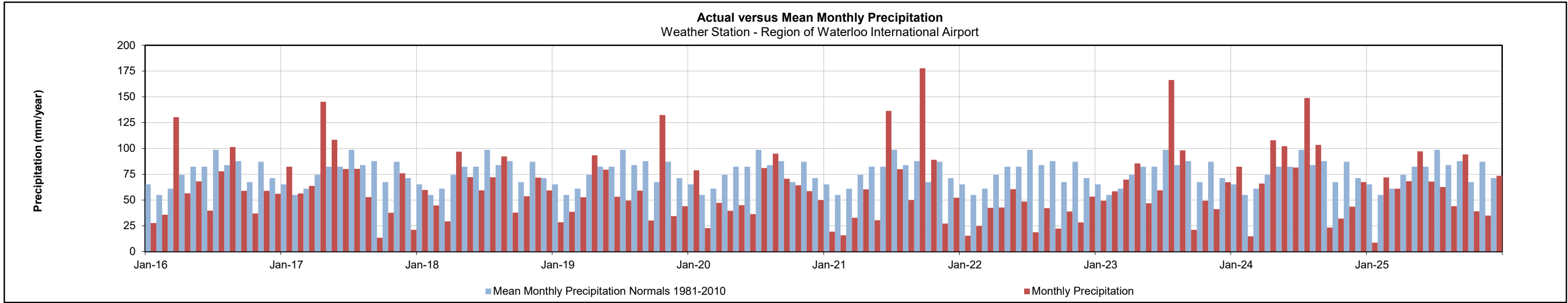
Monitoring Data (Pumped Volumes and Hydrographs)

TABLE C-1
WELL FIELD WATER PRODUCTION SUMMARY
REGION OF WATERLOO - 2025 GROUNDWATER MONITORING REPORT

Well Field	Major or Minor Supply	Production Well Name	Permit to Take Water Details			2021 Production Summary			2022 Production Summary			2023 Production Summary			2024 Production Summary			2025 Production Summary		
			MOE Permit Number ¹	Permitted Capacity (total m ³ /year)*	Permitted Rate (L/s)*	Total Production Well Volume (total m ³ /year)	Average Daily Rate (m ³ /day)	Average Rate (L/s)	Total Production Well Volume (total m ³ /year)	Average Daily Rate (m ³ /day)	Average Rate (L/s)	Total Production Well Volume (total m ³ /year)	Average Daily Rate (m ³ /day)	Average Rate (L/s)	Total Production Well Volume (total m ³ /year)	Average Daily Rate (m ³ /day)	Average Rate (L/s)	Total Production Well Volume (total m ³ /year)	Average Daily Rate (m ³ /day)	Average Rate (L/s)
Maryhill	Minor	MH1 MH2	2613-BBKR76	Combined rate for PTTW 2613-BBKR76 57,345	1.8	11,092	30	0.4	1,004	3	0.0	0	0	0.0	0	0	0.0	17	0	0
			2613-BBKR76			8,624	24	0.3	19,697	54	0.6	16,697	46	0.5	10,905	30	0.3	111	0	0.0
			Well Field Total			19,716	54	0.6	20,701	57	0.7	16,697	46	0.5	10,905	30	0.3	128	0	0.0
			*Maximum rate and amount of taking shall not exceed 109 L/min and 157,110 L/day respectively, for the wellfield																	

Notes:
 - = no applicable data
 n/a = data not available
 * = rates and volumes based on permitted L/day
¹ = Current Permit

REGION OF WATERLOO
2025 GROUNDWATER MONITORING REPORT -
MARYHILL





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Appendix D

Precipitation Data

**Table D-1
Precipitation Variation from Average
Region of Waterloo - 2025 Groundwater Monitoring Report**

Year	Kitchener/Waterloo Weather Station Established 1966		
	Annual Precipitation (mm)	30-yr NORMAL Precipitation 1981-2010 (mm)	Difference (mm)
2016	748	851	-103
2017	818	851	-33
2018	749	851	-102
2019	695	851	-156
2020	689	851	-162
2021	772	851	-79
2022	438	851	-413
2023	813	851	-38
2024	874	851	23
2025	723	851	-128

Year	University of Waterloo Station Established 1988		
	Annual Precipitation (mm)	Average Precipitation 1998-2024 (mm)	Difference (mm)
2016	891	871	20
2017	989	871	118
2018	950	871	79
2019	923	871	52
2020	953	871	82
2021	1022	871	151
2022	578	871	-293
2023	959	871	88
2024	763	871	-108
2025	943	871	72

Year	Shand Dam Established 1939		
	Annual Precipitation (mm)	Average Precipitation 1940-2025 (mm)	Difference (mm)
2016	976	926	50
2017	1093	926	167
2018	849	926	-77
2019	1081	926	155
2020	1017	926	91
2021	876	926	-50
2022	798	926	-128
2023	1015	926	89
2024	994	926	68
2025	995	926	69

Year	Conestogo Dam Established 1961		
	Annual Precipitation (mm)	Average Precipitation 1961-2025 (mm)	Difference (mm)
2016	983	990	-7
2017	1210	990	220
2018	962	990	-28
2019	992	990	2
2020	1021	990	31
2021	975	990	-15
2022	907	990	-83
2023	1053	990	63
2024	972	990	-18
2025	1025	990	35

Year	Woolwich Dam Established 1960		
	Annual Precipitation (mm)	Average Precipitation 1960-2025 (mm)	Difference (mm)
2016	844	835	9
2017	986	835	151
2018	869	835	34
2019	824	835	-11
2020	862	835	27
2021	649	835	-186
2022	668	835	-167
2023	859	835	24
2024	793	835	-42
2025	732	835	-103

Year	Shade's Mills Dam Established 1960		
	Annual Precipitation (mm)	Average Precipitation 1960-2025 (mm)	Difference (mm)
2016	934	909	24
2017	1092	909	183
2018	1042	909	133
2019	1059	909	150
2020	848	909	-62
2021	1020	909	111
2022	682	909	-227
2023	982	909	73
2024	976	909	67
2025	895	909	-14

Year	Laurel Dam Established 1960		
	Annual Precipitation (mm)	Average Precipitation 1960-2025 (mm)	Difference (mm)
2016	985	938	47
2017	1062	938	124
2018	1071	938	133
2019	940	938	2
2020	938	938	0
2021	1027	938	89
2022	689	938	-249
2023	921	938	-17
2024	907	938	-31
2025	894	938	-44

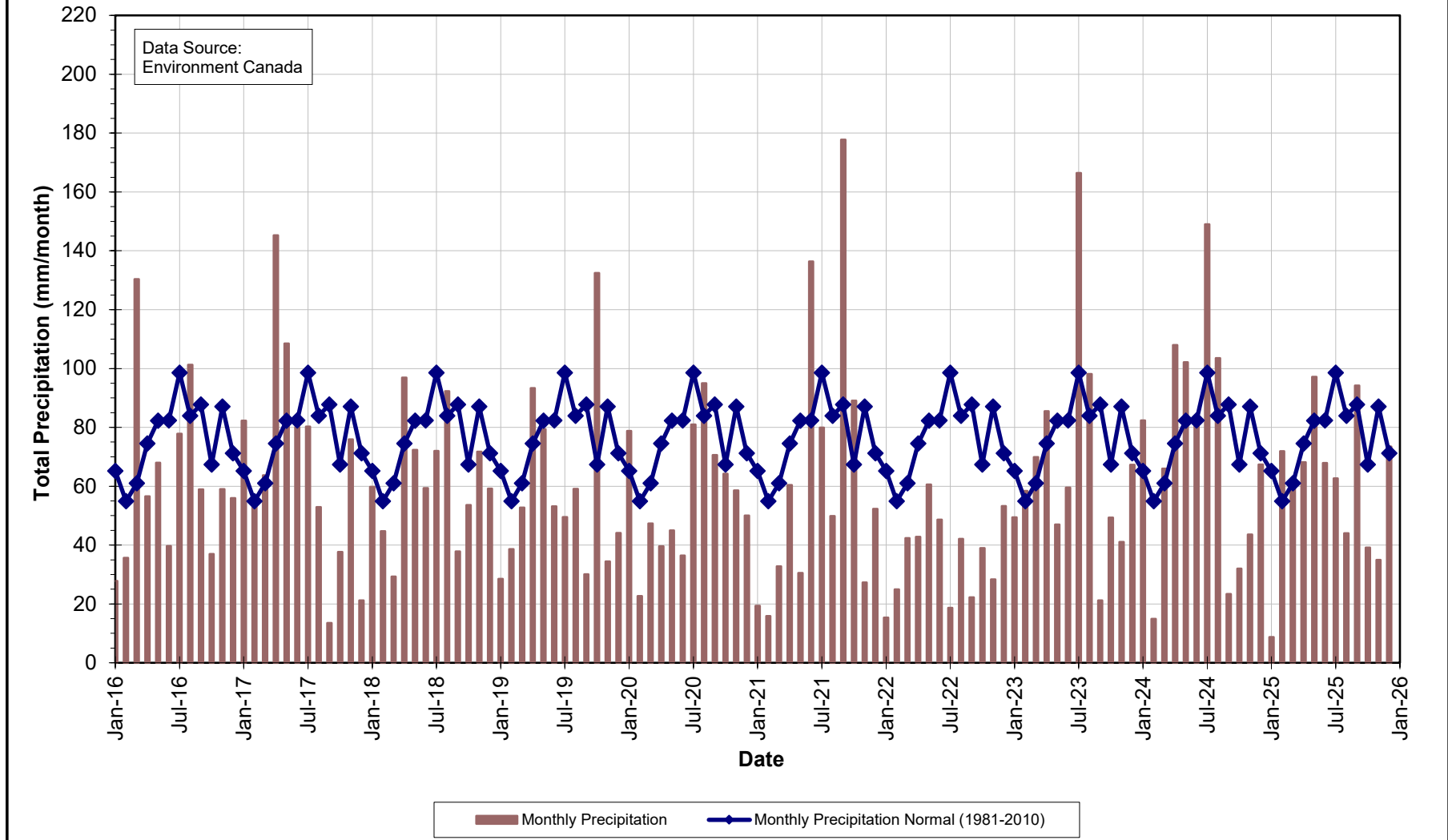
Year	Roseville Weather Station Established 1972		
	Annual Precipitation (mm)	30-yr NORMAL Precipitation 1981-2010 (mm)	Difference (mm)
2016	899	919	-20
2017	882	919	-37
2018	905	919	-14
2019	957	919	38
2020	817	919	-102
2021	832	919	-87
2022	637	919	-282
2023	945	919	26
2024	856	919	-63
2025	786	919	-133

NOTES:

WIA station data is not subject to review by the National Climate Archives, therefore, undergoes very limited quality checking.
GRCA Dam stations data is not reviewed extensively and undergoes limited quality checking.

Region of Waterloo – 2025 Groundwater Monitoring Report

Figure D.1
Waterloo International Airport
Monthly Precipitation





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Appendix E

Monitoring Program Overview

GROUNDWATER LEVEL MONITORING PROGRAM PROCEDURES

E.1 Overview

The Region of Waterloo (Region) collects water level measurements at specific monitoring wells to ensure sustainable long-term water supply and to meet monitoring and reporting requirements for the Region's water-taking permits. The goal of the program is to manage and protect the Region's groundwater supply and to assess the potential impact of municipal pumping on the groundwater and surface water resources in the Region. The ongoing collection and assessment of groundwater level data is integral to assess any changes to the water resources that may occur due to pumping.

E.1.1 Production Well Pumping and Water Levels

In 2023 the Region managed approximately 132 production wells with status defined as:

- Commissioned – Active wells
- New Not-Commissioned – Well are inactive or locked out until future demand or repairs/maintenance of other wells requires activating them

The well fields are referred to as Urban (Kitchener, Waterloo, and Cambridge) and Rural (North Dumfries, Woolwich, Wilmot, and Wellesley). Well fields in Kitchener, Waterloo, and Cambridge are referred to as the Integrated Urban System (IUS).

The Region's active production wells are monitored through the Region's SCADA (Supervisory Control and Data Acquisition) system, which reads and records the volume pumped on a daily basis. A few wells do not have their own meter but are combined with other nearby well(s) in the well field and the combined flow is divided into a record for each source. Water level measurements are obtained from the production wells where required. All manual measurements are obtained using either an air line or a water level tape.

E.1.2 Monitoring Wells and Surface Water levels

Water levels are measured at monitoring wells and at some surface water features. The objective of this monitoring is to collect data to ensure that the Region's water taking has minimal impact on the environment and on private water takers.

Water levels in the Region's monitoring wells are measured either electronically or manually. Most of the wells that are monitored electronically use datalogger equipment manufactured by *In-Situ Inc.*® LevelTROLLs® and RuggedTROLLs®, as well as, by *Van Essen Instruments (formerly Schlumberger Water Services)* Mini-Divers®, Micro-Divers®, and TD-Divers®; or by *Solinst*® Levelloggers®. The datalogger pressure sensor models used may be either vented (gauged) or non-vented (absolute) for *In-Situ Inc.*®; whereas, for *Van Essen Instruments* and for *Solinst*®, non-vented (absolute) models are used. Barometric dataloggers by each manufacturer suspended in select well locations are also used with the non-vented (absolute) models to provide the required barometric pressure compensation necessary in producing the water level data. Manual monitoring is done using a *Solinst*® and/or *Heron Instruments Inc.* electronic water level meter with both visual and audio indicators.

The electronically monitored wells are typically measured every hour, with increased frequency as required. At the hourly frequency, the following trends can be distinguished in an individual monitoring well:

- Seasonal climate trends;
- Water level changes in the aquifer that is being pumped;
- Water level changes in aquifers connected to the pumped aquifer; and
- Individual precipitation events in unconfined aquifers.

The manually monitored wells are measured once per month. At this frequency only the first three responses listed above can be distinguished.

E.1.3 Climatological Data

To evaluate the reaction of water levels to changes in climatic conditions, precipitation data are monitored at various locations throughout the Region. Within the Region of Waterloo, climate data is collected by Environment Canada at the Region of Waterloo International Airport (WIA) and the Roseville weather station, by the Grand River Conservation Authority (GRCA) at various Dam locations and by the University of Waterloo at a weather station located on the north campus.

E.2 Groundwater Level Collection Protocols

E.2.1 Groundwater Level Monitoring Network Summary Well Checklist

A well checklist and data entry spreadsheet are prepared of all the measuring points where water levels will be collected on a monthly basis. The checklist and spreadsheet are organized by well field so wells in close proximity are grouped together and indicates whether locations are measured with electronic dataloggers or manual measurements only. Once a well is visited, data is entered in the spreadsheet and the well is checked off the list; thus, the checklist and spreadsheet provides an obvious indication that work is unfinished if a location is unchecked and has no data.

E.2.2 Well Inspection

Upon visiting a well for the first time, the well/casing/equipment details are noted, photos taken, and GPS coordinates are recorded in a field book and/or in the monthly data entry spreadsheet. Well/casing/equipment details includes: location, access, condition, materials, diameters, casing security, surface seal condition, requiring repair or not, well/casing stickup measurements from ground level, well total depth, and the type of datalogger and/or sampling equipment installed. Any notable deficiencies, concerns, problems, or changes in the well condition are recorded in a field book and/or in the monthly data entry spreadsheet, as well as, photos are taken. Also, any observed activities taking place around or near the well that are worth noting are recorded in a field book and/or in the monthly data entry spreadsheet.

E.2.3 Monitoring Well Manual Water Level Measurement Procedure

- Unlock well casing and open well casing lid.
- Remove well cap (if present).
- Use an Electronic Water Level meter and lower the probe down the well until the meter beeps to indicate the probe has encountered water.
- The probe is raised up until the beep of the meter stops, indicating the probe is now above the water.
- Then the probe is slowly lowered down until the probe just contacts the water level surface causing the meter to beep.
- At this point the depth (in meters) is read off the water level meter tape from the measuring point of the well (in most cases is the top of the casing or pipe) and this provides the water level depth below the measuring point.
- The date, time, and water level depth measured is recorded in a field book and/or in the monthly data entry spreadsheet.
- This procedure is repeated for each of the well screens inside the well casing.

- Replace well caps.
- Close well casing lid and lock well casing.

E.2.4 Downloading of Water Levels from Electronic Dataloggers Procedure

For Non-Vented (Absolute) Datalogger Models:

In-Situ Inc.® LevelTROLLs® and RuggedTROLLs®, *Van Essen Instruments Divers*®, and *Solinst*® Levelloggers®

- Prior to downloading data from the datalogger, a manual water level is measured in each well screen containing a datalogger.
- The datalogger is pulled out of the well, unthreaded from the cap that is attached to a wire cable and connected to (or placed in) the corresponding datalogger communication device. The communication device is connected to a laptop/tablet PC or a RuggedReader® Handheld PC and the associated datalogger software is started.
- Water level data stored in the datalogger is subsequently downloaded and viewed using the datalogger software and saved on the hard drive/memory.
- Note: downloading data from the datalogger does not automatically stop the datalogger from recording.
- The status of the datalogger is viewed and checked for correct operation and to confirm that the datalogger is hanging in the well water within its operating range.
- Select datalogger details such as the battery level and free/used memory are recorded in a field book and/or in the monthly data entry spreadsheet.
- If the datalogger does not require restarting to free up memory or to change the sample rate, then the datalogger is removed from the communication device and is threaded back onto its cap and lowered back down the well on the wire cable.
- If the datalogger does require restarting to free up memory or to change the sample rate, then the datalogger is stopped, reprogrammed, and restarted using the datalogger software and, as a result, erases the previous data stored in memory on the datalogger.
- This procedure is repeated for each datalogger within each of the well screens inside the well casing.
- After all the non-vented (absolute) dataloggers have been downloaded then the Barometric dataloggers are downloaded following the same procedure as above.

For Vented (Gauged) Datalogger Models:*In-Situ Inc.*® LevelTROLLs®

- Prior to downloading data from the datalogger, a manual water level is measured in each well screen containing a datalogger.
- The desiccant tube is unconnected from the datalogger cable.
- The datalogger cable is connected to a communication cable device that is connected to a laptop/tablet PC or a RuggedReader® Handheld PC and the datalogger software is started.
- Water level data stored in the datalogger is subsequently downloaded and viewed using the datalogger software and saved on the hard drive/memory.
- Note: downloading data from the datalogger does not automatically stop the datalogger from recording.
- The status of the datalogger is viewed and checked for correct operation and to confirm that the datalogger is hanging in the well water within its operating range.
- Select datalogger details such as the battery level, free/used memory, and desiccant condition (colour) are recorded in a field book and/or in the monthly data entry spreadsheet.
- The desiccant tube condition is checked and replaced if necessary.
- If the datalogger does not require restarting to free up memory or to change the sample rate, then the communication cable device is disconnected from the datalogger cable and the desiccant tube is reconnected.
- If the datalogger does require restarting to free up memory or to change the sample rate, then the datalogger is stopped, reprogrammed, and restarted using the datalogger software and, as a result, erases the previous data stored in memory on the datalogger.
- This procedure is repeated for each datalogger within each of the well screens inside the well casing.

E.2.5 Data Entry and Processing into the Burnside MS ACCESS/SQL® Database

- All field data collected (i.e. date, time, manual water level depth measured, comments) and recorded for each well screen and datalogger in a field book is entered into the monthly data entry spreadsheet, unless already entered in the field using a laptop/tablet PC.
- The monthly data entry spreadsheet is checked and reviewed prior to importing the data into a database table using Burnside Water Level Data Tools software. Manual water level depth values are converted into water level elevation values using the software during this import process.
- Any associated well notes, comments, and datalogger details are entered into a database table under the appropriate well and screen.

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- Water level data from the dataloggers downloaded to a laptop/tablet PC or a RuggedReader® Handheld PC are transferred to Burnside file folder network upon returning to the office.
- These datalogger water level data files are subsequently read and the data is imported into a database table using Burnside Water Level Data Tools software.
- Using Burnside Water Level Data Tools software, the datalogger water level data are reviewed and processed (as described below) resulting in corrected water level depth values and corrected water level elevation values that are stored in a database table.
- *For Non-Vented (Absolute) Datalogger Models:*
Datalogger water level data is first barometric pressure compensated using selected Barometric datalogger data, then a manual water level depth value measured at the time of the most recent download is applied and used to convert the barometric compensated water level data into corrected water level depth values, which are converted into water level elevation values that are appended to a database table.
- *For Vented (Gauged) Datalogger Models:*
A manual water level depth value measured at the time of the most recent download is applied to the datalogger water level data to convert the water level data into corrected water level depth values, which are converted into water level elevation values that are appended to a database table.
- Temperature data recorded by the dataloggers are also imported into a database table.
- Hydrographs are subsequently created for each well and screen from the water level elevation data in the database for review and presentation. If there are some data points that are erroneous, then these data points are marked as non-reportable (invalid) within the database and/or are removed resulting in them not being plotted on the hydrographs.
- An updated data file is provided to the Region on a quarterly basis for upload into their eWRAS EQUIS database.

