

Region of Peel Permit to Take Water Groundwater and Surface Water Monitoring Program

2025 – Palgrave Annual Water Level and Water Quality Report

February 2026

Prepared for:

The Regional Municipality of Peel
10 Peel Centre Drive, Suite A, Floor 4
Brampton, ON L6T 4B9

Prepared by:

Watermark Environmental Ltd.
3 Whitehorse Road, Unit 15
Toronto, ON M3J 3G8
www.watermarkenv.ca



Table of Contents

1	Introduction	1
1.1	Palgrave Municipal Wells.....	1
1.2	Geological and Hydrogeological Setting.....	2
1.2.1	Physiography	2
1.2.2	Topography and Drainage	2
1.2.3	Surficial Geology.....	2
1.2.4	Bedrock Geology	3
2	Groundwater and Surface Water Level Summary	4
2.1	Groundwater and Surface Water Level Monitoring Scope	4
2.2	Groundwater and Surface Water Level Trends	5
3	Water Quality Summary	7
3.1	Water Quality Sampling Methodology	7
3.2	Groundwater and Surface Water Quality Trends.....	7
4	Conclusions and Recommendations	9
4.1	Conclusions	9
4.2	Recommendations.....	9
5	Signatures	10
6	References	11

List of Figures

Figure 1	Site Location PAL 2
Figure 2	Site Location PAL 3
Figure 3	Site Location PAL 4
Figure 4	Physiography
Figure 5	Topography
Figure 6	Surficial Geology
Figure 7	Palgrave Well 2 Hydrostratigraphic Cross-Sections
Figure 8	Palgrave Well 3 Hydrostratigraphic Cross-Sections
Figure 9	Palgrave Well 4 Hydrostratigraphic Cross-Sections
Figure 10	Bedrock Geology

List of Tables

Table 1.1	Palgrave Municipal Wells Construction Details
Table 1.2	Palgrave Municipal Wells PTTW Summary

Appendices

Appendix A	Palgrave Municipal Wells PTTW P-300-2034379854
Appendix B	Monitoring Network Summary Tables
Appendix C	Groundwater and Surface Water Levels
Appendix D	Groundwater Quality Results
Appendix E	Groundwater Quality Certificates of Analysis

1 Introduction

Watermark Environmental Ltd. (WEL) was retained by the Regional Municipality of Peel (the Region of Peel) to conduct the 2025 Groundwater Level and Groundwater Quality Monitoring Program (2022-222vPC13-1-021) for the Palgrave municipal wellfield. Three (3) municipal production wells, Palgrave Well 2 (PAL 2), Palgrave Well 3 (PAL 3), and Palgrave Well 4 (PAL 4) are operated by the Region of Peel in the Palgrave municipal wellfield.

This report is organized to provide a hydrogeological background on the Palgrave municipal wellfield, and summaries of the groundwater and surface water monitoring work completed in 2025. The summaries of the groundwater and surface water monitoring work completed includes an overview of the methodologies employed; the scope of the monitoring completed; and the results of the monitoring completed. Finally, conclusions of the monitoring program from 2025 are summarized together with any recommendations for the following annual groundwater and surface water level monitoring program in 2026.

1.1 Palgrave Municipal Wells

PAL 2 is located within the Palgrave 2 Water Treatment Plant building located at 16860 Mount Hope Road, Palgrave, Ontario. PAL 3 is located within the PAL 3 Water Treatment Plant located at 17255 Mount Hope Road, Palgrave, Ontario. Finally, PAL 4 is located within the PAL 4 Water Treatment Plant located at 9 Buckstown Trail, Palgrave, Ontario. PAL 2 is considered to have been completed within a semi-confined aquifer consisting of ice-contact sediments of stratified fine to medium sands of the Oak Ridges Moraine Aquifer Complex (ORAC) (Stantec, 2002). PAL 3 (Stantec, 2002) and PAL 4 (Watermark, 2023) are both considered to have been completed within the same semi-confined to confined coarse sand and gravel aquifer representing the regional Thornccliffe Aquifer Complex (TAC). Further discussion of regional hydrostratigraphy as it relates to the current study is provided in the next section. The locations of the PAL 2, PAL 3, and PAL 4 municipal wells are illustrated on **Figure 1**, **Figure 2**, and **Figure 3**, respectively. The well construction details for the municipal wells are summarized in **Table 1.1**.

Table 1.1 Palgrave Municipal Wells Construction Details

Source: WEL, 2024

Well ID	MOE Well Tag	Year of Well Construction	Well Depth (mbgs)	Screen Length (m)	Screen Interval (mbgs)	Aquifer Materials
PAL 2	4905013	1995	47.0	7.4	39.6-47.0	Sand (ORAC)
PAL 3	4906859	1988	82.5	9.1	71.3-80.4	Sand and Gravel (TAC)
PAL 4	4908837	2010	91.4	9.0	79.6-84.4 & 87.2-91.4	Sand and Gravel (TAC)

According to the current PTTW P-300-2034379854, the Region of Peel is permitted to take water from the Palgrave Municipal Wells according to the allotments provided in **Table 1.2**. The current PTTW will expire on May 31, 2029.

Table 1.2 Palgrave Municipal Wells PTTW Summary

Source: Table A from PTTW P-300-2034379854

Well ID	Maximum Volume (L/min)	Maximum Volume (L/day)
PAL 2	1,818	2,618,500
PAL 3	4,091	5,891,625
PAL 4	3,636	5,235,840
Maximum Combined Taking Permitted	9,545.81	13,745,965

1.2 Geological and Hydrogeological Setting

1.2.1 Physiography

The Palgrave municipal wells are located at the western extent of the Oak Ridges Moraine (ORM) physiographic region. The ORM physiographic region rises to approximately 450 metres above sea level (masl) at its apex, and is renowned for its undulating hummocky terrain. This undulating topography has led to the development of closed depressions on the ORM and correspondingly, areas of significant groundwater recharge (Chapman, 1984). Owing to these closed depressions, the Palgrave municipal wellfield and surrounding areas are understood to have recharge rates that are the highest in all of the Humber River Watershed (TRCA, 2008).

The distribution of physiographic regions in the surrounding area is presented on **Figure 4**.

1.2.2 Topography and Drainage

The Palgrave municipal wells differ in elevation between PAL 4 in the north at approximately 288 masl, to PAL 2 in the south at approximately 287 masl. PAL 4 and PAL 2 are separated by approximately 1.95 km, suggesting the Palgrave municipal wellfield covers an area that is gently sloping to the south. The Palgrave municipal wells are situated in the northwest corner of the Humber River Watershed, and specifically within the Main-Upper Subwatershed. The Palgrave municipal wellfield is anticipated to drain to the south-southeast in the direction of the Humber River, or to Gibson Lake and associated wetland features in the case of PAL 2 and PAL 3. Near PAL 4, drainage patterns may be influenced locally by the presence of estate properties, which have modified the undulating landscape to accommodate home construction on these larger properties.

A topographic map of the surrounding area is presented on **Figure 5**.

1.2.3 Surficial Geology

The understanding of regional geology and hydrogeology under which the current report has been prepared is based on the related information and mapping prepared by the Oak Ridges Moraine Groundwater Program (ORMGP) and the Ontario Geological Survey (OGS). The ORMGP, through their online mapping portal, provides the most accessible and up-to-date consensus on regional hydrogeological mapping and a comprehensive compilation of pertinent

hydrogeological data relevant to the current investigation. The following units overlie the bedrock (from youngest to oldest) in the vicinity of the Palgrave municipal wells:

- Halton Till
- Oak Ridges Moraine
- Newmarket Till
- Lower Sediments (including: Thorncliffe Formation, Sunnybrook Drift, and Scarborough Formation)

PAL 2 is screened to approximately 47 metres below ground surface (mbgs) in sand and gravel deposits of the ORAC. Hydraulically, the aquifer deposits of the ORAC in the area of PAL 2 are said to be semi-confined due to a thick aquitard deposit of the ORAC silt zone and the overlying fine-grained deposits of the regional Halton Till aquitard. Those units separate the aquifer from local surface water resources, namely Gibson Lake (Stantec, 2002). As a result of the lack of hydraulic connection between groundwater and surface water, PAL 2 is considered not under the direct influence of surface water (“Non-GUDI”) (Stantec, 2002).

PAL 3 and PAL 4 are screened to approximately 82.5 mbgs and 91.4 mbgs, respectively, in sand and gravel deposits of the TAC which are considered confined to semi-confined by silt zones of the ORAC and the overlying fine-grained deposits of the regional Halton Till aquitard separating the TAC from local surface water resources. As a result of the significant aquitard thickness; lack of hydraulic response in the shallow groundwater and surface water systems during pumping; and differences between groundwater and surface water quality, PAL 3 is considered not under the direct influence of surface water (“Non-GUDI”) (Stantec, 2002). In the case of PAL 4, a study conducted by AMEC Earth & Environment (AMEC) in 2005 (AMEC, 2005) concluded PAL 4 was also not under direct influence of surface water (“Non-GUDI”). A subsequent study by WEL (2021) in accordance with the Ministry of the Environment, Conservation and Parks (MECP) DRAFT Terms of Reference entitled *Determination of Minimum Treatment for Municipal Residential Drinking Water Systems Using Subsurface Raw Water Supplies*, 2019, supported AMEC’s initial findings by concluding that PAL 4 could be considered a Category 1 well.

A surficial geology map capturing the Palgrave municipal wellfield is included as **Figure 6**. Hydrostratigraphic cross-sections taken through PAL 2, PAL 3, and PAL 4 in perpendicular directions from the ORMGP model (2024) are included as **Figure 7**, **Figure 8**, and **Figure 9**.

1.2.4 Bedrock Geology

Bedrock mapping of Southern Ontario, prepared by the OGS (OGS, 2011), accessed through the ORMGP, indicates that shale bedrock of the Georgian Bay Formation underlies the overburden soils in the area. The bedrock in the area is not considered to be a feasible source of potable groundwater as the rock is known to be fairly competent and of low permeability.

A bedrock geology map capturing the study area of the Palgrave municipal wells is included as **Figure 10**.

2 Groundwater and Surface Water Level Summary

2.1 Groundwater and Surface Water Level Monitoring Scope

A summary of the groundwater and surface water level monitoring conducted in 2025 is provided in the summary tables of **Appendix B**. In **Table B-1 of Appendix B**, the monitoring locations are identified along with the frequency of monitoring which was included in the 2025 monitoring year. In 2025, the Palgrave municipal wellfield monitoring program included 18 groundwater monitoring stations capturing shallow, intermediate, and deep aquifer horizons, and 1 surface water monitoring stations. The monitoring locations for PAL 2, PAL 3, and PAL 4 are illustrated on **Figure 1**, **Figure 2**, and **Figure 3**, respectively.

The groundwater and surface water level monitoring program for 2025 included the following major tasks:

- Above ground inspection of monitoring wells, drivepoints, and surface water staff gauges to document any maintenance requirements;
- Collection of above ground monitoring well and drivepoint construction details, including stick-up, well diameters, etc.;
- Entry of all field monitoring data into the Region of Peel Survey123 monitoring well inspection app;
- Installation of seasonal groundwater and surface water level monitoring level loggers in April 2025 and retrieval of the same in November 2025;
- Replacing missing, inoperable, or damaged level loggers with Region of Peel supplied spares, including shipping select inoperable level loggers to Solinst Canada Ltd. for repair and/or data retrieval;
- Downloading and Quality Assurance/Quality Control (QA/QC) of data retrieved from FlowWorks where realtime data for non-seasonal monitoring locations is saved; and
- Compiling groundwater and surface water level monitoring data for submission to the Region of Peel.

Groundwater levels were manually measured using a water level tape. To reduce the risk of cross-contamination between monitoring wells, the probe of the water level meter was cleaned with a 1% solution of Alconox® detergent and rinsed with distilled water, prior to each use.

Continuous groundwater level monitoring data at all permanent (non-seasonal) monitoring locations was downloaded online from FlowWorks. Continuous groundwater levels and surface water levels from seasonal monitoring locations equipped with level loggers continued to be downloaded in the field and the data was managed by Watermark Environmental prior to submission to the Region of Peel.

Groundwater levels from the municipal wells were provided by the Region of Peel, including manual groundwater levels measured by Region of Peel operators and continuous operations data on the Palgrave municipal wells recorded by the Region of Peel supervisory control and data acquisition (SCADA) system. Operations data from the Palgrave municipal wells supplied by the Region of Peel included daily total flow, and maximum, minimum and average groundwater levels.

2.2 Groundwater and Surface Water Level Trends

Table C-1, Table C-2, and Table C-3 in Appendix C summarize the groundwater and surface water levels from the Palgrave wellfield during the monitoring period together with water levels that have been collected historically. Historical groundwater levels were obtained directly from the ORMGP, as needed. Water level hydrographs are also included in **Appendix C** to illustrate the seasonal variability and overall continuity of water levels beginning from January 2025 through December 2025 within the Palgrave wellfield. After review of the water level monitoring data from 2025, the following conclusions are offered:

- When compared with flow data from the municipal pumping wells PAL 2, PAL 3, and PAL 4, the normal short-term pumping operation of the municipal wells does not result in significant drawdowns at the monitoring wells nor drivepoint piezometers. Overall, the influence of the pumping wells on surrounding groundwater levels is most evident in monitoring wells screened closer to, and at similar depths as the pumping wells. Groundwater levels are shown to rebound quickly following a measured drawdown.
- Groundwater level hydrographs between all monitoring wells and drivepoint piezometers in the PAL 2, PAL 3, and PAL 4 wellfields demonstrated an expected range of seasonal variability during the 2025 monitoring period. The exception being PAL OW2R-09D, which was observed to show a response to the drought conditions experienced over the months of July to September 2025. Over that time, less than half of the historical seasonal precipitation was recorded for many areas of southwestern Ontario, leading to a period of prolonged drought. It is anticipated that groundwater levels will recover to seasonal normals in 2026 since drought conditions appear to have ended in 2025.

Considering groundwater levels collected in 2025, there is no significant difference from the groundwater level variability recorded in 2024 within the monitoring network, with the exception of the drought conditions observed to influence PAL OW2R-09D. This suggests that there have been no unexpected changes in the groundwater levels within the municipal wellfield and that the current operations of the Palgrave municipal wells are sustainable at present.

Included in **Appendix C** are hydrographs illustrating static groundwater levels at PAL 2, PAL 3, and PAL 4 over the previous 5 years. As evidenced in those hydrographs, static groundwater levels fluctuate within a normal range of variability and have been stable overall during this time. Based on these monitoring results, there have been no significant changes in the groundwater resources available to PAL 2, PAL 3, and PAL 4. Barring any significant changes in pumping intensity at the municipal wells, similar trends are expected in 2026.

3 Water Quality Summary

3.1 Water Quality Sampling Methodology

The results of groundwater sampling completed in 2025 are provided in the summary tables of **Appendix D**. There is currently no surface water sampling in the Palgrave wellfield. Within the tables of **Appendix D**, the sampling locations are identified along with a water quality parameter reference table organizing the analyses that occur within the Palgrave wellfield. In all, ten (10) groundwater monitoring locations were included in the water quality sampling program for 2025. In 2025, water quality sampling in the Palgrave wellfield was completed in April 2025. It is understood that from year-to-year, water quality sampling alternates between the autumn and spring sampling events; therefore, in 2026, water quality monitoring should be completed in the fall monitoring period.

Where possible, groundwater quality samples were collected following an initial purging of at least three (3) well volumes measured at the time of sampling. In cases where a significant volume of groundwater would require purging, confirmation of sufficient well purging was determined on a case-by-case basis using field parameters for Temperature, pH and conductivity as recorded by a handheld multi-parameter probe. Groundwater quality samples were collected by either a manual inertial pump or hydrolift, using wattera tubing and footvalves, or a bailer where more appropriate. Field-filtered samples were collected for metals as well as for Organic Nitrogen, Chemical Oxygen Demand, and Total Kjeldahl Nitrogen, as needed. Field-filtered samples were passed first through a 0.45 micron field filter.

After collection, all samples were placed on ice within dedicated coolers for transport to the laboratory. All samples were submitted to Bureau Veritas Canada Inc. (BV Labs) in Mississauga, Ontario, for analysis on the same day that they were collected. The Certificates of Analysis (CoAs) and Chains of Custody (COCs). The laboratory certificates of analysis are included in **Appendix E**.

3.2 Groundwater and Surface Water Quality Trends

Analytical results were compared to the Aesthetic Objectives (AOs), Operational Guidelines (OGs), and Maximum Acceptable Concentrations (MACs) of the Ontario Drinking Water Standards (ODWS) Ontario Regulation 169/03. After review of the water quality results from 2025, the following conclusions are offered:

- No exceedances of any parameter with a reported ODWS MAC criteria were identified in the Palgrave wellfields, including Nitrate, which were non-detect at all sampling locations except for a low-level concentration at monitoring well PAL EW3-2 in the PAL 3 wellfield, and monitoring well PAL OW2R-09S in the PAL 4 wellfield;
- VOCs were reported as non-detect at all locations where those parameters were sampled in the PAL 2 wellfield. VOCs are not sampled in the PAL 3 nor the PAL 4 wellfields;

- Arsenic was observed to be over 25% of the ODWS MAC at PAL OW2R-09D in 2025. This location has reported a slightly increasing trend of Arsenic since 2020, while PAL OW2R-09S and PAL CARLING are consistently reported as non-detect; and
- Concentrations for Chloride and Sodium were below the ODWS AOs of 250 mg/L and 200 mg/L, respectively, at all locations sampled in 2025 except for monitoring well PAL OW2R-09S in the PAL 4 wellfield, continuing trends observed historically. It was noted that concentrations at the deep and intermediate monitoring locations were all lower than at this shallow monitoring location, suggesting the source(s) of Chloride and Sodium have not influenced water quality in the intermediate and deep groundwater horizons.

Historical time-concentration plots of the parameters Nitrate, Chloride, and Sodium supplemented with results of sampling from 2025 are provided in **Appendix D**. Historical water quality information was obtained directly from the ORMGP, as needed.

Based on the time-concentration plots, the concentration of Nitrate at the monitored locations have been low, if not non-detect, and stable over the previous 10 years below the Nitrate MAC of 10 mg/L at monitoring locations around PAL 2, PAL 3, and PAL 4. The only exception to this is monitoring well PAL OW2R-09S in the PAL 4 wellfield where, although still below the Nitrate MAC, concentrations steadily increased between 2015 and 2022. More recently, Nitrate concentrations have somewhat decreased and/or stabilized. Based on available monitoring data, shallow groundwater in the area around PAL 4 flows from upgradient of PAL 4 to downgradient of PAL 4 toward the Humber River. Review of Google satellite imagery indicates that many of the large residential estate homes near to PAL 4 have been in place since at least 2016, suggesting that the increasing Nitrate concentrations are a result of private septic systems in the area. By comparison, the lands around PAL 2 and PAL 3 are mostly greenspace or parkland where sources of Nitrate from private septic systems are not as prevalent. This said, the available monitoring data does not indicate that the Nitrate plume is influencing the intermediate and deep groundwater horizons at PAL 4.

When assessing concentrations for Chloride and Sodium, concentrations at the sampled locations were generally within the established stable to declining trends that can be observed in historical water quality data. Again, monitoring well PAL OW2R-09S is the one the exception where concentrations for Chloride and Sodium have well exceeded the AOs of these parameters since sampling for these parameters began in 2020. These results are also anticipated to be linked to private septic systems operating upgradient to PAL 4. However, similar to Nitrate, the concentrations for Chloride and Sodium in the intermediate and deep groundwater horizons have reported very low concentrations for both parameters.

4 Conclusions and Recommendations

4.1 Conclusions

Using the water level and water quality monitoring data collected over the 2025 monitoring period, and considering the results historical water level and water quality monitoring, the following conclusions in regard to the operations of the Palgrave municipal wells are offered:

- Groundwater and surface water elevations between 2025 and historically continue to display near-identical seasonal trends tied to the changing operations of the municipal wells, except for drought conditions observed at monitoring well PAL OW2R-09D. This suggests that there have been no unexpected changes in the groundwater levels within the municipal wellfield and that the current operations of the Palgrave municipal wells are sustainable at present.
- When compared with flow data from the municipal pumping wells, the normal short-term pumping operation of the municipal wells does not result in significant drawdowns at the monitoring wells or drivepoint piezometers. The operations of PAL 3 and PAL 4 had no discernable influence on shallow monitoring locations nor surface water, where monitors are available. Overall, the impact of the pumping wells on surrounding groundwater levels is most evident in monitoring wells screened closer to, and at similar depths as the pumping wells. Groundwater levels are shown to rebound quickly following a measured drawdown.
- In 2025, the concentration of Nitrate at monitoring well PAL OW2R-09S near PAL 4 continued a relatively flat, stable trend that has been observed over the previous 10 years. Increasing trends are reported at this location for Chloride and Sodium. Concentrations for Nitrate, Chloride, and Sodium in the intermediate and deep groundwater horizons were below their respective MACs and AOs, and have an established stable trend over the previous 10 years.
- Arsenic was observed to be over 25% of the ODWS MAC at PAL OW2R-09D in 2025. This location has reported a slightly increasing trend of Arsenic since 2020, while PAL OW2R-09S and PAL CARLING are consistently reported as non-detect.

4.2 Recommendations

Based on these conclusions, the following recommendations are offered for the 2026 monitoring year:

- Continue the current groundwater and surface water level monitoring program and assess the monitoring data in context of historical monitoring results for trends that may indicate irregular influences from the pumping wells; and
- Continue the current water quality sampling program to monitor for any changes in water quality at surrounding wells, and to continue reporting on the recorded concentrations of Nitrate, Chloride, and Sodium at monitoring well PAL OW2R-09S.

5 Signatures



Ian Gardiner, P.Eng.
Project Engineer

Victor Marcucci, P.Eng.
Hydrogeologist

Revision History

Rev	Date	Description	Prepared by	Approved by
--	2026-02-17	Initial Draft submission for review	Victor Marcucci	Ian Gardiner
00	2026-02-26	Report Submission	Victor Marcucci	Ian Gardiner

This report was prepared using scientific principals and professional judgement in the assessment of the available facts and information. The interpretations within this report are based on the limits of the existing information, budgeted scope of work and schedule. The information presented in this document is not to be construed as legal advice.

Watermark Environmental Ltd. relied on information from the Region of Peel, independent sources, and other historical documentation as referenced in this report. The accuracy and completeness of third-party sources was not verified. It is noted that the regulatory guidelines, standards and related documents as they are referenced in this report are subject to interpretation and may change over time.

This report was prepared for the exclusive use of the Region of Peel and the Ministry of the Environment, Conservation and Parks. Any use which a third party makes of this report, or reliance of decisions based on it, are the responsibility of such third parties. Watermark Environmental Ltd. accepts no responsibility for damages, if it were to occur, suffered by any third party as a result of decisions made or actions taken based on this report.

6 References

AMEC Earth & Environmental. February 2005. *GUDI Study for Palgrave Well No. 4 – Region of Peel*.

Chapman, L.J. and Putnam, D.F. 1984. *The Physiography of Southern Ontario*, Third Edition. Ontario Geological Survey, Ontario Ministry of Natural Resources.

Oak Ridges Moraine Groundwater Program (ORMGP). 2022. *Geology*.
<https://maps.oakridgeswater.ca/Html5Viewer/index.html?viewer=ORMGPC&run=Geology#>.
Accessed February 6, 2026.

Regional Municipality of Peel. 2022. *2022 Palgrave Annual Water Level & Quality Report*.

Stantec Consulting Ltd. October 2002. *Groundwater Under the Direct Influence of Surface Water Assessment – Palgrave Wells No. 1, 2, and 3*.

Toronto and Region Conservation Authority (TRCA). (TRCA, 2008). *Humber River Watershed Scenario Modelling and Analysis Report*.

Watermark Environmental Ltd. 2021. *Palgrave Well No. 4 Stage 1 Report on Assessment of Vulnerability to Contamination by Protozoa dated April 20, 2021*.

Watermark Environmental Ltd. 2024. *2023 – Palgrave Annual Water Level and Water Quality Report dated March 25, 2024*.

Watermark Environmental Ltd. 2025. *2024 – Palgrave Annual Water Level and Water Quality Report dated March 4, 2025*.

Figures

Appendix A

Palgrave Municipal Wells PTTW P-300-2034379854

Appendix B

Monitoring Network Summary Tables

Appendix C

Groundwater and Surface Water Levels

Appendix D

Groundwater Quality Results

Appendix E

Groundwater Quality Certificates of Analysis