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AECOM CANADA LTD.

Hydrogeological Assessment
St. Charles Wastewater Sewer District
Winnipeg, Manitoba

Prepared for:
AECOM Canada Ltd.
99 Commerce Drive
Winnipeg, Manitoba
R3P 0Y7

Date: March 2025

EGE Project Number: 0013 056 00

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March 21, 2025 File: 0013 056 00

AECOM Canada Ltd.
99 Commerce Drive
Winnipeg, Manitoba
R3P 0Y7

Attention: Mike Gaudreau, P.Eng.

RE: Hydrogeological Assessment
St. Charles Wastewater Sewer District - Winnipeg, Manitoba

EGE Engineering Ltd. is pleased to submit the following report on the Hydrogeological Assessment completed for the St. Charles Wastewater System located in Winnipeg, Manitoba.

Should you have any questions or require any additional information on the report please contact the undersigned at (204) 975-9433 or (204) 226-7378 (cell).

Sincerely,

EGE ENGINEERING LTD.

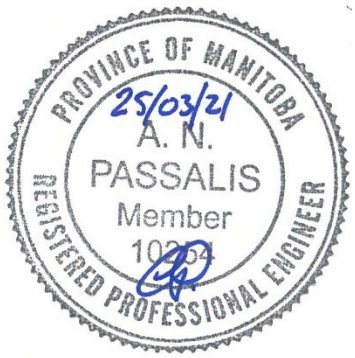
Larry Bielus, M.Sc., P.Eng.
Manager

Revision History

Revision No.	Author	Issue Date	Description
0	Andrew Passalis	December 2, 2024	Internal Draft Report
1	David Klassen	December 20, 2024	Draft Report - Issued for Client Review
2	David Klassen	March 21, 2025	Final Report

Authorization Signatures

Prepared By:



Andrew Passalis, P.Eng.
Project Engineer

Reviewed By:

David Klassen, P.Geo.
Senior Geoscientist

EXECUTIVE SUMMARY

EGE Engineering Ltd. (EGE) was retained by AECOM Canada Ltd. (AECOM) on behalf of the City of Winnipeg to conduct a Hydrogeological Assessment as part of the detailed design to connect the St. Charles Separated Sewer District (SSD) at the existing St. Charles Lift Station (LS) to the Perimeter West SSD via a new wastewater sewer (WWS).

Project Objectives and Scope of Work

The objective of the Hydrogeological Assessment was to determine the hydraulic conductivities and potential groundwater infiltration rates associated with the soil conditions along the proposed WWS alignment and to provide an evaluation of suitable options for construction dewatering based on the findings.

The scope of work for the Hydrogeological Assessment included:

- Characterization of the subsurface conditions through the completion of four boreholes in the clay overburden and four boreholes in the underlying sandy silt till and extending two boreholes to contact the bedrock surface;
- Installation of eight groundwater monitoring wells (four in the clay overburden and four in the sandy silt till) to characterize the aquifer conditions through hydrogeological testing; and
- Analysis of the investigation data to provide recommendations for construction dewatering based on the design details provided by AECOM.

Site Description

The St. Charles SSD services approximately 100 ha of mainly single-family homes with some multi-family residential and commercial development. The commercial development is primarily located along the south side of Portage Avenue, for approximately 600 m of east of St. Charles Street. Included in the district is the Glendale Golf and Country Club, which occupies approximately 52.5 ha.

AECOM completed a preliminary design report dated February 2024 and the project includes the following components:

- New 540 m long 450 mm WWS from the upstream tie-in point located in front of the existing St. Charles LS on Sansome Avenue to the downstream tie-in point located on Oak Forest Crescent;
- The proposed work area extends from the existing LS on Sansome Avenue, west to Gagnon Street, south on Gagnon Street to Augier Avenue, then west on Augier Avenue, beneath the Perimeter Highway (PTH 100) to tie-in to the existing 600 mm WWS manhole at the intersection of Oak Forest Crescent and Oxbow Bend Road;

- Alignment within the road right-of-way;
- Combination of open cut and trenchless (pipe coring) techniques to install the new WWS with either guided auger boring or pilot tube micro tunnelling used to cross the PTH 100 highway right-of-way; and
- Decommissioning and abandoning the existing St. Charles LS.

Findings

From a hydrogeologic perspective relative to the potential for issues with groundwater during construction at the Site, the stratigraphy can be subdivided into four hydrogeologic units as follows:

- An upper clay/silty clay unit extending from near grade to a depth of 4.9 to 8.5 m;
- A loose to very loose sandy silt till directly below the clay/silty clay that is at least 1 to 2 m thick;
- A transition from a loose to very loose sandy silt till to a dense sandy silt till with depth that extends downwards to the bedrock surface; and
- Limestone bedrock that was encountered at a depth of 13.0 m at test hole TH24-02B and at a depth of 11.4 m at TH24-03B and suspected at a depth of 13.2 m at TH24-04B.

The following summarizes the expected hydrogeologic properties of each unit.

Upper Clay/Silty Clay

The upper clay/silty clay unit extends to a depth of 4.9 to 8.5 m and consists primarily of clay with some silt inclusions and locally silty clay. The estimated hydraulic conductivity is in the range of 1.2×10^{-9} to 2.1×10^{-8} m/s. Groundwater within the clay was measured at a depth of 0.570 to 2.904 m below grade (elevation equivalent of 233.88 to 235.61 m). A downward hydraulic gradient towards the underlying till was measured, indicating the groundwater in the clay is perched above the groundwater in the underlying till.

The groundwater conditions within the clay can be considered typical of the City of Winnipeg. There will be some seepage from the clay during construction and this can typically be managed using sump pumps at the base of the trench excavation. None of the test holes encountered distinct layers or lenses of silt or sand within the clay sequence that would contribute additional groundwater seepage. Nevertheless, small lenses or layers of silt or sand may still be encountered. If so, the additional seepage from the upper clay sequence should still be manageable using sump pumps at the base of the trench excavation.

Upper Sandy Silt Till

The upper 1 to 2 m (at least) of the sandy silt till is described as being loose to very loose, with heavy seepage and sloughing. Groundwater within the sandy silt till was measured at a depth of 1.400 to

3.055 m below grade (elevation equivalent of 233.73 to 234.89 m). The monitoring wells were generally screened below the upper loose to very loose portion of the till and the groundwater levels are 2 to 6 m (+/-) above the top of the till layer.

Given the reported loose to very loose conditions near the top of the till layer and the artesian groundwater pressures, groundwater seepage from this layer is a concern at those locations where the base of the trench excavation may extend into the till, as is the potential for issues with side wall stability within the trench in the upper till.

The groundwater monitoring wells in the sandy silt till were installed at depths of approximately 2 to 5 m below the top of the till. The in-situ hydraulic conductivity values from these monitoring wells were noted to vary from 8.7×10^{-6} to 1.1×10^{-4} m/s. However, it is noted that the monitoring wells used to estimate the hydraulic conductivity of the till are all screened below the upper loose to very loose portion of the sandy silt till (i.e.: within the lower denser portion of the till). As such, the estimated hydraulic conductivities may not be fully representative of the hydraulic conductivity of the upper loose to very loose portion of the till. On this basis, depth specific testing of the upper 1 to 2 m thick portion of the loose to very loose till is recommended to better estimate the hydraulic conductivity within this portion of the till, and subsequently, the potential seepage rates that may be encountered.

Upper Sandy Silt Till

The lower portion of the sandy silt till down to the bedrock was noted to be dense to very dense. As noted above, in-situ hydraulic conductivity estimates for the monitoring wells installed in this portion of the sandy silt till were noted to vary from 8.7×10^{-6} to 1.1×10^{-4} m/s.

An analytical solution to calculate the potential groundwater influx into a trench was used to obtain the conceptual estimated range of groundwater influx based on the calculated in-situ hydraulic conductivities. The estimated influx should be considered an approximation for scoping level purposes only, as the actual influxes that will be encountered are strongly dependant on the hydraulic conductivity, which as noted varies across the Site.

The following assumptions have been used:

- Steady state conditions (initial influxes of groundwater will be higher, but will typically decline as the drawdown cone develops and steady state conditions are approached);
- An aquifer thickness of 2.0 m;
- A constant head of 3.0 m at a constant head boundary located 25 m from the trench excavation; and
- A constant head at the edge of the trench of 0.0 m.

Based on the above assumptions, the following are the estimated groundwater influxes from the sandy silt till per 100 m of trench excavation for the upper and lower range of estimated in-situ hydraulic conductivities:

- 1.1×10^{-4} m/s (as measured at TH24-01B) - estimated influx of 5.8 l/s; and
- 8.7×10^{-6} m/s (as measured at TH24-04B) - estimated influx of 0.4 l/s.

Limestone Bedrock

At test holes TH24-02B and TH24-03B, the limestone bedrock was encountered at depths of 13.0 and 11.4 m, respectively and is overlain by approximately 6.5 m of sandy silt till at TH24-02B and 6.0 m of clay/sandy silt till at TH24-03B, based on the distance from the pipe invert to the top of the bedrock surface.

The estimated groundwater elevation in the bedrock, based on the provincial bedrock groundwater level data, is in the range of 232.5 to 234.0 m, and similar to the groundwater elevations in the till. As such, the groundwater levels are approximately 2 to 6 m (+/-) above the top of the till, and an upward artesian pressure exists. Assuming an artesian pressure of between 2 and 6 m, an average till thickness of 6.25 m, a unit weight for the till of 17 kN/m^3, and a unit weight of water of 9.81 kN/m^3, the estimated factor of safety against basal heave (blow-out) varies from 1.8 to 5.4.

Based on published information, the transmissivity of the bedrock aquifer in the area of the Site is estimated to be in the relatively high range of 1.4×10^{-2} to 2.2×10^{-2} m^2/s. Assuming this estimated range of transmissivity is valid for the Site, if basal heave does occur, the influx of groundwater to the excavation could be significant. In such a scenario, pumping well(s) would need to be installed in the bedrock to depressurize the bedrock aquifer and stop the flow.

Recommendations

Based on the available information, the following are the preliminary recommendations for groundwater control assuming open cut methods are used (directional drilling methods would likely only require groundwater control at specific excavation locations):

- Groundwater flow within the clay overburden is expected to be minor and typical for excavations in clay in the City of Winnipeg. The standard construction use of sump pumps at the base of the trench excavation should suffice.
- Groundwater flow within the upper loose to very loose sandy silt till could be significant and further investigation of that specific layer is warranted to better quantify the hydraulic conductivity and the potential inflows. It is anticipated that this portion of the till will need to be depressurized using a sand point type system or equivalent.
- It is understood that the base of the trench excavation may locally be within the upper loose to very loose till. The underlying till is also under artesian pressure; and therefore, some upward

movement of groundwater into the excavation may occur. The sand point type system recommended above should extend downwards into the underlying denser till so that this portion of the unit is also depressurized and upward flow is limited.

- The available information indicates that there is sufficient till thickness beneath the proposed trench excavation to likely prevent basal heave due to the artesian pressures in the bedrock. As such, there is no current need to depressurize the bedrock aquifer. However, if basal heave does occur and bedrock groundwater does flow into the trench excavation, the solution will be to install pumping well(s) in the bedrock to depressurize the bedrock aquifer.

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1.0 INTRODUCTION AND SCOPE

1.1 INTRODUCTION

EGE Engineering Ltd. (EGE) was retained by AECOM Canada Ltd. (AECOM) on behalf of the City of Winnipeg to conduct a Hydrogeological Assessment as part of the detailed design to connect the St. Charles Separated Sewer District (SSD) at the existing St. Charles Lift Station (LS) to the Perimeter West SSD via a new wastewater sewer (WWS).

The following report summarizes the findings of the Hydrogeological Assessment and is based on the project information provided by AECOM and the data generated from the current subsurface investigation and hydrogeological testing. The Site location is illustrated on Figure 01 and a Site plan is provided as Figure 02.

Representative photographs of the Site, taken at the time of the Hydrogeological Assessment, are included throughout the report.

1.2 OBJECTIVES AND SCOPE OF WORK

The objective of the Hydrogeological Assessment was to determine the hydraulic conductivities and potential groundwater infiltration rates associated with the soil conditions along the proposed WWS alignment and to provide an evaluation of suitable options for construction dewatering based on the findings.

The scope of work for the Hydrogeological Assessment included:

- Characterization of the subsurface conditions through the completion of four boreholes in the clay overburden and four boreholes in the underlying sandy silt till and extending two boreholes to contact the bedrock surface;
- Installation of eight groundwater monitoring wells (four in the clay overburden and four in the sandy silt till) to characterize the aquifer conditions through hydrogeological testing; and
- Analysis of the investigation data to provide recommendations for construction dewatering based on the design details provided by AECOM.

1.3 SITE DESCRIPTION

The St. Charles SSD services approximately 100 ha of mainly single-family homes with some multi-family residential and commercial development. The commercial development is primarily located along the south side of Portage Avenue, for approximately 600 m of east of St. Charles Street. Included in the district is the Glendale Golf and Country Club, which occupies approximately 52.5 ha.

1.4 BACKGROUND

AECOM completed a preliminary design report dated February 2024 [(1)], which included an assessment of three design options for the project and completion of a geotechnical investigation to support the preliminary design. The preliminary design was advanced for the gravity connection option and includes the following components:

- New 540 m long 450 mm WWS from the upstream tie-in point located in front of the existing St. Charles LS on Sansome Avenue to the downstream tie-in point located on Oak Forest Crescent;
- The proposed work area extends from the existing LS on Sansome Avenue, west to Gagnon Street, south on Gagnon Street to Augier Avenue, then west on Augier Avenue, beneath the Perimeter Highway (PTH 100) to tie-in to the existing 600 mm WWS manhole at the intersection of Oak Forest Crescent and Oxbow Bend Road;
- Alignment within the road right-of-way;
- Combination of open cut and trenchless (pipe coring) techniques to install the new WWS with either guided auger boring or pilot tube micro tunnelling used to cross the PTH 100 highway right-of-way; and
- Decommissioning and abandoning the existing St. Charles LS.

As part of the previous geotechnical investigation, AECOM drilled seven test holes (TH23-01 through TH23-07) along the WWS alignment. The test holes were completed within the boulevards, ditches and City property. The test hole locations are highlighted on Figure 02 and copies of the test hole logs are provided in Appendix A.

Groundwater seepage and sloughing conditions were observed at each test hole location. One standpipe piezometer was installed at TH23-01 (in the till) and two standpipe piezometers were installed at TH23-05 (one in the clay overburden and one in the underlying till). The recorded piezometric elevations at the time of the investigation (August 25, 2023) were, respectively 233.41, 233.99 and 234.49 m (obtained from the AECOM St. Charles Wastewater Sewer District Detailed Design and Contact Administration Services - Revision No. 2 Geotechnical Report dated December 3, 2024) [(2)].

The proposed design profile of the WWS is shown on Plate 01 below (note that the bottom of the silt till shown at 220.0 m on the profile was not confirmed during the AECOM geotechnical investigation as refusal was encountered within the till at all locations and the investigation did not contact the bedrock). A plot of the standpipe groundwater elevations measured between August 25, 2023 and October 4, 2024 is provided as Plate 02 below.

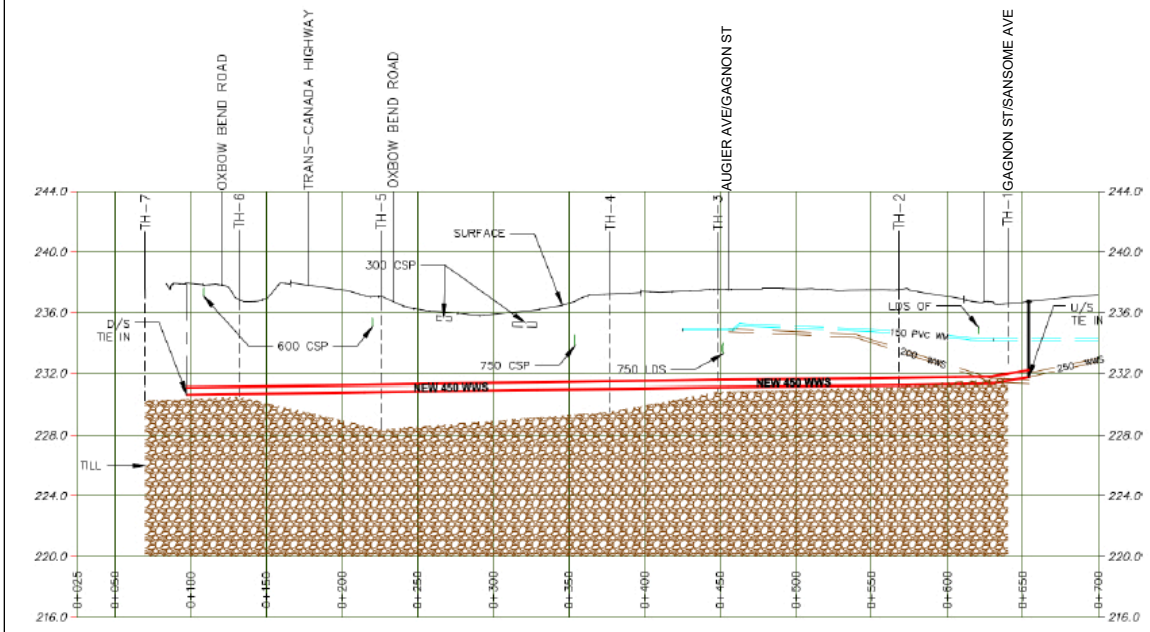


Figure 17: Pipe Profile vs. Glacial Till

Plate 01: Proposed WWS profile (AECOM, 2024).

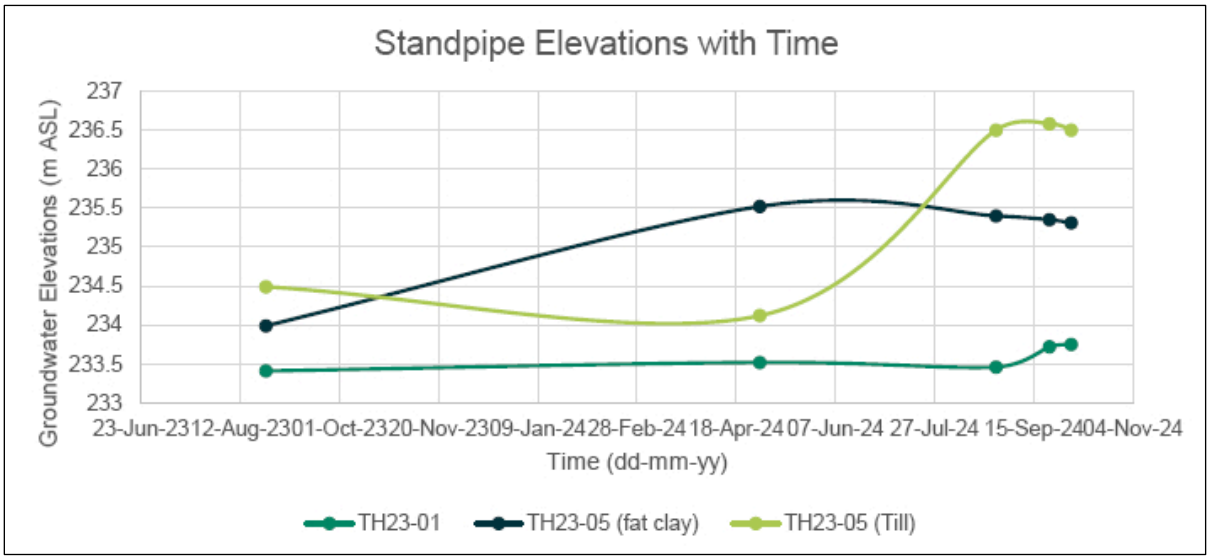


Plate 02: Standpipe groundwater elevations between August 2023 and October 2024 (AECOM, 2024).

2.0 FIELD INVESTIGATION

The field program undertaken during the current Hydrogeological Assessment included drilling eight test holes and completing each test hole as a groundwater monitoring well. The test drilling and monitoring well installations were completed between September 3 and 5, 2024. EGE subsequently returned to Site between September 19 and 30, 2024 to collect groundwater measurements and to conduct in-situ hydraulic conductivity testing at each of the eight monitoring well locations.

2.1 HEALTH AND SAFETY

EGE is committed to providing a safe and healthy work environment for all workers. Employees at every level, including management, are responsible and held accountable for the company's overall safety and are committed to doing everything possible to prevent injuries and to maintain a healthy work environment. To this end:

- The company is committed to maintain a workplace health and safety system;
- Every person must integrate good workplace health and safety practices into their daily activities;
- All employees are required to support the workplace health and safety system;
- Managers are responsible for enhancing health and safety consciousness;
- Supervisors must ensure employees are trained in health and safety work procedures to obtain optimal output without incident and injuries; and
- All employees are accountable for implementing the project safety plan.

Prior to mobilizing to Site, EGE also prepared a site-specific Project Safety Plan. The on-site safety officer for this project was Mr. Andrew Passalis, P.Eng. (Project Engineer). A copy of the signed Project Safety Plan was kept on-site at all times during the field program.

2.2 UTILITY CLEARANCES

Prior to commencing with the site investigation, EGE arranged for the identification of all site utilities and/or underground service locations, and their orientations, by the appropriate authority through the Manitoba One Call service and by a private locator (McCaine Electric). The utility clearance sheets are provided in Appendix B.

2.3 TEST DRILLING AND SOIL SAMPLING

The test drilling program was conducted between September 3 and 5, 2024 using a Renegade B37X track-mounted drill rig equipped with 125 mm solid stem augers and HQ coring equipment. The drill rig was supplied by Maple Leaf Drilling Ltd. of Winnipeg, Manitoba. Mr. Andrew Passalis, P.Eng. and Mr. Eric Schillberg, Engineering Intern (EI), both with EGE, supervised the test drilling program.

Eight test holes were drilled as part of the Hydrogeological Assessment with depths ranging between 6.1 and 13.8 m below ground. The test holes were completed as groundwater monitoring wells in nested pairs at four locations (TH24-01A/B through TH24-04A/B) along the proposed WWS alignment.

Drill cuttings were visually screened for evidence of staining or other impacts prior to being removed for off-site disposal. The soil stratigraphy encountered in the field was recorded in a field book at the time of the site investigation program and the data subsequently entered into a computer logging software program to prepare a stratigraphic log for each of the completed test holes. A description of the soil stratigraphy that was encountered is provided on the test hole logs presented in Appendix A.

A survey of the test hole locations was completed using a handheld GPS unit to obtain Universal Transverse Mercator (UTM) coordinates for each point. Each investigation point was also chained in the field to the nearest identifiable feature on Site. The GPS coordinates for the completed test holes are summarized in Table 1. The test hole locations are shown on Figure 02.

Representative soil samples were collected at various depths from the key stratigraphic units, placed into plastic sample bags and retained for possible laboratory testing. The samples were retrieved directly from the solid stem augers or from the recovered core, where drilling switched to coring following refusal with the solid stem augers. Disposable nitrile gloves were used during the sample handling.

Representative photographs of the test hole drilling are provided below.

Photos 01 and 02: View looking south during drilling at TH24-01A (left) and view looking west during drilling at TH24-02A (right).

Photo 03: View looking west during drilling at TH24-03A.

Three soil samples were subsequently submitted to TREK Geotechnical Inc. (TREK) for grain size analysis. This included:

- TH24-01A from 3.7 to 4.0 m below ground - silty clay;
- TH24-01A from 5.5 to 5.8 m below ground - upper sandy silt till; and
- TH24-02B from 12.5 to 13.0 m below ground - lower sandy silt till.

The results of the grain size analyses are included in Appendix C. The test hole locations are shown on Figure 02.

2.4 GROUNDWATER MONITORING WELL INSTALLATION

As noted above, four pairs of groundwater monitoring wells were installed at the Site (TH24-01A/B through TH24-04A/B). Each pair consisted of one shallow well installed within the clay overburden ("A" series) and one deeper well installed within the underlying sandy silt till ("B" series). The monitoring wells were constructed using 50 mm polyvinyl chloride (PVC) slotted and solid pipe sections, a PVC end cap at the bottom and a J-plug cap at the top.

The annular space between the borehole wall and the slotted sections of pipe was backfilled with silica sand. The annular space between the borehole wall and the solid sections of pipe was backfilled with bentonite pellets. The monitoring wells were constructed with 1.44 to 1.62 m of slotted pipe at the base and 2.95 to 10.57 m of solid riser pipe to grade based on installation depths of between 4.72 and 5.15 m for the wells installed in the clay and between 10.27 and 12.29 m for the deeper wells installed in the underlying till. All wells were completed at grade with a bolt-down steel road box protector.

Representative photographs of the completed groundwater monitoring wells are provided below. The well construction details are provided on the individual test hole logs presented in Appendix A and are also summarized in Table 1.

Photos 04 and 05: View of road box at TH23-01A (left) and view looking north at TH24-02A and TH24-02B (right).

2.5 WELL DEVELOPMENT

On September 25, 2024, EGE developed the newly installed monitoring wells (TH24-01A/B through TH24-04A/B). To complete the development, 16 mm diameter high-density polyethylene (HDPE) tubing connected to a submersible centrifugal Typhoon® pump was lowered to the bottom of each well and then each well was purged dry three times (shallow wells) or a minimum of five well volumes (deeper wells). Purging a minimum of three well volumes is standard field practice for slow recovery wells. The purged groundwater was discharged to the ground surface.

2.6 GROUNDWATER MONITORING

The groundwater monitoring wells were monitored for water level on September 19, 2024 prior to well development. Water level monitoring was completed using a Heron Model H.01L Interface Probe. Following well development, downhole transducers (level-loggers) were placed within each well to record the groundwater levels within the wells for approximately one to two weeks and during the subsequent single well response tests.

The water level data was collected from the transducers on September 27 and 30, 2024 and verified that the water levels at each well had stabilized. The monitoring results from September 19, 2024 are summarized in Table 1 and the individual transducer plots are provided in Appendix D.

2.7 SITE SURVEY

A level survey was completed on September 30, 2024 to establish the vertical positioning of the wells and included the top of the PVC well casing and the ground surface at each location. This information

was used to translate the ground and water level measurements to geodetic elevations and to establish piezometric elevations within the investigated area. The results from the vertical survey of the groundwater monitoring wells are summarized in Table 1 and are based on existing datum elevations proximate to each well installation.

2.8 SINGLE WELL RESPONSE TESTS

Single well hydraulic conductivity tests were completed at each of the eight groundwater monitoring wells to estimate the in-situ hydraulic conductivity of the geological medium intercepted by the well screens at each location. This included the four wells screened within the clay and the four wells screened within the underlying sandy silt till. The monitoring well locations are shown on Figure 02.

At each location, after measurement of the static water level, a rising head slug test was initiated by quickly removing a specified volume of water (via pumping) from the well. The rising water levels were then recorded automatically using a downhole transducer (level-logger).

At three of the four sandy silt till monitoring wells (TH24-01B, TH24-02B and TH24-03B), sufficient draw down could not be achieved by pumping and a falling head slug test was completed by quickly introducing a specified volume of water into the well and recording the falling water levels using the downhole transducer.

The results of the in-situ hydraulic conductivity testing were analyzed using specialty software designed to provide an estimated hydraulic conductivity for the geologic medium intercepted by the well screens. The results are provided in Appendix E.

In addition to the above hydraulic conductivity testing, the grain size distribution data for the samples from the upper silty clay, upper sandy silt till and lower sandy silt till were analyzed using the HydrogeosieveXL tool to estimate the hydraulic conductivity of each unit. The HydrogeosieveXL tool calculates a hydraulic conductivity from the grain size distribution curves and accounts for the characteristics of the porous medium (aquifer material) and temperature-dependent properties of the groundwater. The results from the HydrogeosieveXL tool are provided in Appendix F.

3.0 SUBSURFACE AND HYDROGEOLOGICAL CONDITIONS

3.1 SITE TOPOGRAPHY AND REGIONAL GEOLOGY

The topographic and LiDAR data provided in the preliminary design report [(1)] indicates the ground elevations range from a high of about 238 m above sea level (masl) at Oak Forest Crescent and Oxbow Bend Road to a low of about 236 masl along Augier Avenue.

The Bedrock Mineral Resources of Manitoba's Capital Region (Map GR2002-1-13) [(3)] indicates the Site falls within the Ordovician aged Stony Mountain Formation and the Gunn and Penitentiary Members. The Gunn Member consists of calcareous mudstone and fossiliferous, thin limestone beds. The Penitentiary Member consists of fossiliferous, argillaceous dolomite. The Stony Mountain Formation Gunton Member is found north of the Site and the Red River Formation Upper Fort Garry Member and Reston and Amaranth Formations are found south of the Site. The overburden thickness at the Site is shown between the range of 15 and 20 m [(3)]. A plot of the regional bedrock geology at the Site is provided as Plate 03 below.

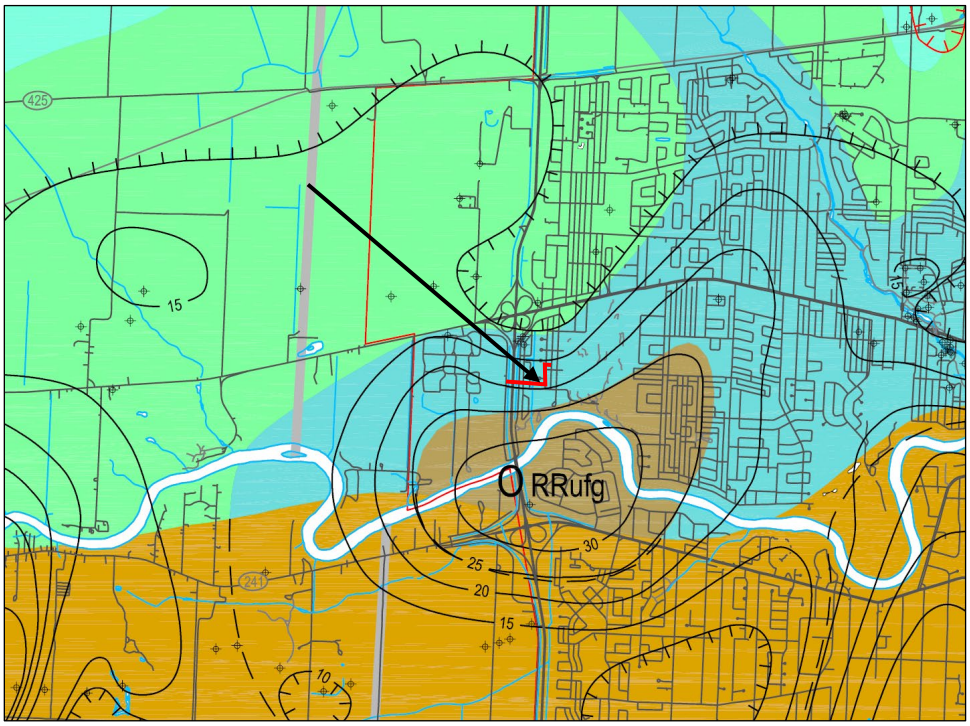


Plate 03: Regional bedrock geology at the Site
(Source: Bedrock Mineral Resources of Manitoba's Capital Region, Map GR2002-1-13).

The surficial geology at the Site consists of Quaternary offshore glaciolacustrine sediments comprised of clay, silt and minor sand that is 1 to 20 m in thickness with low relief, massive and laminated deposits. The material was deposited from suspension in the offshore, deep water of glacial Lake Agassiz and is commonly scoured and homogenized by icebergs [(4)].

3.2 SITE-SPECIFIC STRATIGRAPHY

The AECOM Geotechnical Investigation report included within the Preliminary Design [(1)] indicated the soil stratigraphy at the Site consisted of a thin layer of topsoil underlain by clay and sand and silt till, with some areas of surficial and/or near surface fill observed. Copies of the test holes completed as part of the AECOM Geotechnical Investigation are provided in Appendix A.

The soil stratigraphy observed during test drilling and installation of the eight groundwater monitoring wells for the current Hydrogeological Assessment was generally similar to the AECOM Geotechnical Investigation. This consisted of, in descending order, an upper zone of topsoil, clay fill, high plastic clay and silty clay overlying sandy silt till and limestone bedrock. A detailed description of the soils encountered at each location is provided on the test hole logs presented in Appendix A. The findings are also summarized below.

Topsoil was encountered at three of the nested test hole locations, TH24-02A/B, TH24-03A/B and TH2404A/B. The topsoil was relatively thin (0.1 to 0.3 m) and was underlain by 0.8 and 0.9 m of clay fill at TH24-02A/B and TH24-04A/B, respectively. The clay fill was brown to dark brown, contained some sand and gravel, and was firm and dry to moist.

Clay was encountered at surface at TH24-01A/B (0.0 to 3.7 m), below the clay fill at TH24-02A/B (0.9 to 6.7 m) and TH24-04A/B (1.2 to 1.5 m) and below the topsoil at TH24-03A/B (0.1 to 6.7 m). The clay was grey to brown to dark brown, contained trace to some silt, trace stones and trace to some sand, was dry to moist and stiff to very firm with a high plasticity, becoming firm to soft with depth. A layer of silty clay was encountered below the clay at TH24-01A/B (3.7 to 4.85 m). The silty clay was light grey to brown, contained some fine sand, and was damp and soft.

A sandy silt till was encountered below the silty clay at TH24-01A/B (4.85 m) and below the clay at TH24-02A/B (6.7 m), TH24-03A/B (6.7 m) and TH24-04A/B (5.5 m). The sandy silt till was grey, contained gravel and cobbles and occasional boulders, was poorly sorted and moist to wet. There was heavy seepage and sloughing noted from this layer and the upper portion of the unit was generally loose to very loose becoming denser with depth. The sandy silt till extended to auger refusal at TH24-01A/B (10.8 m) and to limestone bedrock at TH24-02A/B (13.0 m) and TH24-03A/B (11.4 m) and suspected limestone bedrock at TH24-04A/B (13.25 m).

The limestone bedrock was cream to light brown and mottled with minor vugs and minor weathering. Heavy seepage was also noted from the bedrock, which included a layer of broken rubble and/or cobbles near the top of the unit.

Representative photos of the recovered core from the sandy silt till near the bedrock surface and from the limestone bedrock are provided below.

Photo 06: Core recovered from the sandy silt till at TH24-03B.

Photo 07: Core recovered from the limestone bedrock at TH24-03B.

Photo 08: Core recovered from the limestone bedrock at TH24-02B.

Photo 09: Core recovered from the sandy silt till at TH24-01B.

Figure 04 is an updated cross-section of the pipe profile highlighting the previous clay-till interface, based on the AECOM test holes, and the till/bedrock interface based on the recent test drilling program.

3.3 HYDROGEOLOGY

3.3.1 Regional Bedrock Groundwater Elevations and Flow Direction

A search of the groundwater well records in the Manitoba Water Well Database [(5)] for the Site and adjoining properties identified no bedrock groundwater wells within the study area of the Site. The nearest well records are located about 400 to 600 m southwest of the Site and about 1 km southeast of the Site (Bedson Street).

A provincial bedrock groundwater monitoring well (G05MJ006) is located southeast of the Assiniboine River bridge crossing on PTH 100 and a second well (G05MJ009) is located north of Portage Avenue at Olson Way. Historical water elevation data from these two wells was obtained from Manitoba Environment and Climate Change and is provided in Appendix G. Static water level recordings from August 2024 indicates Well G05MJ006 had a water level of 232.402 m and Well G05MJ009 had a water level of 235.905 m. Based on the data from the provincial bedrock wells, the bedrock groundwater flow direction is to the south towards the Assiniboine River. The Assiniboine River is the discharge point for bedrock groundwater flow in this area; and therefore, the hydraulic gradient to the south is normal.

Based on the provincial bedrock groundwater monitoring well data, and a linear projection of the hydraulic gradient between the two provincial well sites, the estimated bedrock groundwater elevation beneath the Site is in the range of 232.5 to 234.0 m. Bedrock groundwater monitoring wells were not established as part of the current work program and as such direct measurements of the bedrock groundwater elevations beneath the Site are unavailable. It is noted that based on the invert elevations shown on Plate 01, the bedrock groundwater elevations are well above the base of the WWS trench excavation. As such a tendency for the bedrock groundwater to move towards the base of the trench exists, and the confining strength of the sandy silt till will be key to determining if basal heave and bedrock groundwater flow will occur.

3.3.2 Local Overburden Groundwater Elevations and Flow Direction

The measured groundwater elevations in the clay and underlying sandy silt till at the Site are provided in Table 1 and range from 233.88 m (TH24-01A) to 235.61 m (TH24-03A) in the clay and from 233.73 (TH24-01B) to 234.89 m (TH24-03B) in the sandy silt till. It is noted that the measured groundwater levels in the sandy silt till are similar to the estimated bedrock groundwater levels noted above. This suggests that the bedrock and till groundwater levels are in roughly static equilibrium. Site specific bedrock groundwater measurements would be required to confirm if this is correct or if a vertical hydraulic gradient exists between the bedrock and the sandy silt till.

The piezometric elevations, as of September 19, 2024 are highlighted on Figure 03. Due to the limited number of data points and the location of the data points it is not possible to accurately depict the piezometric surface across the Site. However, based on the recorded water level measurements the interpreted groundwater flow direction appears to be towards the north within both the upper clay (0.007 m/m) and the underlying sandy silt till (0.005 m/m). It is noted that the interpreted flow direction in the overburden is the opposite of the regional bedrock groundwater flow direction. This variation in flow direction may be due to variations in the stratigraphy or potentially the influence of other buried utilities in the area providing a drainage path for the movement of overburden groundwater.

The vertical groundwater gradient was calculated using the Vertical Gradient Calculator online tool provided by the United States Environmental Protection Agency (EPA Online Tools for Site Assessment Calculation) and was based on the water level measurements recorded at each of the nested well pairs on September 19, 2024. The results are summarized below:

- TH24-01A/TH24-01B - downward gradient at 0.026 m/m;
- TH24-02A/TH24-02B - downward gradient at 0.023 m/m;
- TH24-03A/TH24-03B - downward gradient at 0.133 m/m; and
- TH24-04A/TH24-04B - downward at gradient 0.098 m/m.

The average vertical gradient was downward at 0.070 m/m. The results indicate that the groundwater in the clay is “perched” above the groundwater in the till and not necessarily in direct hydraulic connection. A vertically downward gradient between the clay and till is common in the City of Winnipeg. As noted in Section 3.3.2 above, the groundwater elevations in the sandy silt till are similar to the projected groundwater elevation in the bedrock at the Site, which is also common in the City of Winnipeg, and also typically shows a slight downward gradient from the till into the bedrock followed by a predominantly horizontal gradient within the upper bedrock surface.

Figure 04 is an updated cross-section of the pipe profile highlighting the four nested well pairs installed as part of the current investigation, including the well screen intervals and the recorded water level measurements from September 19, 2024. The updated profile also includes the inferred till/bedrock interface based on the findings from the recent test drilling program. The clay-till interface is based on the test holes competed by AECOM in 2023 as part of the previous geotechnical investigation.

3.3.3 Grain Size Analyses

Three samples were submitted for grain size analysis to allow the grain size distribution to be documented and estimates of the hydraulic conductivity to be made. One sample was collected from the silty clay (TH24-01A at 3.7 to 4.0 m below ground), one sample was collected from the underlying upper sandy silt till (TH24-01A at 5.5 to 5.8 m below ground) and one sample was collected from the underlying lower sandy silt till (TH24-02B at 12.5 to 13.0 m below ground). The test hole locations for the three grain analyses are highlighted on Figure 02.

The results of the grain size analyses are provided in Appendix C. As noted, the silty clay sample contained 23.6% sand, 37.0% silt and 39.4% clay, the upper sandy silt till sample contained 37.4% sand, 52.6% silt and 10.0% clay, and the lower sandy silt till sample contained 16.6% gravel, 21.9% sand, 52.2% silt and 9.3% clay.

The grain size distribution data was analyzed using the empirical Hazen's Approximation (Freeze and Cherry, 1979) to estimate the hydraulic conductivities of each sample. The results of these analyses are provided in Appendix F and are summarized in Table 3.1 below, along with pertinent results from the single well response tests. The findings indicate a hydraulic conductivity of 1.1 x 10^{-9} m/s for the silty clay and hydraulic conductivities of 1.8 x 10^{-8} m/s for the upper sandy silt till and 6.0 x 10^{-8} m/s for the lower sandy silt till.

Table 3.1 - Summary of Hydraulic Conductivity Data

Well ID	Test Interval (mbgs)	Stratigraphic Unit(s)	Hydraulic Conductivity (m/s)	Analysis Performed	Test Method
TH24-01A	3.10 - 4.72	Clay/Silty Clay	2.1 x 10^{-8}	Bouwer-Rice (1976)	Slug Test (Rising or Falling Head)
TH24-02A	3.51 - 5.07	Clay	1.2 x 10^{-9}		
TH24-03A	3.71 - 5.15	Clay	1.9 x 10^{-8}		
TH24-04A	3.54 - 5.04	Clay	2.1 x 10^{-8}		
TH24-01B	9.27 - 10.78	Sandy Silt Till	1.1 x 10^{-4}		
TH24-02B	8.79 - 10.27	Sandy Silt Till	9.2 x 10^{-5}		
TH24-03B	9.19 - 10.72	Sandy Silt Till	1.3 x 10^{-5}		
TH24-04B	10.79 - 12.29	Sandy Silt Till	8.7 x 10^{-6}		
G1 (TH24-01A)	3.7 - 4.0	Silty Clay	1.1 x 10^{-9}	Hazen (Freeze and Cherry, 1979)	Grain Size Analysis
G2 (TH24-01A)	5.5 - 5.8	Sandy Silt Till	1.8 x 10^{-8}		
C11 (TH24-02B)	12.5 - 13.0	Sandy Silt Till	6.0 x 10^{-8}		

The calculated hydraulic conductivity based on the grain size analysis for the sample from the silty clay is comparable to the in-situ values from the four monitoring wells installed in the clay, which as shown in Table 3.1 below ranged from 1.2 x 10^{-9} to 2.1 x 10^{-8} m/s. However, the calculated hydraulic conductivities based on the grain size analyses for the samples from the upper and lower sandy silt till are considerably lower than expected in comparison to the in-situ values from the four monitoring wells installed in the lower sandy silt till, which as shown in Table 3.1 above ranged from 8.7 x 10^{-6} to 1.1 x 10^{-4} m/s. It is likely that the grab samples were not fully representative of the loose and coarse nature of the underlying sandy silt till, and that the in-situ values are more reflective of the actual hydraulic conductivities.

3.3.4 Single Well Response Tests

As discussed in Section 2.8, single well response tests (rising or falling head slug tests) were completed at the eight groundwater monitoring wells installed at the Site to estimate the in-situ hydraulic conductivity of the geological medium intercepted by the well screens. The data was analyzed using the Bouwer-Rice (1976) solution method and the results of these analyses are provided in Appendix E.

The findings are also summarized in Table 3.1 above, along with the hydraulic conductivity values calculated from the three samples submitted for grain size analysis, as discussed in section 3.3.3 above. The test interval for each location (well screen interval or sample depth) is also provided along with the stratigraphic unit tested, analysis performed and test method.

As noted in Table 3.1 above, the findings indicate in-situ hydraulic conductivities of 1.2 x 10^{-9} to 2.1 x 10^{-8} m/s for the four monitoring wells installed within the clay (or clay/silty clay in the case of well TH24-01A) and in-situ hydraulic conductivities of 8.7 x 10^{-6} to 1.1 x 10^{-4} m/s for the four monitoring wells installed within the sandy silt till.

The in-situ hydraulic conductivity values for the monitoring wells installed within the clay or clay/silty clay were relatively consistent across the Site and are generally reflective of the expected hydraulic conductivities for the upper clay overburden in the City of Winnipeg. As discussed in Section 3.3.3 above, the in-situ hydraulic conductivities were also comparable with the hydraulic conductivity value (1.1 x 10^{-9} m/s) calculated from the grain size analysis on the grab sample collected from the silty clay at TH24-01A.

As noted in Table 3.1 above, there was considerably more variability in the in-situ hydraulic conductivity values for the monitoring wells installed within the underlying sandy silt till across the Site and this is likely due to the non-homogeneity of this stratigraphic unit. However, given the loose and coarse nature of the sandy silt till encountered at the Site, the calculated in-situ hydraulic conductivity values are not unexpected. As discussed in Section 3.3.3 above, the in-situ hydraulic conductivities were not comparable with the hydraulic conductivity values calculated from the grain size analyses on the grab samples collected from the upper sandy silt till at TH24-01A (1.8 x 10^{-8} m/s) or the lower sandy silt till at TH24-02B (6.0 x 10^{-8} m/s). As discussed earlier, it is likely that the grab samples were not fully representative of the loose and coarse nature of the underlying sandy silt till, and that the in-situ values are more reflective of the actual hydraulic conductivities.

3.4 HYDROLOGY

The nearest permanent water feature is the Assiniboine River, which is located approximately 275 to 425 m south and southeast of the WWS alignment. The closest surface water monitoring station is Station MJ-001 located at Headingley. Based on the last 10 years of record for that station, surface water levels vary from a low of approximately 231.0 m to a flood high of between 233.0 and 234.0 m.

At bedrock groundwater monitoring station MJ-006 near the Assiniboine River and the Perimeter, groundwater levels vary from a low of approximately 230.0 m in 2015 to a high of approximately 232.75 m in 2022. The variation in groundwater levels over time is roughly consistent with the variation in surface water levels over time, which supports the previous interpretation that the bedrock groundwater is in hydraulic connection with the surface water and that the river is the discharge point for the bedrock groundwater.

Hydrograph plots from the Assiniboine River surface water and the provincial bedrock groundwater monitoring stations are provided in Appendix G.

4.0 HYDROGEOLOGICAL ASSESSMENT

From a hydrogeologic perspective relative to the potential for issues with groundwater during construction at the Site, the stratigraphy can be subdivided into four hydrogeologic units as follows:

- An upper clay/silty clay unit extending from near grade to a depth of 4.9 to 8.5 m;
- A loose to very loose sandy silt till directly below the clay/silty clay that is at least 1 to 2 m thick;
- A transition from a loose to very loose sandy silt till to a dense sandy silt till with depth that extends downwards to the bedrock surface; and
- Limestone bedrock that was encountered at a depth of 13.0 m at test hole TH24-02B and at a depth of 11.4 m at TH24-03B and suspected at a depth of 13.2 m at TH24-04B.

The following summarizes the expected hydrogeologic properties of each unit.

4.1 UPPER CLAY/SILTY CLAY

The upper clay/silty clay unit extends to a depth of 4.9 to 8.5 m. As per the test hole logs, TH23-01 through TH23-07 from the AECOM Geotechnical Report [(2)], and the test hole logs from the current investigation, TH24-01A/B through TH24-04A/B, this sequence consists primarily of clay with some silt inclusions, and locally silty clay.

The estimated hydraulic conductivity is in the range of 1.2×10^{-9} to 2.1×10^{-8} m/s. Groundwater within the clay was measured in the monitoring wells (TH24-01A through TH24-04A) at a depth of 0.570 to 2.904 m below grade (elevation equivalent of 233.88 to 235.61 m). A downward hydraulic gradient towards the underlying till was measured at all four locations, indicating the groundwater in the clay is perched above the groundwater in the underlying till.

The groundwater conditions within the clay can be considered typical of the City of Winnipeg. There will be some seepage from the clay during construction and this can typically be managed using sump pumps at the base of the trench excavation. None of the test holes encountered distinct layers or lenses of silt or sand within the clay sequence that would contribute additional groundwater seepage. Nevertheless, small lenses or layers of silt or sand may still be encountered. If so, the additional seepage from the upper clay sequence should still be manageable using sump pumps at the base of the trench excavation.

4.2 UPPER SANDY SILT TILL

As per the test hole logs, TH23-01 through TH23-07 from the AECOM Geotechnical Report [(2)], and the test hole logs from the current investigation, TH24-01A/B through TH24-04A/B, the upper 1 to 2 m (at least) of the sandy silt till is described as being loose to very loose, with heavy seepage and sloughing.

Groundwater within the sandy silt till was measured in the monitoring wells (TH24-01B through TH24-04B) at a depth of 1.400 to 3.055 m below grade (elevation equivalent of 233.73 to 234.89 m). As per the test hole logs, the monitoring wells were generally screened below the upper loose to very loose portion of the till, and as per Figure 04, the groundwater levels are 2 to 6 m (+/-) above the top of the till layer. Given the reported loose to very loose conditions near the top of the till layer and the artesian groundwater pressures, groundwater seepage from this layer is a concern at those locations where the base of the trench excavation may extend into the till, as is the potential for issues with side wall stability within the trench in the upper till.

The groundwater monitoring wells in the sandy silt till were installed at depths of approximately 2 to 5 m below the top of the till. The in-situ hydraulic conductivity values from these monitoring wells were noted to vary from 8.7×10^{-6} to 1.1×10^{-4} m/s. However, it is noted that the monitoring wells used to estimate the hydraulic conductivity of the till are all screened below the upper loose to very loose portion of the sandy silt till (i.e.: within the lower denser portion of the till). As such, the estimated hydraulic conductivities may not be fully representative of the hydraulic conductivity of the upper loose to very loose portion of the till. On this basis, depth specific testing of the upper 1 to 2 m thick portion of the loose to very loose till is recommended to better estimate the hydraulic conductivity within this portion of the till, and subsequently, the potential seepage rates that may be encountered.

4.3 LOWER SANDY SILT TILL

The lower portion of the sandy silt till down to the bedrock was noted to be dense to very dense. As noted above, in-situ hydraulic conductivity estimates for the monitoring wells installed in this portion of the sandy silt till were noted to vary from 8.7×10^{-6} to 1.1×10^{-4} m/s.

The analytical solution to calculate the potential groundwater influx into a trench, "Steady Groundwater Influx to Open Excavations Calculator" [(6)], was used to obtain the conceptual estimated range of groundwater influx based on the calculated in-situ hydraulic conductivities. The estimated influx should be considered an approximation for scoping level purposes only, as the actual influxes that will be encountered are strongly dependant on the hydraulic conductivity, which as noted varies across the Site.

The following assumptions have been used in this estimate:

- Steady state conditions are assumed (initial influxes of groundwater will be higher, but will typically decline as the drawdown cone develops and steady state conditions are approached);
- An aquifer thickness of 2.0 m;
- A constant head of 3.0 m at a constant head boundary located 25 m from the trench excavation; and
- A constant head at the edge of the trench of 0.0 m.

Based on the above assumptions, the following are the estimated groundwater influxes from the sandy silt till per 100 m of trench excavation for the upper and lower range of estimated in-situ hydraulic conductivities:

- 1.1×10^{-4} m/s (as measured at TH24-01B) - estimated influx of 5.8 L/s; and
- 8.7×10^{-6} m/s (as measured at TH24-04B) - estimated influx of 0.4 L/s.

4.4 LIMESTONE BEDROCK

At test holes TH24-02B and TH24-03B, the limestone bedrock was encountered at depths of 13.0 and 11.4 m, respectively and is overlain by approximately 6.5 m of sandy silt till at TH24-02B and 6.0 m of clay/sandy silt till at TH24-03B, based on the distance from the pipe invert to the top of the bedrock surface.

The estimated groundwater elevation in the bedrock, based on the provincial bedrock groundwater level data, is in the range of 232.5 to 234.0 m, and similar to the groundwater elevations in the till. As such, the groundwater levels are approximately 2 to 6 m (+/-) above the top of the till, and an upward artesian pressure exists. Assuming an artesian pressure of between 2 and 6 m, an average till thickness of 6.25 m, a unit weight for the till of 17 kN/m^3, and a unit weight of water of 9.81 kN/m^3, the estimated factor of safety against basal heave (blow-out) varies from 1.8 to 5.4.

Based on published information [7], the transmissivity of the bedrock aquifer in the area of the Site is estimated to be in the relatively high range of 1.4×10^{-2} to 2.2×10^{-2} m^2/s. Assuming this estimated range of transmissivity is valid for the Site, if basal heave does occur, the influx of groundwater to the excavation could be significant. In such a scenario, pumping well(s) would need to be installed in the bedrock to depressurize the bedrock aquifer and stop the flow.

4.5 PRELIMINARY GROUNDWATER CONTROL RECOMMENDATIONS

Based on the available information, the following are the preliminary recommendations for groundwater control assuming open cut methods are used (directional drilling methods would likely only require groundwater control at specific excavation locations):

- Groundwater flow within the clay overburden is expected to be minor and typical for excavations in clay in the City of Winnipeg. The standard construction use of sump pumps at the base of the trench excavation should suffice.
- Groundwater flow within the upper loose to very loose sandy silt till could be significant and further investigation of that specific layer is warranted to better quantify the hydraulic conductivity and the potential inflows. It is anticipated that this portion of the till will need to be depressurized using a sand point type system or equivalent.
- It is understood that the base of the trench excavation may locally be within the upper loose to very loose till. The underlying till is also under artesian pressure; and therefore, some upward movement of groundwater into the excavation may occur. The sand point type system

recommended above should extend downwards into the underlying denser till so that this portion of the unit is also depressurized and upward flow is limited.

- The available information indicates that there is sufficient till thickness beneath the proposed trench excavation to likely prevent basal heave due to the artesian pressures in the bedrock. As such, there is no current need to depressurize the bedrock aquifer. However, if basal heave does occur and bedrock groundwater does flow into the trench excavation, the solution will be to install pumping well(s) in the bedrock to depressurize the bedrock aquifer.

5.0 CLOSURE

This report has been prepared by EGE for the exclusive use of AECOM and the City of Winnipeg (the Client) for the specific application described in Section 1.0. The information and data contained herein are to be treated as confidential and are intended for the sole use of the client and may not be relied upon by any other persons or entity without the express written consent of the Client.

Any use of this report by a third party or any reliance on decisions made based on it, are the responsibility of such third parties. EGE does not accept any responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this report.

The work has been conducted in accordance with generally accepted engineering practices. Although every effort has been made to confirm that the information and data presented is factual, complete and accurate, EGE makes no guarantees or warranties whatsoever, whether expressed or implied, with respect to such information or data.

The findings presented in this report are based on the conditions which existed on the Site at the time of the work, in the area of the work and in respect of the media which were assessed. The Client, and any other parties using this report with the express written consent of the Client, should acknowledge that conditions affecting the Site can vary. EGE cannot warrant against undiscovered liabilities.

Should additional information become available, EGE requests that this information be brought to our attention so that we may re-evaluate the findings and conclusions of this report.

6.0 REFERENCES

1. AECOM Canada Ltd., St. Charles Wastewater Sewer District Preliminary Design - Final, February 2024.

2. AECOM Canada Ltd., St. Charles Wastewater Sewer District Detailed Design and Contract Administration Services - Revision No. 2, Geotechnical Report, December 3, 2024.

3. Bezys, R.K., Bamburak, J.D. and Conley, G.G., 2002: Bedrock Mineral Resources of Manitoba's Capital Region; Manitoba Industry, Trade and Mines, Manitoba Geological Survey, Geoscientific Report GR2002-1, [1 v.] plus 16 maps at 1:50,000 scale.

4. Manitoba Science Technology, Energy and Mines, Manitoba Geological Survey, Surficial Geology Compilation Map Series of Manitoba, Second Edition, 2007; Surficial Geology Compilation Map Series SC-CMS, 1 DVD, scale 1:250,000, 1:500:000, 1:1,000,000.

5. Manitoba Water Stewardship, Groundwater Management Section, GWDrill, 2018.

6. Nevill, C. and Wang, X., S.S. Papadopulus & Associates Inc., Steady Groundwater Inflows to Open Excavation. April 27, 2014.

7. Baracos, Shields, Kjartanson, 1983. Geological Engineering Maps and Reports for Urban Development of Winnipeg. University of Manitoba.

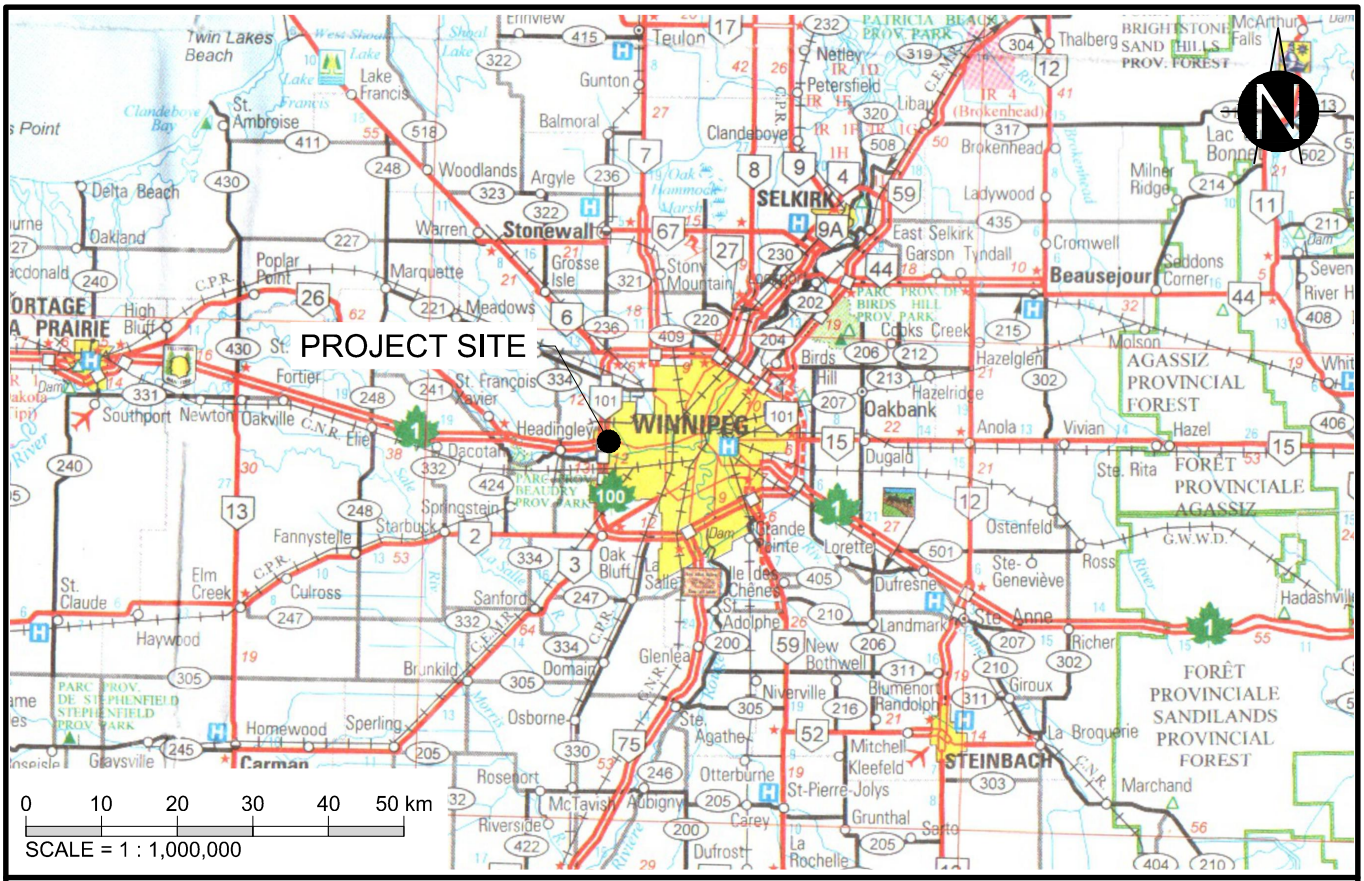
TABLES

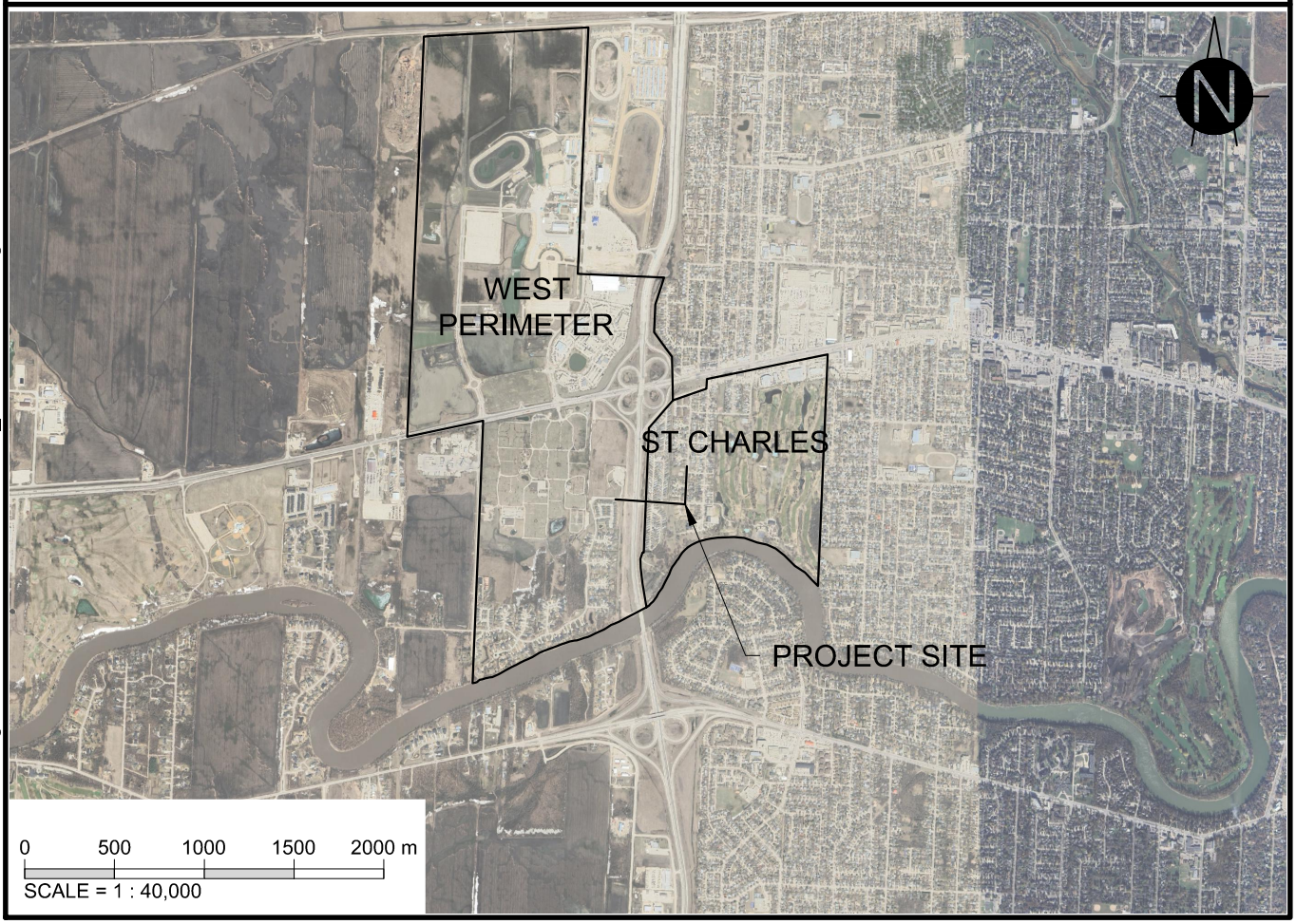
Table 1 - Groundwater Monitoring Well Construction Details and Water Levels
Hydrogeological Assessment
St. Charles Wastewater Sewer District - Winnipeg, MB

Well ID	UTM (14U)		Ground Surface	Top of Casing	Well Stick-up	Well Depth	Well Depth	Screen Length	Riser Length	Water Level 24-09-19	Water Elevation
	Northing	Easting	(masl)	(masl)	(m, bgs)	(m, btoc)	(m, bgs)	(m)	(m)	(m, btoc)	(masl)
TH24-01A	5526240.2	621581.8	236.93	236.78	-0.15	4.57	4.72	1.62	2.95	2.904	233.88
TH24-01B	5526235.7	621581.8	236.90	236.78	-0.12	10.66	10.78	1.51	9.15	3.055	233.73
TH24-02A	5526160.8	620557.4	237.48	237.31	-0.17	4.90	5.07	1.56	3.34	2.625	234.69
TH24-02B	5526159.1	620557.0	237.46	237.38	-0.08	10.19	10.27	1.48	8.71	2.810	234.57
TH24-03A	5526054.6	620430.7	236.30	236.18	-0.12	5.03	5.15	1.44	3.59	0.570	235.61
TH24-03B	5526055.1	620428.9	236.36	236.29	-0.075	10.65	10.72	1.53	9.12	1.400	234.89
TH24-04A	5526071.3	620234.8	236.70	236.58	-0.12	4.92	5.04	1.50	3.42	1.030	235.55
TH24-04B	5526069.8	620234.8	236.68	236.46	-0.22	12.07	12.29	1.50	10.57	1.615	234.85

FIGURES

8.5" x 11"





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EGE ENGINEERING

AECOM Canada Ltd.

Hydrogeological Assessment

St. Charles Wastewater Sewer District - Winnipeg, MB

Location Plan

Figure 01

11" x 17"

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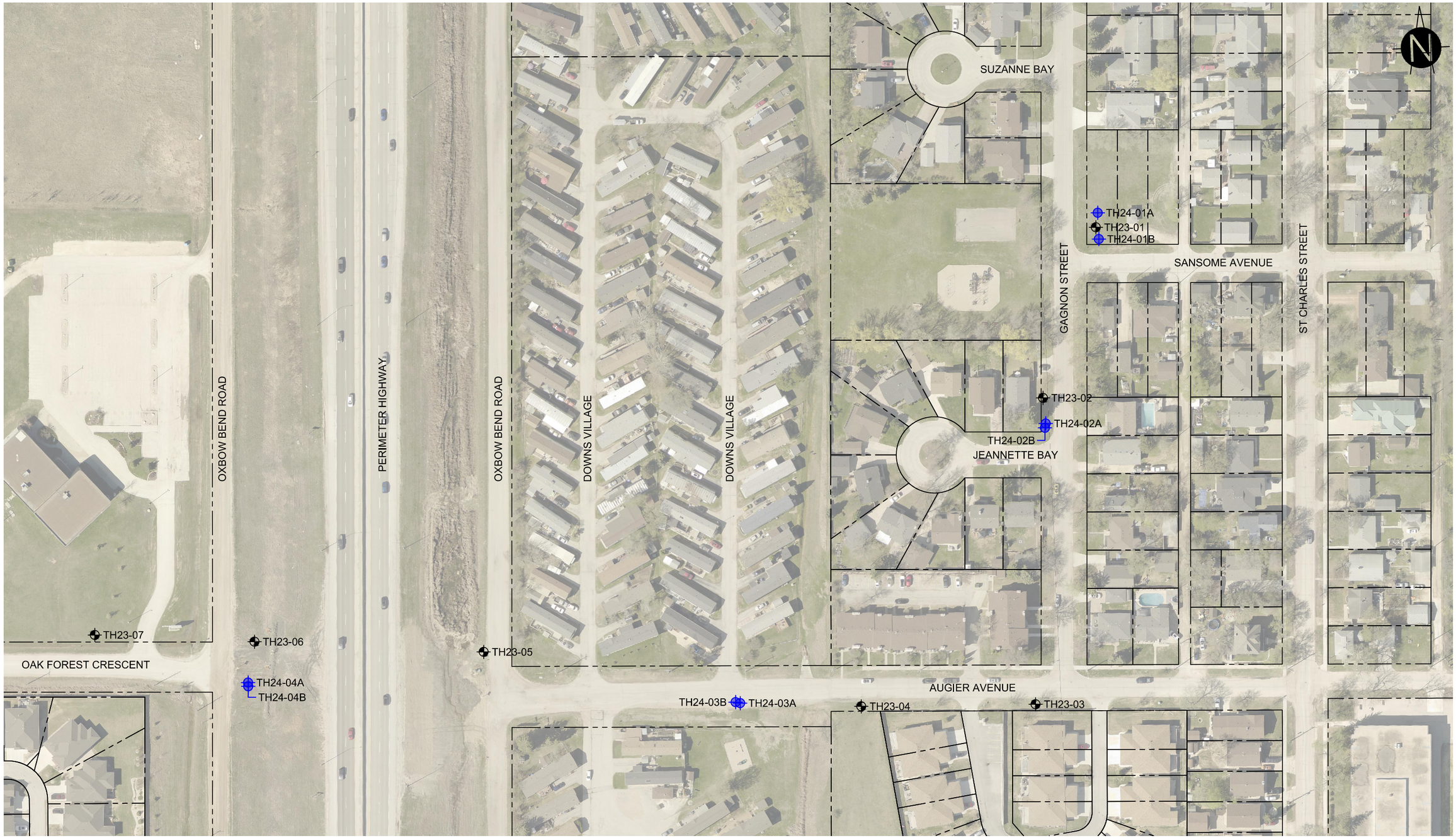

AECOM Canada Ltd.

Hydrogeological Assessment

St. Charles Wastewater Sewer District - Winnipeg, MB

Site Plan

Figure 02

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11" x 17"

EGE FILE NAME: Fig 03 2024-12-04 St Charles WW 0_A 0013-056-00.dwg

OXBOW BEND ROAD

PERIMETER HIGHWAY

OXBOW BEND ROAD

DOWNS VILLAGE

DOWNS VILLAGE

SUZANNE BAY

GAGNON STREET

TH24-01A
(233.88)

TH23-01

TH24-01B
(233.73)

SANSOME AVENUE

ST CHARLES STREET

TH23-02

TH24-02A
(234.69)

TH24-02B
(234.57)

JEANNETTE BAY

TH23-07

TH23-06

TH23-05

OAK FOREST CRESCENT

TH24-04A
(235.55)

TH24-04B
(234.85)

AUGIER AVENUE

TH24-03B
(234.89)

TH24-03A
(235.61)

TH23-04

TH23-03

N

0 25 50 75 m

SCALE = 1 : 1,500

LEGEND:

MONITORING WELL (EGE, 2024)

TEST HOLE (AECOM, 2023)

(233.88) GROUNDWATER ELEVATION (masi)

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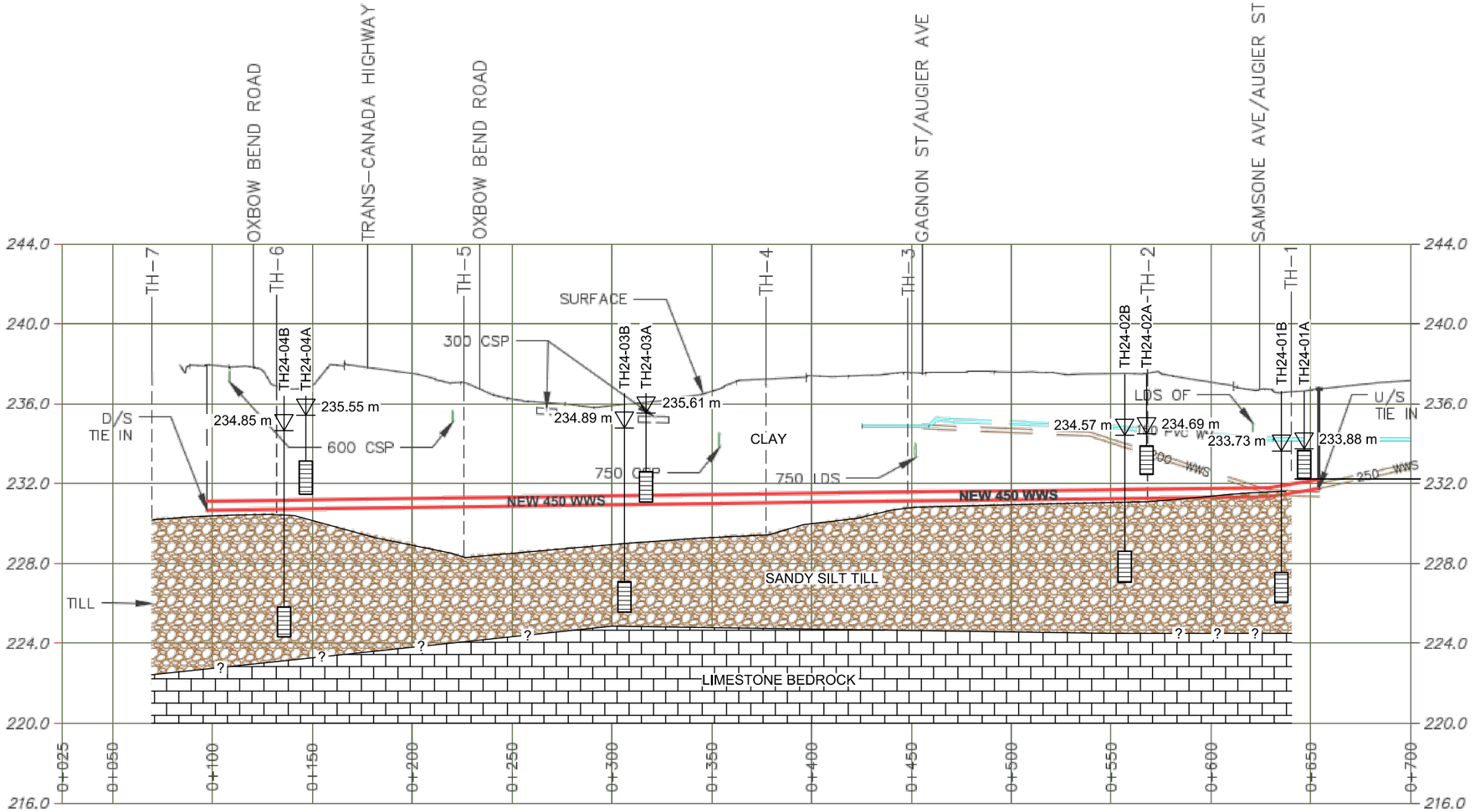
Hydrogeological Assessment

St. Charles Wastewater Sewer District - Winnipeg, MB

Piezometric Elevations (September 19, 2024)

Figure 03



LEGEND:

234.85 ▽ PIEZOMETRIC SURFACE (SEPTEMBER 19, 2024)

NOTE:

THE PLOTTED LOCATIONS FOR TH24-01A THROUGH TH24-04A HAVE BEEN ADJUSTED FOR VISUAL DEPICTION OF THE WELL SCREEN INTERVALS AND WATER LEVELS. THE ACTUAL LOCATIONS ARE ADJACENT TO TH24-01B THROUGH TH24-04B AND AS SHOWN ON FIGURE 02.

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St. Charles Wastewater Sewer District - Winnipeg, MB

Cross Section of Pipe Profile

Figure 04

APPENDIX A

TEST HOLE LOGS

(AECOM 2024 AND EGE 2024)

TEST HOLE: TH24-01A

Client: AECOM	**Project:** St. Charles Wastewater Sewer District - Hydrogeological Assessment	
Project Location: NE of Sansome Rd & Gagnon St	**Project No:** 0013-056-00	**Page:** 1 of 1
Test Hole Location: 2.5 m north of TH23-01, UTM 621581.8 E, 5526240.2 N		**Elev.:** 236.93 m

SUBSURFACE PROFILE / SAMPLE / TEST DATA

Depth (m)	Soil Symbol	Soil Description	Monitoring Well	Sample No.	Sample Type	% Recovery	Combustible Organic Vapours (ppm) 1–1000	Laboratory Analyses	Elevation (m)
0		**Ground Surface**							236.9
0		CLAY - grey - some silt, trace topsoil to 0.1 m - dry to damp, firm						Well Collar Elevation = 236.78 m	
1		- brown - some silt, trace stones - damp, stiff to firm at 1.5 m							236.0
2									235.0
3								WL = 233.88 m on 24/09/19	234.0
4		SILTY CLAY - light grey/brown - some fine sand - damp, soft		G1				Soil sample submitted for Grain Size Analysis	233.0
5		SANDY SILT (Till) - light brown/grey - with gravel and cobbles - occasional boulders - poorly sorted - loose, wet - heavy seepage - becoming denser with depth		G2				Soil sample submitted for Grain Size Analysis	232.0
6		End of Test Hole at 6.1 m in sandy silt till. Power auger refusal. Seepage and sloughing below 4.9 m. Monitoring well installed.							231.0
7									230.0

Monitoring Well: 1.62 m slotted / 2.95 m solid 50 mm dia. PVC pipe; Bentonite; Sand; Bentonite; Slough

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Ph: (204) 975-9433; contact@egeengineering.ca

Drilling Contractor: Maple Leaf Drilling	
Drilling Method: B37X Track Mounted Rig, 125 mm SSA	
Logged By: A. Passalis	**Checked By:** L. Bielus
Start Date: 2024/09/03	**Completion:** 2024/09/03

TEST HOLE: TH24-01B

Client: AECOM	**Project:** St. Charles Wastewater Sewer District - Hydrogeological Assessment	
Project Location: NE of Sansome Rd & Gagnon St	**Project No:** 0013-056-00	**Page:** 1 of 2
Test Hole Location: 2.0 m south of TH23-01, UTM 621581.8 E, 5526235.7 N		**Elev.:** 236.90 m

SUBSURFACE PROFILE

Depth (m)	Soil Symbol	Soil Description
0		**Ground Surface**
		CLAY - grey - some silt, trace topsoil to 0.1 m - dry to damp, firm
1		- brown - some silt, trace stones - damp, stiff to firm at 1.5 m
2		
3		
4		SILTY CLAY - light grey/brown - some fine sand - damp, soft
5		SANDY SILT (Till) - light brown/grey - with gravel and cobbles - occasional boulders - poorly sorted - loose, wet - heavy seepage - becoming denser with depth
6		
7		

Monitoring Well: 1.51 m slotted / 9.15 m solid 50 mm dia. PVC pipe; Bentonite

SAMPLE

Sample No.	Sample Type	% Recovery
C12		82

TEST DATA

Combustible Organic Vapours (ppm) — 1 to 1000

Laboratory Analyses

Well Collar Elevation = 236.78 m

WL = 233.73 on 24/09/19

Elevation (m)
236.9
236.0
235.0
234.0
233.0
232.0
231.0
230.0

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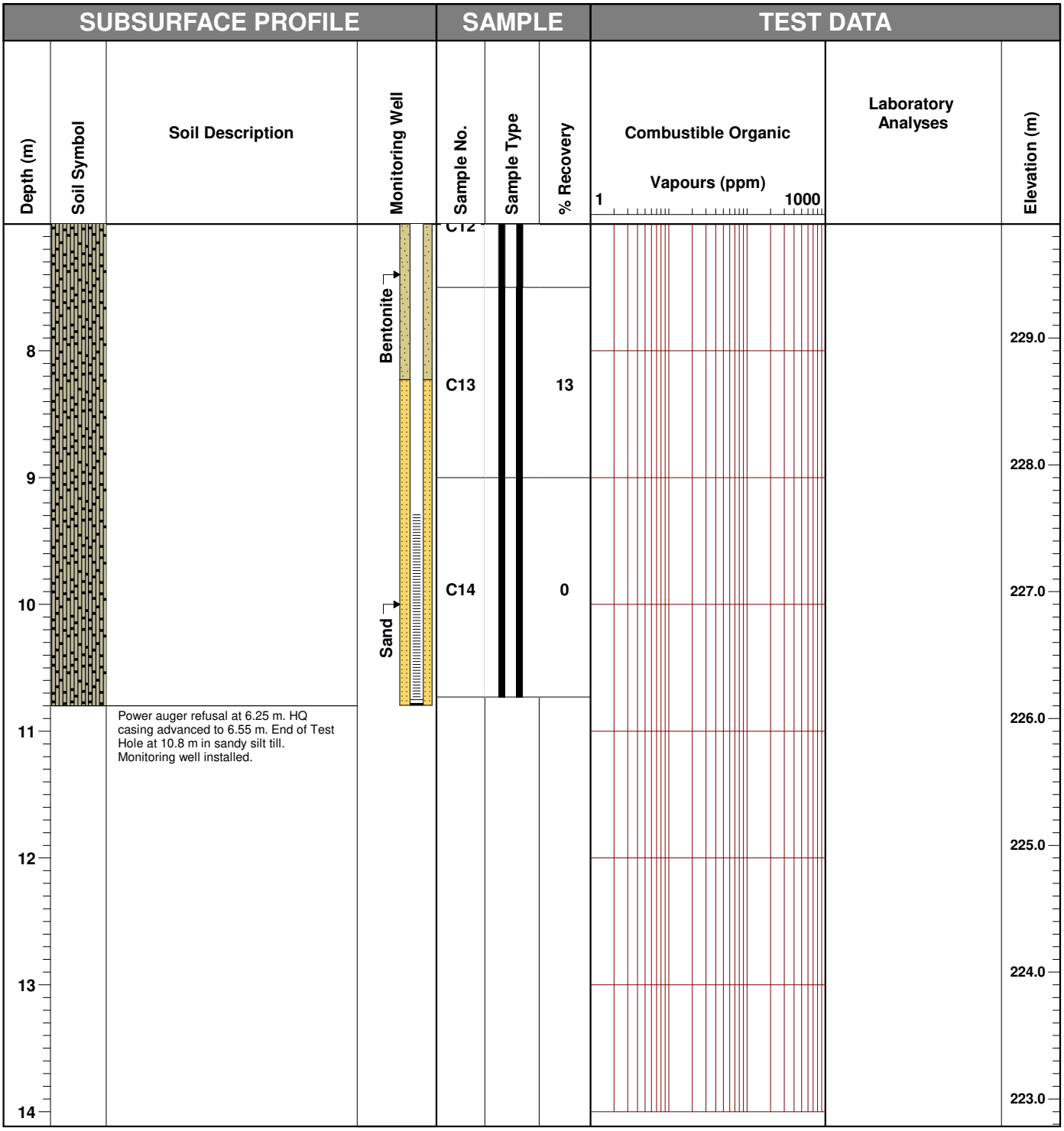
Drilling Contractor: Maple Leaf Drilling	
Drilling Method: B37X Track Mounted Rig, HQ Core	
Logged By: A. Passalis	**Checked By:** L. Bielus
Start Date: 2024/09/04	**Completion:** 2024/09/04

TEST HOLE: TH24-01B

Client: AECOM	**Project:** St. Charles Wastewater Sewer District - Hydrogeological Assessment	
Project Location: NE of Sansome Rd & Gagnon St	**Project No:** 0013-056-00	**Page:** 2 of 2
Test Hole Location: 2.0 m south of TH23-01, UTM 621581.8 E, 5526235.7 N		**Elev.:** 236.90 m



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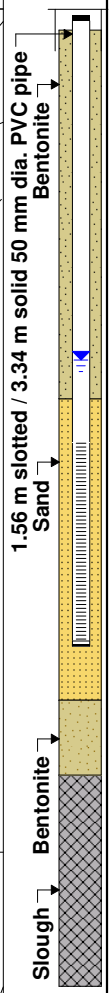
Drilling Contractor: Maple Leaf Drilling	
Drilling Method: B37X Track Mounted Rig, HQ Core	
Logged By: A. Passalis	**Checked By:** L. Bielus
Start Date: 2024/09/04	**Completion:** 2024/09/04

TEST HOLE: TH24-02A

Client: AECOM	**Project:** St. Charles Wastewater Sewer District - Hydrogeological Assessment	
Project Location: NW of Gagnon St & Jeannette Bay	**Project No:** 0013-056-00	**Page:** 1 of 1
Test Hole Location: 0.4 m W of Gagnon St., 6.5 m N of Jeannette Bay, UTM 14U 620557.4 E, 5526160.8 N		**Elev.:** 237.48 m

SUBSURFACE PROFILE

Depth (m)	Soil Symbol	Soil Description
0		**Ground Surface**
		TOPSOIL
		CLAY (Fill) - dark brown - some sand and gravel - dry
1		CLAY - some silt - stiff, damp - high plasticity
		- brown - trace silt - stiff, damp
2		
3		
4		
5		
6		
7		SANDY SILT (Till) - grey - some gravel and cobbles - some boulders up to 0.3 m - trace clay - poorly sorted - moist to wet - heavy seepage - becoming denser with depth
8		End of Test Hole at 7.77 m in silt till. Power auger refusal. Trace seepage and sloughing below 6.7 m. Monitoring well installed.
9		



SAMPLE

Sample No.	Sample Type	% Recovery

TEST DATA

Combustible Organic Vapours (ppm) 1 – 1000	Laboratory Analyses	Elevation (m)
	Well Collar Elevation = 237.31 m	237.5
		237.0
		236.0
		235.0
	WL = 234.69 m on 24/09/19	
		234.0
		233.0
		232.0
		231.0
		230.0
		229.0

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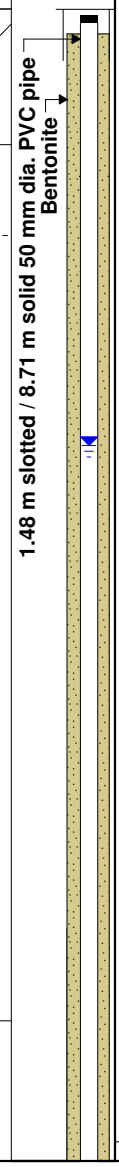
Drilling Contractor: Maple Leaf Drilling	
Drilling Method: B37X Track Mounted Rig, 125 mm SSA	
Logged By: A. Passalis	**Checked By:** L. Bielus
Start Date: 2024/09/03	**Completion:** 2024/09/03

TEST HOLE: TH24-02B

Client: AECOM	**Project:** St. Charles Wastewater Sewer District - Hydrogeological Assessment	
Project Location: NW of Gagnon St & Jeannette Bay	**Project No:** 0013-056-00	**Page:** 1 of 2
Test Hole Location: 0.4 m W of Gagnon St., 4.75 m N of Jeannette Bay, UTM 14U 620557.0 E, 5526159.1 N		**Elev.:** 237.46 m

SUBSURFACE PROFILE

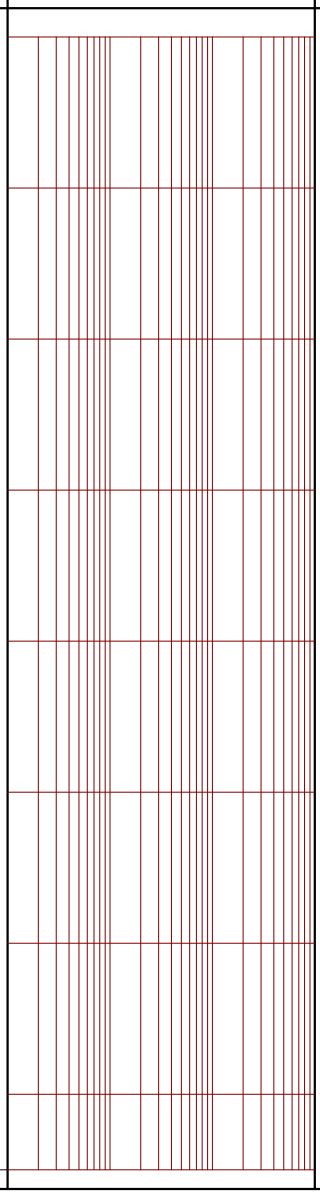
Depth (m)	Soil Symbol	Soil Description
0		**Ground Surface**
		TOPSOIL
		CLAY (Fill) - dark brown - some sand and gravel - dry
1		CLAY - some silt - stiff, damp - high plasticity
		- brown - trace silt - stiff, damp
2		
3		
4		
5		
6		
7		



SAMPLE

Sample No.	Sample Type	% Recovery

TEST DATA



Laboratory Analyses

Well Collar Elevation = 237.38 m

WL = 234.57 m

Elevation (m)
237.5
237.0
236.0
235.0
234.0
233.0
232.0
231.0
230.0

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Drilling Method: B37X Track Mounted Rig, HQ Core	
Logged By: A. Passalis	**Checked By:** L. Bielus
Start Date: 2024/09/04	**Completion:** 2024/09/04

TEST HOLE: TH24-02B

Client: AECOM	**Project:** St. Charles Wastewater Sewer District - Hydrogeological Assessment	
Project Location: NW of Gagnon St & Jeannette Bay	**Project No:** 0013-056-00	**Page:** 2 of 2
Test Hole Location: 0.4 m W of Gagnon St., 4.75 m N of Jeannette Bay, UTM 14U 620557.0 E, 5526159.1 N		**Elev.:** 237.46 m

SUBSURFACE PROFILE / SAMPLE / TEST DATA

Depth (m)	Soil Symbol	Soil Description	Monitoring Well	Sample No.	Sample Type	% Recovery	Combustible Organic Vapours (ppm) 1–1000	Laboratory Analyses	Elevation (m)
8		SANDY SILT (Till) - grey - some gravel and cobbles - some boulders up to 0.3 m - trace clay - poorly sorted - moist to wet - heavy seepage - becoming denser with depth	Bentonite	C8		53			229.0
9			Sand						228.0
10				C9		38			227.0
11				C10		0			226.0
12			Bentonite						225.0
13		BEDROCK (Limestone) - cream to light brown - mottled, minor vugs up to 10 mm - minor weathering - heavy seepage		C11		62		Soil sample submitted for Grain Size Analysis	224.0
14		Power auger refusal at 7.62 m. HQ casing advanced to 7.62 m..End of Test Hole at 13.8 m in limestone bedrock. Monitoring well installed.							223.0
15									

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Drilling Contractor: Maple Leaf Drilling	
Drilling Method: B37X Track Mounted Rig, HQ Core	
Logged By: A. Passalis	**Checked By:** L. Bielus
Start Date: 2024/09/04	**Completion:** 2024/09/04

TEST HOLE: TH24-03A

Client: AECOM	**Project:** St. Charles Wastewater Sewer District - Hydrogeological Assessment	
Project Location: S of Augier St	**Project No:** 0013-056-00	**Page:** 1 of 1
Test Hole Location: 4.3 m S of Augier St., S of power pole, UTM 14U 620430.7 E, 5526054.6 N		**Elev.:** 236.30 m

SUBSURFACE PROFILE / SAMPLE / TEST DATA

Depth (m)	Soil Symbol	Soil Description	Monitoring Well	Sample No.	Sample Type	% Recovery	Combustible Organic Vapours (ppm) 1–1000	Laboratory Analyses	Elevation (m)
0		**Ground Surface**							236.3
0		TOPSOIL						Well Collar Elevation = 236.18 m	
		CLAY - dark brown - trace stones, trace silt - stiff to very firm, damp						WL = 235.61 m on 24/09/19	
1									235.0
		- brown - trace silt - very firm to firm, damp to moist - high plasticiity							
2									234.0
3									233.0
4									232.0
5									231.0
6									230.0
7		SANDY SILT (Till) - grey - with gravel and cobbles - some boulders, trace clay - poorly sorted - loose, wet - heavy seepage - becoming denser with depth							229.0
8		End of Test Hole at 7.32 m in sandy silt till. Power auger refusal.. Monitoring well installed.							228.0

Monitoring Well: Bentonite; 1.44 m slotted / 3.59 m solid 50 mm dia. PVC pipe; Sand; Bentonite

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Drilling Contractor: Maple Leaf Drilling	
Drilling Method: B37X Track Mounted Rig, 125 mm SSA	
Logged By: A. Passalis	**Checked By:** L. Bielus
Start Date: 2024/09/03	**Completion:** 2024/09/03

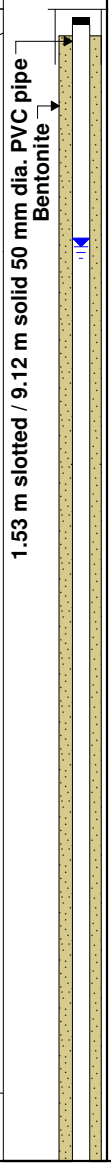
TEST HOLE: TH24-03B

Client: AECOM	**Project:** St. Charles Wastewater Sewer District - Hydrogeological Assessment	
Project Location: S of Augier St	**Project No:** 0013-056-00	**Page:** 1 of 2
Test Hole Location: 1.3 m WNW of TH24-03A, UTM 14U 620428.9 E, 5526055.1 N		**Elev.:** 236.36 m

SUBSURFACE PROFILE

Depth (m)	Soil Symbol	Soil Description
0		**Ground Surface**
		TOPSOIL
		CLAY - dark brown - trace stones, trace silt - stiff to very firm, damp
1		
		- brown - trace silt - very firm to firm, damp to moist - high plasticity
2		
3		
4		
5		
6		
7		

Monitoring Well



SAMPLE

Sample No.	Sample Type	% Recovery

TEST DATA

Combustible Organic Vapours (ppm)

1 — 1000

Laboratory Analyses

Well Collar Elevation = 236.29 m

WL = 234.89 m on 24/09/19

Elevation (m)
236.4
236.0
235.0
234.0
233.0
232.0
231.0
230.0

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Drilling Contractor: Maple Leaf Drilling	
Drilling Method: B37X Track Mounted Rig, HQ Core	
Logged By: A. Passalis	**Checked By:** L. Bielus
Start Date: 2024/09/03	**Completion:** 2024/09/03

TEST HOLE: TH24-03B

Client: AECOM	**Project:** St. Charles Wastewater Sewer District - Hydrogeological Assessment	
Project Location: S of Augier St	**Project No:** 0013-056-00	**Page:** 2 of 2
Test Hole Location: 1.3 m WNW of TH24-03A, UTM 14U 620428.9 E, 5526055.1 N		**Elev.:** 236.36 m

SUBSURFACE PROFILE

Depth (m): 8, 9, 10, 11, 12, 13, 14

Soil Symbol

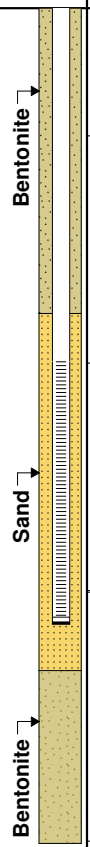
Soil Description

SANDY SILT (Till)
- grey
- with gravel and cobbles
- some boulders, trace clay
- poorly sorted
- loose, wet
- heavy seepage
- becoming denser with depth

BEDROCK (Limestone)
- cream
- conglomerate-type matrix
- minor weathering

Power auger refusal at 7.32 m. HQ casing advanced to 8.69 m. End of Test Hole at 12.04 m in limestone bedrock. Monitoring well installed.

Monitoring Well



SAMPLE

Sample No.	Sample Type	% Recovery
C5		46
C6		30
C7		50

TEST DATA

Combustible Organic Vapours (ppm)

1 — 1000

Laboratory Analyses

Elevation (m): 229.0, 228.0, 227.0, 226.0, 225.0, 224.0, 223.0

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Drilling Contractor: Maple Leaf Drilling	
Drilling Method: B37X Track Mounted Rig, HQ Core	
Logged By: A. Passalis	**Checked By:** L. Bielus
Start Date: 2024/09/03	**Completion:** 2024/09/03

TEST HOLE: TH24-04A

Client: AECOM	**Project:** St. Charles Wastewater Sewer District - Hydrogeological Assessment	
Project Location: Oak Forest Cres. / Oxbow Bend Rd.	**Project No:** 0013-056-00	**Page:** 1 of 1
Test Hole Location: 21.5 m E, 11.8 m N of SW corner of intersection., UTM 14U 620234.8 E, 5526071.3 N		**Elev.:** 236.70 m

SUBSURFACE PROFILE / SAMPLE / TEST DATA

Depth (m)	Soil Symbol	Soil Description	Monitoring Well	Sample No.	Sample Type	% Recovery	Combustible Organic Vapours (ppm) 1–1000	Laboratory Analyses	Elevation (m)
0		**Ground Surface**							236.7
0		TOPSOIL						Well Collar Elevation = 236.58 m	
1		CLAY (Fill) - brown - some sand and gravel - firm, damp to moist							236.0
1		CLAY - grey - some sand, trace gravel - stiff to very stiff, damp						WL = 235.55 m on 24/09/19	
2									235.0
2		- brown/grey - some silt, trace to some sand - firm to soft, moist to wet at 3.6 m							
3									234.0
4		- becomes very soft							233.0
5									232.0
6		SANDY SILT (Till) - light brown/grey - with gravel and cobbles - occasional boulders - poorly sorted - loose, wet - becoming denser with depth							231.0
7		End of Test Hole at 6.1 m in sandy silt till. Power auger refusal. Monitoring well installed.							230.0
8									229.0

Monitoring Well: 1.50 m slotted / 3.42 m solid 50 mm dia. PVC pipe; Bentonite; Sand; Bentonite

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Drilling Contractor: Maple Leaf Drilling	
Drilling Method: B37X Track Mounted Rig, 125 mm SSA	
Logged By: A. Passalis	**Checked By:** L. Bielus
Start Date: 2024/09/05	**Completion:** 2024/09/05

TEST HOLE: TH24-04B

Client: AECOM	**Project:** St. Charles Wastewater Sewer District - Hydrogeological Assessment	
Project Location: Oak Forest Cres. / Oxbow Bend Rd.	**Project No:** 0013-056-00	**Page:** 1 of 2
Test Hole Location: 21.5 m E, 10.3 m N of SW corner of intersection, UTM 14U 620234.8 E, 5526069.8 N		**Elev.:** 236.68 m

SUBSURFACE PROFILE / SAMPLE / TEST DATA

Depth (m)	Soil Symbol	Soil Description	Monitoring Well	Sample No.	Sample Type	% Recovery	Combustible Organic Vapours (ppm) 1–1000	Laboratory Analyses	Elevation (m)
0		**Ground Surface**							236.7
		TOPSOIL						Well Collar Elevation = 236.46 m	
		CLAY (Fill) - brown - some sand and gravel - firm, damp to moist							236.0
1									
		CLAY - grey - some sand and gravel - stiff to very stiff, damp							235.0
2								WL = 234.85 m on 24/09/19	
		- brown/grey - some silt, trace to some sand - firm to soft, moist to wet at 3.6 m							234.0
3									
		- becomes very soft							233.0
4									
									232.0
5									
		SANDY SILT (Till) - light brown/grey - with gravel and cobbles - occasional boulders - poorly sorted - loose, wet - becoming denser with depth							231.0
6									
									230.0
7									

Monitoring Well: 1.5 m slotted / 10.57 m solid 50 mm dia. PVC pipe; Bentonite

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Drilling Contractor: Maple Leaf Drilling	
Drilling Method: B37X Track Mounted Rig, HQ Core	
Logged By: A. Passalis	**Checked By:** L. Bielus
Start Date: 2024/09/05	**Completion:** 2024/09/05

TEST HOLE: TH24-04B

Client: AECOM	**Project:** St. Charles Wastewater Sewer District - Hydrogeological Assessment	
Project Location: Oak Forest Cres. / Oxbow Bend Rd.	**Project No:** 0013-056-00	**Page:** 2 of 2
Test Hole Location: 21.5 m E, 10.3 m N of SW corner of intersection, UTM 14U 620234.8 E, 5526069.8 N		**Elev.:** 236.68 m

SUBSURFACE PROFILE / SAMPLE / TEST DATA

Depth (m)	Soil Symbol	Soil Description	Monitoring Well	Sample No.	Sample Type	% Recovery	Combustible Organic Vapours (ppm) 1–1000	Laboratory Analyses	Elevation (m)
8			Bentonite						229.0
9									228.0
10				C15		0			227.0
11				C16		0			226.0
12			Sand						225.0
13		BEDROCK (Limestone) - suspected	Bentonite	C17		33			224.0
14		Power auger refusal at 8.53 m. HQ casing advanced to 8.66 m. End of Test Hole at 13.4 m in suspected bedrock. Seepage below 5.5 m. Monitoring well installed.							223.0
15									222.0

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Drilling Contractor: Maple Leaf Drilling	
Drilling Method: B37X Track Mounted Rig, HQ Core	
Logged By: A. Passalis	**Checked By:** L. Bielus
Start Date: 2024/09/05	**Completion:** 2024/09/05

PROJECT: St. Charles Wastewater Sewer Preliminary Design	CLIENT: The City of Winnipeg	TESTHOLE NO: TH23-01
LOCATION: UTM: 14U, 5526237.7 m N, 0620581.8 m E		PROJECT NO.: 60686223
CONTRACTOR: Paddock Drilling	METHOD: Solid Stem Auger/Hollow Stem Auger	ELEVATION (m): 236.90

SAMPLE TYPE: GRAB | SHELBY TUBE | SPLIT SPOON | BULK | NO RECOVERY | CORE

BACKFILL TYPE: BENTONITE | GRAVEL | SLOUGH | GROUT | CUTTINGS | SAND

DEPTH (m)	USCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	COMMENTS	ELEVATION (m)
0	OR	TOPSOIL: black, moist, with organic content					
		firm to stiff brown fat CLAY (CH)		G1			
1				G2			236
				G3			
2							235
	CH						
3		- soft to firm below 3.05 m		G4		(G4): Liquid Limit 62%, Plastic Limit 16%; Gravel 0%, Sand 8%, Silt 33%, Clay 59%	234
4							233
5				T5			232
	TILL	POORLY GRADED SAND (SP-SM) with silt and gravel (TILL) - very loose to loose light grey -moist below 3.05 m					
6				S6	50		231
		END OF TEST HOLE - auger refusal at a depth of 6.55 m in POORLY GRADED SAND (SP-SM) with silt and gravel (TILL) - sloughing observed at a depth of 6.10 m in POORLY GRADED SAND (SP-SM) with silt and gravel (TILL) - heavy seepage observed at a depth of 6.10 m in POORLY GRADED SAND (SP-SM) with silt and gravel (TILL) - groundwater observed at a depth of 3.81 m - standpipe piezometer slotted from 5.5 to 6.1 m in POORLY GRADED SAND (SP-SM) with silt and gravel (TILL) - standpipe annulus backfilled with sand and bentonite chips					230
7							
8							229
9							228
10							227
11							226
12							225

PENETRATION TESTS: ✳ Becker ✳ | ◇ Dynamic Cone ◇ | ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) 0 20 40 60 80 100 | ■ Total Unit Wt ■ (kN/m^3) 16 17 18 19 20 21 | Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: + Torvane + | × QU/2 × | □ Lab Vane □ | △ Pocket Pen. △ | ⬘ Field Vane ⬘ (kPa) 50 100 150 200

LOG OF TEST HOLE 60686223 - TEST HOLE LOGS - FINAL LOGS.GPJ UMA WINN.GDT 24-2-22

AECOM

LOGGED BY: CW	COMPLETION DEPTH: 6.55 m
REVIEWED BY: GL	COMPLETION DATE: 23-8-25
PROJECT ENGINEER: Mike Gaudreau	Page 1 of 1

PROJECT: St. Charles Wastewater Sewer Preliminary Design	CLIENT: The City of Winnipeg	TESTHOLE NO: TH23-02
LOCATION: UTM: 14U, 5526169.8 m N, 0620556.3 m E		PROJECT NO.: 60686223
CONTRACTOR: Paddock Drilling	METHOD: Solid Stem Auger	ELEVATION (m): 237.54

SAMPLE TYPE: GRAB | SHELBY TUBE | SPLIT SPOON | BULK | NO RECOVERY | CORE

DEPTH (m)	USCS	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	COMMENTS	ELEVATION (m)
0	OR		TOPSOIL: black, moist, with organic content					
			firm to stiff brown fat CLAY (CH)		G1			237
			- moist below 0.15 m					
1					G2		(G2): Liquid Limit 67%, Plastic Limit 18%; Gravel 0%, Sand 3%, Silt 21%, Clay 76%	
					G3			236
2								
								235
3	CH		- silt inclusions below 3.05 m		G4			
								234
4								
					G5			233
5								
								232
6			- very soft below 6.10 m		G6			
			POORLY GRADED SAND (SP-SM) with silt and gravel (TILL)					231
7			- very loose to loose light grey					
			- moist below 6.40 m					
	TILL							230
			- compact to dense below 7.62 m		S7	30		
8								
								229
9			END OF TEST HOLE					
			- auger refusal at a depth of 8.69 m in POORLY GRADED SAND (SP-SM) with silt and gravel (TILL)					228
10			- heavy seepage observed at a depth of 6.40 m in POORLY GRADED SAND (SP-SM) with silt and gravel (TILL)					
			- sloughing observed at a depth of 8.38 m in POORLY GRADED SAND (SP-SM) with silt and gravel (TILL)					227
11			- ground water observed at a depth of 3.81 m					
								226
12								

PENETRATION TESTS: Becker | Dynamic Cone | SPT (Standard Pen Test) (Blows/300mm) 0 20 40 60 80 100 | Total Unit Wt (kN/m³) 16 17 18 19 20 21 | Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: Torvane | QU/2 | Lab Vane | Pocket Pen. | Field Vane (kPa) 50 100 150 200

AECOM

LOGGED BY: CW	COMPLETION DEPTH: 8.69 m
REVIEWED BY: GL	COMPLETION DATE: 23-8-25
PROJECT ENGINEER: Mike Gaudreau	Page 1 of 1

LOG OF TEST HOLE 60686223 - TEST HOLE LOGS - FINAL LOGS.GPJ UMA WINN.GDT 24-2-22

PROJECT: St. Charles Wastewater Sewer Preliminary Design	CLIENT: The City of Winnipeg	TESTHOLE NO: TH23-03
LOCATION: UTM: 14U, 5526048.8 m N, 0620550.8 m E		PROJECT NO.: 60686223
CONTRACTOR: Paddock Drilling	METHOD: Solid Stem Auger	ELEVATION (m): 237.56

SAMPLE TYPE: GRAB | SHELBY TUBE | SPLIT SPOON | BULK | NO RECOVERY | CORE

DEPTH (m)	USCS	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	COMMENTS	ELEVATION (m)
0	OR		TOPSOIL: black, moist, with organic content					
			firm to stiff brown fat CLAY (CH)		G1			237
1					G2		(G2): Liquid Limit 69%, Plastic Limit 18%; Gravel 0%, Sand 3%, Silt 24%, Clay 73%	
			- silt inclusions below 3.05 m - soft to firm below 3.05 m		G3			236
2								
								235
3					G4			
	CH							234
4								
					G5			233
5								
								232
6			- grey below 6.10 m - very soft to soft below 6.10 m		T6			
								231
7			POORLY GRADED SAND (SP-SM) with silt and gravel (TILL) - very loose to loose light grey - wet below 6.71 m					
	TILL							230
8					S7	14		
					G8			229
9			END OF TESTHOLE - auger refusal at a depth of 8.38 m in POORLY GRADED SAND (SP-SM) with silt and gravel (TILL) - heavy seepage observed at a depth of 7.62 m in POORLY GRADED SAND (SP-SM) with silt and gravel (TILL) - sloughing observed at a depth of 7.16 m in POORLY GRADED SAND (SP-SM) with silt and gravel (TILL) - groundwater observed at a depth of 5.18 m					228
10								
								227
11								
12								226

PENETRATION TESTS: ✳ Becker ✳ | ◇ Dynamic Cone ◇ | ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) 0 20 40 60 80 100 | ■ Total Unit Wt ■ (kN/m^3) 16 17 18 19 20 21 | Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: + Torvane + | × QU/2 × | □ Lab Vane □ | △ Pocket Pen. △ | ⬘ Field Vane ⬘ (kPa) 50 100 150 200

LOG OF TEST HOLE 60686223 - TEST HOLE LOGS - FINAL LOGS.GPJ UMA WINN.GDT 24-2-22

AECOM

LOGGED BY: CW	COMPLETION DEPTH: 8.38 m
REVIEWED BY: GL	COMPLETION DATE: 23-8-25
PROJECT ENGINEER: Mike Gaudreau	Page 1 of 1

PROJECT: St. Charles Wastewater Sewer Preliminary Design	CLIENT: The City of Winnipeg	TESTHOLE NO: TH23-04
LOCATION: UTM: 14U, 5526051.6 m N, 0620479.9 m E		PROJECT NO.: 60686223
CONTRACTOR: Paddock Drilling	METHOD: Solid Stem Auger	ELEVATION (m): 237.15

SAMPLE TYPE: GRAB | SHELBY TUBE | SPLIT SPOON | BULK | NO RECOVERY | CORE

DEPTH (m)	USCS	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS / UNDRAINED SHEAR STRENGTH	COMMENTS	ELEVATION (m)
0	OR		TOPSOIL: black, moist, with organic content						237
			firm to stiff brown fat CLAY (CH)		G1				
			- moist below 0.08 m		G2				
1									236
					G3				
2			- silt inclusions below 2.13 m						235
					G4				
3									234
	CH								
4									233
					T5				
5									232
6			- soft to firm below 6.10 m		G6				231
7									230
8			POORLY GRADED SAND (SP-SM) with silt and gravel (TILL)						229
			- very loose to loose light grey						
			- moist below 7.62 m						
9	TILL				S7	23			228
			END OF TESTHOLE						
10			- testhole was terminated at a depth of 9.60 m in POORLY GRADED SAND (SP-SM) with silt and gravel (TILL)						227
			- no seepage was observed						
			- sloughing was observed at a depth of 8.53 m in POORLY GRADED SAND (SP-SM) with silt and gravel (TILL)						
11			- groundwater was observed at a depth 3.66 m						226
12									

PENETRATION TESTS: ✳ Becker ✳ | ◇ Dynamic Cone ◇ | ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) 0 20 40 60 80 100 | ■ Total Unit Wt ■ (kN/m^3) 16 17 18 19 20 21 | Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: + Torvane + | × QU/2 × | ☐ Lab Vane ☐ | △ Pocket Pen. △ | ⬘ Field Vane ⬘ (kPa) 50 100 150 200

LOGGED BY: CW	COMPLETION DEPTH: 9.60 m
REVIEWED BY: GL	COMPLETION DATE: 23-8-25
PROJECT ENGINEER: Mike Gaudreau	Page 1 of 1

AECOM

LOG OF TEST HOLE 60686223 - TEST HOLE LOGS - FINAL LOGS.GPJ UMA WINN.GDT 24-2-22

PROJECT: St. Charles Wastewater Sewer Preliminary Design	CLIENT: The City of Winnipeg	TESTHOLE NO: TH23-05
LOCATION: UTM: 14U, 5526080.2 m N, 0620329.6 m E		PROJECT NO.: 60686223
CONTRACTOR: Paddock Drilling	METHOD: Solid Stem Auger/Hollow Stem Auger	ELEVATION (m): 236.92

SAMPLE TYPE: GRAB; SHELBY TUBE; SPLIT SPOON; BULK; NO RECOVERY; CORE

BACKFILL TYPE: BENTONITE; GRAVEL; SLOUGH; GROUT; CUTTINGS; SAND

PENETRATION TESTS: Becker; Dynamic Cone; SPT (Standard Pen Test) (Blows/300mm); Total Unit Wt (kN/m³); Plastic; MC; Liquid

UNDRAINED SHEAR STRENGTH: Torvane; QU/2; Lab Vane; Pocket Pen.; Field Vane (kPa)

DEPTH (m)	USCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	COMMENTS	ELEVATION (m)
0	FILL	FILL: black fat CLAY, trace gravel - moist below 0 m		G1		(G1): Liquid Limit 69%, Plastic Limit 18%; Gravel 0%, Sand 2%, Silt 32%, Clay 67%	236
1				G2			
2	CH	firm to stiff brown fat CLAY (CH) - moist below 2.13 m					235
3		- silt inclusions below 3.05 m		G3		(G3): Liquid Limit 78%, Plastic Limit 20%; Gravel 0%, Sand 1%, Silt 28%, Clay 71%	234
4							233
5				T4			232
6		- soft to firm below 6.10 m		G5			231
7				T6			230
8				T7			229
9	TILL	POORLY GRADED SAND (SP-SM) with silt and gravel (TILL) - very loose to loose light grey - moist below 8.53 m - compact to dense below 9.30 m		G8		(G8): Liquid Limit 22%, Plastic Limit 11%; Gravel 3%, Sand 31%, Silt 45%, Clay 21%	228
10				S9	14	No Recovery	227
11				G10			226
12		END OF TESTHOLE - auger refusal at a depth of 11.43 m in POORLY GRADED SAND (SP-SM) with silt and gravel (TILL) - heavy seepage observed at a depth of 9.30 m in POORLY GRADED SAND (SP-SM) with silt and gravel (TILL) - sloughing observed at a depth of 8.53 m in POORLY GRADED SAND (SP-SM) with silt and gravel (TILL) - groundwater observed at a depth of 3.05 m - standpipe piezometer installed at a depth of 5.94 m in fat CLAY - standpipe piezometer installed at a depth of 10.67 m in POORLY GRADED SAND (SP-SM) with silt and gravel (TILL) - standpipe annulus backfilled with sand and bentonite chips					225
13							224
14							223
15							222
16							

AECOM

LOGGED BY: CW	COMPLETION DEPTH: 11.43 m
REVIEWED BY: GL	COMPLETION DATE: 23-8-24
PROJECT ENGINEER: Mike Gaudreau	Page 1 of 1

LOG OF TEST HOLE 60686223 - TEST HOLE LOGS - FINAL LOGS.GPJ UMA WINN.GDT 24-2-22

PROJECT: St. Charles Wastewater Sewer Preliminary Design	CLIENT: The City of Winnipeg	TESTHOLE NO: TH23-06
LOCATION: UTM: 14U, 5526088.2 m N, 0620236.9 m E		PROJECT NO.: 60686223
CONTRACTOR: Paddock Drilling	METHOD: Solid Stem Auger	ELEVATION (m): 236.77

SAMPLE TYPE: GRAB | SHELBY TUBE | SPLIT SPOON | BULK | NO RECOVERY | CORE

DEPTH (m)	USCS	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	COMMENTS	ELEVATION (m)
0	FILL	FILL: black fat CLAY, trace gravel - moist below 0 m		G1			
1	FILL	FILL: tan silty sand with gravel - moist below 0.61 m		G2			236
2	CH	soft to firm brown fat CLAY (CH) - moist below 1.52 m		G3		(G3): Liquid Limit 76%, Plastic Limit 20%; Gravel 0%, Sand 6%, Silt 21%, Clay 74%	235
3				T4			234
4		- silt inclusions below 3.96 m					233
5		- very soft to soft below 4.57 m - grey below 5.18 m		G5		(G5): Liquid Limit 58%, Plastic Limit 17%; Gravel 0%, Sand 4%, Silt 25%, Clay 71%	232
6				T6			231
7	TILL	POORLY GRADED SAND (SP-SM) with silt and gravel (TILL) - very loose to loose light grey - moist to wet below 6.25 m					230
8		- dense to very dense below 7.77 m		S7	50/ 102mm		229
9		END OF TESTHOLE - auger refusal at a depth of 7.92 m in POORLY GRADED SAND (SP-SM) with silt and gravel (TILL) - heavy seepage was observed at a depth of 6.25 m in POORLY GRADED SAND (SP-SM) with silt and gravel (TILL) - no sloughing was observed - groundwater was observed at a depth of 3.81					228
10							227
11							226
12							225

PENETRATION TESTS: Becker | Dynamic Cone | SPT (Standard Pen Test) (Blows/300mm) 0 20 40 60 80 100 | Total Unit Wt (kN/m³) 16 17 18 19 20 21 | Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: Torvane | QU/2 | Lab Vane | Pocket Pen. | Field Vane (kPa) 50 100 150 200

AECOM

LOGGED BY: CW	COMPLETION DEPTH: 7.92 m
REVIEWED BY: GL	COMPLETION DATE: 23-8-24
PROJECT ENGINEER: Mike Gaudreau	Page 1 of 1

LOG OF TEST HOLE 60686223 - TEST HOLE LOGS - FINAL LOGS.GPJ UMA WINN.GDT 24-2-22

PROJECT: St. Charles Wastewater Sewer Preliminary Design	CLIENT: The City of Winnipeg	TESTHOLE NO: TH23-07
LOCATION: UTM: 14U, 5526093.4 m N, 0620174.7 m E		PROJECT NO.: 60686223
CONTRACTOR: Paddock Drilling	METHOD: Solid Stem Auger	ELEVATION (m): 237.57

SAMPLE TYPE: GRAB | SHELBY TUBE | SPLIT SPOON | BULK | NO RECOVERY | CORE

DEPTH (m)	USCS	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	COMMENTS	ELEVATION (m)
0	OR		TOPSOIL: black, moist, with organic content					
			firm to stiff brown fat CLAY (CH) - moist below 0.30 m		G1			237
1					G2		(G2): Liquid Limit 61%, Plastic Limit 20%; Gravel 0%, Sand 1%, Silt 26%, Clay 73%	
					G3			236
2								
								235
3					T4			
	CH							234
4								
			- soft to firm below 4.57 m		G5		(G5): Liquid Limit 69%, Plastic Limit 18%; Gravel 0%, Sand 4%, Silt 35%, Clay 62%	233
5								
			- sloughing observed at a depth of 5.64 m					232
6			- silt inclusions below 6.10 m		T6			
								231
7								
			POORLY GRADED SAND (SP-SM) with silt and gravel (TILL)					230
	TILL		- compact to dense light grey					
8			- moist below 7.32 m		S7	45		
			END OF TESTHOLE - auger refusal at a depth of 8.38 m in POORLY GRADED SAND (SP-SM) with silt and gravel (TILL) - heavy seepage observed at a depth of 7.62 m in POORLY GRADED SAND (SP-SM) with silt and gravel (TILL) - sloughing observed at a depth of 5.64 m - groundwater observed at a depth of 2.74 m					229
9								
								228
10								
								227
11								
								226
12								

PENETRATION TESTS: ✳ Becker ✳ | ◇ Dynamic Cone ◇ | ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) 0 20 40 60 80 100 | ■ Total Unit Wt ■ (kN/m^3) 16 17 18 19 20 21 | Plastic MC Liquid 20 40 60 80 100

UNDRAINED SHEAR STRENGTH: + Torvane + | × QU/2 × | ☐ Lab Vane ☐ | △ Pocket Pen. △ | ⬘ Field Vane ⬘ (kPa) 50 100 150 200

AECOM

LOGGED BY: CW	COMPLETION DEPTH: 8.38 m
REVIEWED BY: GL	COMPLETION DATE: 23-8-24
PROJECT ENGINEER: Mike Gaudreau	Page 1 of 1

LOG OF TEST HOLE 60686223 - TEST HOLE LOGS - FINAL LOGS.GPJ UMA WINN.GDT 24-2-22

APPENDIX B

UTILITY CLEARANCES

McCAINE™
Member of the Canem Group
106 Lowson Crescent
Winnipeg, MB R3P 2H8
Phone (204) 786-2435
Fax (204) 783-2180

Private Utilities Locator Report

Customer: EGE Engineering **Phone:** Andrew

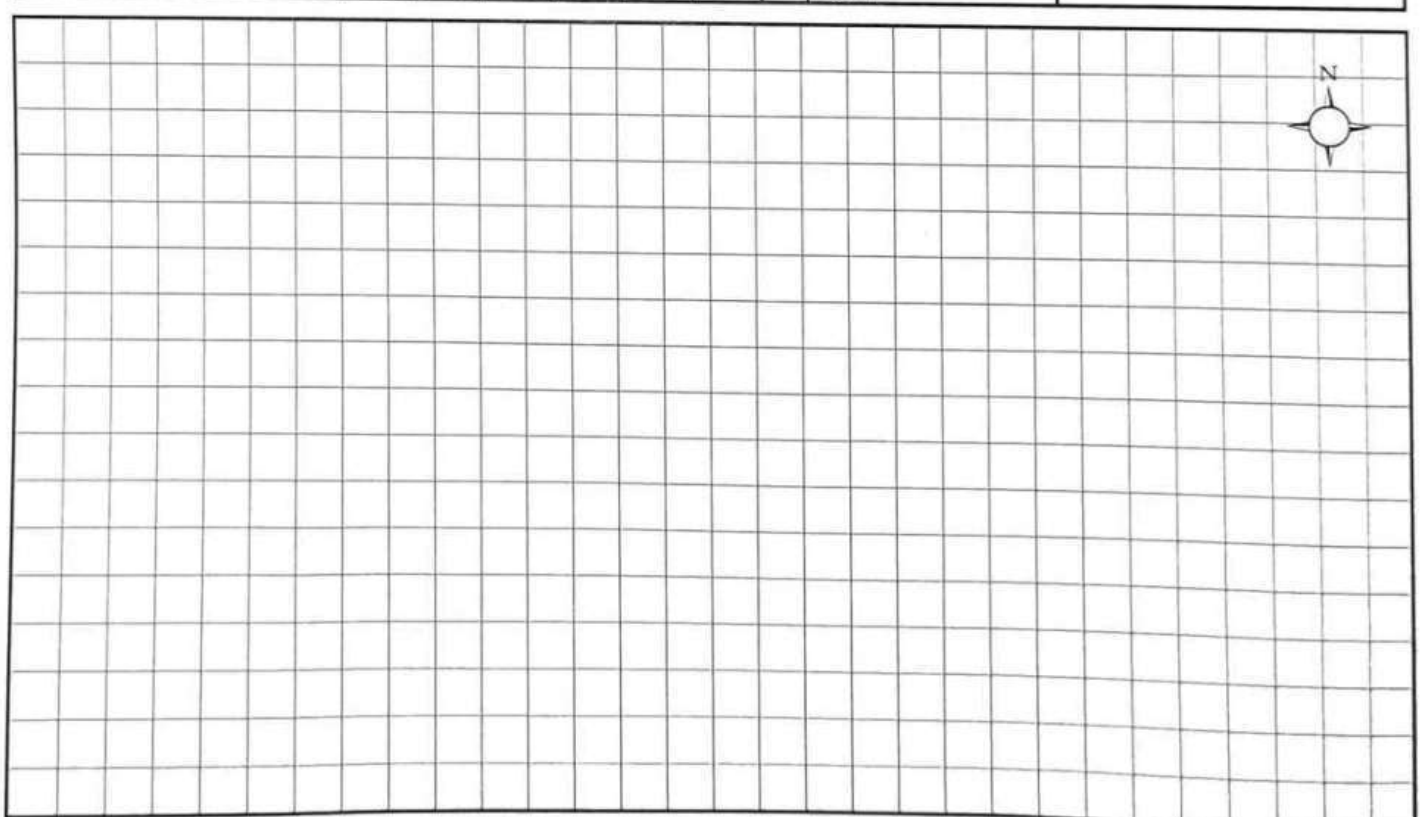
Job Site Address: Sansome Ave and Gagnon Street **Client's PO:**

Job Number: 5062865

☐ Hydro Vac/Day Lighting/Soft Dig Recommended ☑ Utilities Locate ☐ GPR/Concrete Scan

Comments: Underground locates at 4 test hole locations in the St.Charles area. Blind scan at each hole. Inductive locate at each marked location. Check locations of documented hydro lines and discover one new new line at the 3rd hole location on Augier Ave. Marked it out for hole placement. Confirm with hydro.

Labour							Locate Methods Used:		Marking of Buried Facilities:	
Date Work Performed	Aug 30/24						✓	Direct Conductive	✓	Spray Paint
Electrician (s)	Reg Time	Shift Prem	Over Time	Reg Time	Shift Prem	Over Time	✓	Indirect Inductive		Plastic Pin Flags
Thomas Bender	2						✓	Radio		
							✓	Power - 60HZ		
								CP - Cathodic Protection		
							✓	8 KHZ		
								33KHZ		

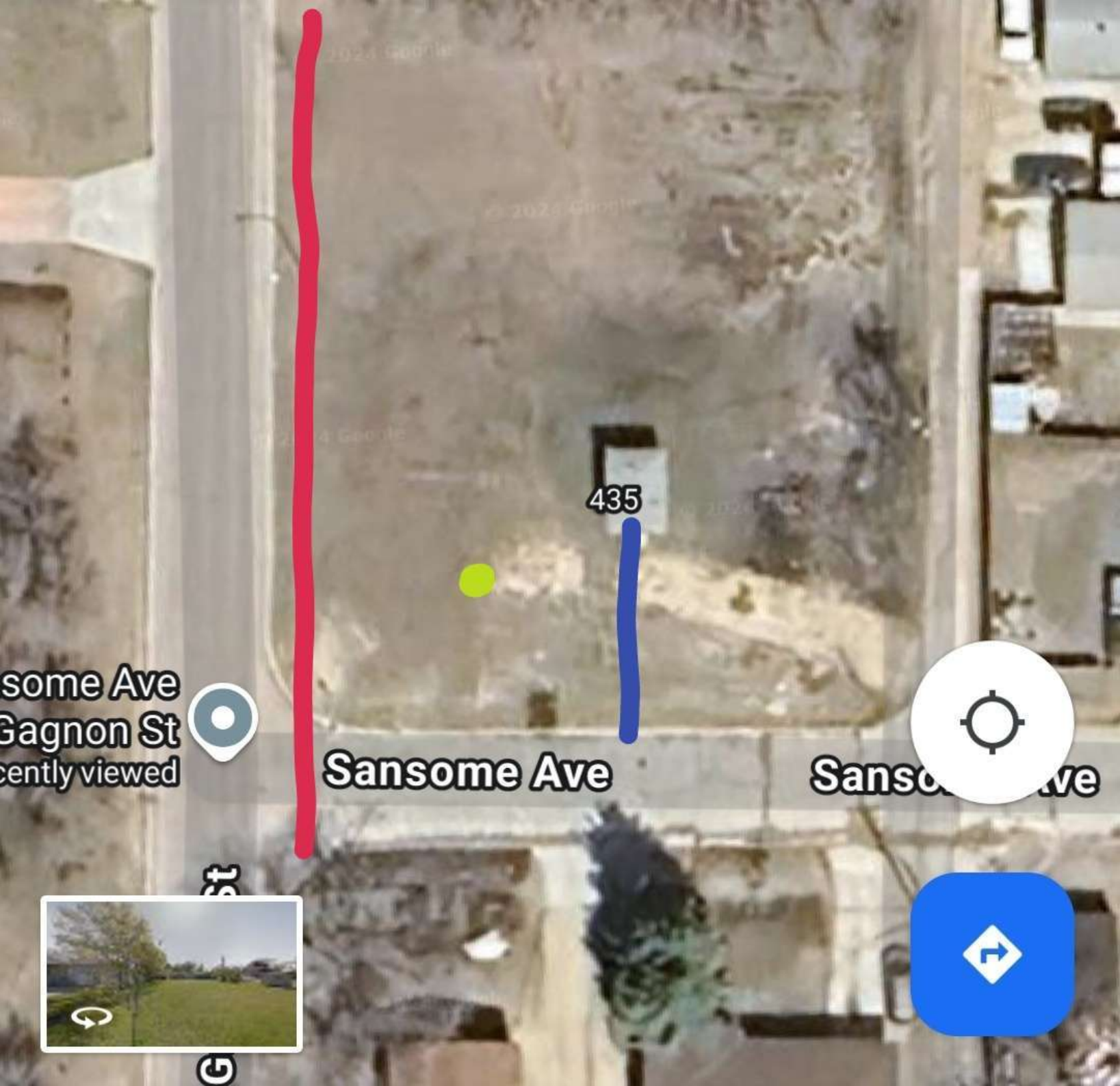


Disclaimer: *Locations are given as accurately as possible, but because of limitations in the equipment used to locate utilities, (hydro, water, sewer) underground conduits containing cables, teck cables or the like, we are unable to guarantee the complete accuracy of the locations and exterior locates. If after (5) five working days, work is not started at the locate, the requestor of this service, must reschedule for another locate. McCaine Electric Ltd. assumes no responsibility whatsoever for the cable locations.*

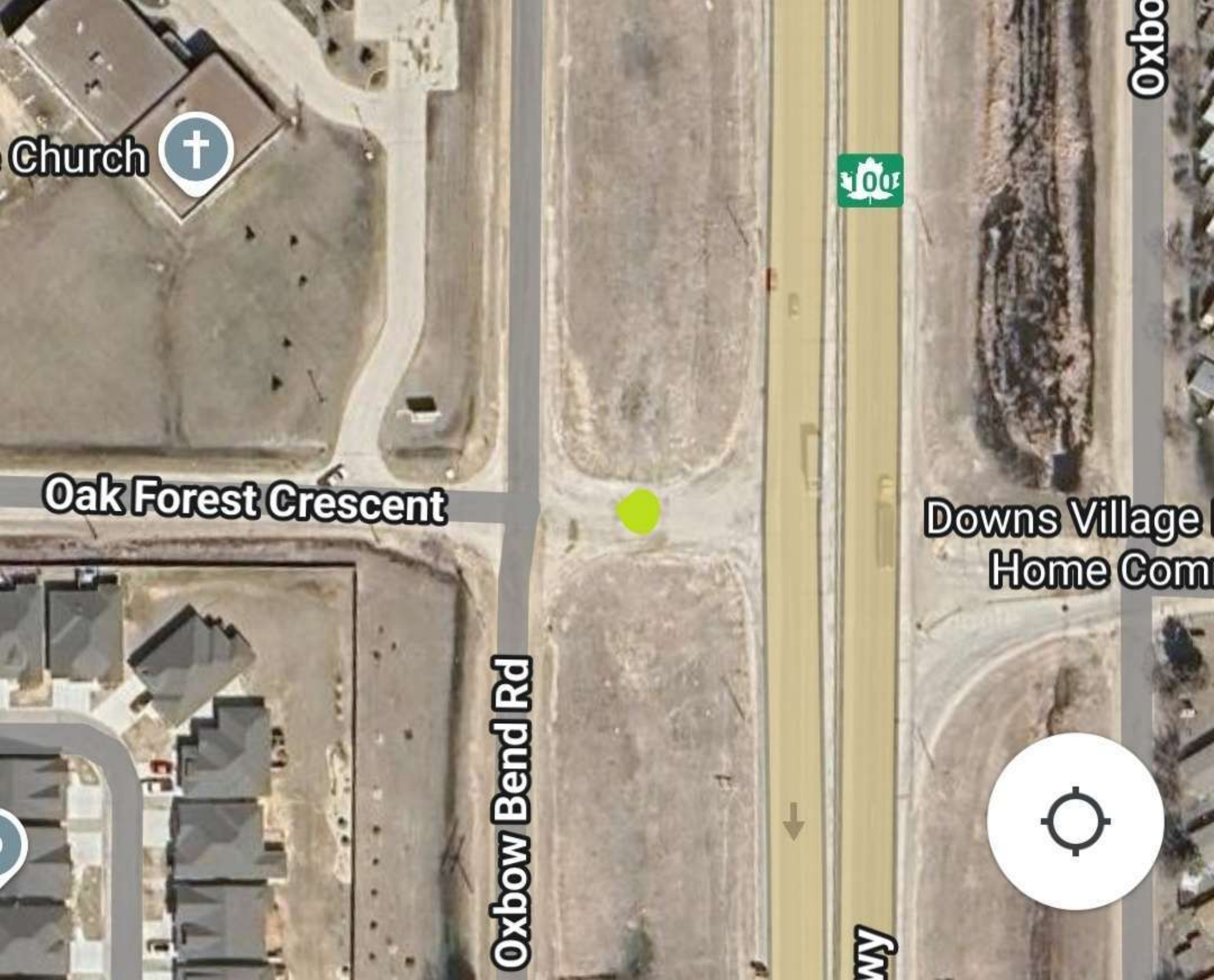
Customer's Signature: _____ **Technician Signature:** T. Bender

Print Name: _____ **Print Name:** Thomas Bender

White – Customer Copy Yellow – Office Copy Pink – File Copy


435
some Ave
Gagnon St
cently viewed
Sansome Ave


Downs Vlg
Augier Ave
A.J And Th


Church
Oak Forest Crescent
Oxbow Bend Rd
100
Downs Village
Home Com

Ticket No: 20243318326

Excavator Details

Caller Id: 599586
Contact: Andrew Passalis
Company: EGE Engineering Ltd.
Phone: 204-228-5775
Mobile: 204-228-5775
Email: apassalis@egeengineering.ca

Dig Site and Ticket Details

Open Map

Drill locations (2) to be placed in boulevard area. Call 204.228.5775 to confirm locates have been completed.

Land Grids: LLD

Not Supplied

Latitude: 49.876411 **Longitude:** -97.321756

Ticket Status	Original
Ticket Type	Regular
Previous Ticket No.	Not Supplied
User Reference	0013-056-00
Ticket Date	2024-08-16T09:24:43-05:00
Work Start Date	2024-09-04T02:00:00-05:00
Address	435 Sansome Ave, Winnipeg,
Nearest Cross Street	Not Supplied
Type of work	Poles/Holes
Activity	Soil Sample
Excavation Method	Drilling
Excavation Depth	>3m
Public Property	Green Space
Private Property	None
Onsite Contact	Andrew Passalis
Onsite Phone	2042285775
Municipality	Not Supplied
Nearest Community	Not Supplied
Rural Subdivision	Not Supplied
Lot No.	
Block No.	
Plan No.	
ALP Option	No

Your Responsibilities

- Do not proceed with any excavation until all notified asset owners have responded by providing clearance, OR by identifying the location of their facilities with maps OR by placing locate marks on the ground.
- Pothole to establish the exact location of all underground assets using a hand shovel, before using heavy machinery.
- If you damage an underground asset you MUST advise the asset owner immediately.
- By using the Before You Dig Partners service, you agree to our privacy policy and the terms and conditions set out at on our web site.
- **For more information, visit www.BeforeYouDigPartners.com**

Utility Owner Details

The public utility owners listed below with a Status of "Notification Sent" have been requested to respond to your request. They may contact you directly for clarification of your request details.

Station Code	Authority Name	Status
WPGWS	CITY OF WINNIPEG WATER AND WASTE (MB)	Notification Sent
MBHYDRO	MANITOBA HYDRO	Notification Sent
MTSWPG	MTS INC (MTSWPG)	Notification Sent

END OF UTILITIES LIST

Ticket No: 20243318326

Utility Details

Utility ID:	42011	**Station Code:**	WPGWS
Utility Name:	CITY OF WINNIPEG WATER AND WASTE (MB)	**Sequence No:**	16
Utility Contact:	wwd-locates@winnipeg.ca	**Previous Ticket No:**	

Excavator Details

Excavator ID:	599586	**Phone:**	204-228-5775
Contact:	Andrew Passalis	**Mobile:**	204-228-5775
Company:	EGE Engineering Ltd.	**Email:**	apassalis@egeengineering.ca
User Type:	Contractor		

Dig Site and Ticket Details

Ticket Status	Original
Ticket Type	Regular
User Reference	0013-056-00
Request Date	2024-08-16T09:24:43-05:00
Work Start Date	2024-09-04T02:00:00-05:00
Address	435 Sansome Ave, Winnipeg,
Nearest Cross Street	Not Supplied
Type of work	Poles/Holes
Activity	Soil Sample
Excavation Method	Drilling
Excavation Depth	>3m
Public Property	Green Space
Private Property	None
Onsite Contact	Andrew Passalis
Onsite Phone	2042285775
Urban/Rural	Urban
Municipal District	Not Supplied
Nearest Community	Not Supplied
Rural Subdivision	Not Supplied
Lot No.	
Block No.	
Plan No.	
Latitude Longitude	49.876411 -97.321756
ALP Option	No

Customer Remarks Open Map

Drill locations (2) to be placed in boulevard area. Call 204.228.5775 to confirm locates have been completed.

Stations Affected List:

MTSWPG, MBHYDRO, WPGWS

Land Grids: LLD

Not Supplied

END OF TRANSMISSION – V4.8.2

Ticket No: 20243318473

Excavator Details

Caller Id: 599586
Contact: Andrew Passalis
Company: EGE Engineering Ltd.
Phone: 204-228-5775
Mobile: 204-228-5775
Email: apassalis@egeengineering.ca

Dig Site and Ticket Details

Open Map

Dig locations (6) spaced around N, S, E & W site perimeter. Call 204.228.5775 to confirm locates have been completed.

Land Grids: LLD

Not Supplied

Latitude: 49.875593 **Longitude:** -97.322158

Ticket Status	Original
Ticket Type	Regular
Previous Ticket No.	Not Supplied
User Reference	0121-057-01
Ticket Date	2024-08-16T09:46:19-05:00
Work Start Date	2024-09-04T02:00:00-05:00
Address	38 Jeannette Bay, Winnipeg, R3K 2A3
Nearest Cross Street	Gagnon Street
Type of work	Poles/Holes
Activity	Soil Sample
Excavation Method	Drilling
Excavation Depth	>3m
Public Property	Road/Sidewalk
Private Property	Commercial
Onsite Contact	Andrew Passalis
Onsite Phone	2042285775
Municipality	Not Supplied
Nearest Community	Not Supplied
Rural Subdivision	Not Supplied
Lot No.	
Block No.	
Plan No.	
ALP Option	No

Your Responsibilities

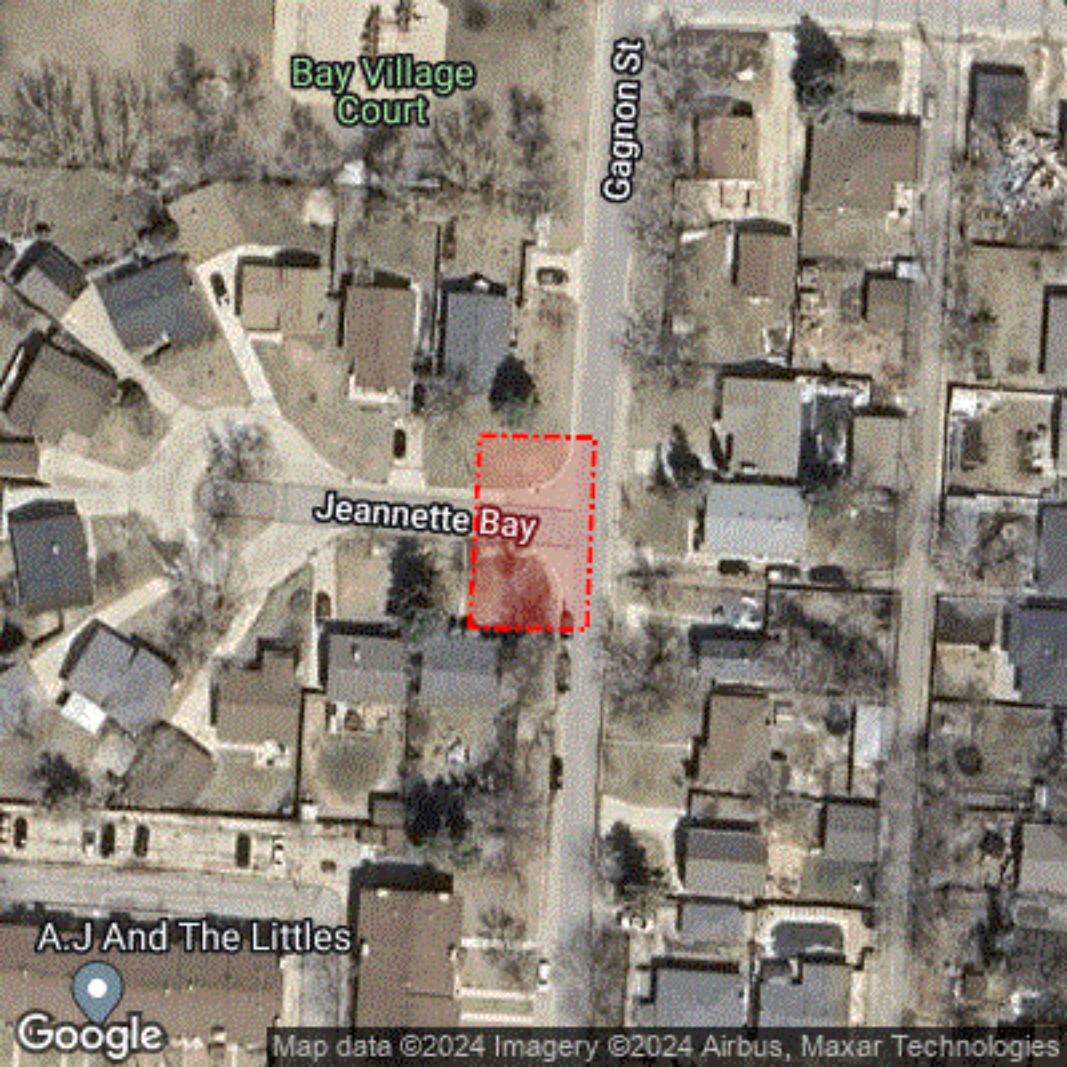
- Do not proceed with any excavation until all notified asset owners have responded by providing clearance, OR by identifying the location of their facilities with maps OR by placing locate marks on the ground.
- Pothole to establish the exact location of all underground assets using a hand shovel, before using heavy machinery.
- If you damage an underground asset you MUST advise the asset owner immediately.
- By using the Before You Dig Partners service, you agree to our privacy policy and the terms and conditions set out at on our web site.
- **For more information, visit www.BeforeYouDigPartners.com**

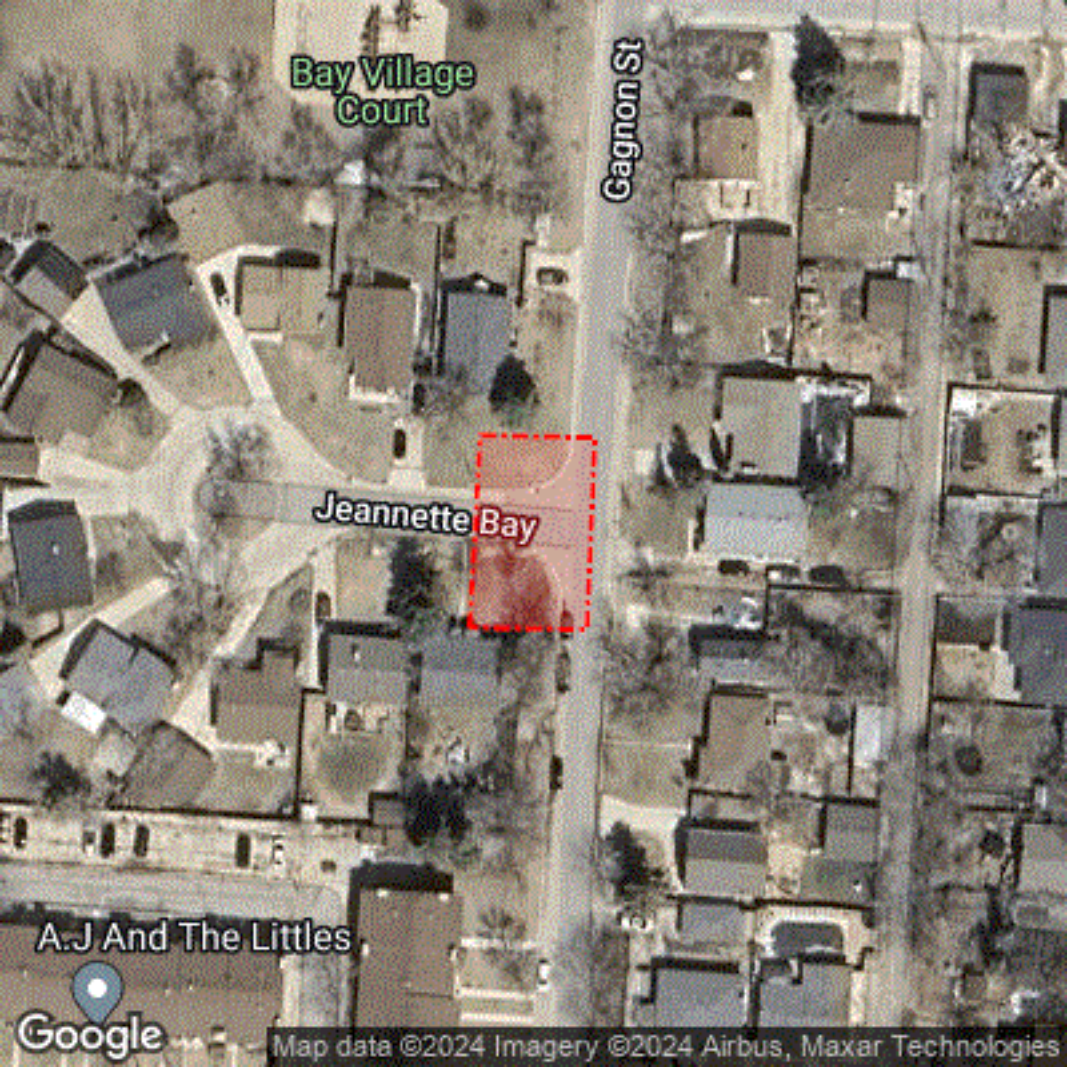
Utility Owner Details

The public utility owners listed below with a Status of "Notification Sent" have been requested to respond to your request. They may contact you directly for clarification of your request details.

Station Code	Authority Name	Status
WPGWS	CITY OF WINNIPEG WATER AND WASTE (MB)	Notification Sent
MBHYDRO	MANITOBA HYDRO	Notification Sent
MTSWPG	MTS INC (MTSWPG)	Notification Sent
ROGSHWM1	ROGERS COMMUNICATIONS CANADA INC. (HERITAGE SHAW)	Notification Sent

END OF UTILITIES LIST


Bay Village Court
Gagnon St
Jeannette Bay
A.J And The Littles
Google
Map data ©2024 Imagery ©2024 Airbus, Maxar Technologies


Bay Village Court
Gagnon St
Jeannette Bay
A.J And The Littles
Google
Map data ©2024 Imagery ©2024 Airbus, Maxar Technologies

Locate Response Cover Letter

Date: 08/24/2024

The Installation Group
10 Bulmer Ave
Sundbury, ON
PJ3 3C3

Ph: (705)-222-2444
E: locate@installationgroup.ca

Requested By:
ANDREW PASSALIS
EGE ENGINEERING LTD.
(204)-228-5775 ext.
APASSALIS@EGEENGINEERING.CA

Re: Locate Results for OneCall Request

Ticket Number: 20243318473

Location: 38 JEANNETTE BAY
WINNIPEG, MB

Method of Marking:
☒ Paint ☒ Chalk ☒ Stakes ☒ Flags ☒ Offset Flags ☒ No Marks Other _____

The excavator or their agent must not work outside the area mentioned in this email/response (and/or other documents accompanying this email/response) without further locates by The Installation Group. If the excavation is necessary over, under, or near underground or surface utilities and/or assets, extreme caution must be observed and the utility(s) and/or asset(s) shall be exposed by hand digging of the location given.

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Disclaimer:
You must HAND DIG within one meter of markings for copper, distribution and power cables; and within 1 meter of markings for Fiber-optic cables. If you damage the plant you may be held liable. Depth varies and must be verified by hand digging or vacuum excavation with max 1500 psi. If you damage underground plant please notify facility owner immediately.

Locate Results:

UTILITY: BELLMTS STATUS: MARKED DATE LOCATED: 08/23/2024 LOCATED BY: ING NOTES: LOCATE COMPLETED

Ticket No: 20243318473

Utility Details

Utility ID:	42011	**Station Code:**	WPGWS
Utility Name:	CITY OF WINNIPEG WATER AND WASTE (MB)	**Sequence No:**	19
Utility Contact:	wwd-locates@winnipeg.ca	**Previous Ticket No:**	

Excavator Details

Excavator ID:	599586	**Phone:**	204-228-5775
Contact:	Andrew Passalis	**Mobile:**	204-228-5775
Company:	EGE Engineering Ltd.	**Email:**	apassalis@egeengineering.ca
User Type:	Contractor		

Dig Site and Ticket Details

Customer Remarks Open Map

Dig locations (6) spaced around N, S, E & W site perimeter. Call 204.228.5775 to confirm locates have been completed.

Stations Affected List:

MTSWPG, ROGSHWM1, MBHYDRO, WPGWS

Ticket Status	Original
Ticket Type	Regular
User Reference	0121-057-01
Request Date	2024-08-16T09:46:19-05:00
Work Start Date	2024-09-04T02:00:00-05:00
Address	38 Jeannette Bay, Winnipeg, R3K 2A3
Nearest Cross Street	Gagnon Street
Type of work	Poles/Holes
Activity	Soil Sample
Excavation Method	Drilling
Excavation Depth	>3m
Public Property	Road/Sidewalk
Private Property	Commercial
Onsite Contact	Andrew Passalis
Onsite Phone	2042285775
Urban/Rural	Urban
Municipal District	Not Supplied
Nearest Community	Not Supplied
Rural Subdivision	Not Supplied
Lot No.	
Block No.	
Plan No.	
Latitude Longitude	49.875593 -97.322158
ALP Option	No

Land Grids: LLD

Not Supplied

END OF TRANSMISSION – V4.8.2

Ticket No: 20243318517

Excavator Details

Caller Id: 599586
Contact: Andrew Passalis
Company: EGE Engineering Ltd.
Phone: 204-228-5775
Mobile: 204-228-5775
Email: apassalis@egeengineering.ca

Dig Site and Ticket Details

Open Map

Pls call 204.228.5775 to confirm locates have been completed.

Land Grids: LLD

Not Supplied

Latitude: 49.874728 **Longitude:** -97.323936

Ticket Status	Original
Ticket Type	Regular
Previous Ticket No.	Not Supplied
User Reference	0121-057-01
Ticket Date	2024-08-16T09:53:39-05:00
Work Start Date	2024-09-04T02:00:00-05:00
Address	480 Augier Ave, Winnipeg, R3K 1S5
Nearest Cross Street	Downs Village
Type of work	Poles/Holes
Activity	Soil Sample
Excavation Method	Drilling
Excavation Depth	>3m
Public Property	Road/Sidewalk
Private Property	Residential
Onsite Contact	Andrew Passalis
Onsite Phone	2042285775
Municipality	Not Supplied
Nearest Community	Not Supplied
Rural Subdivision	Not Supplied
Lot No.	
Block No.	
Plan No.	
ALP Option	No

Your Responsibilities

- Do not proceed with any excavation until all notified asset owners have responded by providing clearance, OR by identifying the location of their facilities with maps OR by placing locate marks on the ground.
- Pothole to establish the exact location of all underground assets using a hand shovel, before using heavy machinery.
- If you damage an underground asset you MUST advise the asset owner immediately.
- By using the Before You Dig Partners service, you agree to our privacy policy and the terms and conditions set out at on our web site.
- **For more information, visit www.BeforeYouDigPartners.com**

Utility Owner Details

The public utility owners listed below with a Status of "Notification Sent" have been requested to respond to your request. They may contact you directly for clarification of your request details.

Station Code	Authority Name	Status
MBHYDRO	MANITOBA HYDRO	Notification Sent
MTSWPG	MTS INC (MTSWPG)	Notification Sent
ROGSHWM1	ROGERS COMMUNICATIONS CANADA INC. (HERITAGE SHAW)	Notification Sent

END OF UTILITIES LIST


A.J And The Littles
Downs Vlg
Downs Vlg
Augier Ave
Google
Map data ©2024 Imagery ©2024 Airbus, Maxar Technologies


A.J And The Littles
Downs Vlg
Downs Vlg
Augier Ave
Google
Map data ©2024 Imagery ©2024 Airbus, Maxar Technologies

Locate Response Cover Letter

Date: 08/23/2024

The Installation Group
10 Bulmer Ave
Sundbury, ON
PJ3 3C3

Ph: (705)-222-2444
E: locate@installationgroup.ca

Requested By:
ANDREW PASSALIS
EGE ENGINEERING LTD.
(204)-228-5775 ext.
APASSALIS@EGEENGINEERING.CA

Re: Locate Results for OneCall Request

Ticket Number: 20243318517

Location: 480 AUGIER AVE
WINNIPEG, MB

Method of Marking:
☒ Paint ☒ Chalk ☒ Stakes ☒ Flags ☒ Offset Flags ☒ No Marks Other _____

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Locate Results:

UTILITY: BELLMTS STATUS: MARKED DATE LOCATED: 08/23/2024 LOCATED BY: ING NOTES: LOCATE COMPLETED

Ticket No: 20243318559

Excavator Details

Caller Id: 599586
Contact: Andrew Passalis
Company: EGE Engineering Ltd.
Phone: 204-228-5775
Mobile: 204-228-5775
Email: apassalis@egeengineering.ca

Dig Site and Ticket Details

Open Map

Call 204.228.5775 to confirm locates have been completed.

Land Grids: LLD

Not Supplied

Latitude: 49.874952 **Longitude:** -97.326483

Ticket Status	Original
Ticket Type	Regular
Previous Ticket No.	Not Supplied
User Reference	0121-057-01
Ticket Date	2024-08-16T09:58:24-05:00
Work Start Date	2024-09-04T02:00:00-05:00
Address	70 Oak Forest Crescent, Winnipeg, R3K 1M4
Nearest Cross Street	Oxbow Bend Road
Type of work	Poles/Holes
Activity	Soil Sample
Excavation Method	Drilling
Excavation Depth	>3m
Public Property	Road/Sidewalk
Private Property	None
Onsite Contact	Andrew Passalis
Onsite Phone	2042285775
Municipality	Not Supplied
Nearest Community	Not Supplied
Rural Subdivision	Not Supplied
Lot No.	
Block No.	
Plan No.	
ALP Option	No

Your Responsibilities

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Station Code	Authority Name	Status
MBHYDRO	MANITOBA HYDRO	Notification Sent

END OF UTILITIES LIST

Locate Response Cover Letter

Date: 08/24/2024

The Installation Group
10 Bulmer Ave
Sundbury, ON
PJ3 3C3

Ph: (705)-222-2444
E: locate@installationgroup.ca

Requested By:
ANDREW PASSALIS
EGE ENGINEERING LTD.
(204)-228-5775 ext.
APASSALIS@EGEENGINEERING.CA

Re: Locate Results for OneCall Request

Ticket Number: 20243318473

Location: 38 JEANNETTE BAY
WINNIPEG, MB

Method of Marking:
☐ Paint ☐ Chalk ☐ Stakes ☐ Flags ☐ Offset Flags ☐ No Marks Other _____

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Locate Results:

UTILITY: BELLMTS STATUS: MARKED DATE LOCATED: 08/23/2024 LOCATED BY: ING NOTES: LOCATE COMPLETED

Locate Response Cover Letter

Date: 08/23/2024

The Installation Group
10 Bulmer Ave
Sundbury, ON
PJ3 3C3

Ph: (705)-222-2444
E: locate@installationgroup.ca

Requested By:
ANDREW PASSALIS
EGE ENGINEERING LTD.
(204)-228-5775 ext.
APASSALIS@EGEENGINEERING.CA

Re: Locate Results for OneCall Request

Ticket Number: 20243318517

Location: 480 AUGIER AVE
WINNIPEG, MB

Method of Marking:
☐ Paint ☐ Chalk ☐ Stakes ☐ Flags ☐ Offset Flags ☐ No Marks Other _____

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Locate Results:

UTILITY: BELLMTS STATUS: MARKED DATE LOCATED: 08/23/2024 LOCATED BY: ING NOTES: LOCATE COMPLETED

April 06th, 2022

To all Excavators :

Bell locates are valid for the life of the excavation project and will not automatically be relocated every 90days.

Please note the following for the above apply:

A) Construction within the located area begins within 90 days of the ‘‘locate completed date’’ on the original ticket.

B) The construction company named on the locate remains active on the site.

Bell expects excavators will protect and preserve the paint marks put down on the original locate ticket. If markings are removed due to weather or excavation work, the excavator is expected to recreate the markings based on the tie-in measurements provided on the original locate ticket.

If an excavator would like their, markings freshened up, they can contact **TIG** (Bell Canada Locate Service Provider in this area) directly to arrange for them to place a fresh markings on the ground. **However, this will be at the excavator's expense.**

TIG can be reached at: 705 222 2444

The locate will be considered officially expired one day after the final day of construction.

Best regards

Bell Canada

April 06th, 2022

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Please note the following for the above apply:

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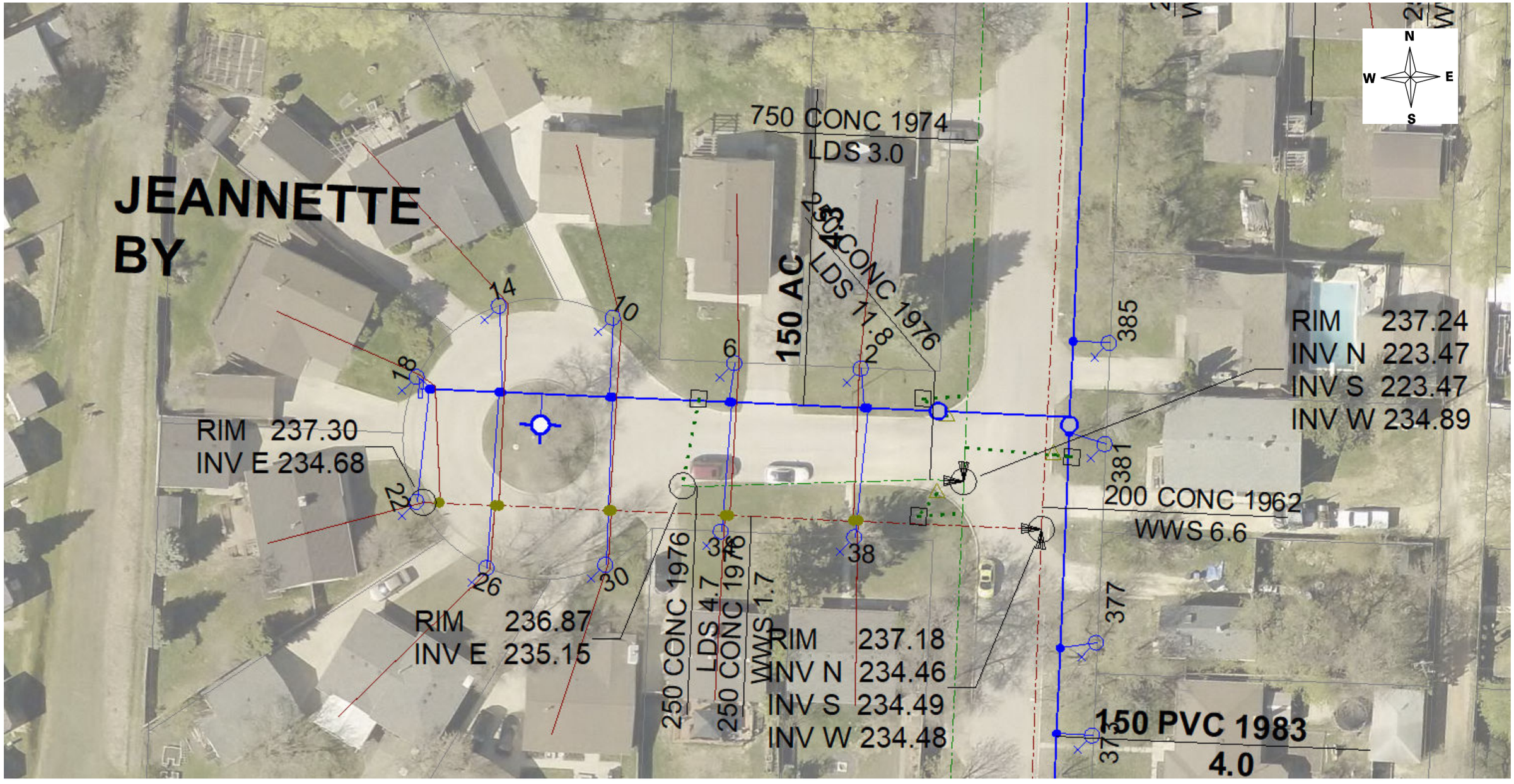
Bell Canada



Winnipeg
Water and Waste Department

CAUTION:
This is for information only.
There is no guarantee as to the accuracy or completeness of the data.
For record drawing information, please contact Underground Structures at 204-986-6401 or by e-mail at: ugsinforequest@winnipeg.ca

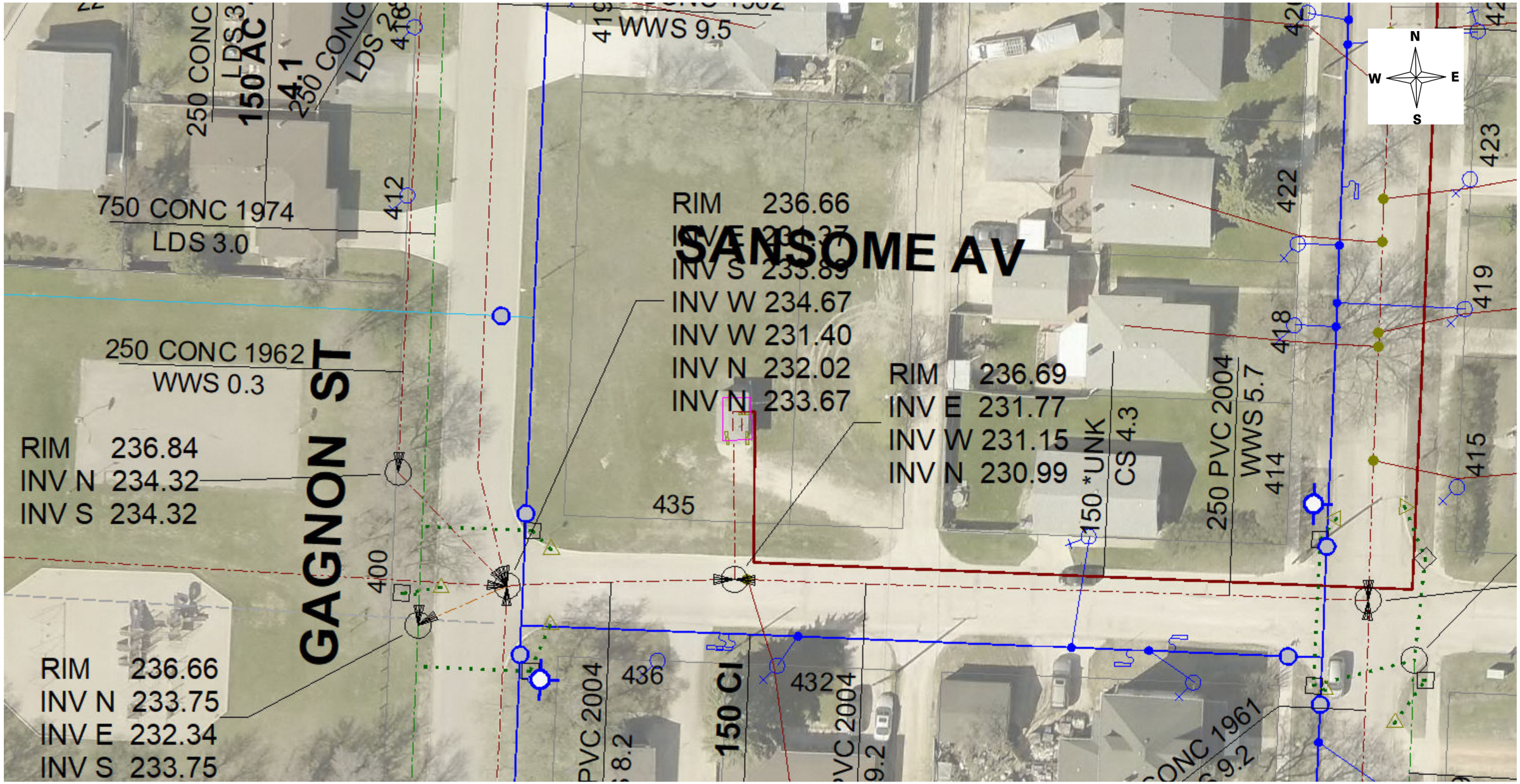
WATER

- Hydrant
- Valve, LH
- Valve, RH
- Valve, Air
- Curb Stop
- Anode
- Plug
- Service Corp
- Watermain
- Feedermain
- Aqueduct

SEWER

- Man Hole
- Catch Basin
- Curb Inlet
- Plug
- Service Junction
- Combined
- Land Drainage
- Waste Water
- Storm Relief
- Interceptor
- Force Main
- CB Lead

Print Date: August 20, 2024
Map Not to Scale



Winnipeg
Water and Waste Department

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WATER
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- Valve, LH
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- Curb Stop
- Anode
- Plug
- Service Corp
- Watermain
- Feedermain
- Aqueduct

SEWER
- Man Hole
- Catch Basin
- Curb Inlet
- Plug
- Service Junction
- Combined
- Land Drainage
- Waste Water
- Storm Relief
- Interceptor
- Force Main
- CB Lead

Print Date: August 20, 2024
Map Not to Scale

Auxiliary Locate Sheet

The Installation Group
Phone: 1-705-222-2444
Email: locate@installationgroup.ca

LOCATED:	Date Located: mm/dd/yyyy	Request #:
BellMTS	08 - 23 - 2024	20243318473

LOCATED AREA: EXCAVATION SHALL NOT WORK OUTSIDE THE LOCATED AREA WITHOUT OBTAINING ANOTHER LOCATE

FROM: CL OF GAGNON ST
TO: 14 M WEST
FROM: 15 M NORTH FROM CL JEANNETTE BAY
TO: 15 M SOUTH FROM CL JEANNETTE BAY

You must HAND DIG within one meter (3.28 feet) of markings for copper, distribution Fiber-optic cable and BELLMTS power cables. If you damage the plant you may be held liable. Depth varies and must be verified by hand digging or vacuum excavation. If you damage underground plant please notify facility owner immediately.

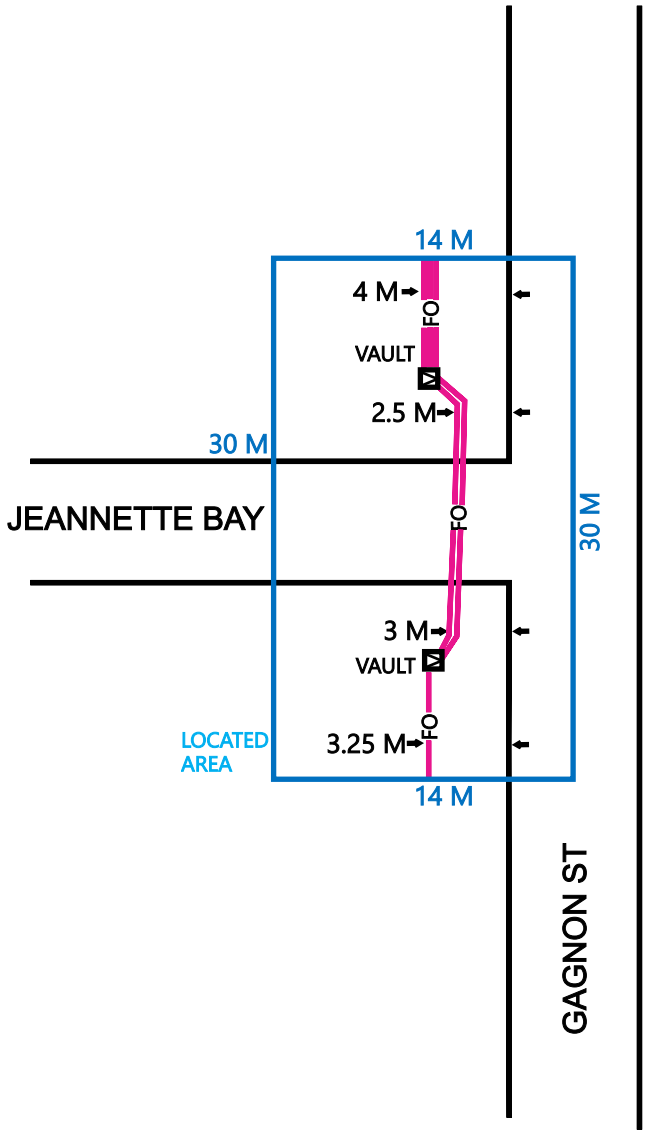
N W E S

LEGEND

Railway
Fence
Pole
Pedestal
Manhole
Box
Vault
Duct
Fire Hydrant
Building
North N
South S
East E
West W
Meter M
Fiber Optic Cable -FO-
Conduit -C-
Road Curb -Road Curb-
Road Edge-Road Edge-

Copper - Orange Broken Line
Fibre Optic - Pink Line
Conduit - Green Line
JUH - Black Line
Un Tonable Cable - Purple

MD



Auxiliary Locate Sheet

The Installation Group
Phone: 1-705-222-2444
Email: locate@installationgroup.ca

LOCATED:	Date Located: mm/dd/yyyy	Request #:
BellMTS	08 - 23 - 2024	20243318517

LOCATED AREA: EXCAVATION SHALL NOT WORK OUTSIDE THE LOCATED AREA WITHOUT OBTAINING ANOTHER LOCATE

FROM: SOUTH EDGE OF AUGIER RD TO: 12 M SOUTH

FROM: 2 M EAST FROM THE EAST EDGE OF PL 329 TO: 28 M EAST

You must HAND DIG within one meter (3.28 feet) of markings for copper, distribution Fiber-optic cable and BELLMTS power cables. If you damage the plant you may be held liable. Depth varies and must be verified by hand digging or vacuum excavation. If you damage underground plant please notify facility owner immediately.

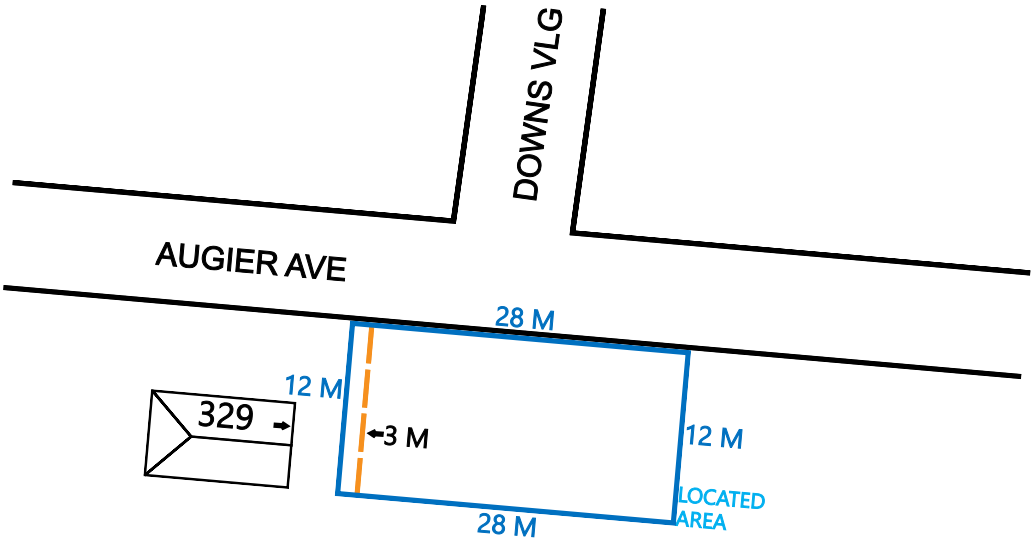
N W E S

LEGEND

Railway
Fence
Pole
Pedestal
Manhole
Box
Vault
Duct
Fire Hydrant
Building
North N
South S
East E
West W
Meter M
Fiber Optic Cable -FO-
Conduit -C-
Road Curb -Road Curb-
Road Edge-Road Edge-

Copper - Orange Broken Line
Fibre Optic - Pink Line
Conduit - Green Line
JUH - Black Line
Un Tonable Cable - Purple

MD



Auxiliary Locate Sheet

The Installation Group
Phone: 1-705-222-2444
Email: locate@installationgroup.ca

LOCATED:	Date Located: mm/dd/yyyy	Request #:
BellMTS	08 - 23 - 2024	20243318517

LOCATED AREA: EXCAVATION SHALL NOT WORK OUTSIDE THE LOCATED AREA WITHOUT OBTAINING ANOTHER LOCATE

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FROM: 2 M EAST FROM THE EAST EDGE OF PL 329 TO: 28 M EAST

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N W E S

LEGEND

Railway
Fence
Pole
Pedestal
Manhole
Box
Vault
Duct
Fire Hydrant
Building
North N
South S
East E
West W
Meter M
Fiber Optic Cable -FO-
Conduit -C-
Road Curb -Road Curb-
Road Edge-Road Edge-

Copper - Orange Broken Line
Fibre Optic - Pink Line
Conduit - Green Line
JUH - Black Line
Un Tonable Cable - Purple

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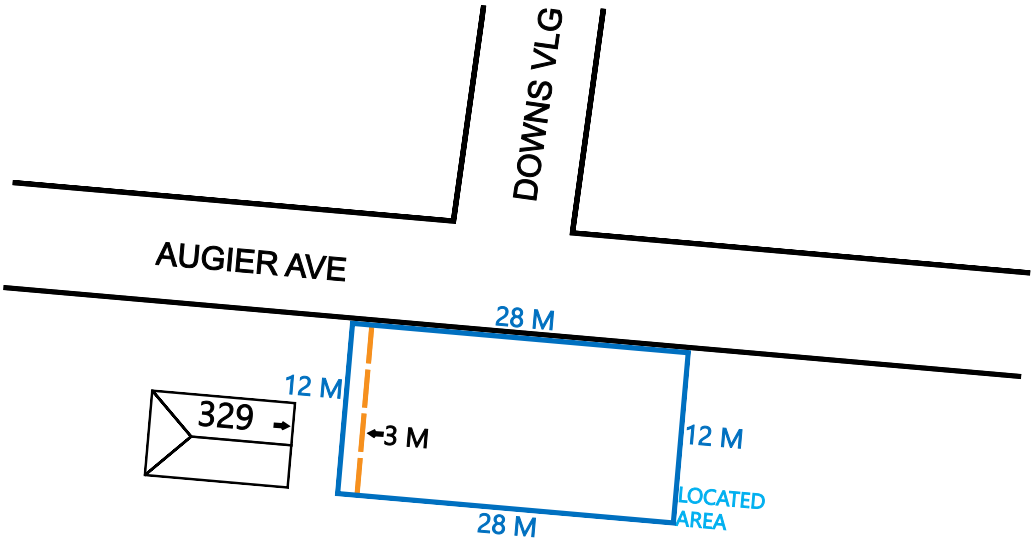


APPENDIX C

GRAIN SIZE ANALYSES

MEMORANDUM

Quality Engineering | Valued Relationships

Date	September 26, 2024
To	Andrew Passalis, TREK Geotechnical
From	Angela Fidler-Kliewer, TREK Geotechnical
Project No.	0013-056-00
Project	St. Charles Hydrogeological
Subject	Laboratory Analysis – R24-475

Distribution

Attached are the laboratory testing results for the above noted project. The testing included moisture content determinations and particle size analysis (Hydrometer method).

Regards,

Angela Fidler-Kliewer, C.Tech.

Attach.

Review Control:

Prepared By: DS	*Reviewed By:* AFK	*Checked By:* NJF

www.trekgeotechnical.ca
1712 St. James Street | Winnipeg, Manitoba R3H 0L3 | Tel 1.204.975.9433 | Fax 1.204.975.9435

TREK GEOTECHNICAL
1712 St. James Street
Winnipeg, Manitoba R3H 0L3
T 204.975.9433 F 204.975.9435

Lab Requisition

PROJECT: ST. CHARLES HYDROGEOLOGICAL PROJECT NO: 0013-056-00

CLIENT: AECOM FIELD TECHNICIAN: A. PASSALIS

TEST HOLE NUMBER	SAMPLE NUMBER	DEPTH OF SAMPLE (ft)	TARE NUMBER (LAB USE ONLY)	MOISTURE	VISUAL CLASS.	ATTERBERG LIMITS	HYDROMETER	GRADATION	STD. PROCTOR	UNCONFINED AND AUXILLARY TESTS				Soil Description/ Comments
TH24-01A	G1	12-13'		X			X	X						Clay.
TH24-01A	G2	18-19'		X			X	X						Silt till.
TH24-02B	C11	41'1"-42'8"		X			X	X						Silt till

REQUESTED BY: A. PASSALIS REPORT TO: A. PASSALIS

REQUISITION DATE: SEPT 18/24

COMMENTS:

REQUISITION NO. R24-475

SHEET 1 OF 1

Feb 21, 2023

www.trekgeotechnical.ca
1712 St. James Street
Winnipeg, MB R3H 0L3
Tel: 204.975.9433 Fax: 204.975.9435

Moisture Content Report
ASTM D2216-98

Project No. 0013-056-00
Client Aecom
Project St. Charles Hydrogeological

Sample Date 12-Sep-24
Test Date 18-Sep-24
Technician E.Gutierre

Test Hole	TH24-01A	TH24-01A	TH24-02B			
Depth (m)	3.7 - 4.0	5.5 - 5.8	12.5 - 13.0			
Sample #	G1	G2	C11			
Tare ID	M15	P33	Wendy			
Mass of tare	6.9	8.4	440.9			
Mass wet + tare	420.7	609.9	1784.7			
Mass dry + tare	323.7	538.3	1626.1			
Mass water	97.0	71.6	158.6			
Mass dry soil	316.8	529.9	1185.2			
Moisture %	30.6%	13.5%	13.4%			

www.trekgeotechnical.ca
1712 St. James Street
Winnipeg, MB R3H 0L3
Tel: 204.975.9433 Fax: 204.975.9435

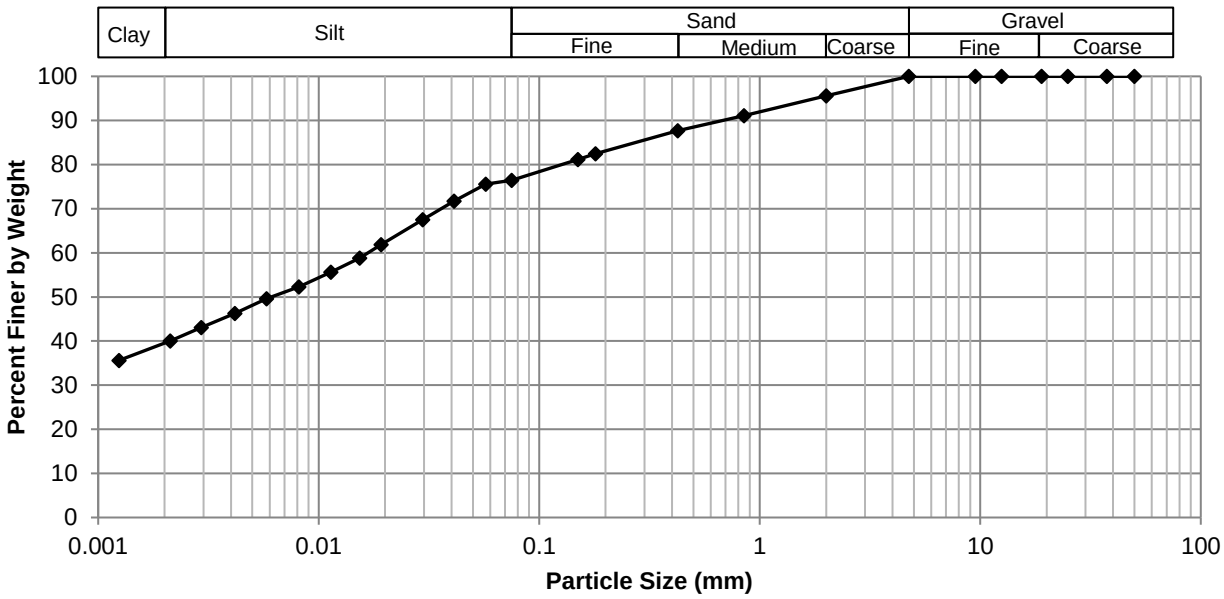
Grain Size Analysis (Hydrometer Method)
AASHTO T 88

Project No.	0013-058-00
Client	Aecom
Project	St. Charles Hydrogeological
Test Hole	TH24-01A
Sample #	G1
Depth (m)	3.7 - 4.0
Sample Date	12-Sep-24
Test Date	23-Sep-24
Technician	S. Lee

CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Gravel	0.0%
Sand	23.6%
Silt	37.0%
Clay	39.4%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**
50.0	100.00	4.75	100.00	0.0750	76.42
37.5	100.00	2.00	95.58	0.0572	75.59
25.0	100.00	0.850	91.12	0.0412	71.70
19.0	100.00	0.425	87.68	0.0296	67.52
12.5	100.00	0.180	82.48	0.0192	61.84
9.50	100.00	0.150	81.14	0.0154	58.85
4.75	100.00	0.075	76.42	0.0113	55.60
				0.0081	52.32
				0.0058	49.63
				0.0042	46.26
				0.0029	43.11
				0.0021	40.06
				0.0012	35.62

www.trekgeotechnical.ca
1712 St. James Street
Winnipeg, MB R3H 0L3
Tel: 204.975.9433 Fax: 204.975.9435

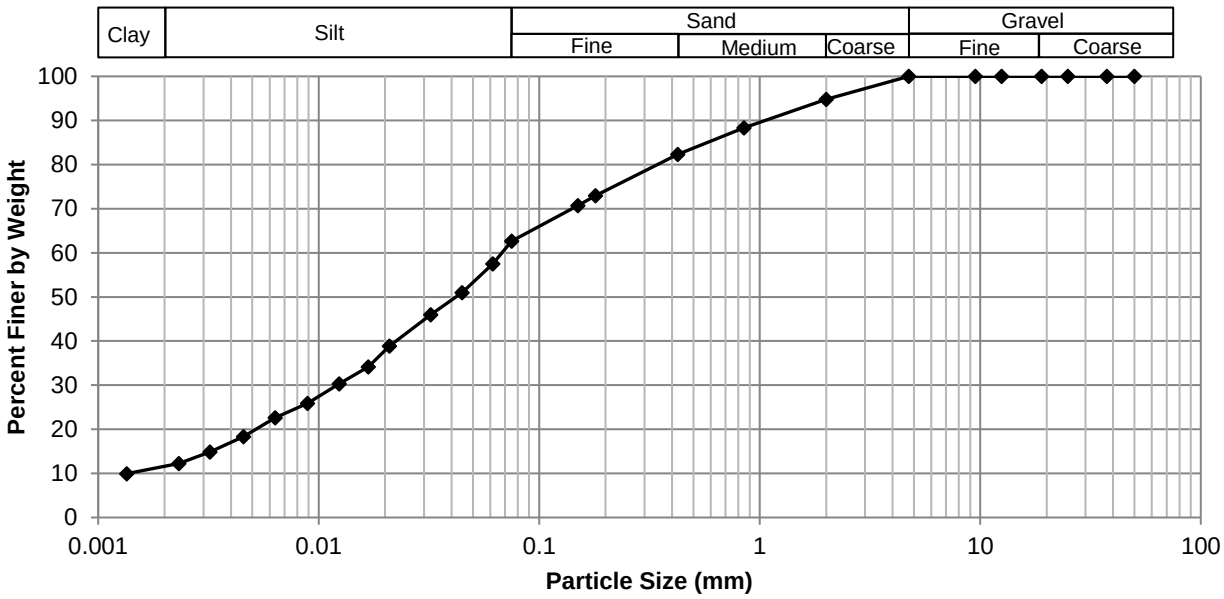
Grain Size Analysis (Hydrometer Method)
AASHTO T 88

Project No.	0013-058-00
Client	Aecom
Project	St. Charles Hydrogeological
Test Hole	TH24-01A
Sample #	G2
Depth (m)	5.5 - 5.8
Sample Date	12-Sep-24
Test Date	23-Sep-24
Technician	S. Lee

CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Gravel	0.0%
Sand	37.4%
Silt	52.6%
Clay	10.0%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**
50.0	100.00	4.75	100.00	0.0750	62.64
37.5	100.00	2.00	94.78	0.0617	57.53
25.0	100.00	0.850	88.31	0.0447	51.01
19.0	100.00	0.425	82.31	0.0322	45.97
12.5	100.00	0.180	72.97	0.0209	38.86
9.50	100.00	0.150	70.69	0.0168	34.12
4.75	100.00	0.075	62.64	0.0124	30.32
				0.0089	25.88
				0.0064	22.62
				0.0046	18.35
				0.0032	14.86
				0.0023	12.25
				0.0013	9.93

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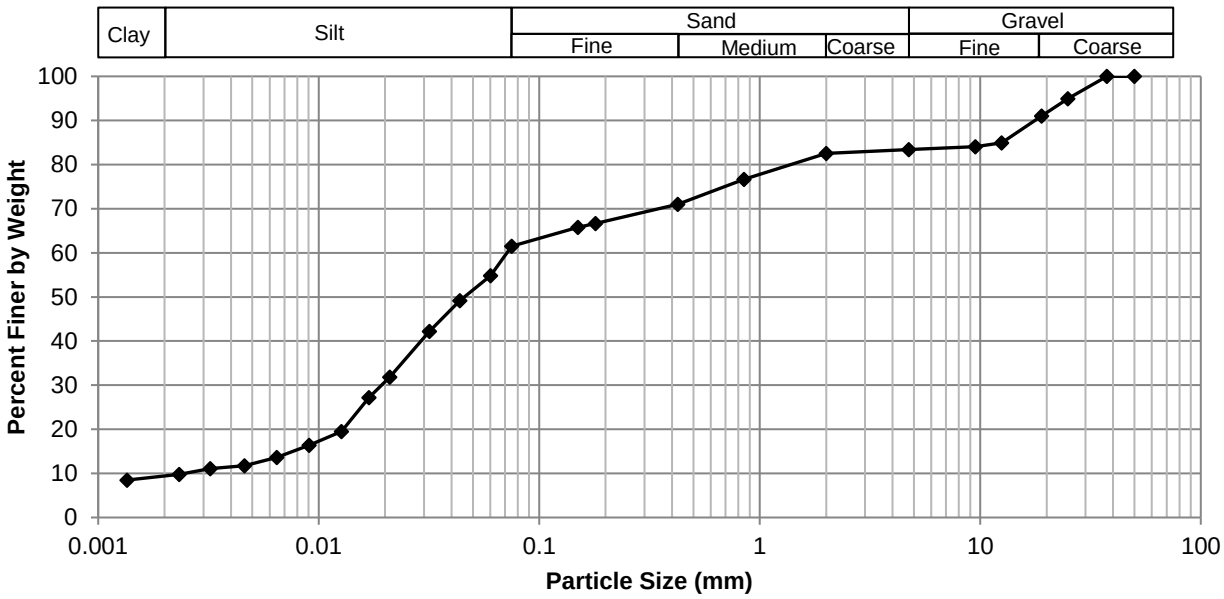
Grain Size Analysis (Hydrometer Method)
AASHTO T 88

CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Project No.	0013-058-00
Client	Aecom
Project	St. Charles Hydrogeological
Test Hole	TH24-02B
Sample #	C11
Depth (m)	12.5 - 13.0
Sample Date	12-Sep-24
Test Date	24-Sep-24
Technician	S. Lee

Gravel	16.6%
Sand	21.9%
Silt	52.2%
Clay	9.3%

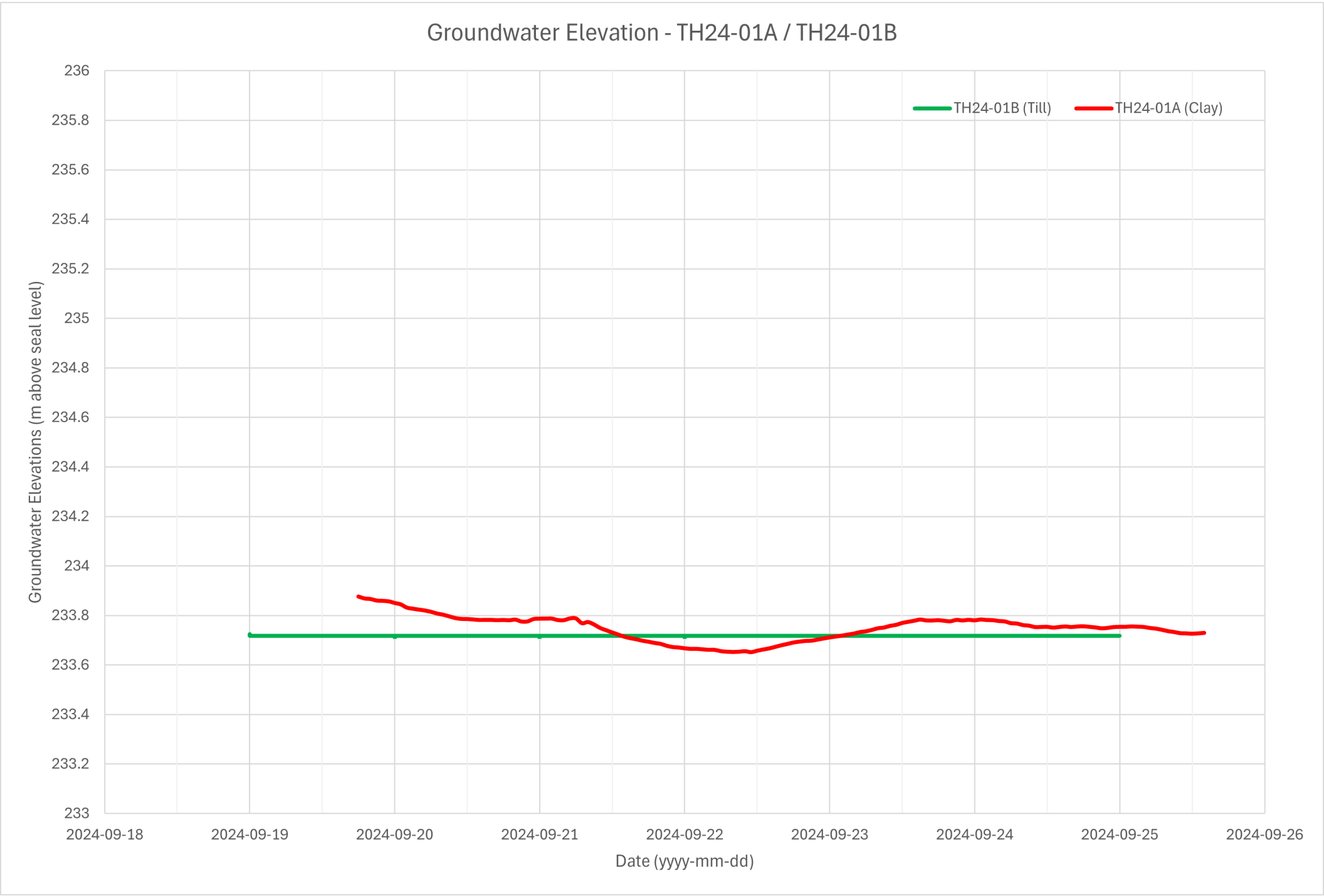
Particle Size Distribution Curve

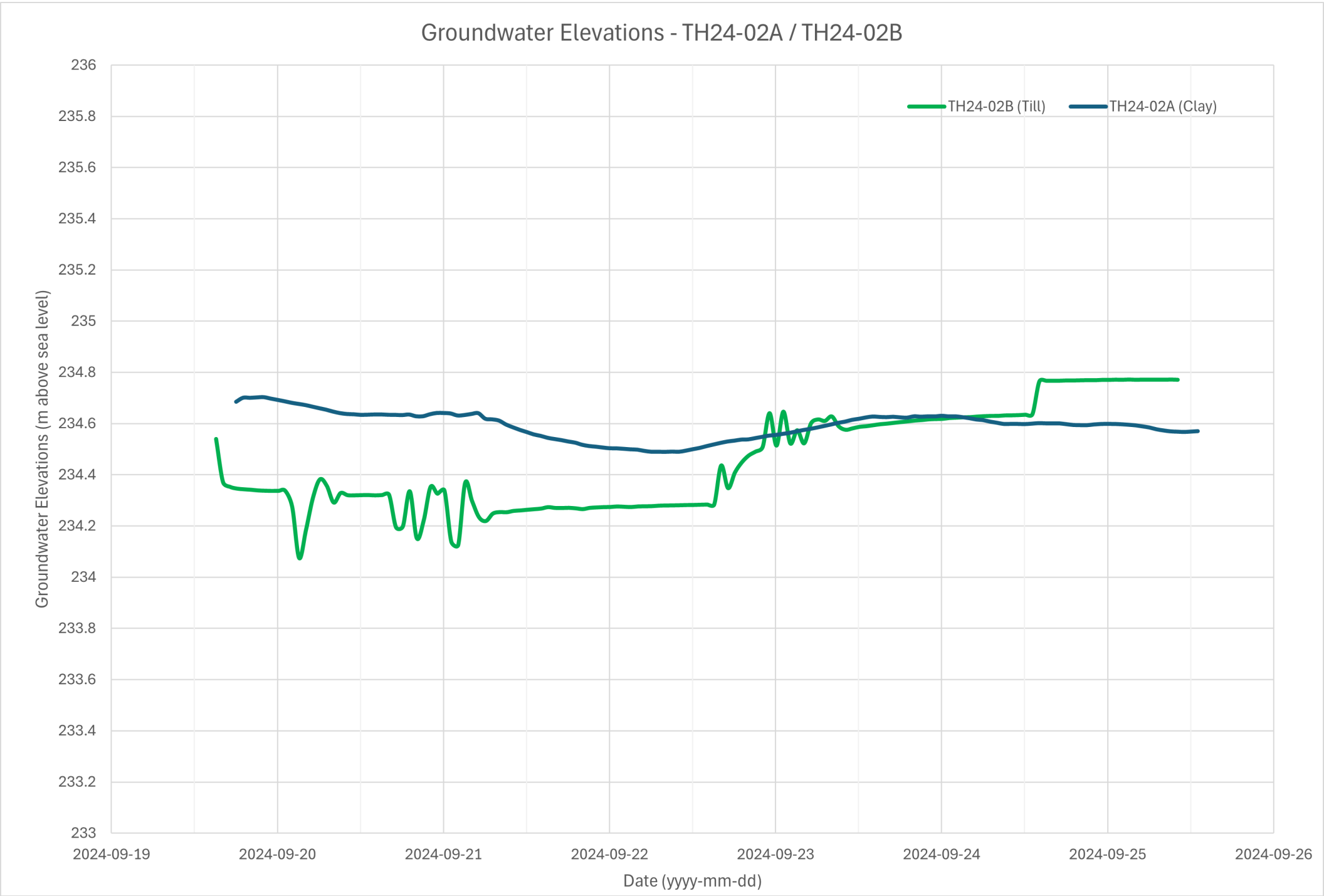


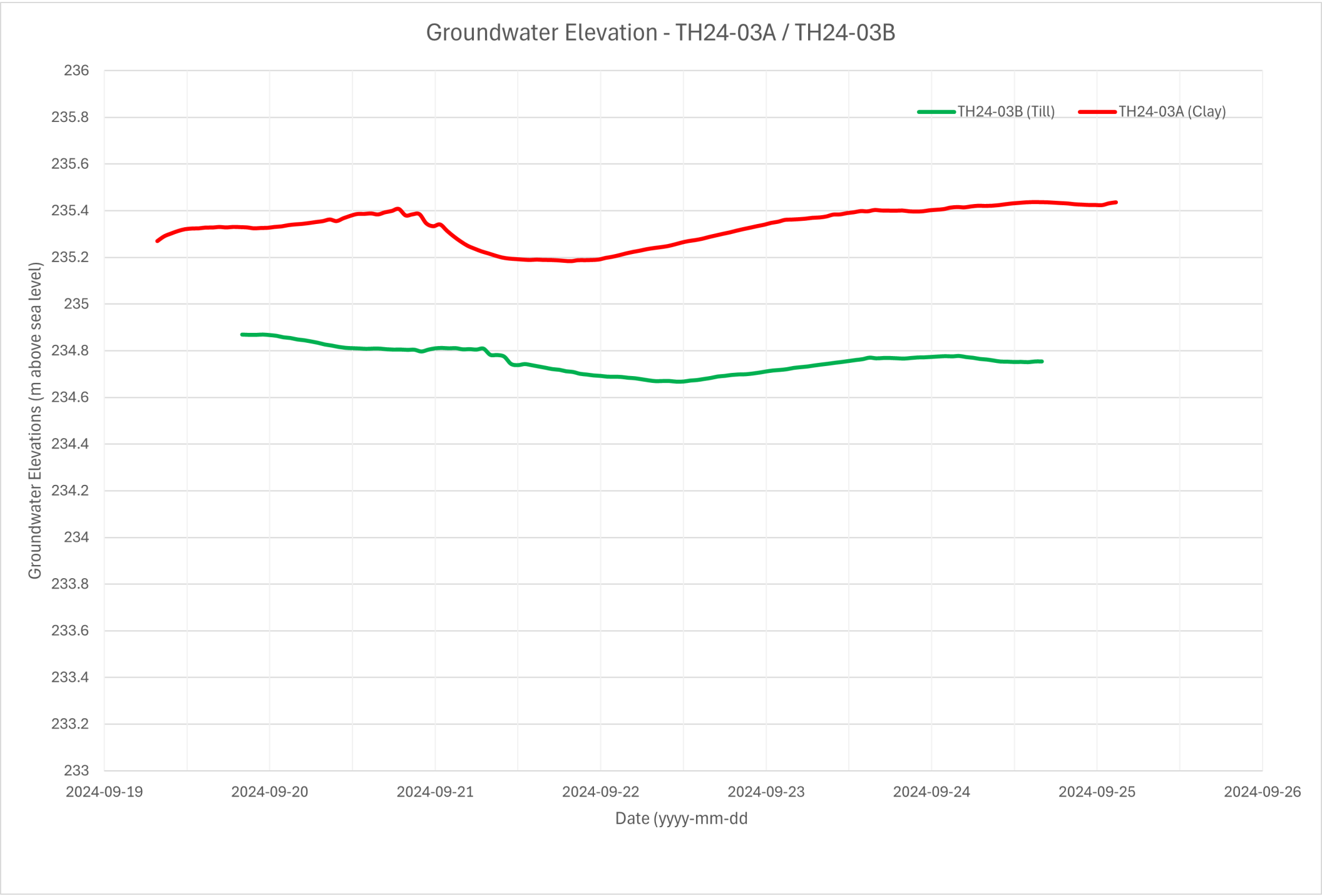
Gravel		Sand		Silt and Clay	
Particle Size (mm)	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**
50.0	100.00	4.75	83.43	0.0750	61.50
37.5	100.00	2.00	82.54	0.0601	54.83
25.0	94.95	0.850	76.65	0.0436	49.15
19.0	90.99	0.425	70.98	0.0318	42.18
12.5	84.94	0.180	66.68	0.0210	31.86
9.50	84.08	0.150	65.79	0.0169	27.22
4.75	83.43	0.075	61.50	0.0127	19.47
				0.0091	16.41
				0.0065	13.61
				0.0046	11.77
				0.0032	11.06
				0.0023	9.77
				0.0014	8.48

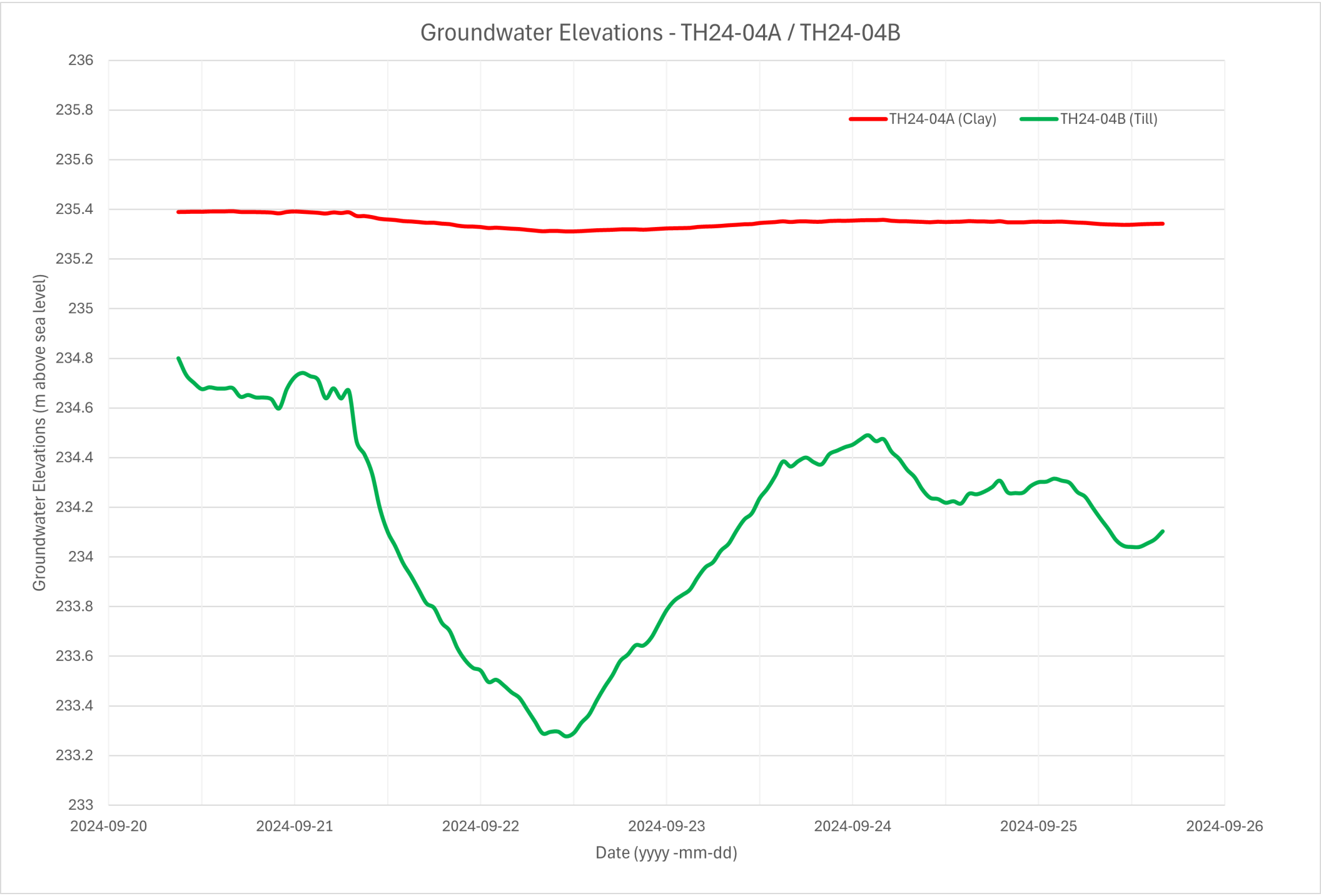
APPENDIX D

WATER LEVEL TRANSDUCER PLOTS


Groundwater Elevation - TH24-01A / TH24-01B
TH24-01B (Till)
TH24-01A (Clay)
Groundwater Elevations (m above seal level)
236
235.8
235.6
235.4
235.2
235
234.8
234.6
234.4
234.2
234
233.8
233.6
233.4
233.2
233
2024-09-18
2024-09-19
2024-09-20
2024-09-21
2024-09-22
2024-09-23
2024-09-24
2024-09-25
2024-09-26
Date (yyyy-mm-dd)


Groundwater Elevations - TH24-02A / TH24-02B
TH24-02B (Till)
TH24-02A (Clay)
Groundwater Elevations (m above sea level)
236
235.8
235.6
235.4
235.2
235
234.8
234.6
234.4
234.2
234
233.8
233.6
233.4
233.2
233
2024-09-19
2024-09-20
2024-09-21
2024-09-22
2024-09-23
2024-09-24
2024-09-25
2024-09-26
Date (yyyy-mm-dd)


Groundwater Elevation - TH24-03A / TH24-03B
TH24-03B (Till)
TH24-03A (Clay)
Groundwater Elevations (m above sea level)
236
235.8
235.6
235.4
235.2
235
234.8
234.6
234.4
234.2
234
233.8
233.6
233.4
233.2
233
2024-09-19
2024-09-20
2024-09-21
2024-09-22
2024-09-23
2024-09-24
2024-09-25
2024-09-26
Date (yyyy-mm-dd


Groundwater Elevations - TH24-04A / TH24-04B
TH24-04A (Clay)
TH24-04B (Till)
Groundwater Elevations (m above sea level)
236
235.8
235.6
235.4
235.2
235
234.8
234.6
234.4
234.2
234
233.8
233.6
233.4
233.2
233
2024-09-20
2024-09-21
2024-09-22
2024-09-23
2024-09-24
2024-09-25
2024-09-26
Date (yyyy -mm-dd)

APPENDIX E

SINGLE WELL RESPONSE /

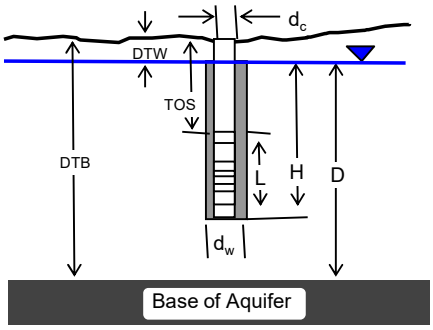
HYDRAULIC CONDUCTIVITY TEST DATA PLOTS

St. Charles Hydrogeological Assessment

Well ID: **TH24-01A** 2189535
Date: 2024-09-25
Time: 2:36:59 PM

INPUT

Construction:		
Casing dia. (d_c)	50	mm
Annulus dia. (d_w)	130	mm
Screen Length (L)	1.62	Meter
Depths to:		
water level (DTW)	2.904	Meter
top of screen (TOS)	3.1	Meter
Base of Aquifer (DTB)	4.85	Meter
Annular Fill:		
across screen --	Fine Sand	
above screen --	Bentonite	
Aquifer Material --	Till	



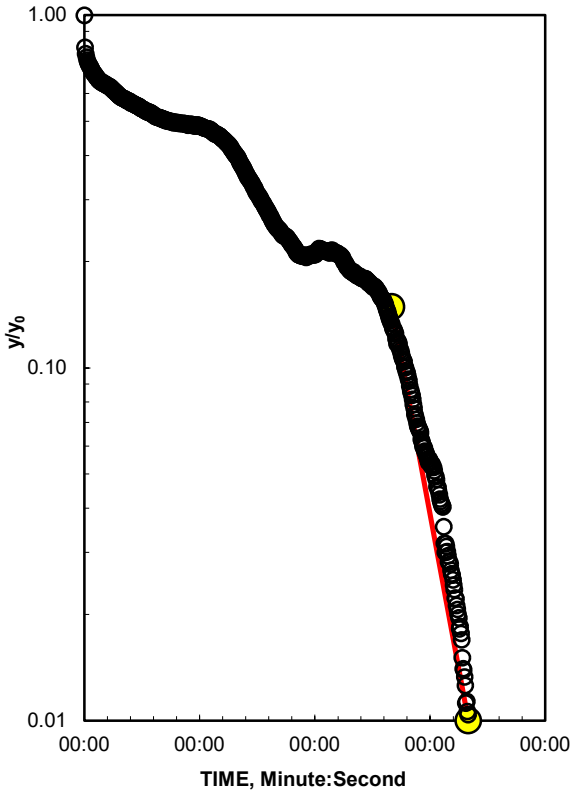
COMPUTED

L_{wetted}	1.62	Meter
D =	1.946	Meter
H =	1.816	Meter
L/r_w =	24.92	
$y_{0\text{-DISPLACEMENT}}$ =	0.96	Meter
$y_{0\text{-SLUG}}$ =	1.10	Meter
From look-up table using L/r_w		
Partial penetrate A =	2.362	
B =	0.383	
ln(Re/rw) =	2.295	
Re =	2.12	Meter
Slope =	2.04E-05	log_{10}/sec
$t_{90\%}$ recovery =	49046	sec

Input is consistent.

K = 2.1E-08 Meter/Second

Adjust slope of line to estimate K



REMARKS:

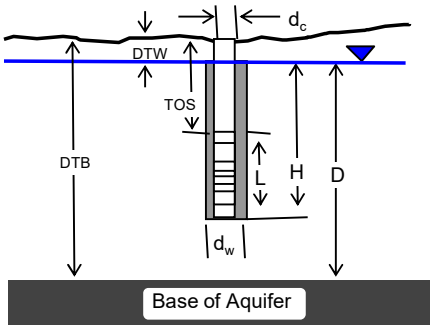
Bouwer and Rice analysis of slug test, WRR 1976

St. Charles Hydrogeological Assessment

Well ID: **TH24-02A** 2189541
Date: 2024-09-25
Time: 3:00:45 PM

INPUT

Construction:		
Casing dia. (d_c)	50	mm
Annulus dia. (d_w)	130	mm
Screen Length (L)	1.56	Meter
Depths to:		
water level (DTW)	2.625	Meter
top of screen (TOS)	3.51	Meter
Base of Aquifer (DTB)	6.7	Meter
Annular Fill:		
across screen --	Fine Sand	
above screen --	Bentonite	
Aquifer Material --	Clay	



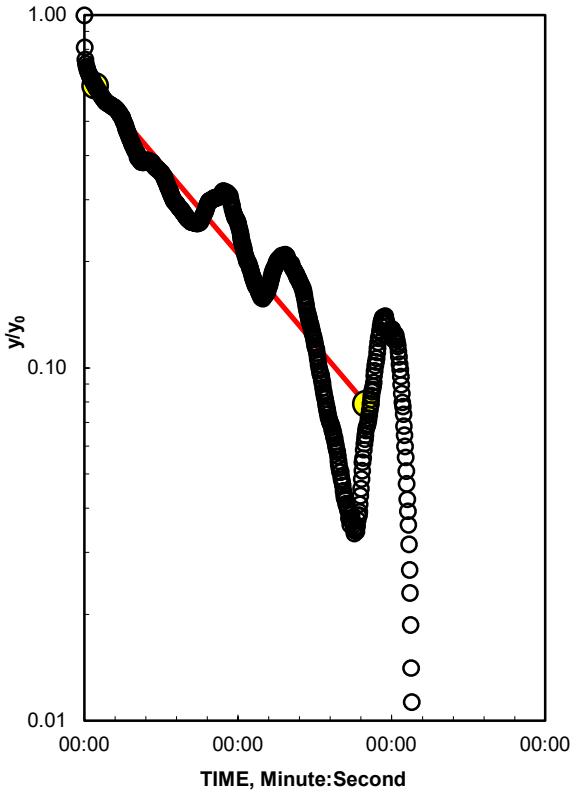
COMPUTED

L_{wetted}	1.56	Meter
D =	4.075	Meter
H =	2.445	Meter
L/r_w =	24.00	
$y_{0\text{-DISPLACEMENT}}$ =	1.97	Meter
$y_{0\text{-SLUG}}$ =	1.73	Meter
From look-up table using L/r_w		
Partial penetrate A =	2.334	
B =	0.376	
ln(Re/rw) =	2.217	
Re =	1.96	Meter
Slope =	1.18E-06	log_{10}/sec
$t_{90\%}$ recovery =	843948	sec

Input is consistent.

K = 1.2E-09 Meter/Second

Adjust slope of line to estimate K



K= 0.0000000012 is greater than likely maximum of 0.000000000353 for Clay

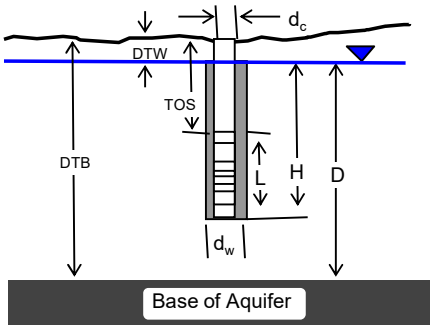
REMARKS: Bouwer and Rice analysis of slug test, WRR 1976

St. Charles Hydrogeological Assessment

Well ID: **TH24-02B** 2189543
Date: 2024-09-27
Time: 3:05:57 PM

INPUT

Construction:		
Casing dia. (d_c)	50	mm
Annulus dia. (d_w)	130	mm
Screen Length (L)	1.48	Meter
Depths to:		
water level (DTW)	2.81	Meter
top of screen (TOS)	8.79	Meter
Base of Aquifer (DTB)	13	Meter
Annular Fill:		
across screen --	Fine Sand	
above screen --	Bentonite	
Aquifer Material --	Sand and Gravel Mixes	



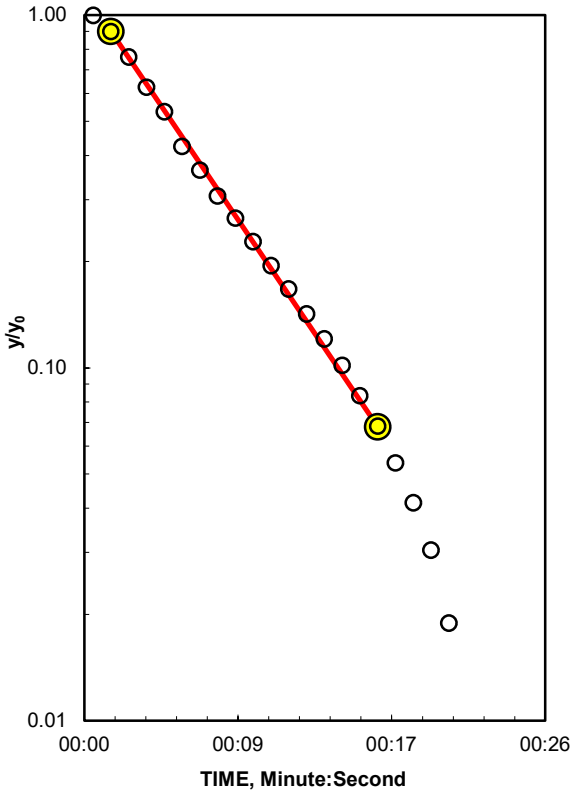
COMPUTED

L_{wetted}	1.48	Meter
D =	10.19	Meter
H =	7.46	Meter
L/r_w =	22.77	
$y_{0\text{-DISPLACEMENT}}$ =	1.33	Meter
$y_{0\text{-SLUG}}$ =	1.26	Meter
From look-up table using L/r_w		
Partial penetrate A =	2.296	
B =	0.367	
ln(Re/rw) =	2.544	
Re =	2.72	Meter
Slope =	0.074782	$\log_{10}$/sec
$t_{90\%}$ recovery =	13	sec

Input is consistent.

K = 0.000092 Meter/Second

Adjust slope of line to estimate K



K= 0.000092 is less than likely minimum of 0.000106 for Sand and Gravel Mixes

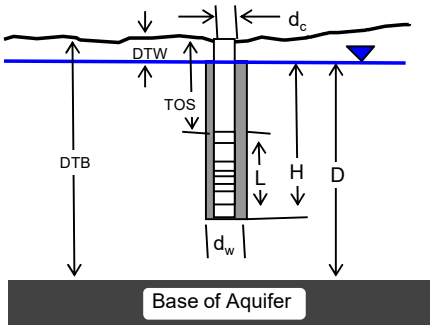
REMARKS: Bouwer and Rice analysis of slug test, WRR 1976

St. Charles Hydrogeological Assessment

Well ID: **TH24-03A** 2136482
Date: 2024-09-25
Time: 3:42:31 PM

INPUT

Construction:		
Casing dia. (d_c)	50	mm
Annulus dia. (d_w)	130	mm
Screen Length (L)	1.44	Meter
Depths to:		
water level (DTW)	0.57	Meter
top of screen (TOS)	3.71	Meter
Base of Aquifer (DTB)	6.7	Meter
Annular Fill:		
across screen --	Fine Sand	
above screen --	Bentonite	
Aquifer Material --	Silt, Loess	



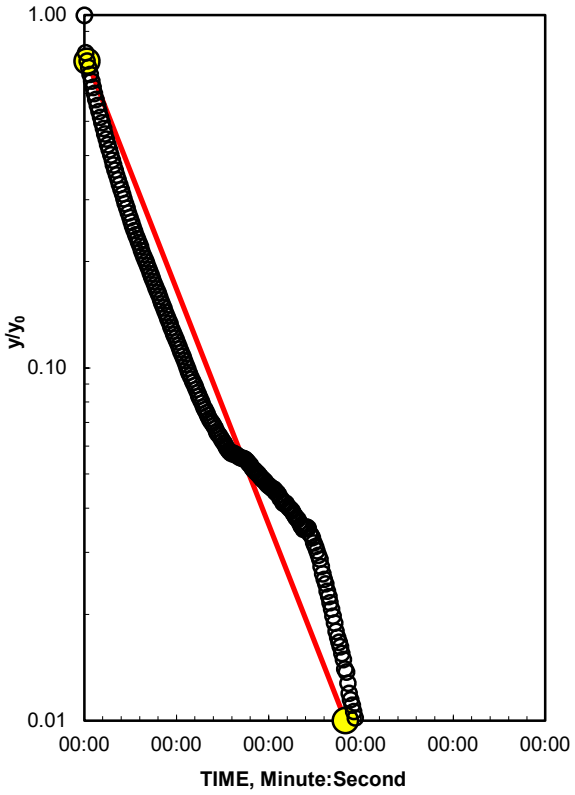
COMPUTED

L_{wetted}	1.44	Meter
D =	6.13	Meter
H =	4.58	Meter
L/r_w =	22.15	
$y_{0\text{-DISPLACEMENT}}$ =	3.91	Meter
$y_{0\text{-SLUG}}$ =	3.45	Meter
From look-up table using L/r_w		
Partial penetrate A =	2.276	
B =	0.363	
ln(Re/rw) =	2.420	
Re =	2.40	Meter
Slope =	1.55E-05	$\log_{10}$/sec
$t_{90\%}$ recovery =	64723	sec

Input is consistent.

K = 1.9E-08 Meter/Second

Adjust slope of line to estimate K



REMARKS:

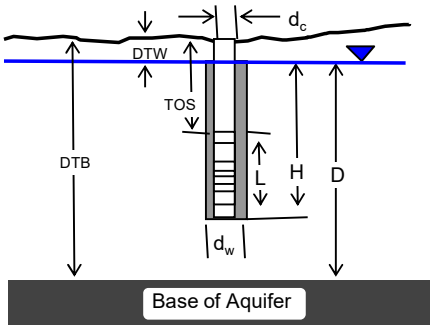
Bouwer and Rice analysis of slug test, WRR 1976

St. Charles Hydrogeological Assessment

Well ID: **TH24-03B** 2189542
Date: 2024-09-27
Time: 3:51:21 PM

INPUT

Construction:		
Casing dia. (d_c)	50	mm
Annulus dia. (d_w)	130	mm
Screen Length (L)	1.53	Meter
Depths to:		
water level (DTW)	1.4	Meter
top of screen (TOS)	9.195	Meter
Base of Aquifer (DTB)	12.05	Meter
Annular Fill:		
across screen --	Fine Sand	
above screen --	Bentonite	
Aquifer Material --	Sand and Gravel Mixes	



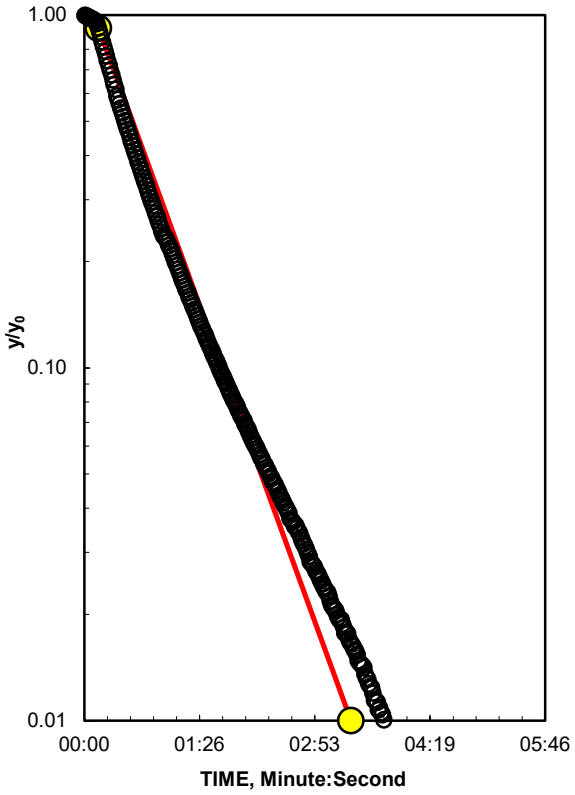
COMPUTED

L_{wetted}	1.53	Meter
D =	10.65	Meter
H =	9.325	Meter
L/r_w =	23.54	
$y_{0\text{-DISPLACEMENT}}$ =	1.46	Meter
$y_{0\text{-SLUG}}$ =	1.26	Meter
From look-up table using L/r_w		
Partial penetrate A =	2.320	
B =	0.373	
ln(Re/rw) =	2.718	
Re =	3.23	Meter
Slope =	0.010363	$\log_{10}$/sec
$t_{90\%}$ recovery =	96	sec

Input is consistent.

K = 0.000013 Meter/Second

Adjust slope of line to estimate K



K= 0.000013 is less than likely minimum of 0.000106 for Sand and Gravel Mixes

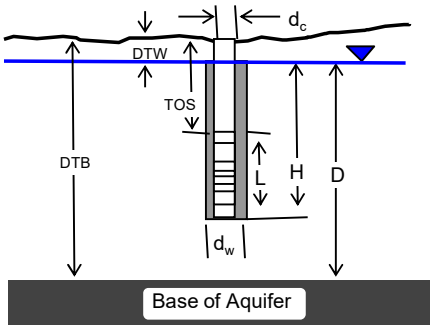
REMARKS: Bouwer and Rice analysis of slug test, WRR 1976

St. Charles Hydrogeological Assessment

Well ID: **TH24-04A** 2136482
Date: 2024-09-25
Time: 3:42:31 PM

INPUT

Construction:		
Casing dia. (d_c)	50	mm
Annulus dia. (d_w)	130	mm
Screen Length (L)	1.5	Meter
Depths to:		
water level (DTW)	1.03	Meter
top of screen (TOS)	3.54	Meter
Base of Aquifer (DTB)	5.5	Meter
Annular Fill:		
across screen --	Fine Sand	
above screen --	Bentonite	
Aquifer Material --	Silt, Loess	



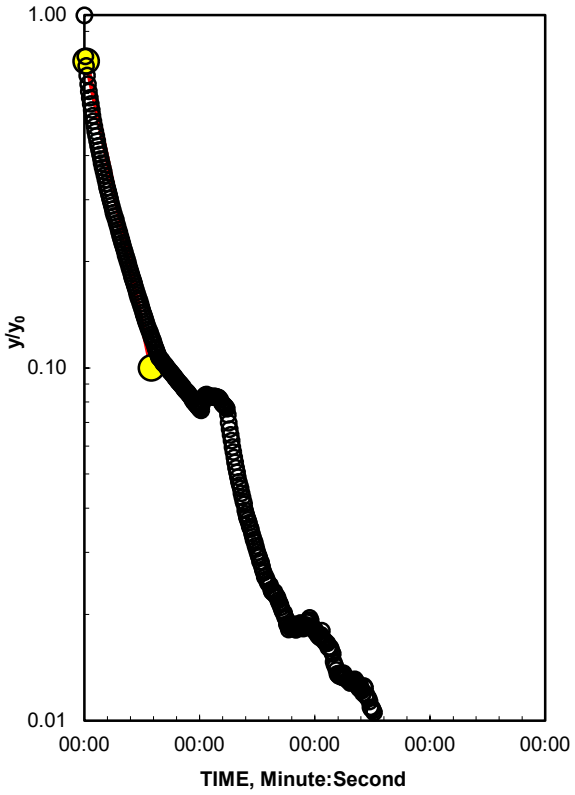
COMPUTED

L_{wetted}	1.5	Meter
D =	4.47	Meter
H =	4.01	Meter
L/r_w =	23.08	
$y_{0\text{-DISPLACEMENT}}$ =	3.65	Meter
$y_{0\text{-SLUG}}$ =	3.45	Meter
From look-up table using L/r_w		
Partial penetrate A =	2.306	
B =	0.370	
ln(Re/rw) =	2.512	
Re =	2.63	Meter
Slope =	1.77E-05	$\log_{10}$/sec
$t_{90\%}$ recovery =	56356	sec

Input is consistent.

K = 2.1E-08 Meter/Second

Adjust slope of line to estimate K



REMARKS:

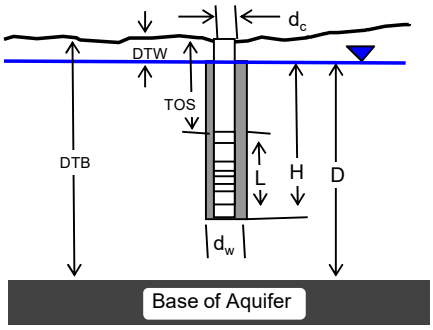
Bouwer and Rice analysis of slug test, WRR 1976

St. Charles Hydrogeological Assessment

Well ID: **TH24-04B** 2152577
Date: 2024-09-27
Time: 4:23:06 PM

INPUT

Construction:		
Casing dia. (d_c)	50	mm
Annulus dia. (d_w)	130	mm
Screen Length (L)	1.5	Meter
Depths to:		
water level (DTW)	1.615	Meter
top of screen (TOS)	10.79	Meter
Base of Aquifer (DTB)	13.24	Meter
Annular Fill:		
across screen --	Fine Sand	
above screen --	Bentonite	
Aquifer Material --	Sand and Gravel Mixes	



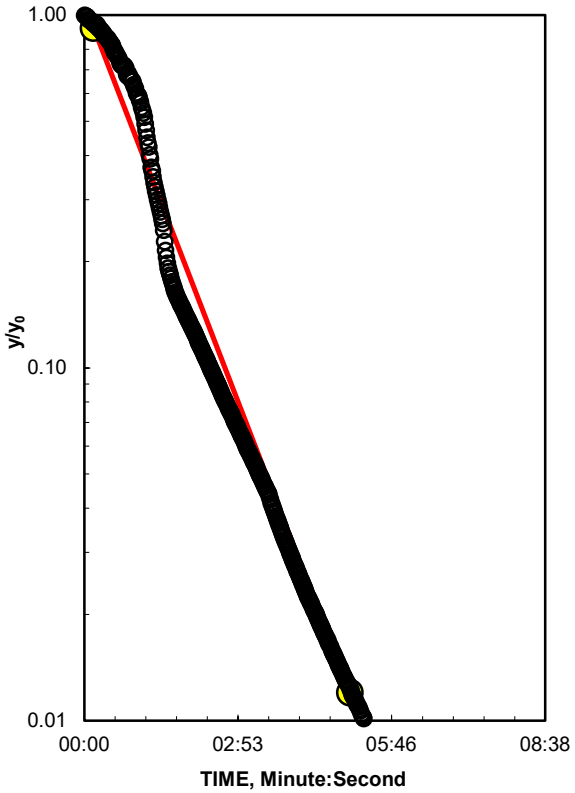
COMPUTED

L_{wetted}	1.5	Meter
D =	11.625	Meter
H =	10.675	Meter
L/r_w =	23.08	
$y_{0\text{-DISPLACEMENT}}$ =	8.69	Meter
$y_{0\text{-SLUG}}$ =	7.22	Meter
From look-up table using L/r_w		
Partial penetrate A =	2.306	
B =	0.370	
ln(Re/rw) =	2.789	
Re =	3.47	Meter
Slope =	0.006532	$\log_{10}$/sec
$t_{90\%}$ recovery =	153	sec

Input is consistent.

K = 8.7E-06 Meter/Second

Adjust slope of line to estimate K



K= 0.0000087 is less than likely minimum of 0.000106 for Sand and Gravel Mixes

REMARKS: Bouwer and Rice analysis of slug test, WRR 1976

APPENDIX F

HYDROGEOSIEVEXL DATA /

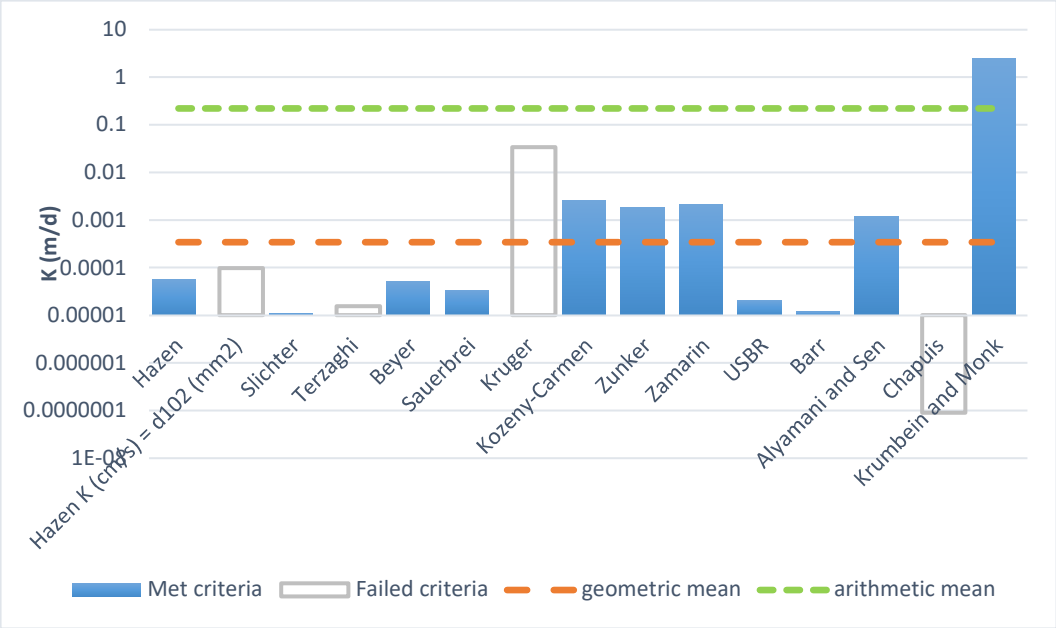
HYDRAULIC CONDUCTIVITY TEST DATA PLOTS

K from Grain Size Analysis Report Date:

Sample Name: G1 - TH24-01A - 3.7 - 4.0 m (Clay)

Mass Sample (g): 316.8 T (oC) 20

Poorly sorted clay low in fines



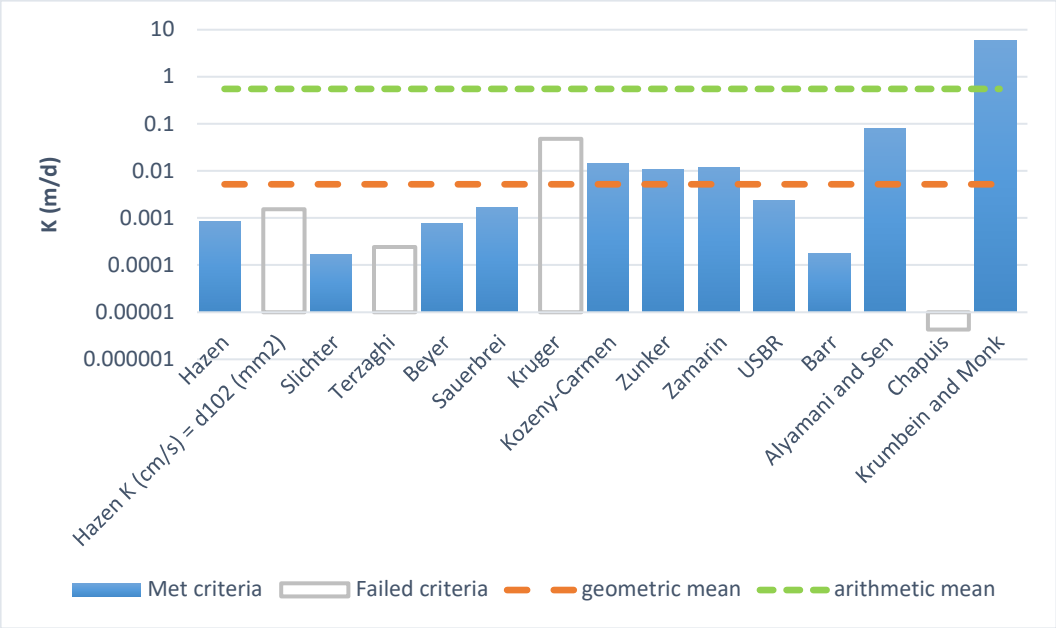
Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	.643E-07	.643E-09	0.00	
Hazen K (cm/s) = d_{10} (mm)	.113E-06	.113E-08	0.00	
Slichter	.126E-07	.126E-09	0.00	
Terzaghi	.180E-07	.180E-09	0.00	
Beyer	.586E-07	.586E-09	0.00	
Sauerbrei	.384E-07	.384E-09	0.00	
Kruger	.390E-04	.390E-06	0.03	
Kozeny-Carmen	.296E-05	.296E-07	0.00	
Zunker	.218E-05	.218E-07	0.00	
Zamarin	.250E-05	.250E-07	0.00	
USBR	.242E-07	.242E-09	0.00	
Barr	.135E-07	.135E-09	0.00	
Alyamani and Sen	.140E-05	.140E-07	0.00	
Chapuis	.103E-09	.103E-11	0.00	
Krumbein and Monk	.284E-02	.284E-04	2.46	
geometric mean	.397E-06	.397E-08	0.00	
arithmetic mean	.259E-03	.259E-05	0.22	

K from Grain Size Analysis Report Date:

Sample Name: G2 - TH24-01A - 5.5 - 5.8 m (Silt Till)

Mass Sample (g): 529.9 T (oC) 20

Poorly sorted silt low in fines



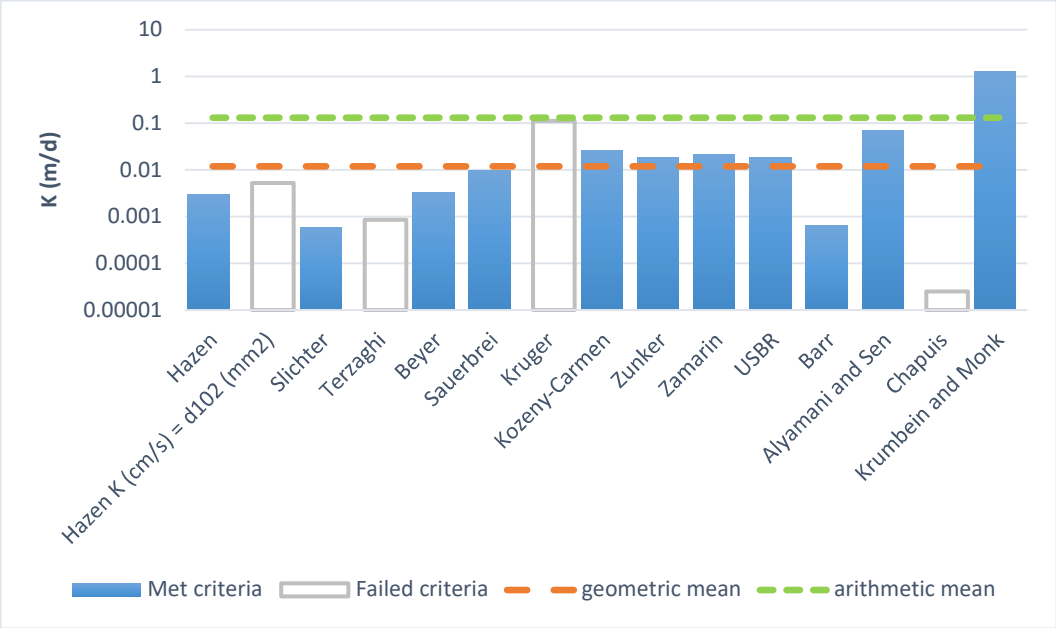
Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	.100E-05	.100E-07	0.00	
Hazen K (cm/s) = d_{10} (mm)	.177E-05	.177E-07	0.00	
Slichter	.197E-06	.197E-08	0.00	
Terzaghi	.281E-06	.281E-08	0.00	
Beyer	.904E-06	.904E-08	0.00	
Sauerbrei	.193E-05	.193E-07	0.00	
Kruger	.553E-04	.553E-06	0.05	
Kozeny-Carmen	.165E-04	.165E-06	0.01	
Zunker	.123E-04	.123E-06	0.01	
Zamarin	.141E-04	.141E-06	0.01	
USBR	.278E-05	.278E-07	0.00	
Barr	.211E-06	.211E-08	0.00	
Alyamani and Sen	.931E-04	.931E-06	0.08	
Chapuis	.496E-08	.496E-10	0.00	
Krumbein and Monk	.693E-02	.693E-04	5.98	
geometric mean	.602E-05	.602E-07	0.01	
arithmetic mean	.643E-03	.643E-05	0.56	

K from Grain Size Analysis Report Date:

Sample Name: C11 - TH24-02B - 12.5 - 13.0 m (Silt Till)

Mass Sample (g): 1185.2 T (oC) 20

Poorly sorted silt low in fines

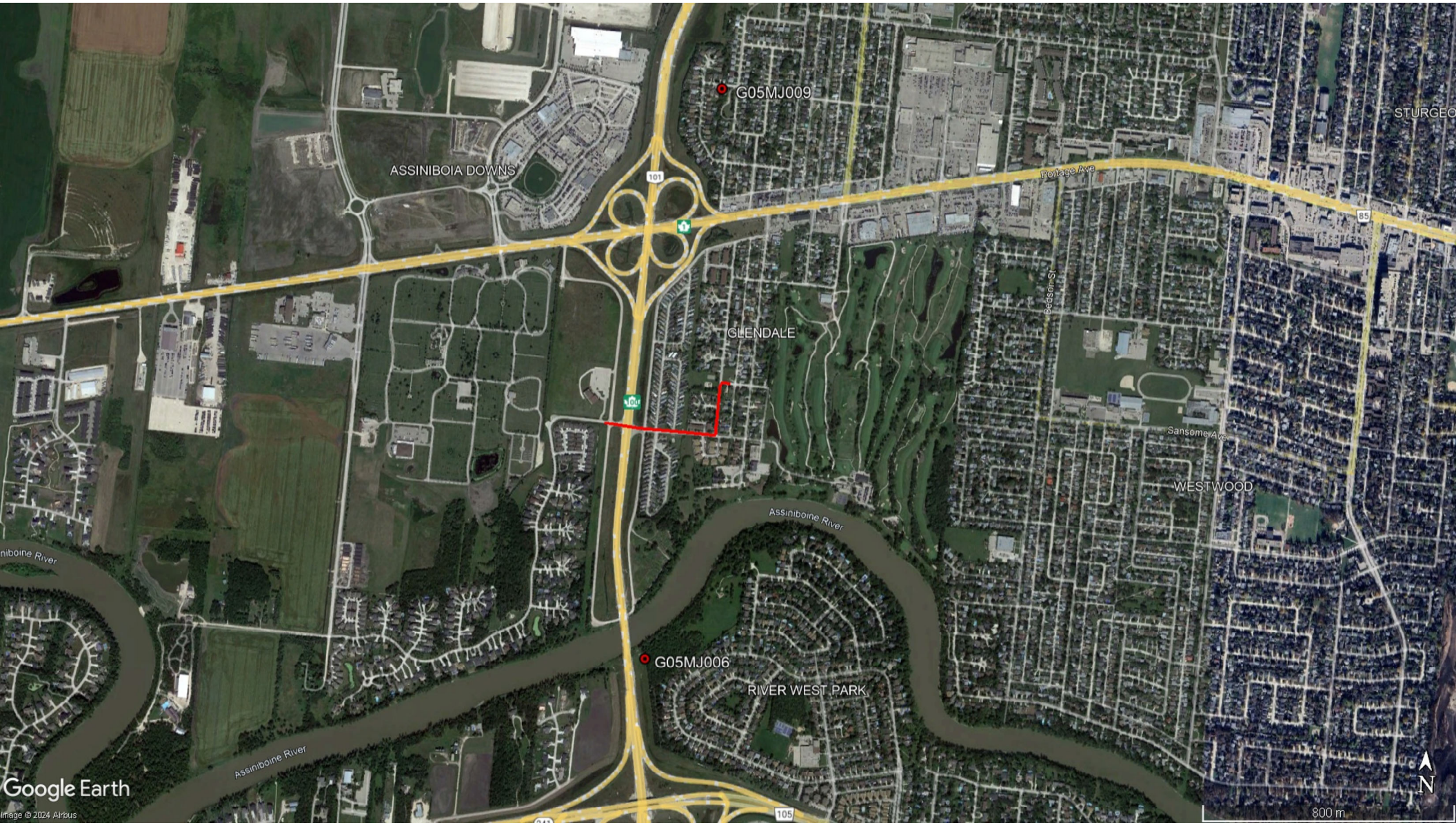


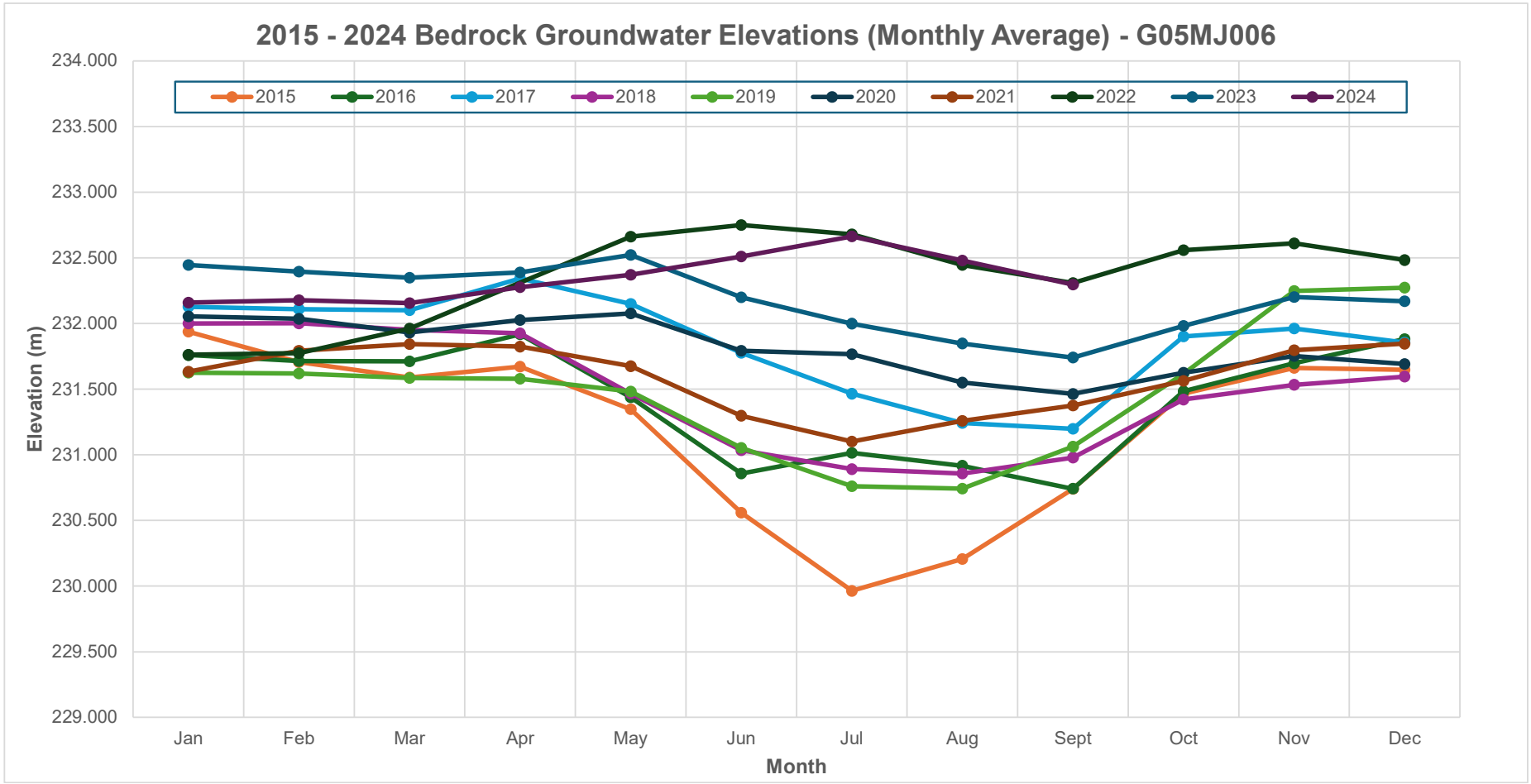
Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	.347E-05	.347E-07	0.00	
Hazen K (cm/s) = d_{10} (mm)	.605E-05	.605E-07	0.01	
Slichter	.683E-06	.683E-08	0.00	
Terzaghi	.979E-06	.979E-08	0.00	
Beyer	.386E-05	.386E-07	0.00	
Sauerbrei	.114E-04	.114E-06	0.01	
Kruger	.129E-03	.129E-05	0.11	
Kozeny-Carmen	.298E-04	.298E-06	0.03	
Zunker	.219E-04	.219E-06	0.02	
Zamarin	.251E-04	.251E-06	0.02	
USBR	.218E-04	.218E-06	0.02	
Barr	.734E-06	.734E-08	0.00	
Alyamani and Sen	.813E-04	.813E-06	0.07	
Chapuis	.288E-07	.288E-09	0.00	
Krumbein and Monk	.147E-02	.147E-04	1.27	
geometric mean	.137E-04	.137E-06	0.01	
arithmetic mean	.152E-03	.152E-05	0.13	

APPENDIX G

PROVINCIAL BEDROCK GROUNDWATER AND

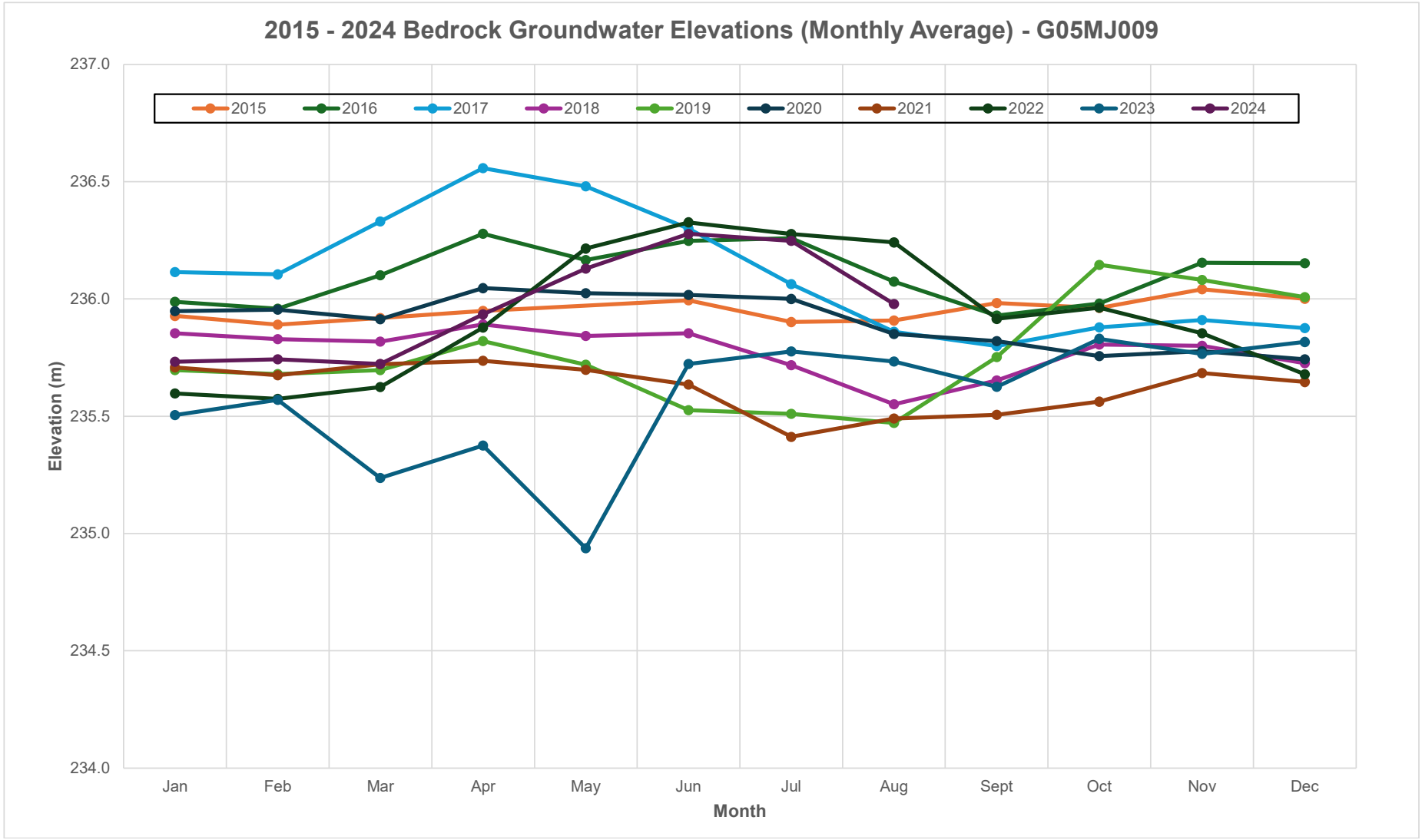
SURFACE WATER MONITORING STATION HYDROGRAPH PLOTS


G05MJ009
ASSINIBOIA DOWNS
Portage Ave
GLENDALE
Pedson St
Sansome Ave
WESTWOOD
Assiniboine River
G05MJ006
RIVER WEST PARK
Assiniboine River
Google Earth
800 m
N


2015 - 2024 Bedrock Groundwater Elevations (Monthly Average) - G05MJ006
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
234.000
233.500
233.000
232.500
232.000
231.500
231.000
230.500
230.000
229.500
229.000
Elevation (m)
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec
Month

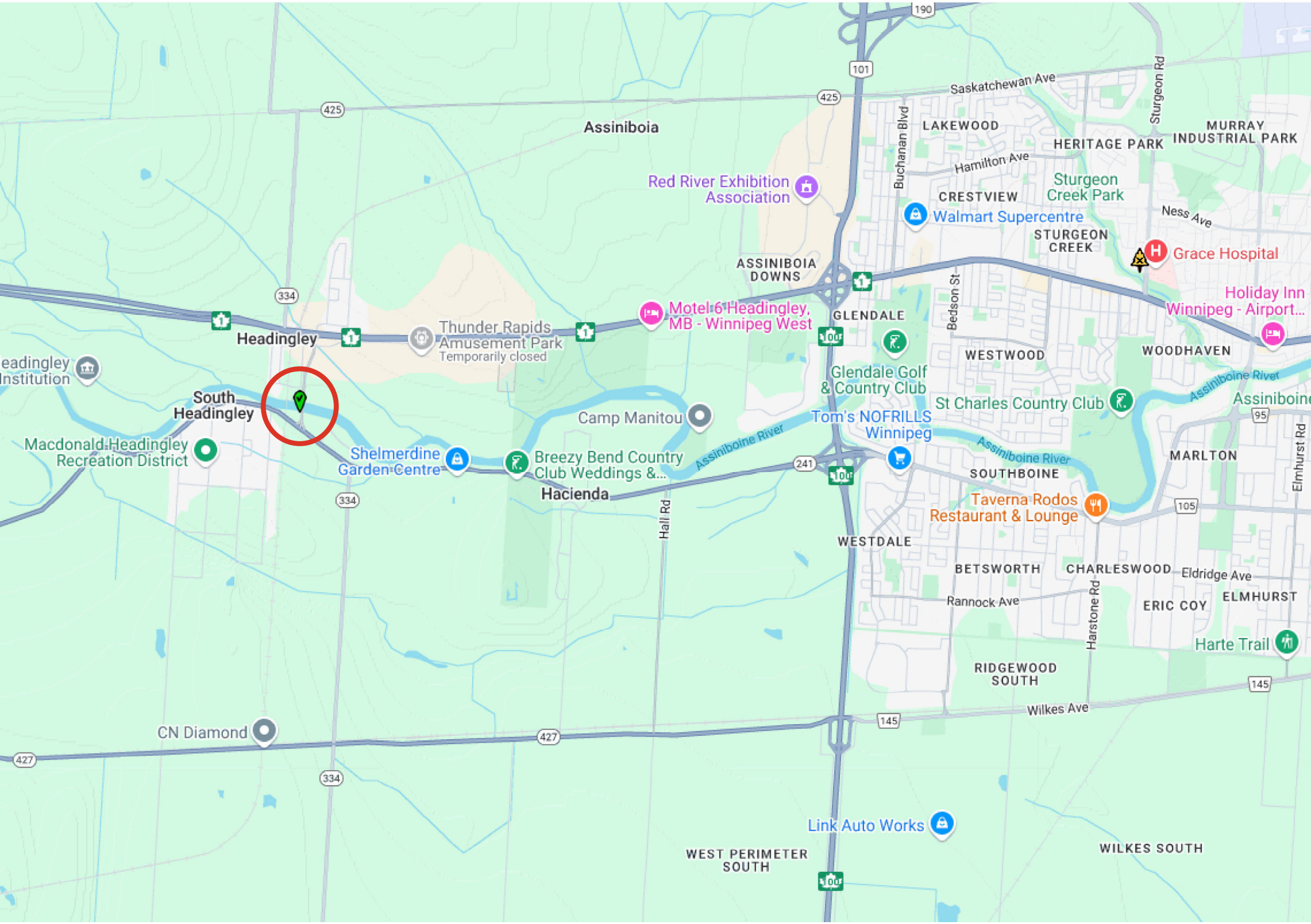
2015 - 2024 Bedrock Groundwater Elevations (Monthly Average) - G05MJ006

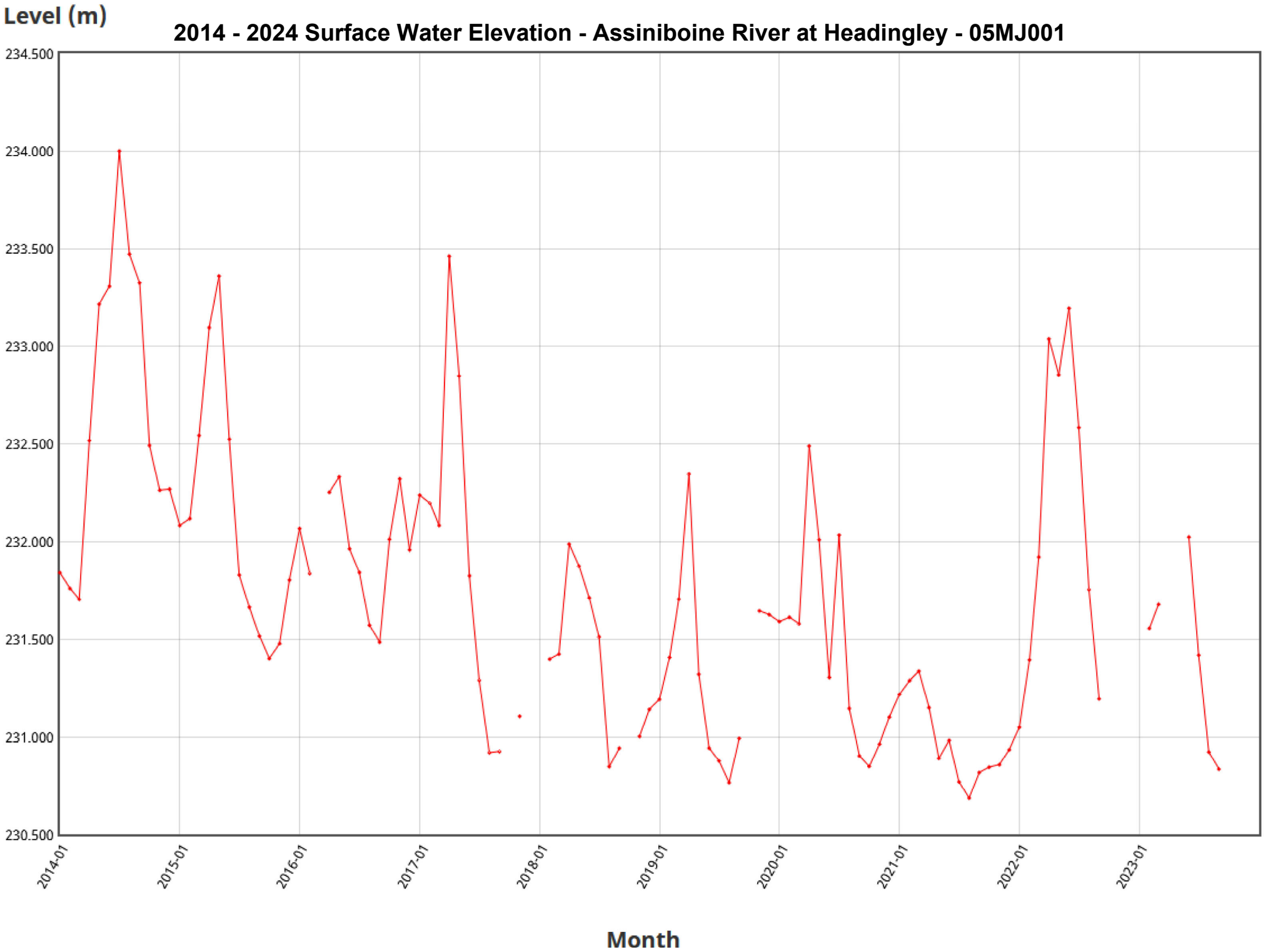
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
2015	231.937	231.707	231.589	231.671	231.347	230.559	229.964	230.206	230.740	231.465	231.662	231.647
2016	231.759	231.714	231.712	231.918	231.438	230.859	231.015	230.916	230.741	231.483	231.697	231.882
2017	232.127	232.109	232.103	232.343	232.150	231.777	231.465	231.242	231.198	231.902	231.962	231.855
2018	232.001	232.001	231.951	231.925	231.468	231.034	230.891	230.857	230.978	231.421	231.533	231.595
2019	231.625	231.620	231.585	231.580	231.482	231.053	230.760	230.742	231.063	231.617	232.248	232.273
2020	232.055	232.036	231.931	232.027	232.077	231.792	231.768	231.549	231.464	231.625	231.752	231.691
2021	231.633	231.792	231.843	231.824	231.675	231.298	231.101	231.260	231.376	231.562	231.797	231.847
2022	231.762	231.774	231.962		232.662	232.749	232.681	232.446	232.308	232.559	232.610	232.483
2023	232.446	232.395	232.350	232.390	232.523	232.200	231.999	231.848	231.741	231.983	232.201	232.171
2024	232.158	232.178	232.156	232.278	232.371	232.511	232.664	232.479	232.297			


2015 - 2024 Bedrock Groundwater Elevations (Monthly Average) - G05MJ009
237.0
236.5
236.0
235.5
235.0
234.5
234.0
Elevation (m)
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec
Month

2015 - 2024 Bedrock Groundwater Elevations (Monthly Average) - G05MJ009

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
2015	235.928	235.890	235.919	235.950		235.994	235.902	235.908	235.983	235.962	236.041	236.001
2016	235.988	235.958	236.101	236.278	236.166	236.248	236.259	236.074	235.929	235.980	236.154	236.153
2017	236.115	236.104	236.330	236.558	236.480	236.300	236.063	235.860	235.800	235.879	235.911	235.877
2018	235.854	235.829	235.819	235.892	235.842	235.854	235.717	235.551	235.652	235.806	235.800	235.727
2019	235.696	235.681	235.696	235.820	235.720	235.526	235.510	235.472	235.753	236.146	236.081	236.008
2020	235.949	235.955	235.913	236.046	236.025	236.017	236.000	235.851	235.821	235.756	235.777	235.742
2021	235.709	235.675	235.721	235.736	235.698	235.635	235.412	235.491	235.506	235.562	235.684	235.646
2022	235.597	235.574	235.624	235.878	236.215	236.327	236.277	236.241	235.915	235.963	235.854	235.678
2023	235.505	235.570	235.237	235.375	234.937	235.723	235.776	235.734	235.625	235.830	235.766	235.817
2024	235.732	235.743	235.722	235.934	236.129	236.278	236.248	235.979	235.889			


Assiniboia
Red River Exhibition Association
LAKEWOOD
HERITAGE PARK
MURRAY INDUSTRIAL PARK
CRESTVIEW
Sturgeon Creek Park
Walmart Supercentre
STURGEON CREEK
Grace Hospital
ASSINIBOIA DOWNS
Motel 6 Headingley, MB - Winnipeg West
Holiday Inn Winnipeg - Airport...
GLENDALE
Thunder Rapids Amusement Park
Temporarily closed
Headingley
WESTWOOD
WOODHAVEN
Glendale Golf & Country Club
St Charles Country Club
South Headingley
Camp Manitou
Tom's NOFRILLS Winnipeg
Macdonald Headingley Recreation District
Shelmerdine Garden Centre
Breezy Bend Country Club Weddings &...
Hacienda
SOUTHBOINE
MARLTON
Taverna Rodos Restaurant & Lounge
WESTDALE
BETSWORTH
CHARLESWOOD
ELMHURST
ERIC COY
Harte Trail
RIDGEWOOD SOUTH
CN Diamond
Link Auto Works
WEST PERIMETER SOUTH
WILKES SOUTH
Saskatchewan Ave
Hamilton Ave
Ness Ave
Rannock Ave
Eldridge Ave
Wilkes Ave
Assiniboine River
Buchanan Blvd
Sturgeon Rd
Bedson St
Hall Rd
Harstone Rd
Elmhurst Rd
190
101
425
334
241
105
95
145
427


Level (m)
2014 - 2024 Surface Water Elevation - Assiniboine River at Headingley - 05MJ001
234.500
234.000
233.500
233.000
232.500
232.000
231.500
231.000
230.500
2014-01
2015-01
2016-01
2017-01
2018-01
2019-01
2020-01
2021-01
2022-01
2023-01
Month