



BURNSIDE

**2025 Biennial Groundwater Monitoring
Report - Ayr Well Field (A1, A2, A3)**

The Region of Waterloo



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2025 Biennial Groundwater Monitoring Report - Ayr Well Field (A1, A2, A3)

The Region of Waterloo

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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) for the Ayr Well Field, (P-300-2094925631) 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 conditions of the PTTW for 2024 and 2025. A copy of the PTTW is included in Appendix A.

The location of the Ayr Well Field is shown on Figure 1 and the production wells in North Dumfries are shown on Figure 2 with the monitoring network for the Ayr Well Field shown on 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 Permits to Take Water (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 Ayr Well Field which consists of the following activities:

- Measuring the daily volume pumped from the A1, A2 and A3 production wells (Condition 4.1 of the PTTW);
- Measuring the water levels in monitoring wells ND-AR-MW1-03-AB and ND-AR-MW2-03-AB (Condition 4.2 of the PTTW);
- Review of precipitation data from the nearest GRCA / Environment Canada weather station; 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 Ayr Well Field is located in the southwest portion of North Dumfries Township. The closest municipal well field is Roseville, located about 4.5 km to the north of Ayr (Figure 2). Wells A1, A2 and A3 are located just to the north of the confluence of the Nith River and Cedar Creek adjacent to Watson Pond in the central portion of Ayr (Figure 3).

2.1.1 Pumping Wells

The Ayr Well Field consists of three production wells; A1, A2 and A3. Well records for the production wells are found in Appendix B. The production wells obtain water from an outwash sand and gravel aquifer (AFD1), located at a depth of about 20 m to 50 mbgs. 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 / Screen Diameter (mm)	Screened Interval (mbgs)	Aquifer
A1	1976	250	44.5 – 50.6	AFD1
A2	1976	250	43.0 – 49.1	AFD1
A3	2004	300	42.7 – 48.8	AFD1

The water taking volumes for the Ayr 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	2024			2025		
	Permitted Max. Daily Water Taking (m ³)	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)
A1	5,480	856	1,670	312,372	794	1,675	289,778
A2	5,480	832	1,907	303,683	726	1,878	265,012
A3	5,480	525	2,302	191,784	631	1,536	230,428

Well	PTTW	2024			2025		
Total	5,480	2,213	3,148	807,839	2,151	3,553	785,218

Condition 3.3 of the PTTW specifies that the combined water taking from the well field shall not exceed an annual daily average of 5,480 m³/day. As shown in Table 2, this requirement was met in both 2024 and 2025.

The Region of Waterloo's SCADA system records total daily water taking volumes including the dates and times of water takings, the rates of pumping, and calculations of the total amounts of water pumped per day for each supply well, which complies with condition 4.1 of the PTTW.

The pumping volumes are presented in Appendix C as total monthly volumes. Pumping volumes from the well field ranged from 55,921 m³/month to 74,836 m³/month in 2024, and from 53,358 m³/month to 78,063 m³/month in 2025. In total, 807,839 m³ was produced at this well field in 2024 and 785,218 m³ was produced in 2025. These volumes are higher than pumping for the previous five years and well below the permitted volume of 2,000,200 m³ per year (Table C-1).

2.1.2 Monitoring Wells

The well names on the PTTW are slightly different than the Region's current nomenclature. The monitoring wells on the PTTW are shown below in Table 3 along with the name that is used by the Region. The Region names will be used throughout this report.

Table 3: Well Nomenclature

Monitoring well names as they appear on the PTTW	Revised well names consistent with Region nomenclature
ND-AYR-MW1A-03	ND-AR-MW1-03-A
ND-AYR-MW1B-03	ND-AR-MW1-03-B
ND-AYR-MW2A-03	ND-AR-MW2-03-A
ND-AYR-MW2B-03	ND-AR-MW2-03-B

Monitoring well construction details for ND-AR-MW1-03-AB and ND-AR-MW2-03-AB are described in the table below and the well locations are shown on Figure 4. Well records for the monitoring wells are provided in Appendix B.

Table 4: Monitoring Well Construction Details

Monitoring Well ID	Year Built	Screened Depth (mbgs)	Screened Formation	Distance to A1/A2 (m)	Distance to A3 (m)
ND-AR-MW1-03-A	2003	44.2 – 47.2	AFD1	240	241
ND-AR-MW1-03-B	2003	5.2 – 8.2	AFB3		
ND-AR-MW2-03-A	2003	45.4 – 48.5	AFD1	94	135
ND-AR-MW2-03-B	2003	3.4 – 6.4	AFB3		

2.2 Regional Geology and Hydrostratigraphy

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

The recently completed Tier Three Assessment Update Project (Aqua Insight et al, 2023) has revised the previous (Matrix 2015) stratigraphic interpretation of the lithology around the Ayr Wellfield. The lithological layers were updated in accordance with documentation provided in the Numerical Model Surface Transfer memorandum (Aqua Insight Inc, 2026).

The cross-sections are provided as a visual aid and do not necessarily contain all wells in the monitoring program for the Ayr Well Field. The recently completed Tier Three Assessment Update Project (Aqua Insight et al, 2023) has revised the previous (Matrix 2015) stratigraphic interpretation of the lithology around the Ayr Wellfield. The lithological layers were updated in accordance with documentation provided in the Numerical Model Surface Transfer memorandum (Aqua Insight Inc, 2026). The discussion of changes to the lithology is based on information in the. Updates to the Moraine and Cambridge Model following Model Calibration Reporting (Aqua Insight Inc et al, 2024)

Several changes were made to the interpretation of the lithology in the vicinity of the Ayr Wellfield (Aqua Insight Inc. et al). The pre-Catfish Creek Aquifer (AFD1) was previously interpreted as being discontinuous north of the well field toward Roseville. The continuity of the pre-Catfish Creek Aquifer (AFD1) between Roseville and Ayr was extended using available borehole lithology data. A thick gravel zone, 5 to 10 m in thickness, was interpreted in this area at an elevation of 250 to 270 m asl.

Layer updates were also made within the well field to enhance aquifer continuity and smooth the aquifer layer elevation interpretation in areas that were previously

characterized as having abrupt changes in elevation over short distances. The Lower Waterloo Moraine Sand Aquifer (AFB3) was adjusted to be more continuous south of the municipal wells (Figures 5 and 6) using available lithologic data, and the elevation of the pre-Catfish Creek Aquifer (AFD1) was reduced from 270 m asl to 250 m asl, to be a similar elevation as found at the Ayr municipal well screens.

The thickness of the pre-Canning Aquifer (AFF1) was previously interpreted (Matrix 2015) to reach 20 m local to the wellfield and extending to the south, but this unit was also interpreted to completely pinch out further south. The thickness of this unit has been reduced to 3 to 5 m and interpreted to be continuous in areas south of Ayr (Figures 5 and 6).

Layer updates made in the current version of the Moraine Model increased the continuity of the production aquifer and addressed steep changes in the elevation of the Lower Waterloo Moraine Sand Aquifer (AFB3), the pre-Catfish Creek Aquifer (AFD1) and pre-Canning Aquifer (AFF1) surfaces, mainly south of the production wells (Figure 5).

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 Ayr Well Field is characterized by gravelly glaciofluvial deposits (Figure 4). Modern alluvial outwash deposits are present along Cedar Creek and the Nith River. Deposits of glacial tills and ice-contact deposits are also in the vicinity of the Ayr Well Field (Figure 4).

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

Aquitard ATA1 – Whittlesey Clay

This surficial silt and clay unit, interpreted as glaciolacustrine Whittlesey Clay (Bajc and Shirota, 2007), is present across portions of the Well Field but is not laterally continuous. The unit is generally absent in the northern portions of the cross sections and becomes more evident toward the central and southern areas. Where present, ATA1 occurs as a relatively thin to moderately thick layer at surface and acts as a low-permeability horizon that locally restricts infiltration and contributes to partial confinement of the underlying overburden deposits.

Aquifer AFA1 – Whittlesey Sand

This sand unit, interpreted as glaciolacustrine Whittlesey Sand (Bajc and Shirota, 2007), occurs beneath the upper deposits but is discontinuous across the site. AFA1 is not observed in the northern portions of the cross sections and becomes more prominent

toward the south and east, where it generally increases in thickness. Where present, the unit ranges from thin and locally developed to more substantial accumulations in the southeastern area, and functions as a permeable zone facilitating groundwater flow within the upper overburden sequence.

Aquitard ATB1 – Port Stanley Till

The Ingersoll, Tillsonburg, Norwich and Paris Moraines coalesce to the south and west of Ayr. These moraines are generally composed of Port Stanley Till except for the Paris Moraine which is composed of Wentworth Till. The Port Stanley Till is composed of silt to sandy silt till and the Wentworth Till is composed of stony, sandy silt till. This unit is considered an aquitard and, where present, acts to restrict recharge to the lower aquifers. ATB1 is interpreted to be thin or absent in the area of the Ayr Well Field.

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

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, 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. The unit is not noted in boreholes for the Ayr Well Field.

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. The unit is not noted in boreholes for the Ayr Well Field.

Aquifer AFB3 – Catfish Creek Outwash Deposits

Aquifer AFB3 is mainly found along the eastern flank of the Waterloo Moraine below ATB3. The unit consists of stratified gravel, sands or silts. In the area of the Ayr Well Field the unit consists of sand and gravel and is the shallow overburden aquifer.

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. The Catfish Creek Till is typically thickest in the core area of the Waterloo Moraine, and thin or absent along the eastern flank. At the Ayr Wellfield the unit is a confining layer consisting of clay separating the shallow aquifer (AFB3) from the deep production well aquifer (AFD1) with thickness ranging from 5 m to 22 m (Stantec, 2003).

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 Till and represents the main supply aquifer in several production wells in the Cities of Kitchener and Waterloo and is the production aquifer for the Ayr Well Field. The aquifer is interpreted to pinch out south and west of the Ayr production wells (Stantec, 2003).

Aquitard ATE1 – Canning Drift

The Canning Drift is comprised of till and associated fine-textured lake deposits. It is typically found at depths 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.

Aquifer AFF1 – Pre-Canning Till

The Pre-Canning aquifer is characterized by coarse-grained sand and gravel sediments and is typically found within bedrock depressions. This unit is discontinuous throughout the Region, and where present is hydraulically connected with the upper weathered portion of the bedrock aquifer.

2.2.2 Bedrock Geology

Bedrock in the area is comprised of interbedded grey and brown dolostone of the Salina Formation. Interbeds of green and red shale and gypsum are common. Karrow (1963) indicated that there are numerous buried bedrock valleys west of the Niagara Escarpment, the largest of which is a deep trough extending northwest under Ayr and is interpreted to be an extension of the Dundas Valley.

2.3 Local Geology

Figure 3 displays the Ayr Well Field well plan and cross-section locations. Representative cross-sections generated from the regional model layers are included as Figures 5 and 6 to visualize the stratigraphy described in this section. The geological

descriptions are based on the lithology described in the borehole logs and may not match the lithology as shown on the Regional cross section.

Catfish Creek Outwash Deposits (AFB3) – Consisting of sand and gravel the unit was identified at ND-AR-MW1-03-A from 4.3 m to 8.2 mbgs and at ND-AR-MW2-03-A from 2.4 m to 6.7 m

Catfish Creek Till (ATC1 / ATC2) - This unit consisting of clay till ranges from 5 m to 22 m in thickness and is generally situated between 256 m amsl and 275 m amsl. The unit was identified at ND-AR-MW1-03-A from 8.2 m to 12.8 m and at ND-AR-MW2-03-A from 6.7 m to 27.1 m. At the production well A1 a till unit was encountered above the Lower Aquifer from 24 m to 36 mbgs.

Pre-Catfish Creek Sand and Gravel (AFD1) – This unit consisting of sand and gravel is identified as the Lower Aquifer in the Ayr Well Field area, and ranges in thickness from 22 m to 36 m. The unit was identified at ND-AR-MW1-03-A from 12.8 m to 48.8 mbgs and at ND-AR-MW2-03-A from 27.1 m to 49.7 mbgs. A1 is screened in AFD1 from 44.50 to 50.6 mbgs and A2 and A3 are screened in the same unit from 43.0 to 49.0 mbgs and 42.7 to 48.8 mbgs, respectively.

Canning Drift (ATE1) – This unit consisting of clay and boulders is approximately 7 m thick at the production wells. At ND-AR-MW2-03-A the base of the aquitard was encountered at a depth of 50.3 mbgs. The unit was not encountered at monitoring well ND-AR-MW2-03-A. The elevation of the Lower Aquitard ranges from 225 m amsl to 239 m amsl, when present.

Bedrock – Dolostone bedrock of the Salina Formation was encountered at A3 at a depth of 54.4 mbgs and monitoring well ND-AR-MW2-03-A at a depth of 49.6 mbgs (elevation of 233.7 m amsl).

3.0 2024 / 2025 Results

The following sections summarize groundwater levels at monitoring wells in relation to precipitation and water taking from the aquifer (in accordance with condition 4.3 of the PTTW).

3.1 Precipitation

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 Ayr Well Field is the Shades Mills Dam station located 16.3 km northeast from the well field. The closest Environment Canada station is Roseville located about 7.5 km north 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 Roseville are shown on Figure D.1, Appendix D. At the Shades Mills Dam station, the long-term average was calculated from when measurements started until the end of 2025. The Roseville climate station has “Climate Normals” calculated by Environment Canada for 1981 to 2010 (1991 to 2020 normals are not available for this location).

Annual 2024 / 2025 precipitation data for the GRCA and Environment Canada meteorological station closest to the Ayr Well Field are presented in Table 5 below. In 2024 Roseville was missing 5 days of data and 20 days in 2025. As a result, the precipitation totals may be under reported at this location.

Table 5: Summary of Precipitation Data

Station	2024 Precipitation (mm)	2024 Deviation (mm)	Long-Term Average (mm)	2025 Precipitation (mm)	2025 Deviation (mm)
Shades Mills Dam ⁽²⁾	976	+67	909 ^(B)	895	-14
Roseville Station ⁽¹⁾	856	-63	919 ^(A)	786	-133
Sources: Environment Canada (1), GRCA (2) ^A 1981 to 2010 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 Shades Mills station was 976 mm, which is 67 mm above the long-term average, indicating 2024 was wetter-than-average at the well field. At Roseville however precipitation was 63 mm below the long-term average trend. The March 1 GRCA snow survey indicated a snowpack across the Region that was low compared to normal. In 2025, the total precipitation was 895 mm, which is 14 mm below the long-term average.

Similarly, the total precipitation at the Roseville station was 133 mm below the long-term average, indicating 2025 was a drier-than-average year. However, Roseville was missing 25 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

In accordance with Condition 4.2 of the PTTW, water levels were measured once per month in the monitoring wells. 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.

ND-AR-MW1-03-AB

Monitoring well nest ND-AR-MW1-03-AB is located 240 m from production wells A1 / A2 and 241 m from production well A3. Water levels at monitoring well ND-AR-MW1-03-A are collected using an electronic water level meter (datalogger) and water levels at ND-AR-MW1-03-B were collected manually. The A screen is installed at approximately the same depth as the production wells in the AFD1. The B screen is installed at about 4.8 m below grade in AFB3.

The 2024 and 2025 water levels in both screens were within historical ranges. The hydrograph indicates that water levels in the A screen vary within 0.7 m and show seasonal trends with highest water levels generally occurring in the spring and lowest water levels in the fall. Water levels in the B screen are stable and only vary by 0.1 to 0.2 m. The water levels at ND-AR-MW1-03-AB do not indicate a response to pumping of the Ayr Well Field.

ND-AR-MW2-03-AB

Monitoring well nest ND-AR-MW2-03-AB is located 94 m from production wells A1 / A2 and 135 m from production well A3. Water level monitoring at ND-AR-MW2-03-A is completed with a datalogger and at ND-AR-MW2-03-B monthly manual readings are collected. The A screen is installed at 45.4 m below grade at approximately the same depth as the production wells in AFD1 and the B screen is installed at 3.4 m below grade in gravel overlying clay in AFB3. The 2024 and 2025 water levels in both screens were within historical ranges.

ND-AR-MW2-03-A is a flowing artesian well which makes manual readings challenging. In May 2016, the well was converted from a flush-mount configuration to an above-grade installation and a datalogger was installed beneath a packer to record hourly measurements. However, the packer subsequently became lodged in the well and the datalogger failed. A replacement datalogger was installed in May 2017. In October 2025 a new logger was installed in ND-AR-MW2-03A and a manual reading was collected. The logger had drifted approximately 0.6 m since it was last installed in 2017. Review of the ND-AR-MW2-03-A hydrograph identified a gradual divergence from ND-AR-MW1-

03-A beginning in approximately May 2021, despite the two wells having historically demonstrated similar water level behaviour. A manual water level collected on October 31, 2025 confirmed agreement with the logger data, indicating that post-October 2025 data are reliable. The observed long-term divergence prior to October 9, 2025 is therefore interpreted to reflect progressive mechanical drift associated with the packer / logger configuration rather than a change in groundwater conditions.

Water levels in the A Screen from 2017 to 2025 are consistent with seasonal trends seen at ND-AR-MW1-03-A varying by 0.7 m. Water levels respond by about 0.1 m to pumping of the well field. Water levels in the B screen vary within a 1 m range and are usually lowest in January of each year. A review of historical aerial photographs indicates that the adjacent Watson pond is drained in December which coincides with a decline in water levels in the B screen. Water levels in the B screen do not respond to pumping of the well field.

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."

There are privately serviced properties for water supply within 500 m of the Ayr Well Field. 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

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Biennial Groundwater Monitoring Report – Multiple Well Fields (Burnside, 2020). There were no well interference complaints related to pumping of A1, A2 and A3 received in 2024 and 2025.

Groundwater takings registered in the MECP's PTTW database in the vicinity of the wellfield were reviewed. There are no groundwater takings registered in the MECP PTTW database within 2 km of the well field (Figure 3).

4.2 Aquifer Response to Pumping and Precipitation

PTTW Condition 4.3 states: "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, assesses changes in water levels in the supply aquifer(s) in relation to precipitation and water taking from the aquifer(s)".

Water levels in the AFD1 and AFB3 were monitored in accordance with the PTTW conditions. Based on monitoring results, the water levels in AFD1 and AFB3 did not show a response to pumping at the Ayr Well Field.

Seasonal fluctuations in the AFB3 aquifer are observed at ND-AR-MW2-03-B with the highest and lowest levels observed in spring and late summer / fall, respectively. Water levels are also influenced by the adjacent Watson pond. The correlation of individual precipitation events with groundwater levels is difficult due to several reasons including but not limited to hydraulic conductivity, well depth, precipitation intensity and ground cover conditions.

5.0 Conclusions

Impacts from pumping the municipal wells at the Ayr Well Field (A1, A2, A3) 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 P-300-20949256311;
- 2024 and 2025 pumping volumes were within the permitted range;
- There were no reported well interference complaints arising from water taking at the Ayr Well Field; and
- There have been no impacts to groundwater levels as a result of pumping at the Ayr Well Field.

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R.J. Burnside & Associates Limited, 2022. Region of Waterloo 2020 / 2021 Biennial Groundwater Monitoring Report- Ayr Well Field.

Stantec Consulting Ltd, 2003. Hydrogeological Assessment Ayr Water Supply

Stantec Consulting Ltd, 2005. Construction and Testing of Production Well A3 Ayr Water Supply.

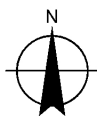
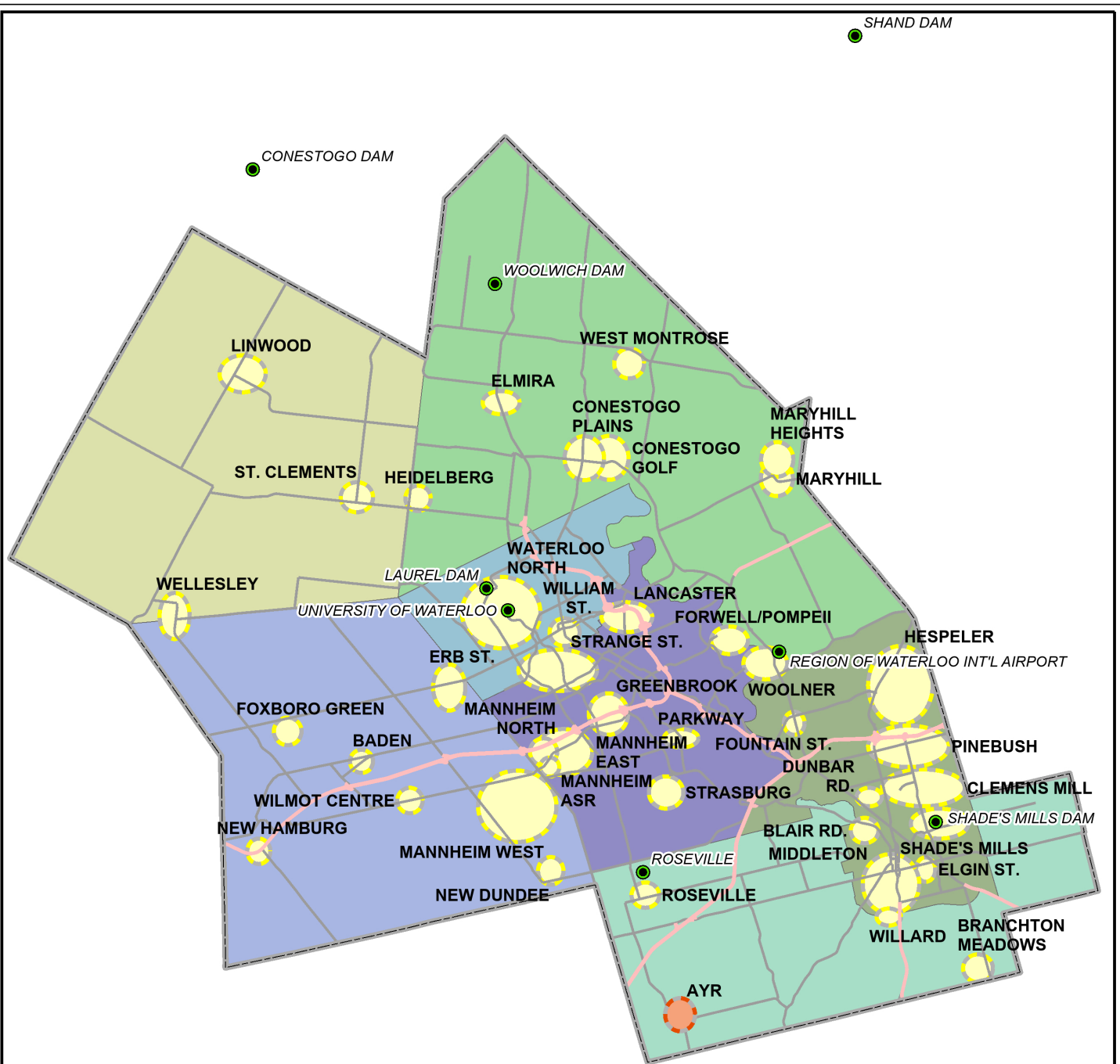


BURNSIDE

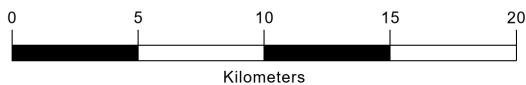
[THE DIFFERENCE IS OUR PEOPLE]



Figures



Data Source:
Region of Waterloo; Includes material © 2012 of the Queen's
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- | | |
|-------------------------------|-------------------------------------|
| Well Field Location | Township of North Dumfries |
| Well Fields | Township of Wellesley |
| Regional Municipal Boundaries | Township of Wilmot |
| City of Cambridge | Township of Woolwich |
| City of Kitchener | Meteorological Monitoring Locations |
| City of Waterloo | |



Map Title

2025 GROUNDWATER MONITORING REPORT - AYR WELL FIELD

WELL FIELD LOCATION MAP

Client

REGION OF WATERLOO

Drawn

HN

Scale

1:300,000

Checked

SQ

Date

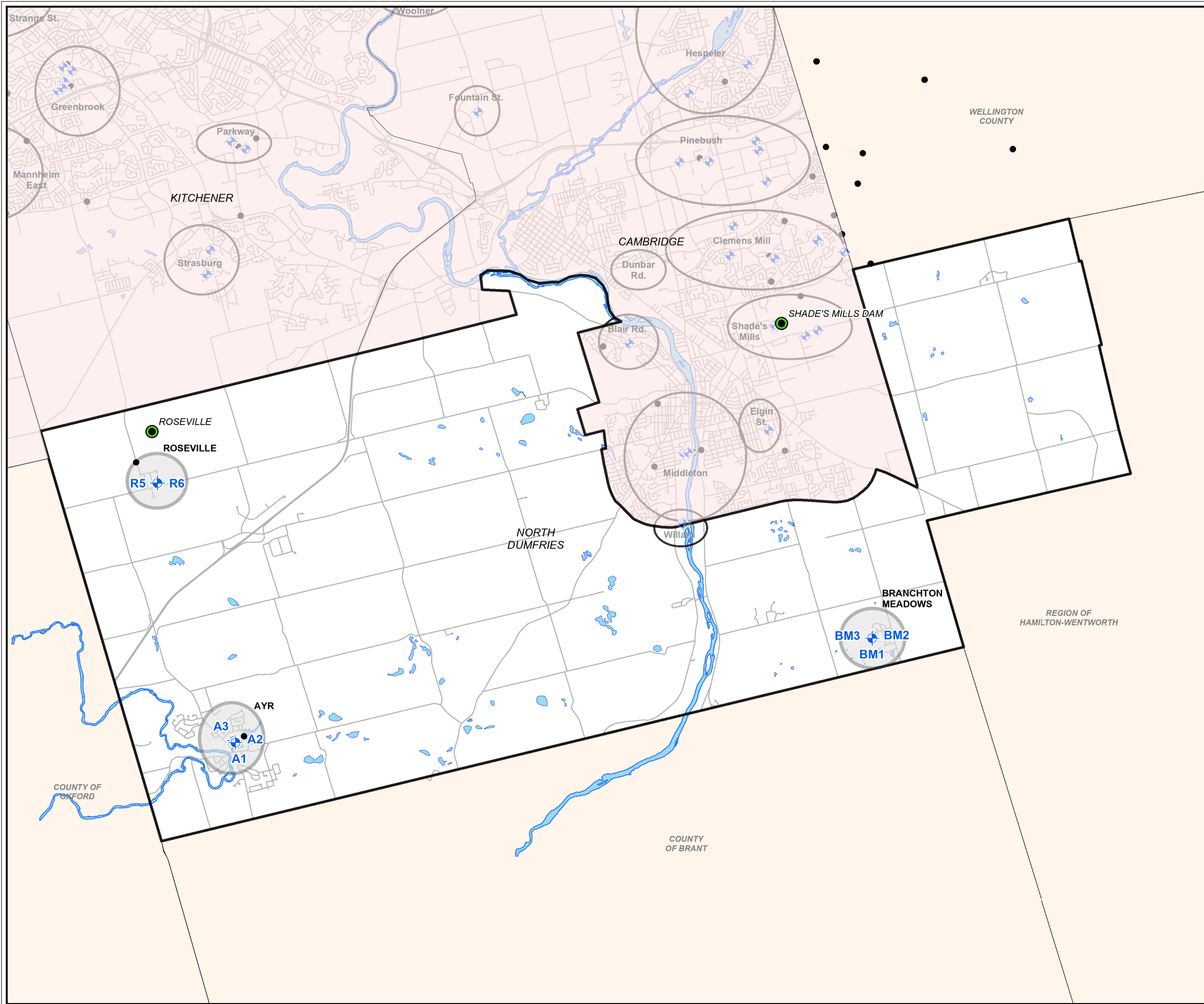
February 2026

Project No.

HA0464020

Figure No.

1



LEGEND

 Production Well Location

 Monitoring Well Location

 North Dumfries Municipal Boundary

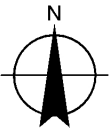
 Well Fields

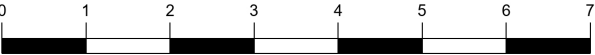
 Meteorological Monitoring Locations

Sources:

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

Datum: North American 1983 CSRS
Coord. System: NAD 1983 CSRS UTM Zone 17N


N


0 1 2 3 4 5 6 7
Kilometers



Client

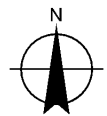
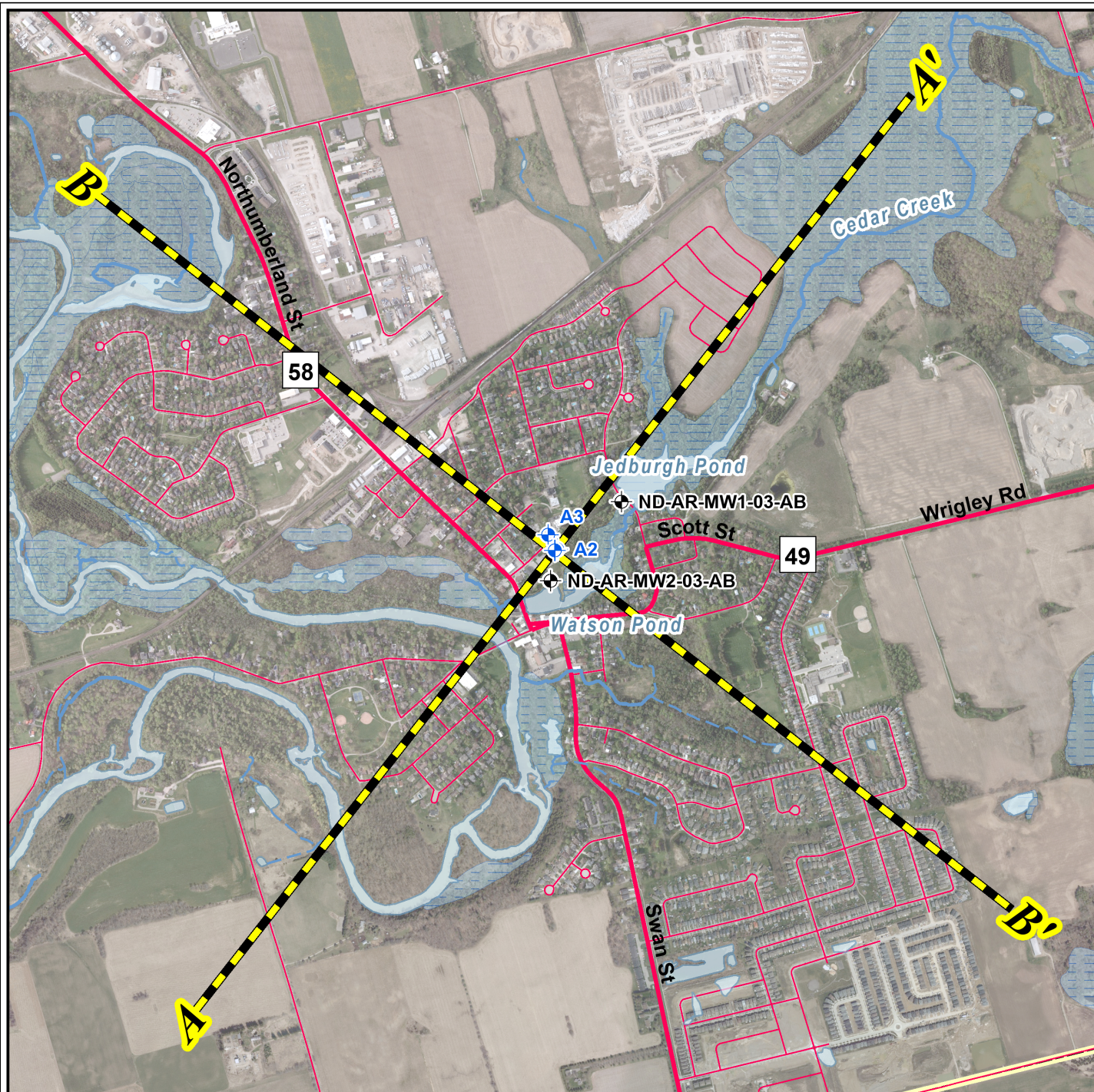
REGION OF WATERLOO

Figure Title

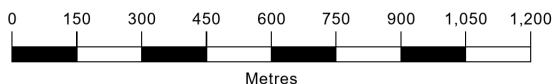
2025 GROUNDWATER MONITORING
REPORT - AYR WELL FIELD

NORTH DUMFRIES WELL FIELDS AND
MONITORING NETWORK

Drawn	Checked	Date	Figure No. 2
HN	SQ	April 2026	
Scale		Project No.	
1:90,000		HA0464020	



Data Source:
Region of Waterloo GIS Data; Background 2020 Air Photo;
ArcGIS Image Service Region of Waterloo; Ministry of
Natural Resources, © Queen's Printer for Ontario; Natural
Resources Canada © Her Majesty the Queen in Right of
Canada.



- | | | |
|---|---|---|
| <p>PTTW
Monitoring Well
Location</p> <p>Production Well
Location</p> <p>Cross Section
Orientation</p> | <p>Intermittent
Creek</p> <p>Creek</p> <p>Waterbody</p> <p>Provincially
Significant
Wetland (MNR)</p> | <p>Regional Road</p> <p>Local Road</p> <p>Region of
Waterloo
Boundary</p> |
|---|---|---|



Map Title

2025 GROUNDWATER MONITORING REPORT - AYR WELL FIELD

WELL LOCATION MAP

Client

REGION OF WATERLOO

Drawn

HN

Scale

1:17,500

Checked

SQ

Date

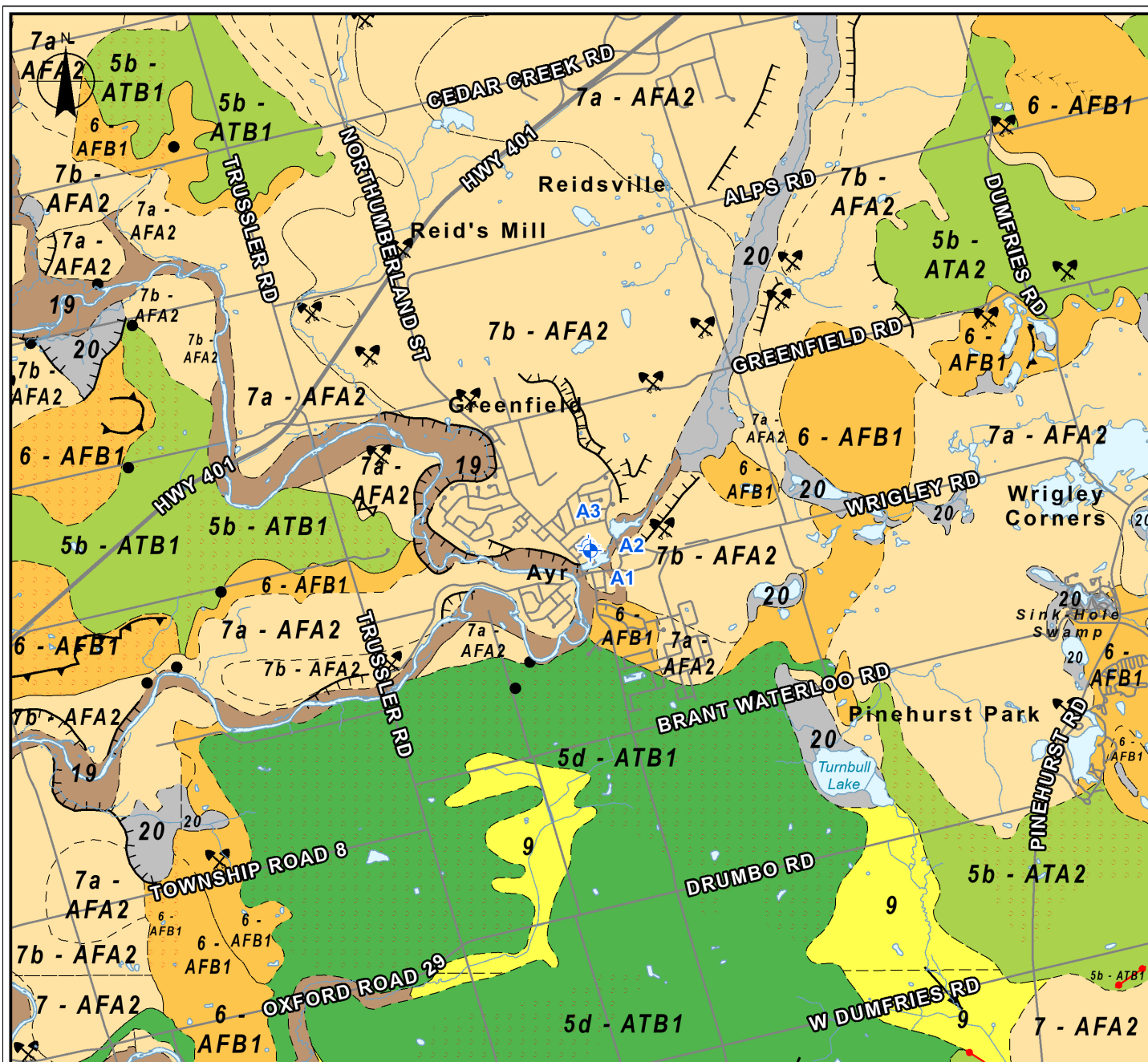
April 2026

Project No.

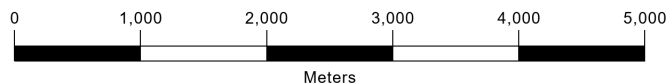
HA0464020

Figure No.

3



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



- | | |
|---|---|
| <ul style="list-style-type: none"> RMOV 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) 7: Glaciofluvial deposits (AFA2 - Aquifer) 7a: Glaciofluvial deposits: Sandy deposits (AFA2 - Aquifer) 7b: Glaciofluvial deposits: Gravelly deposits (AFA2 - Aquifer) 9: Coarse-textured glaciolacustrine deposits 19: Modern alluvial deposits 20: Organic deposits Sand and Gravel Pit Beach | <ul style="list-style-type: none"> Esker: Direction of Flow Known Ice-Contact Slope Meltwater Flow: Inferred Direction of Flow Terrace Delta, glaciolacustrine Sample Location Hummocky Topography Unit Contact Boundary |
|---|---|



Map Title

2025 GROUNDWATER MONITORING REPORT - AYR WELL FIELD

SURFICIAL GEOLOGY

Client

REGION OF WATERLOO

Drawn

HN

Scale

1:60,000

Checked

SQ

Date

February 2026

Project No.

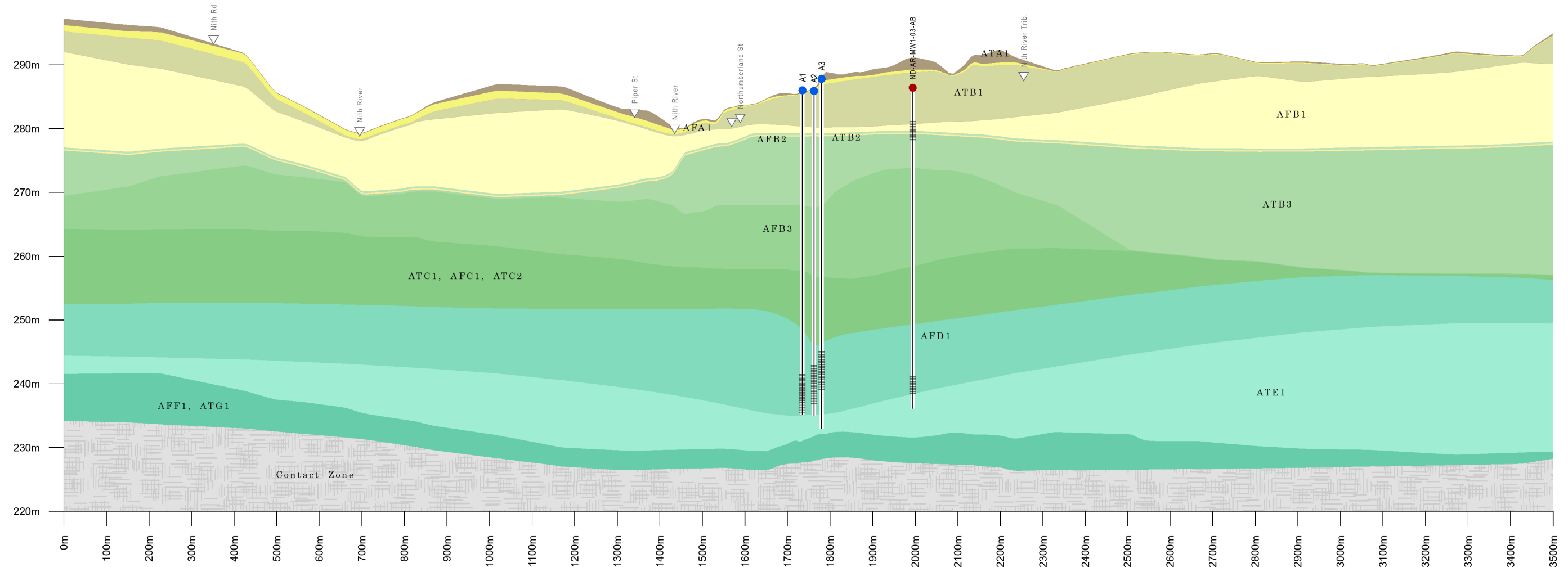
HA0464020

Figure No.

4

A

A'



Wells

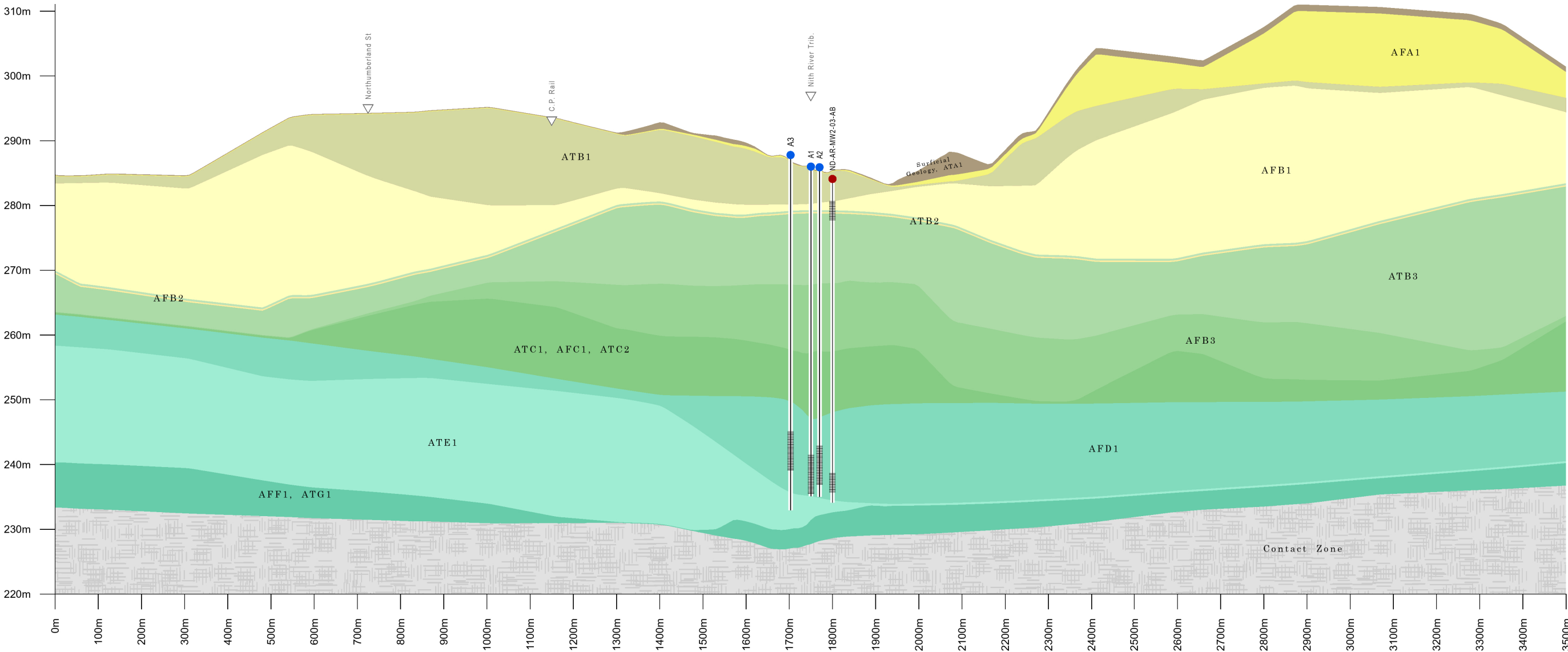
- Production Well (Active) ● Monitoring Well

Moraine Model 2026

Surficial Geology, Whittlesey Clay (ATA1) Whittlesey Sand (AFA1) Upper Maryhill, Port Stanley, Tavistock, Mornington, & Stratford Tills (ATB1) Upper Waterloo Moraine Stratified Sediments & Equivalents (AFB1) Middle Maryhill Till & Equivalents (ATB2) Middle Waterloo Moraine Stratified Sediments & Equivalents (AFB2) Lower Maryhill Till & Stratified Equivalents (ATB3) Lower Waterloo Moraine Stratified Sediments or Catfish Creek Till Outwash (AFB3) Upper/Main Catfish Creek Till (ATC1), Middle Catfish Creek Stratified Deposits (AFC1), Lower Catfish Creek Till (ATC2) Pre-Catfish Creek Coarse-Grained Glaciofluvial/Lacustrine Deposits (AFD1) Canning Drift, Till & Fine Textured Glaciolacustrine Deposits (ATE1) Pre-Canning Coarse Textured Glaciofluvial / Glaciolacustrine Deposits (AFF1), Pre-Canning Coarse Textured Till (ATG1) Weathered Bedrock	Wellhead Well Screen or Open Hole	BURNSIDE Client REGION OF WATERLOO	Figure Title GEOLOGIC CROSS SECTION REGION OF WATERLOO Ayr Cross Section A - A' <table><tr><td>Drawn</td><td>Checked</td><td>Date</td><td rowspan="3">Figure No. 5</td></tr><tr><td>PS</td><td>DH</td><td>2026/06/19</td></tr><tr><td colspan="2">Horizontal Scale 1:10,000</td><td>Project No.</td></tr><tr><td colspan="2">Vertical Ex.:15x</td><td>HA046402</td><td></td></tr></table>	Drawn	Checked	Date	Figure No. 5	PS	DH	2026/06/19	Horizontal Scale 1:10,000		Project No.	Vertical Ex.:15x		HA046402	
Drawn	Checked	Date	Figure No. 5														
PS	DH	2026/06/19															
Horizontal Scale 1:10,000		Project No.															
Vertical Ex.:15x		HA046402															

B

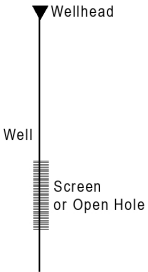
B'



Wells
● Production Well (Active) ● 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 Ayr Cross Section B - B'				Figure No. 6
Drawn	Checked	Date		
PS	DH	2026/06/01		
Horizontal Scale 1:10,000		Project No.		
Vertical Ex.:15x		HA046402		



BURNSIDE

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Appendix A

Permit To Take Water

PERMIT TO TAKE WATER

Ground Water

NUMBER P-300-2094925631

Version: 1.0

Effective Date: June 15, 2021

Expiry Date: May 31, 2031

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

REGIONAL MUNICIPALITY OF
WATERLOO

150 Frederick Street
6th Floor
KITCHENER
ONTARIO
Canada
N2G 4J3

For the water taking from

A1

A2

A3

Located at:

Lot Number: 34, Concession Number: 8, Geographic Township:
NORTH DUMFRIES, Municipality: NORTH DUMFRIES, County
/District: WATERLOO, State/Province: Ontario

Lot Number: 34, Concession Number: 8, Geographic Township:
NORTH DUMFRIES, Municipality: NORTH DUMFRIES, County
/District: WATERLOO, State/Province: Ontario

This Permit cancels and replaces Permit Number 6350-8VPSBP, issued on June 29, 2012.

DEFINITIONS

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

- 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 of the 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 the ministry of the government of Ontario responsible for the administration of the OWRA, currently named the Ministry of the Environment, Conservation and Parks.
- d. "District Office" means the Guelph District Office
Guelph District Office
of the Ministry.
- e. "Permit" or "PTTW" means this Permit to Take Water No. P-300-2094925631 including its Schedules, if any, issued in accordance with Section 34.1 of the OWRA, as may amended.
- f. "Permit Holder" means REGIONAL MUNICIPALITY OF WATERLOO.
- g. "OWRA" means the *Ontario Water Resources Act*, R.S.O. 1990, c. O. 40.

TERMS AND CONDITIONS

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

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, attested to by Karl Belan, on February 24, 2021, 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 May 31, 2031. 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 (litres)

	Source Name / Description	Source Type	Purpose Category	Specific Purpose	Activity	Max. Taken per minute	Max. No. of Hrs Taken per day	Max. volume per Day	Max. days in a year	Zone / Easting / Northing
1	A3 (A3)	Well	Public administration	Municipal Supply	Water Supply	3805	24	5480000	365	17 / 544602 / 4792942
2	A1 (A1)	Well	Public administration	Municipal Supply	Water Supply	3805	24	5480000	365	17 / 544622 / 4792895
3	A2 (A2)	Well	Public administration	Municipal Supply	Water Supply	3805	24	5480000	365	17 / 544629 / 4792898
Total Taking								5480000		

3.3. Notwithstanding the Maximum Taken per Day specified in Table A of Condition 3.2, the combined taking from wells A1, A2 and A3 shall not exceed an annual daily average of 5,480,000 litres per day.

4. Monitoring

4.1. The Permit Holder shall maintain a record of all water takings. This record shall include the dates and times of water takings, the rates of pumping, and an estimated calculation of the total amounts of water pumped per day for each day that water is taken under the authorization of this Permit. A separate record shall be maintained for each source. The Permit Holder shall keep all required records up to date and available at or near the site of the taking and shall produce the records immediately for inspection by a Provincial Officer upon his or her request.

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

ND-AYR-MW1A-03

ND-AYR-MW1B-03

And the Permit Holder shall measure and record water levels once a month in the following monitoring wells, access permitting:

ND-AYR-MW2A-03

ND-AYR-MW2B-03

4.3. The Permit Holder shall prepare and submit a report to the Director every two years by June 30 commencing June 30, 2023, 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), and provides 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.

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. Impacts for Water Situation Type

For Surface-Water Takings

The taking of water (including the taking of water into storage and the subsequent or simultaneous withdrawal from storage) shall be carried out in such a manner that streamflow is not stopped and is not reduced to a rate that will cause interference with downstream uses of water or with the natural functions of the stream.

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

- 6.1. 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).

REASONS

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.

APPEAL PROVISIONS

In accordance with Section 100 of the Ontario Water Resources Act, R.S.O. 1990, you may by written notice served upon me, the Environmental Review Tribunal and the Minister of the Environment, Conservation and Parks, within 15 days after receipt of this Notice, require a hearing by the Tribunal. The Minister of the Environment, Conservation and Parks will place notice of your appeal on the Environmental Registry. Section 101 of the Ontario Water Resources Act, as amended, provides that the Notice requiring a 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
135 St.Clair Avenue West, 1st Floor
Toronto, ON
M4V 1P5*

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*

Dated at Hamilton this 14th day of June, 2021



Gregory Meek

Director, Section 34.1

Ontario Water Resources Act , R.S.O. 1990

c: Karl Belan, Regional Municipality of Waterloo

SCHEDULE 1

This Schedule "A" forms part of Permit To Take Water P-300-2094925631 Version Number 1.0, dated June 14, 2021.



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Appendix B

Well Records

Due to the large mud loss during the drilling of test wells 1/76 and 3/76, an added precaution was taken to minimize the movement of any drilling mud through the gravel pack to the screen by the placement of bentonite seals within the gravel pack.

PW 1

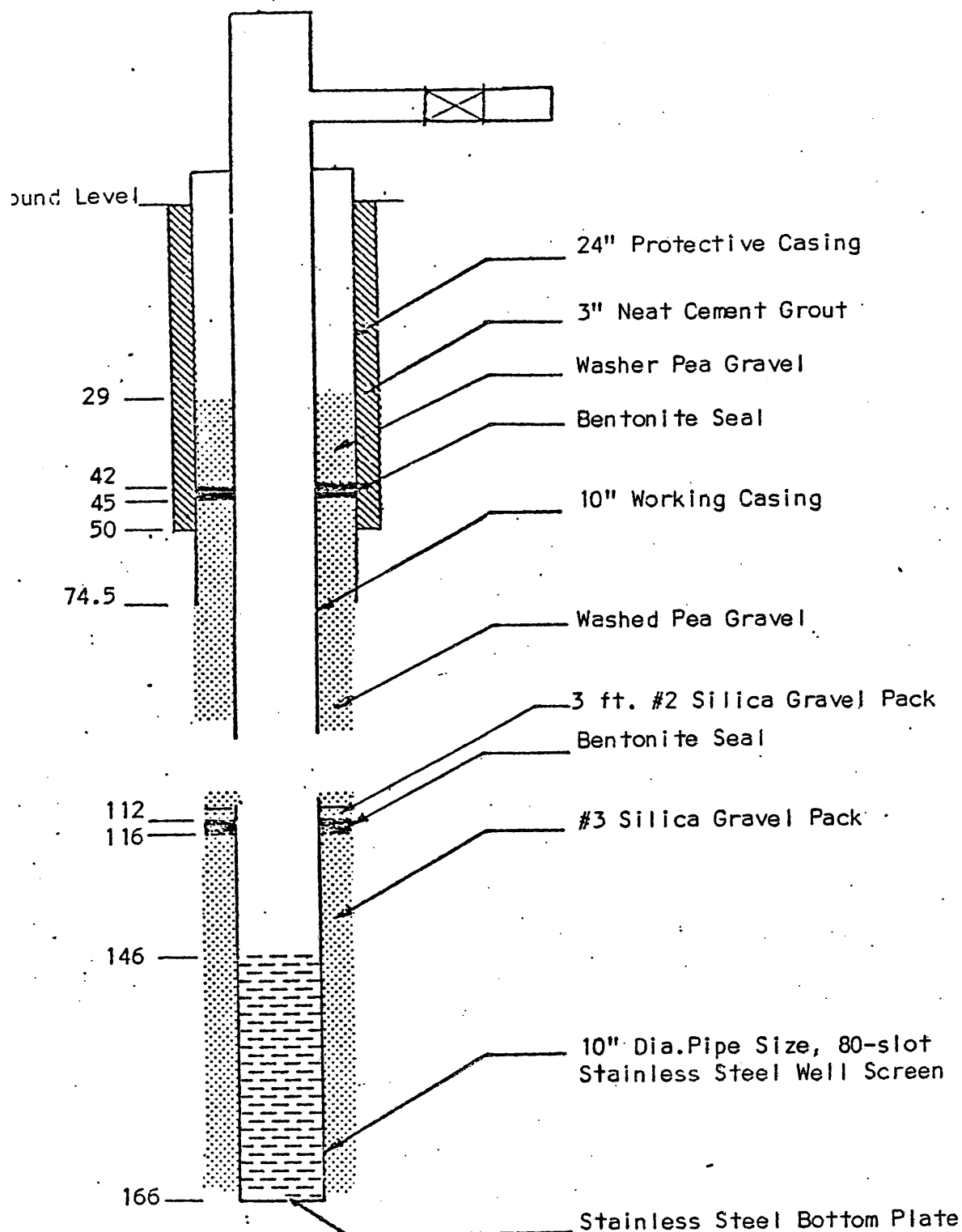
A1

Construction features of the well are provided in Figure 2 and the driller's geologic log of the well is as follows:

0-6 ft.	muck
6-15	sand
15-18	medium to coarse sand, stones, boulders
18-30	fine silt, clay trace, stones
30-34	medium to coarse sand, stones, boulders
34-58	fine silt, clay trace
58-82	medium to coarse sand, gravel, stones, boulders
82-120	hard silt, sand, gravel, stones and boulders, cemented, clay trace (possible till)
120-167	medium to coarse sand, gravel, stones up to 6-inch diameter

Mechanical analyses were conducted on the lower aquifer samples to select a suitable screen and gravel pack. Graphs of the analyses are attached in Appendix A.

The analyses indicated that the aquifer is coarse-gravel and stratified, with a D_{70} size exceeding 0.020 inches. The gravel pack and screen were designed in accordance with the UOP Johnson procedure, leading to the selection of an 80-slot screen and No. 3 commercial silica gravel.



Ministry of the Environment
Township North Dumfries (Ayr) Project 5-0124

PW 1 WELL CONSTRUCTION DETAILS

HYDROLOGY CONSULTANTS LIMITED

1114 Dundas Street E.

Mississauga, Ontario

Job NR 8517

Designed by

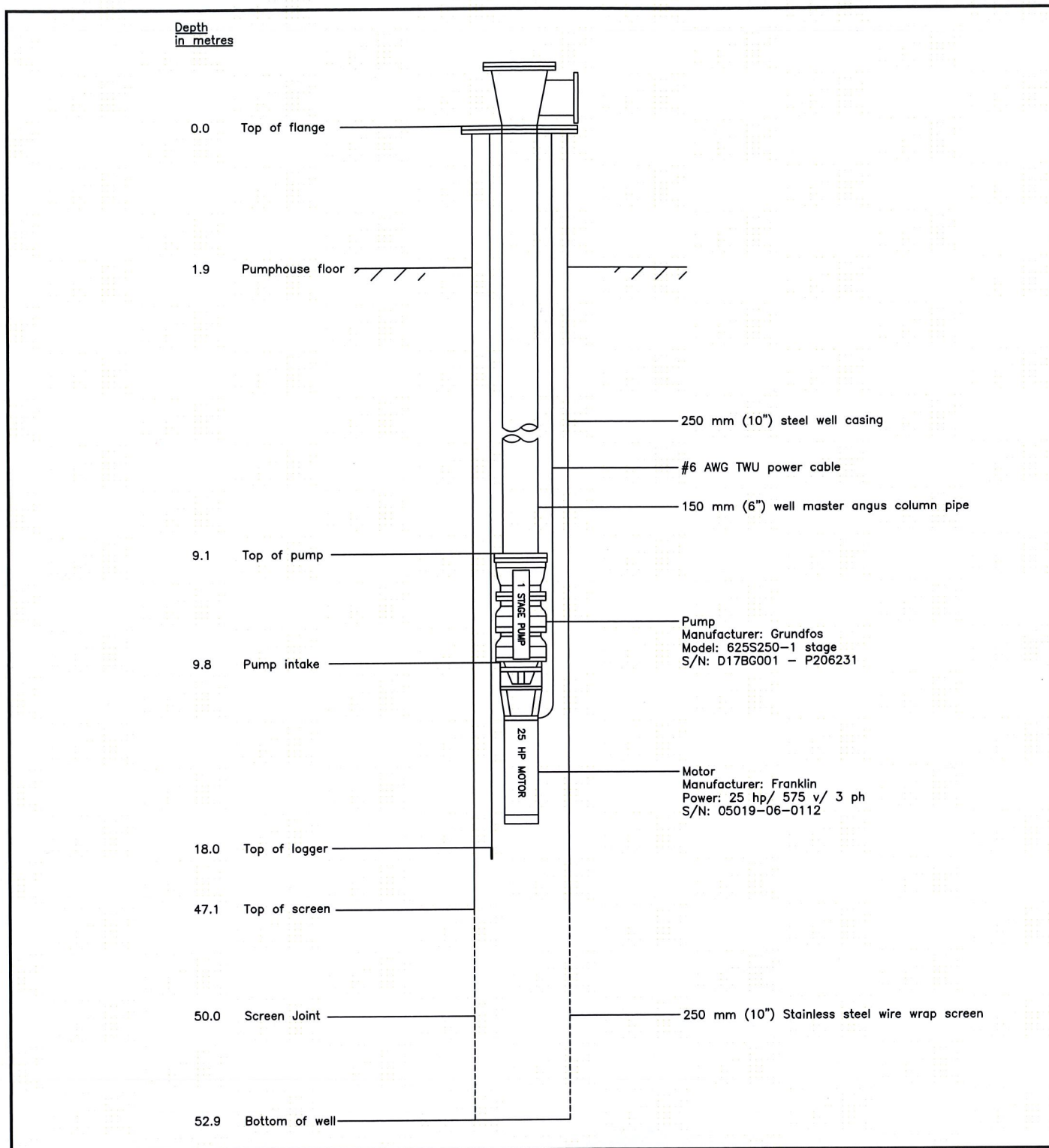
Drawn by

Checked by

Date April, 1976

Fig. 2

N.T.S.



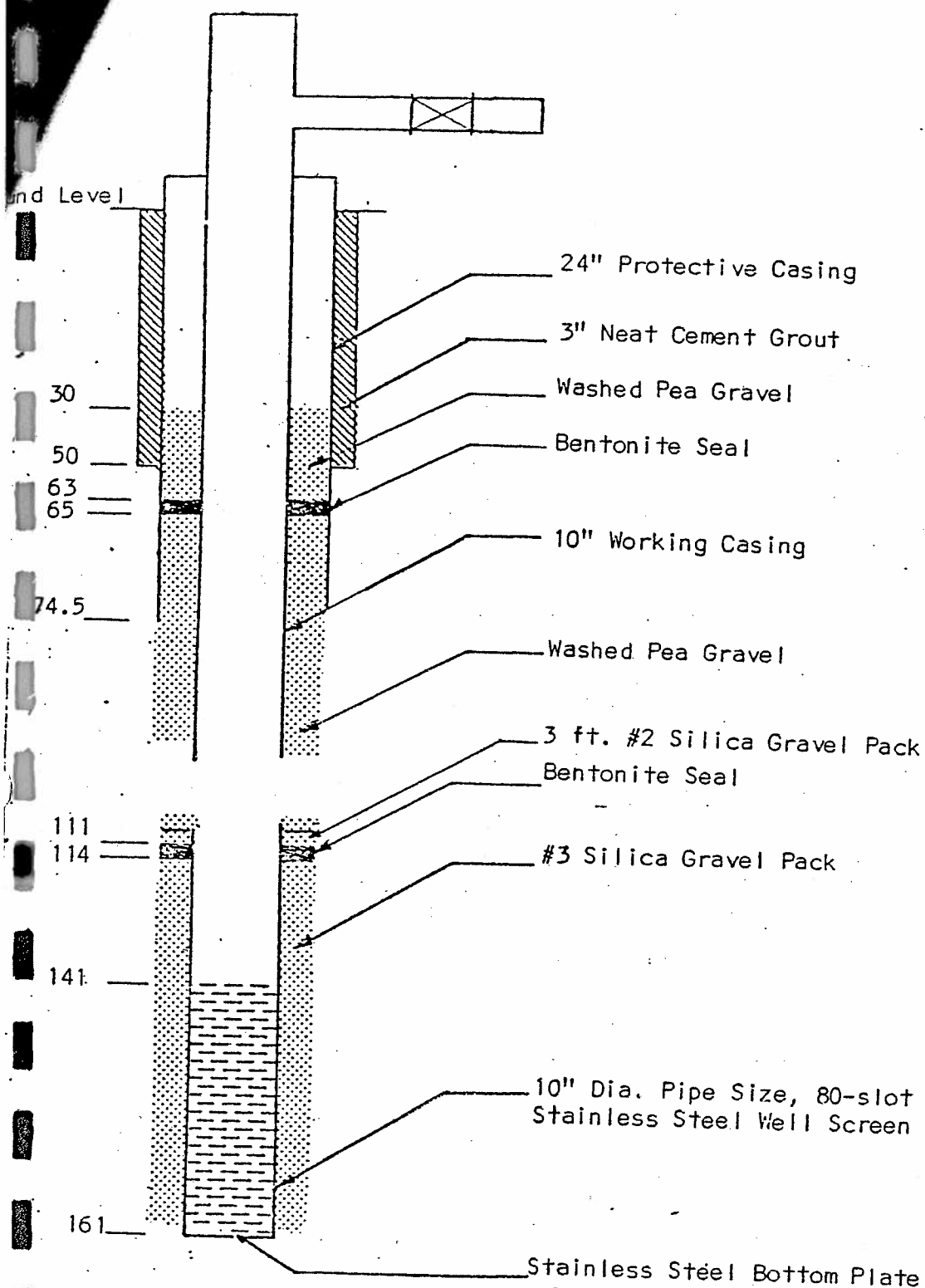
CLIENT

Regional Municipality of Waterloo

TITLE

Ayr Well A1
Pump Installation Drawing

PROJECT No.006-353			G:\Lotowater Projects\006 Region of Waterloo\353\A1 Pump Installation.dwg		FIGURE 2
DESIGN			2016-01-25	SCALE N.T.S.	
DRAWN	EH	2016/01/22			
CHECKED					



Ministry of the Environment
Township North Dumfries (Ayr) Project 5-0124

W 2 WELL CONSTRUCTION DETAILS

A2

HYDROLOGY CONSULTANTS LIMITED

1125 Dundas Street E.

Mississauga, Ontario

Job NR 8517

Designed by

Drawn by

Checked by

Date

April, 1976

Fig. 3

N.T.S.

PW 2

A2

Construction features of the well are provided in Figure 3 and the driller's geologic log of the well is as follows:

0-8	ft.	sand, till
8-12		medium to coarse sand, cobbles
12-22		silty sand, gravel, clay trace
22-28		medium to coarse gravel, cobble
28-55		silt, occasional thin clay layers
55-70		fine to coarse sand
70-102		fine to medium, clean gravel, cobbles
102-124		fine to medium gravel, stones, some silt and sand cemented with silty clay
124-139		fine to medium gravel, cobbles, cemented by silty clay
139-166		fine to coarse, clean gravel
166-167		clay, gravel, cobbles

Mechanical analyses of the lower aquifer are attached in the Appendix B. Based on analysis of the graphs, an 80-slot screen and No. 3 commercial silica gravel were selected for the well.

WELL HEAD CONSTRUCTION

The well heads were constructed to the specifications of the Ministry of the Environment, as shown in Figures 4 and 5. Under open valve flow, the water levels in PW 1 and PW2 were measured to be 2.30 ft. and 2.58 ft. below top of casing, respectively.

Borehole No.: A3

Project: Ayr Water Supply

Date: 4-5 Nov-04

Project No: 1611-10481

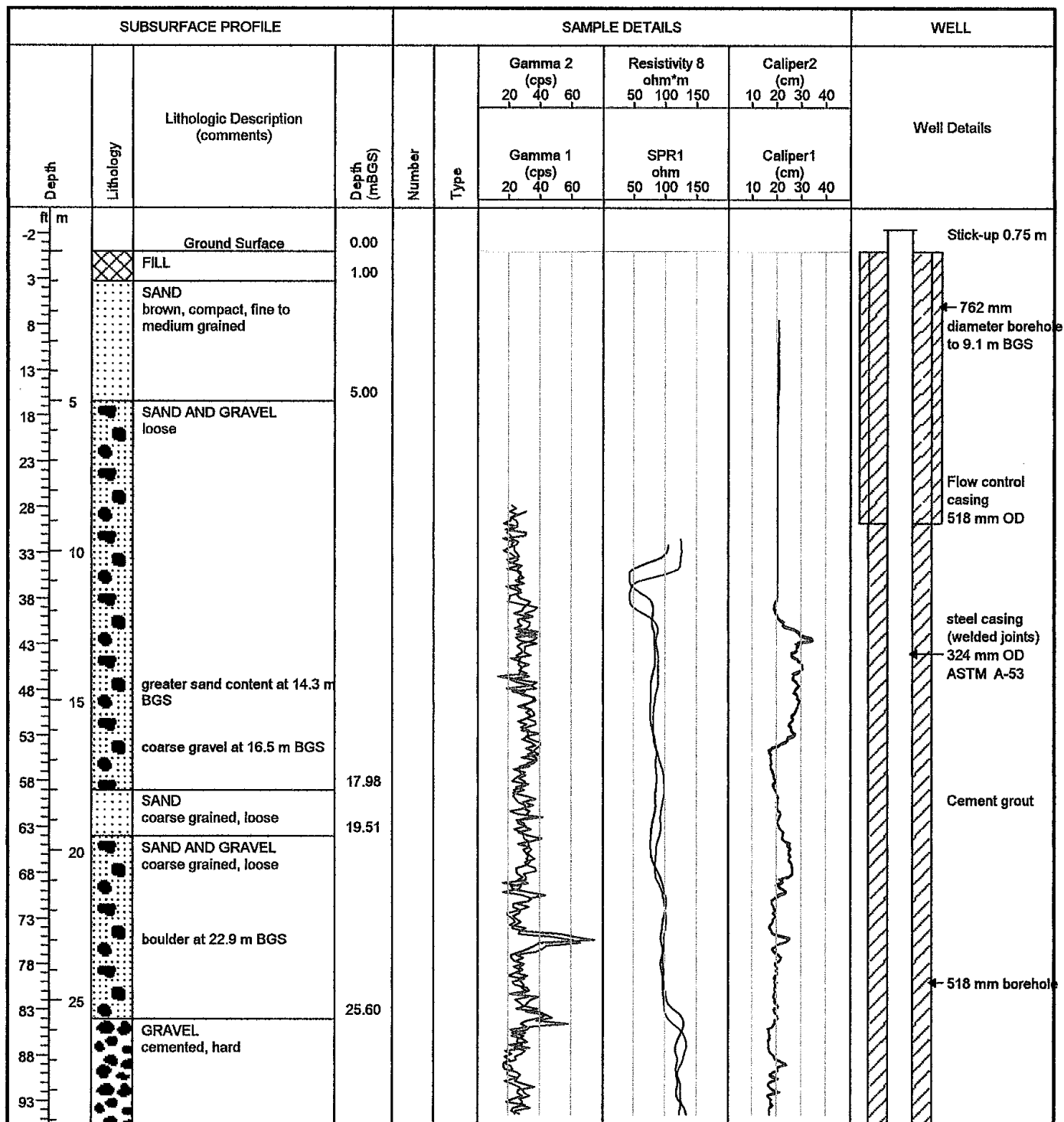
Supervisor: L.Veale

Location: Ayr, Ontario

Ground Surface: 288.18 m AMSL

Contractor: Davidson Well Drilling Ltd.

Drilling Method: dual rotary reverse circulation



Drawn By/Checked By: OR/CJ

Notes:
mBGS - metres below ground surface
GRAB - grab sample



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Borehole No.: A3

Project: Ayr Water Supply

Date: 4-5 Nov-04

Project No: 1611-10481

Supervisor: L.Veale

Location: Ayr, Ontario

Ground Surface: 288.18 m AMSL

Contractor: Davidson Well Drilling Ltd.

Drilling Method: dual rotary reverse circulation

SUBSURFACE PROFILE				SAMPLE DETAILS									WELL					
Depth	Lithology	Lithologic Description (comments)	Depth (mBGS)	Number	Type	Gamma 2 (cps)			Resistivity 8 ohm*m			Caliper2 (cm)			Well Details			
						20	40	60	50	100	150	10	20	30		40		
						Gamma 1 (cps)			SPR1 ohm			Caliper1 (cm)						
						20	40	60	50	100	150	10	20	30	40			
99		becoming loose at 29.3 m BGS	31.39															
104		SAND AND GRAVEL coarse grained sand to fine and coarse gravel																
109	33																	
114																		
119				1	GRAB													
124		some fine sand present at 38.1 m BGS		2	GRAB													
129	38				3	GRAB												
134					4	GRAB												
139		coarse gravel at 40.8 m BGS increase sand content at 41.2 m BGS boulder at 41.9 m BGS(1.5 feet in diameter) increase fine gravel content at 42.4 m BGS		5	GRAB													
144	43				6	GRAB												
149					7	GRAB												
154		significant coarse gravel content at 45.4 m BGS(coarse gravel from 25 to 100 mm)		8	GRAB													
159	48				9	GRAB												
164					10	GRAB												
169		sand content increased at 51.5-53 m BGS	11	GRAB														
174	53			12	GRAB													
179				13	GRAB													
184		BEDROCK blue grey rock, soft	54.86 55.17															
189	58	End of Log																

<

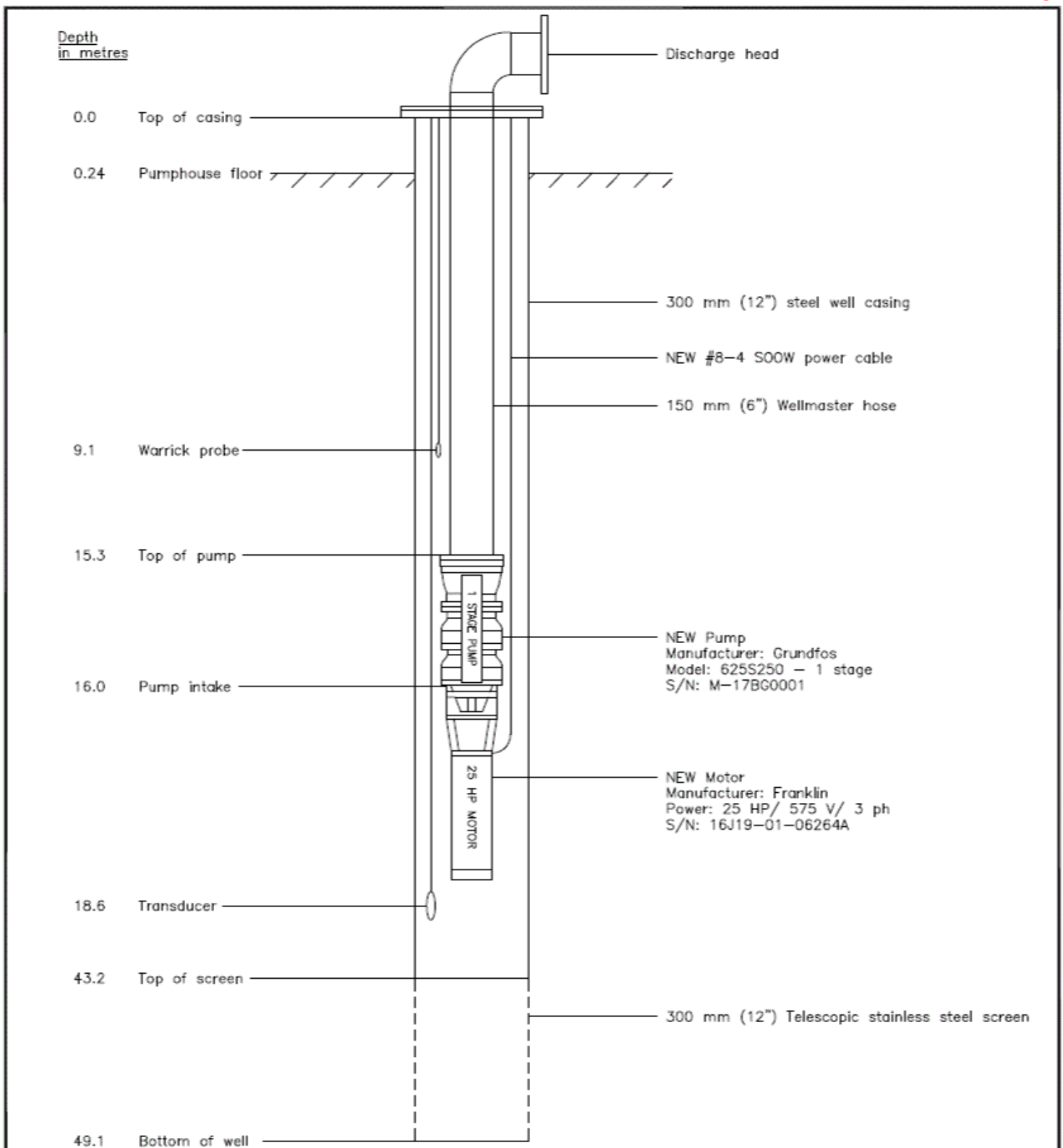
Drawn By/Checked By: OR/CJ

Notes:
mBGS - metres below ground surface
GRAB - grab sample



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CLIENT

Regional Municipality of Waterloo

TITLE

Ayr Well A3
Pump Installation Drawing

PROJECT No.006—388			G:\Lotowater Projects\006 Region of Waterloo\388 Ayr Well Service\Pump Install.dwg		FIGURE 2
DESIGN			REVISION No. 2017—02—24	SCALE N.T.S.	
DRAWN	EH	2017—02—24			
CHECKED					

9201422

ND-AR-MW1AB-03

Borehole No.: MW1S/D-03

6509518

Project: Hydrogeological Assessment - Ayr Water Supply

Date: 9-July-03

Project No: 609-00192

Field Investigator: Lesley Veale

Location: North of Jedburgh Pond Dam on Main Street

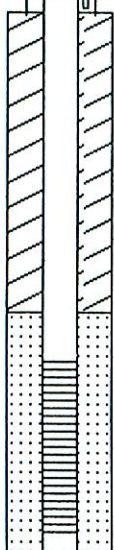
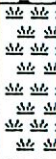
Ground Surface: 287.3(S)/287.4(D) m AMSL

Contractor: Davidson Well Drilling Ltd.

Top of Casing: 288.3(S)/288.4(D) m AMSL

Drilling Method: Mud-rotary

Note: OBS-Num 9201596 DELETED (DUPLICATE)

SUBSURFACE PROFILE					SAMPLE DETAILS				WELL DETAILS	
Depth	Depth (m BGS)	Lithologic Symbol	Lithologic Description	Elevation (m AMSL)	Number	Type	N-Value	Recovery	Well	
-2 -1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17	0.00		Ground Surface	287.40					Shallow  Above ground protective casing stick-up 1.0 m PVC Riser 50 mm diameter Holeplug Top of sand (4.6 m BGS) Top of screen (5.2 m BGS) No.10 Slot PVC screen 50 mm diameter Bottom of screen (8.2 m BGS) PVC Riser 50 mm diameter Top of formation cave (12.8 m BGS) Deep	
	1.52		GRAVEL(FILL) brown, coarse grained	285.88	1	GS				
			PEAT black, soft		2	GS				
	4.27		SAND brown, medium grained	283.13	3	GS				
	8.23		CLAY trace silt and sand, grey, fine grained	279.17	4	GS				
	12.80		SAND AND GRAVEL brown, coarse grained	274.60	5	GS				

Screen interval: 5.2 m to 8.2; 44.2 m to 47.2 m BGS

Sand pack interval: 4.6 m to 8.2 m; 12.8 m to 50.3 m BGS

Well seal interval: 0 to 4.6 m; 0 to 12.8 m BGS

Notes:

mAMSL - metres above mean sea level

mBGS - metres below ground surface

GS - grab sample of cuttings



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9201422

Borehole No.: MW1S/D-03

Project: Hydrogeological Assessment - Ayr Water Supply

Date: 9-July-03

Project No: 609-00192

Field Investigator: Lesley Veale

Location: North of Jedburgh Pond Dam on Main Street

Ground Surface: 287.3(S)/287.4(D) m AMSL

Contractor: Davidson Well Drilling Ltd.

Top of Casing: 288.3(S)/288.4(D) m AMSL

Drilling Method: Mud-rotary

SUBSURFACE PROFILE					SAMPLE DETAILS				WELL DETAILS	
Depth	Depth (m BGS)	Lithologic Symbol	Lithologic Description	Elevation (m AMSL)	Number	Type	N-Value	Recovery	Well	
57									Formation cave	
58										
59	18									
60										
61					6	GS				
62	19									
63										
64										
65	20									
66										
67										
68										
69	21									
70										
71										
72	22									
73										
74										
75	23									
76										
77										
78	24									
79										
80										
81	25				7	GS				
82										
83										
84	26									
85										
86										
87										
88	27									
89										
90										
91	28									
92										
93										
94	29									
95										
96										
97	30									
98										
99										
00	31				8	GS				
01										
02										
03	32									
04										
05										
06	33									
07										
08										
09	34									
10										
11										
12										
13										
14										

Screen interval: 5.2 m to 8.2; 44.2 m to 47.2 m BGS

Sand pack interval: 4.6 m to 8.2 m; 12.8 m to 50.3 m BGS

Well seal interval: 0 to 4.6 m; 0 to 12.8 m BGS

Notes:

mAMSL - metres above mean sea level

mBGS - metres below ground surface

GS - grab sample of cuttings



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9201422

Borehole No.: MW1S/D-03

Project: Hydrogeological Assessment - Ayr Water Supply

Date: 9-July-03

Project No: 609-00192

Field Investigator: Lesley Veale

Location: North of Jedburgh Pond Dam on Main Street

Ground Surface: 287.3(S)/287.4(D) m AMSL

Contractor: Davidson Well Drilling Ltd.

Top of Casing: 288.3(S)/288.4(D) m AMSL

Drilling Method: Mud-rotary

SUBSURFACE PROFILE				SAMPLE DETAILS				WELL DETAILS	
Depth	Depth (m BGS)	Lithologic Symbol	Lithologic Description	Elevation (m AMSL)	Number	Type	N-Value	Recovery	Well
15	35								
16									
17									
18	36								
19									
20									
21	37				9	GS			
22									
23									
24									
25	38								
26									
27									
28	39								
29									
30									
31	40								
32									
33									
34	41								
35									
36									
37	42								
38									
39									
40									
41	43				10	GS			
42									
43									
44	44								
45									
46									
47	45								
48									
49									
50	46								
51									
52									
53	47								
54									
55									
56									
57	48								
58									
59	48.77			238.63					
60									
61	49								
62									
63									
64	50								
65	50.29			237.11	11	GS			
66									
67	51								
68									
69									
70	52								
71									
72									

Top of screen
(44.2 m BGS)No.10 Slot
PVC screen
50 mm diameterBottom of screen
(47.2 m BGS)Bottom of borehole
(50.3 m BGS)

Screen interval: 5.2 m to 8.2; 44.2 m to 47.2 m BGS

Sand pack interval: 4.6 m to 8.2 m; 12.8 m to 50.3 m BGS

Well seal interval: 0 to 4.6 m; 0 to 12.8 m BGS

Notes:

mAMSL - metres above mean sea level

mBGS - metres below ground surface

GS - grab sample of cuttings

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9203299

Borehole No.: MW2 S/D-03

Project: Hydrogeological Assessment - Ayr Water Supply

Date: 9-July-03

Project No: 609-00192

Field Investigator: Lesley Veale

Location: Centennial Park North of Watson Pond

Ground Surface: 283.4(S/D) m AMSL

Contractor: Davidson Well Drilling Ltd.

Top of Casing: 283.3(S/D) m AMSL

Drilling Method: Mud-rotary

SUBSURFACE PROFILE				SAMPLE DETAILS				WELL DETAILS	
Depth	Depth (m BGS)	Lithologic Symbol	Lithologic Description	Elevation (m AMSL)	Number	Type	N-Value	Recovery	Well
0.00	0.00		Ground Surface	283.40					
1	1	PEAT black, soft			1	GS			
2	2								
3	3								
4	4								
5	5								
6	6								
7	7								
8	8								
9	9								
10	10								
11	11								
12	12								
13	13								
14	14								
15	15								
16	16								
17	17								
18	18								
19	19								
20	20								
21	21								
22	22								
23	23								
24	24								
25	25								
26	26								
27	27								
28	28								
29	29								
30	30								
31	31								
32	32								
33	33								
34	34								
35	35								
36	36								
37	37								
38	38								
39	39								
40	40								
41	41								
42	42								
43	43								
44	44								
45	45								
46	46								
47	47								
48	48								
49	49								
50	50								
51	51								
52	52								
53	53								
54	54								
55	55								
56	56								

Screen interval: 3.4 m to 6.4 m; 45.4 m to 48.5 m BGS

Sand pack interval: 2.7 m to 6.4 m; 39.6 m to 50.0 m BGS

Well seal interval: 0 to 2.7 m; 0 to 39.6 m BGS

Notes:

mAMSL - metres above mean sea level
 mBGS - metres below ground surface
 GS - grab sample of cuttings



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9203299

Borehole No.: MW2 S/D-03

Project: Hydrogeological Assessment - Ayr Water Supply

Date: 9-July-03

Project No: 609-00192

Field Investigator: Lesley Veale

Location: Centennial Park North of Watson Pond

Ground Surface: 283.4(S/D) m AMSL

Contractor: Davidson Well Drilling Ltd.

Top of Casing: 283.3(S/D) m AMSL

Drilling Method: Mud-rotary

SUBSURFACE PROFILE					SAMPLE DETAILS				WELL DETAILS	
Depth	Depth (m BGS)	Lithologic Symbol	Lithologic Description	Elevation (m AMSL)	Number	Type	N-Value	Recovery	Well	
57									Holeplug	
58										
59	18									
60										
61					6	GS				
62	19									
63										
64										
65	20									
66										
67										
68										
69	21									
70										
71										
72	22									
73										
74										
75	23									
76										
77										
78	24									
79										
80										
81	25				7	GS				
82										
83										
84	26									
85										
86										
87	27									
88	27.13			256.27						
89										
90			SAND AND GRAVEL							
91			brown, coarse grained							
92	28									
93										
94										
95	29									
96										
97										
98	30									
99										
00										
01	31				8	GS				
02										
03										
04	32									
05										
06										
07	33									
08										
09										
10	34									
11										
12										
13										
14										

Screen interval: 3.4 m to 6.4 m; 45.4 m to 48.5 m BGS

Sand pack interval: 2.7 m to 6.4 m; 39.6 m to 50.0 m BGS

Well seal interval: 0 to 2.7 m; 0 to 39.6 m BGS

Notes:

mAMSL - metres above mean sea level

mBGS - metres below ground surface

GS - grab sample of cuttings

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9203299

Borehole No.: MW2 S/D-03

Project: Hydrogeological Assessment - Ayr Water Supply

Project No: 609-00192

Location: Centennial Park North of Watson Pond

Contractor: Davidson Well Drilling Ltd.

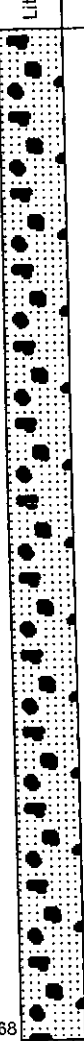
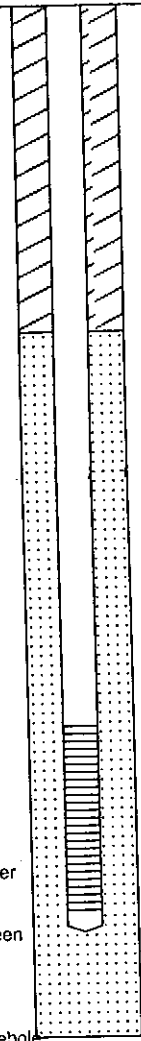
Drilling Method: Mud-rotary

Date: 9-July-03

Field Investigator: Lesley Veale

Ground Surface: 283.4(S/D) m AMSL

Top of Casing: 283.3(S/D) m AMSL

SUBSURFACE PROFILE					SAMPLE DETAILS				WELL DETAILS			
Depth	Depth (m BGS)	Lithologic Symbol	Lithologic Description	Elevation (m AMSL)	Number	Type	N-Value	Recovery	Well			
15	35								 Top of sand (39.6 m BGS) Top of screen (45.4 m BGS) No.10 Slot PVC screen 50 mm diameter Bottom of screen (48.5m BGS) Bottom of borehole (50.0 m BGS)			
16												
17												
18	36											
19												
20												
21	37				9	GS						
22												
23												
24	38											
25												
26												
27												
28	39											
29												
30												
31	40											
32												
33												
34	41											
35												
36												
37	42											
38												
39												
40												
41	43				10	GS						
42												
43												
44	44											
45												
46												
47	45											
48												
49												
50	46											
51												
52												
53	47											
54												
55												
56	48											
57												
58												
59	49											
60												
61	49.68					233.72						
62	49.99					233.41	11	GS				
63												
64					DOLOSTONE BEDROCK grey							
65												
66												
67	51											
68												
69												
70	52											
71												
72												

Screen interval: 3.4 m to 6.4 m; 45.4 m to 48.5 m BGS

Sand pack interval: 2.7 m to 6.4 m; 39.6 m to 50.0 m BGS

Well seal interval: 0 to 2.7 m; 0 to 39.6 m BGS

Notes:
 mAMSL - metres above mean sea level
 mBGS - metres below ground surface
 GS - grab sample of cuttings



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Appendix C

Monitoring Data (Pumped Volumes and Hydrographs)



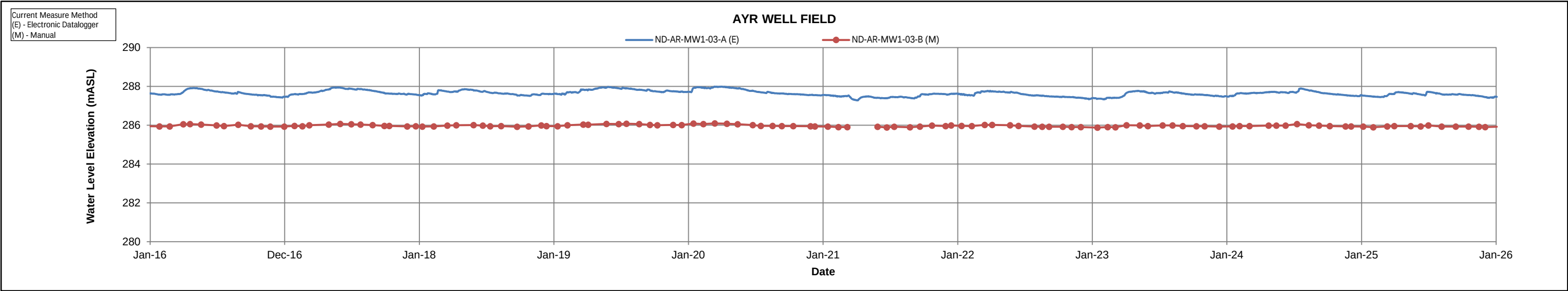
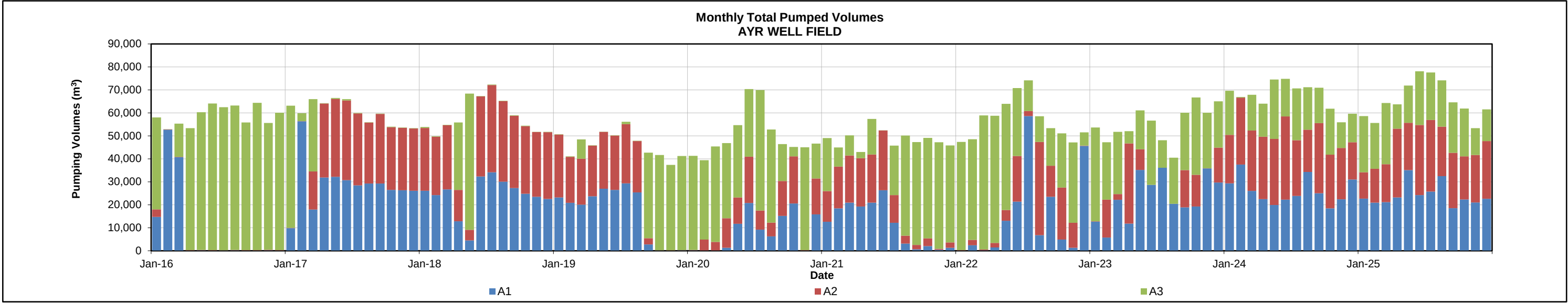
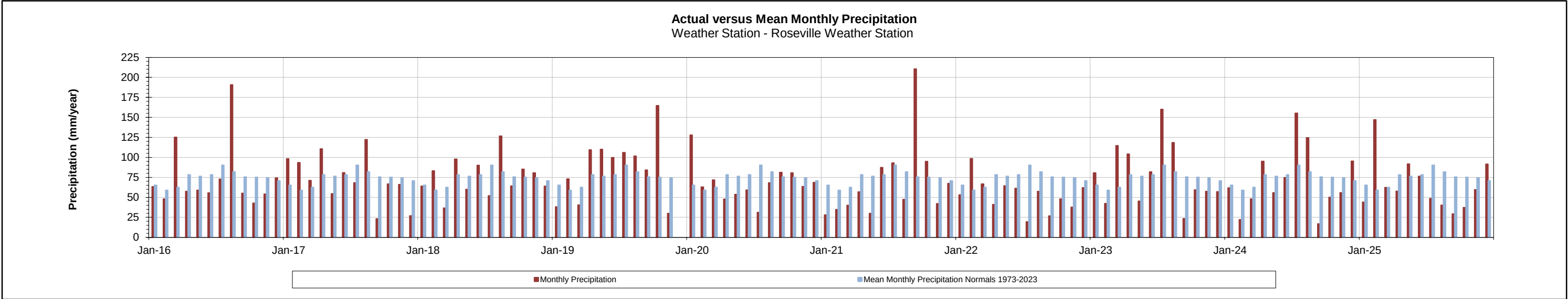
TABLE C-1
WELL FIELD WATER PRODUCTION SUMMARY
REGION OF WATERLOO - 2025 GROUNDWATER MONITORING REPORT



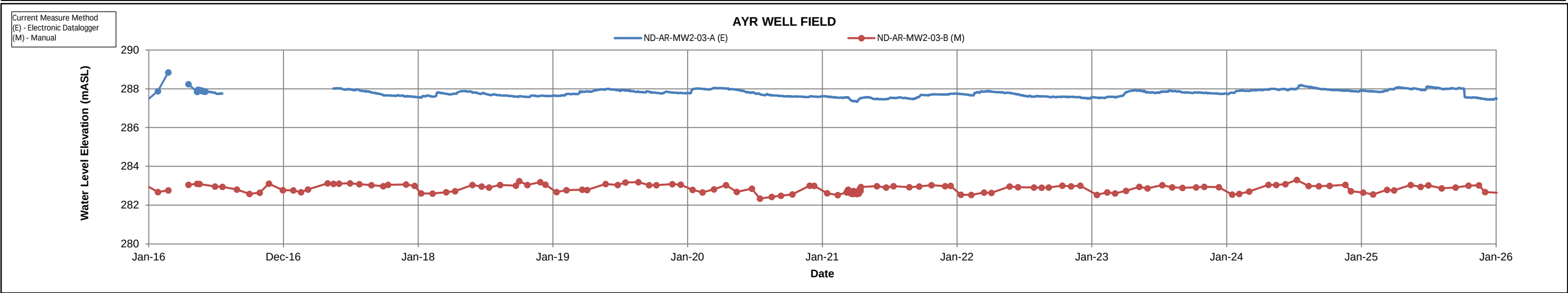
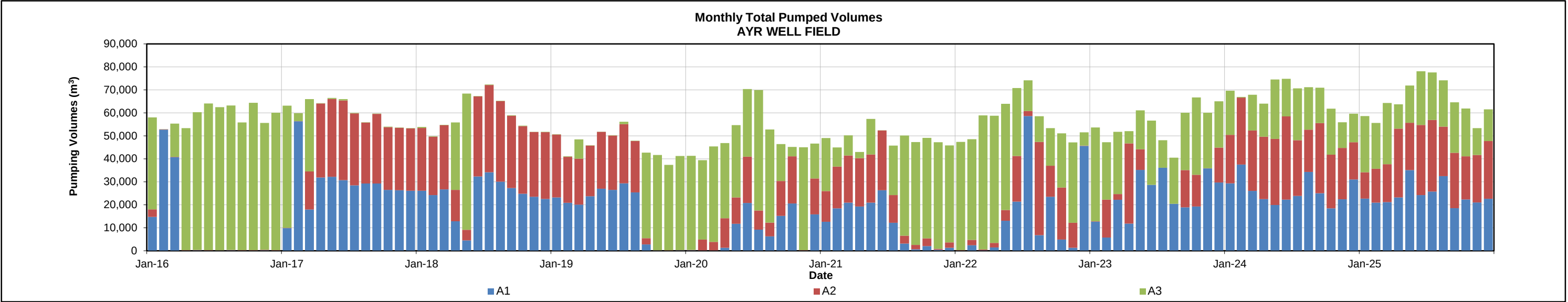
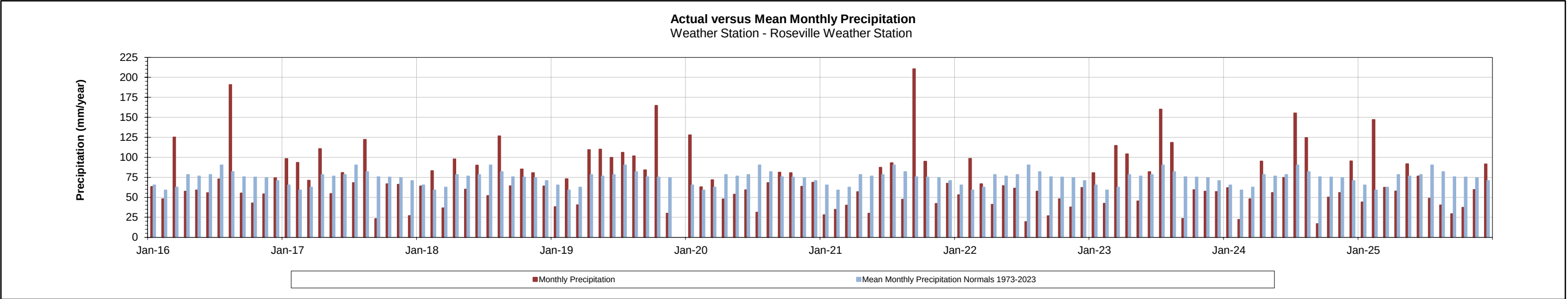
Well Field	Major or Minor Supply	Production Well Name	Permit to Take Water Details			2021 Production Summary			2022 Production Summary			2023 Production Summary			2024 Production Summary			2025 Production Summary		
			MOE Permit Number	Permitted Capacity (total m³/year)*	Permitted Rate (L/s)*	Total Production Well Volume (total m³/year)	Average Daily Rate (m³/day)	Average Rate (L/s)	Total Production Well Volume (total m³/year)	Average Daily Rate (m³/day)	Average Rate (L/s)	Total Production Well Volume (total m³/year)	Average Daily Rate (m³/day)	Average Rate (L/s)	Total Production Well Volume (total m³/year)	Average Daily Rate (m³/day)	Average Rate (L/s)	Total Production Well Volume (total m³/year)	Average Daily Rate (m³/day)	Average Rate (L/s)
Ayr	Major	A1	P-300-2094925631	2,000,200	63.4	137,964	378	4.4	179,055	491	5.7	276,238	757	8.8	312,372	856	9.9	289,778	794	9.2
		A2		2,000,200	63.4	143,438	393	4.5	119,267	327	3.8	108,374	297	3.4	300,683	832	9.5	265,012	726	8.4
		A3		2,000,200	63.4	300,727	824	9.5	385,511	1,056	12.2	278,033	762	8.8	191,784	525	6.1	230,428	631	7.3
		Well Field Total		2,000,200	228,300	582,129	1,595	18.5	683,833	1,874	21.7	662,645	1,815	21.0	807,839	2,213	25.6	785,218	2,151	24.9
				Maximum taking is 3,805L/min at each well and combined taking shall not exceed 5,480,000L/day																

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

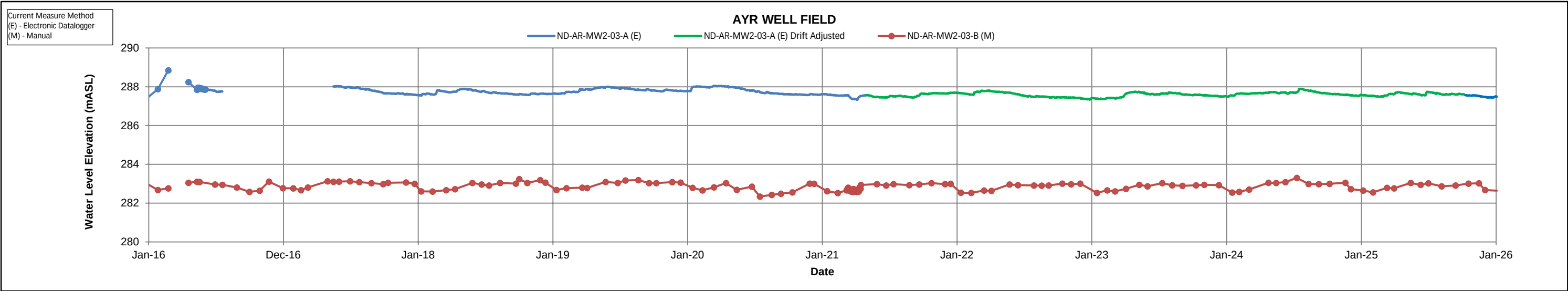
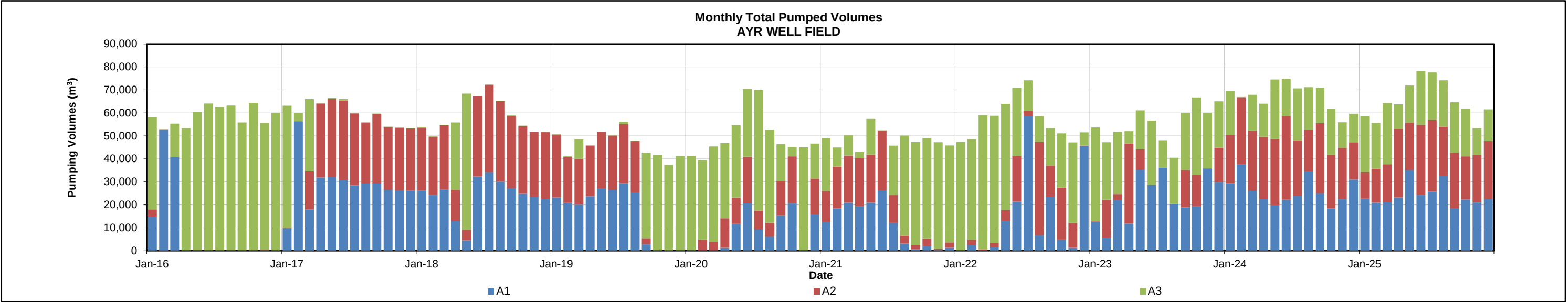
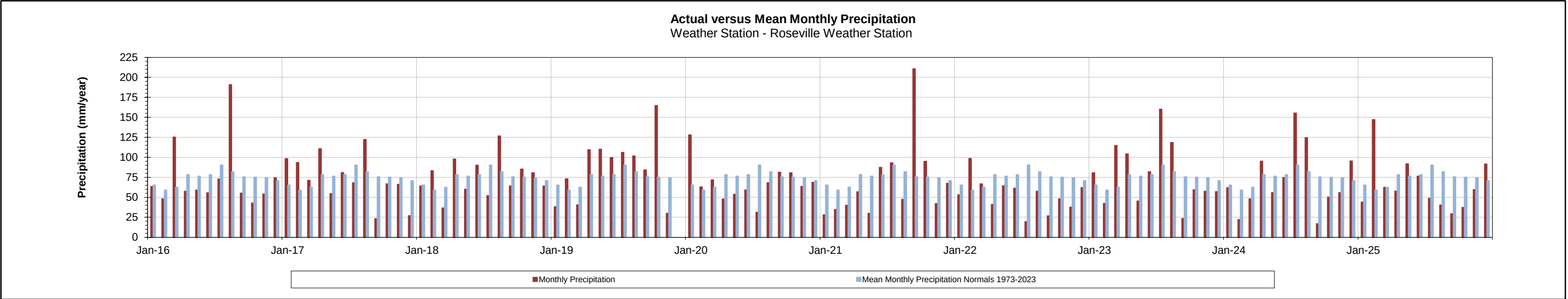
REGION OF WATERLOO
2025 GROUNDWATER MONITORING REPORT -
AYR



REGION OF WATERLOO
2025 GROUNDWATER MONITORING REPORT -
AYR



REGION OF WATERLOO
2025 GROUNDWATER MONITORING REPORT -
AYR





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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

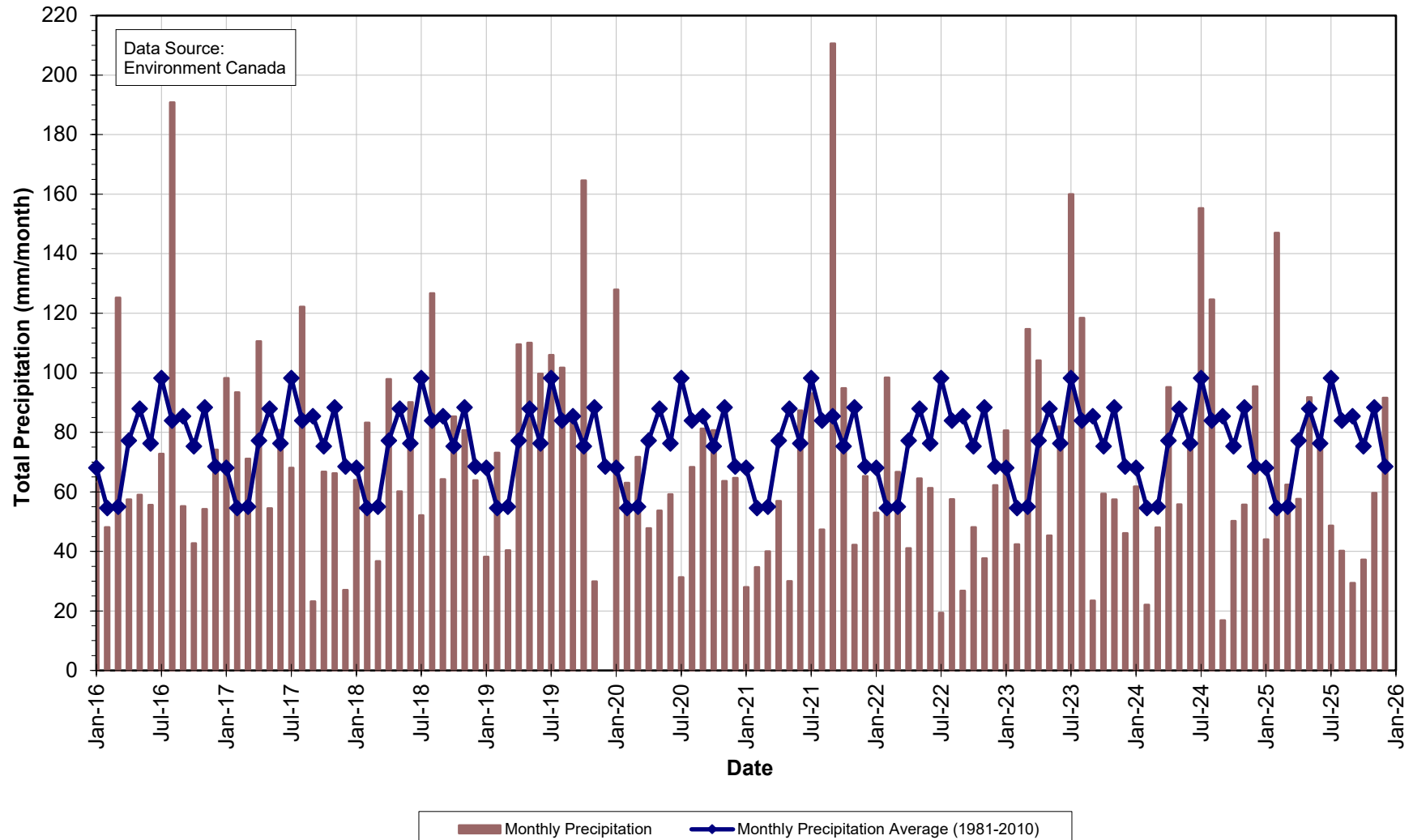
Year	Roseville Weather Station Established 1972		
	Annual Precipitation (mm)	30-yr NORMAL Precipitation 1981-2010 (mm)	Difference (mm)
2016	899	919	-20
2017	882	919	-37
2018	905	919	-14
2019	957	919	38
2020	817	919	-102
2021	832	919	-87
2022	637	919	-282
2023	945	919	26
2024	856	919	-63
2025	786	919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

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Figure D.1
Roseville Weather Station
Monthly Precipitation





BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

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*® Leveloggers®

- 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 disconnected 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.

- 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.

