GROUNDWATER MONITORING OF SHALLOW WELL NETWORKS

South Bruce Pressure Data Annual Report 2023

APM-REP-01332-0420 **November 2024**

KGS Group

NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

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STATEMENT OF LIMITATIONS AND CONDITIONS

Limitations

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1.0 INTRODUCTION

1.1 Overview

The Groundwater Monitoring of Shallow Well Networks project is part of the Phase 2 Geoscientific Preliminary Field Investigations of the NWMO's Adaptive Phased Management (APM) Site Selection Phase. As part of the Phase 2 Preliminary Field Investigations, NWMO has established a shallow groundwater monitoring network at the two potential candidate sites in Canada. The sites are located in the Wabigoon Lake Ojibway Nation (WLON)-Ignace Area in Northwestern Ontario and Saugeen Ojibway Nation (SON)-South Bruce area in southern Ontario. The objective of this project is to retrieve, on a quarterly basis, measurements of groundwater pressures and temperatures that are collected from installed dataloggers, and to collect groundwater samples for chemical analyses. The collection of this information is necessary to evaluate shallow groundwater system behaviour and characteristics.

A separate test plan was prepared for each of the two locations so that details specific to each site were properly captured and planned for. The field work for each Site started in the beginning of the third quarter (Q3) of year 2022 (i.e., in July 2022), followed by another field event each quarter until (and including) Q1 2024.

This annual report presents the work completed and the data findings/analysis for the groundwater pressure results collected between January 1, 2023, and February 29, 2024, from the shallow well network at the South Bruce Site in the SON-South Bruce area in southern Ontario.

1.2 Scope of Work

The objective of the groundwater monitoring and sampling program is to collect groundwater pressure measurements and baseline groundwater samples from each of the 26 permanently installed monitoring well intervals over eight (8) quarters, starting in July 2022, and ending in Q1 (February) 2024. This annual report focuses on the findings and analysis for the data collected in all of 2023 and the first quarter (Q1) of 2024, which includes five field events. A separate report will present the groundwater sampling results for the same period. Activities conducted that are described in this report include:

- Mobilization of personnel and all required equipment
- Downloading of pressure and temperature data at each interval from the non-vented pressure transducers and barologger
- Summary of the monitoring data, including graphical presentation of pressure data results

Additional details regarding the work involved in completing specific activities outlined in the test plan are provided in Section 3.0 below. Task-specific activities to ensure health and safety, environment, data management, and quality assurance compliance are also described.

2.0 PROJECT LOCATION

2.1 Land Acknowledgment

It is important to acknowledge that this project was completed on the traditional territory of the Anishinaabe people of the Saugeen Treaty 45 1/2, 1836. KGS Group and its subcontractors are grateful for being given the opportunity to complete work within the area and are thankful for the generations of people who have taken care of the land for thousands of years.

2.2 Study Area

The South Bruce site is located approximately 7 km north-west of the Town of Teeswater in southwestern Ontario (Figure 1). This area is in the Western St. Lawrence Lowland that comprises a gently undulating land surface which occupies much of southwestern Ontario. The area is covered with a surficial layer of glacial sediments. The regional topography shows a general slope down towards Lake Huron from southeast to northwest. The municipality of South Bruce and the surrounding areas are predominantly under agricultural land use, with terrestrial features such as valley lands, along with watercourses and wetlands. The Teeswater River is the predominant drainage feature in the area that flows from east to west in the Municipality of South Bruce, and bends to flow in the north direction to eventually discharge into the Saugeen River at Paisley (NWMO, 2023).

Within the South Bruce site, a total of seven (7) shallow groundwater monitoring well groups were drilled and installed in 2021/2022. The seven (7) groups consist of MW01, MW02, MW03, MW04, MW05, MW06, and MW07. Monitoring well group MW06 contains a separate redrilled well which is designated MW09 and should be considered as part of the MW06 group. MW09 was drilled as a replacement for a compromised interval in MW06 and is located approximately 50m away from the main well group. It was constructed in late December 2022 and was therefore not included in the 2022 field events. MW08 was a potential monitoring well group that did not proceed with drilling and testing, and therefore will not be further discussed. Six (6) of the monitoring well groups (MW02 through MW07) consist of a standalone overburden monitoring well and three nested bedrock monitoring wells installed in a single borehole at various depth intervals. One site (MW01) consists of a single overburden monitoring well and a single six-inch open bedrock well.

Each monitoring well was instrumented with a non-vented Solinst Levelogger pressure transducer to measure and record groundwater pressures and temperatures, and Waterra tubing installed with foot valves. A single Solinst Barologger was installed at group SB_MW01 to measure and record barometric pressures for compensation of the non-vented pressure transducers. In total, the seven well groups include (Figure 1):

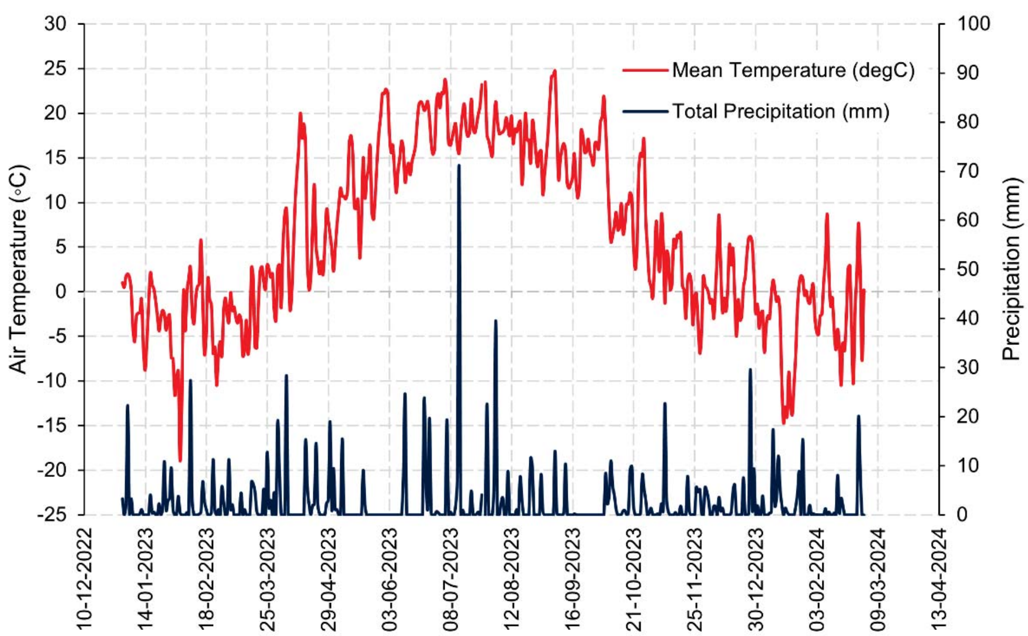
- SB_MW01
- SB_MW02
- SB_MW03
- SB_MW04
- SB_MW05
- SB_MW06 (Includes SB_MW09)
- SB_MW07

FIGURE 1 SITE LOCATION

2.3 Climate

The study area is subject to a humid continental climate of the warm summer subtype, Dfb under the Köppen climate classification defined by Kottek et al., (2006)). The closest weather station that exhibits the 1981-2010 Climate Normal Data is located in Hanover, ON, and is located approximately 14 kms Northeast of the South Bruce Site (Environment and Climate Change Canada, 2017). The monthly average temperature varies from -6.8 ⁰C in January to 19.6 ⁰C in July as per the 1981 – 2010 Canadian Climate Normal . The area receives an average annual rainfall precipitation of 819.7 mm and 271.3 mm of snowfall precipitation, with a total annual precipitation of 1087.1 mm. The wettest months are July and September (Environment and Climate Change Canada, 2017). The daily temperature and precipitation data for the reporting period was available from the Mount Forest (AUT) weather station, located approximately 31 km southeast of the South Bruce Site, and is presented on Figure 2.

FIGURE 2 SITE CLIMATE



2.4 Geology and Hydrogeology

The South Bruce Site is located on the eastern portion of the Michigan Basin that consists of laterally extensive sedimentary rock formations deposited during the Cambrian (541 to 485 million years ago), Ordovician (485 to 444 million years ago), Silurian (444 to 419 million years ago), and Devonian (419 to 359 million years ago) periods. As the name suggests, the Michigan Basin is centered in the Michigan State of the United States of America, and extends across southern Ontario, where at the South Bruce Site its thickness is reduced to approximately 800 m, composed of multiple geological layers above the underlying Precambrian (older than 541 million years) basement granitic rock. The bedrock is overlain with Quaternary sediments that are sand, clays and soil deposits (NWMO, 2023).

The shallow bedrock aquifers within the area comprise the upper few metres to over 100 m of bedrock formations. Water quantity and quality within the shallow bedrock aquifers can vary across the area based on the different chemical and physical characteristics of the individual bedrock formations (NWMO, 2023).

The carbonate bedrock aquifers of the Lucas, Amherstburg and Bois Blanc formations are important sources of drinking water in the area and are the primary source for municipal water supplies. The borehole logs suggest that the overburden wells consist of sand, clays and soil deposits, whereas the bedrock wells are drilled in the Lucas (dolostone), Amherstburg (limestone) and Bois Blanc (limestone) formations (Geofirma, 2024).

3.0 GROUNDWATER MONITORING OF SHALLOW WELL NETWORK

3.1 Overview

Monitoring and sampling activities were scheduled to be completed by KGS Group on a quarterly basis. Each quarterly event consisted of measuring static water levels, checking and downloading all 27 pressure transducers (26 Solinst Leveloggers (water level and temperature) and 1 Solinst Barologger (barometric pressure)), followed by purging select intervals, taking field measurements of a variety of water chemistry parameters, collecting groundwater samples, and submitting them for laboratory analysis. A detailed Test Plan for the South Bruce site was prepared in advance of the first field event. The Test Plan outlines all the equipment, methodologies, criteria, and steps needed to achieve the desired outcomes of the project within the confines of the approved scope of work. Seven (7) overburden and nineteen (19) bedrock wells were drilled and installed at the South Bruce Site in 2021 under NWMO's supervision, with the addition of a replacement well MW09 installed in December 2022 (Geofirma, 2024).

For each quarterly event, wells to be sampled were pre-determined together with the NWMO project team in advance of the event. Technical work as part of the pressure data collection scope followed the same general procedures as outlined below, but were not limited to:

- Pre-mobilization equipment and material checks.
- Mobilization of all personnel.
- Manual measurement of depth to water level before removing and downloading data from all 27 pressure transducers, verification that equipment was in good working condition, field verification of the data, and saving data following the DMP requirements (see Section 3.3).
- Storing, processing, and preparing transducer data for analysis and submission to NWMO.
- Preparing quarterly pressure data packages and reports.

The steps outlined above are detailed further as pre-mobilization and mobilization activities, fluid pressure and temperature monitoring, and data assessment and reporting activities. All data collected in the field was recorded directly onto approved Data Quality Confirmation Forms (DQCFs) as per the approved Project Quality Plan (PQP), the Data Management Plan (DMP), and the Test Plan.

3.2 Health, Safety and Environment Activities

As per the Health, Safety and Environment Management Plan (HSEP) developed for the project, the KGS Group project team held a pre-job meeting via MS Teams to review the HSEP and the Test Plan to ensure all team members understood their roles and the expectations given the planned scope of work.

While the field team was working on site, the Field Lead/Supervisor held daily tailgate meetings with the field crew at the beginning of their workday to review the planned work activities; the related health, safety, and environmental issues related to the planned work; the specific hazards associated with each task; and mitigation and control measures related to the hazards. All Job Safety Analysis (JSA) forms were updated as needed and signed off by the field team. Completed JSAs have been provided with the data package. Examples of some of the specific hazards identified during the field events include:

- Heavy lifting.
- Generator and Hydrolift pump use, including fuel handling and storage.
- Water containment.
- Slips, trips, and falls.
- Hand tool safety.
- Use/handling of cleaning detergents and sample preservatives.
- Highway driving.
- Tire punctures from driving on gravel roads, narrow forest road access, and farm field access, etc.
- Wildlife crossings/encounters.
- Travel to and from the work site including safely and respectfully navigating around horse and buggies on roadways and safely approaching blind hills on the road.
- All-Terrain Vehicle use (where required).
- Weather (e.g., heavy rain, thunderstorms, lightning protocols).

No health and safety or environmental incidents occurred during any of the field events in 2023/Q1-2024. The field lead conducted a daily environmental inspection at each of the sites using a prescribed checklist. The completed checklists were included in the data packages.

3.3 Fluid Pressure and Temperature Monitoring

Fluid pressure and temperature monitoring was completed between February 28 and March 5, 2023, for the Q1 2023 event; between June 6 and 8, 2023 for the Q2 2023 event; between September 12 and 14, 2023 for the Q3 2023 event; between November 21 and 22 for the Q4 2023 event; and between February 27 and 29, 2024 for the Q1 2024 event. During each event, the depth to groundwater in each of the groundwater monitoring wells was measured and the pressure transducer data from each of the 26 Solinst Leveloggers and 1 Solinst Barologger were downloaded and checked. To calculate the depth to groundwater below ground surface, the well stick-up height was subtracted from the groundwater depth that was measured from top of casing of each well. The groundwater elevations at each well were calculated using the Top of Casing (TOC) elevation (meters above sea level [masl]) and the measured depth to water from TOC. Survey data were provided by NWMO for use in calculating water level elevations (Geofirma, 2024; Geofirma, 2022).

3.3.1 TRANSDUCER DOWNLOADS

To download the pressure transducer data, KGS Group followed the steps outlined by the manufacturer Solinst for connecting and downloading all 26 of the pressure transducers and 1 barologger using the manufacturer's supplied docking station connected to a field laptop with the Solinst Levelogger software.

At the end of each field event, downloaded data were saved on the KGS Group File Management System (FMS) in accordance with the DMP. The unprocessed datafiles (as a .CSV) were included in each quarterly Data Deliverable package.

Checks of the data were performed in the field to verify that the data were downloaded properly, and any errors were flagged for review by a senior reviewer. Any deviations were recorded directly onto an electronic version of *DQCF02-Datalogger Download* and were provided with each quarterly Data Deliverable package.

3.3.2 TRANSDUCER DATA PROCESSING

Processing of the pressure transducer data from South Bruce was performed with the manufacturer's software to compensate for barometric pressure fluctuations using the data collected by the Barologger. Data were then exported and added to Excel spreadsheets that were created by KGS Group to be used as source files for Grapher (a graphing software) to generate hydrographs of the transducer data for each well. The post-processed Excel spreadsheet for each monitoring well was included with the quarterly Data Deliverable packages.

The processing and analysis of each groundwater pressure dataset followed the same general procedure, outlined below:

- The Solinst Levelogger transducers are non-vented units, which were suspended in the monitoring wells on aircraft cable. Because most of the monitoring wells (except for SB_MW03 bedrock wells) are open to the atmosphere, barometric compensation was required. As noted above, all water pressure data were compensated with barometric pressure data collected from the Solinst Barologger deployed on site (SB_MW01_BR-A), using the compensation wizard function in the Solinst Levelogger software.
- The raw pressure data recorded by the Solinst Leveloggers in kilopascals (kPa) were converted to pressure head using the following conversion:
  - 1 kPa = 0.101972 mH_2O
- Pressure head data were converted to groundwater elevations/hydraulic head, calculated based on the surveyed top of casing (TOC) elevations and manual depth to water (DTW) measurements for each monitoring well using the formula:
  - Hydraulic Head or Groundwater Elevation (masl) = Transducer Elevation (masl) + Pressure Head (mH_20))
- To accurately calculate the transducer elevation, the depth of the pressure transducer was verified every time it was removed and replaced in the monitoring well during monitoring and sampling.
  - Verification of the depth that the transducer was positioned in the monitoring well was performed by manually measuring the depth to water in the well at a known time and adding the most recent pressure head reading (i.e., depth of immersion) measured by the transducer. This assumes that pressure changes between the most recent transducer reading and the time of manual DTW measurement were insignificant. Transducer depth was calculated as:
    - Transducer Depth (m below TOC) = DTW (m below TOC) + Most Recent Transducer Pressure Head (mH_2O)
  - The transducer elevation was then calculated using:
    - Transducer Elevation (masl) = TOC Elevation (masl) - Transducer Depth (m below TOC)

3.3.3 MANUAL DEPTH TO WATER MEASUREMENTS

Manual Depth to Water (DTW) measurements were measured from the Top of Casing (TOC) at each monitoring well using a calibrated electronic sensor water level meter. The groundwater elevations based upon manual measurements are included on the hydrographs in Appendix A as verification of the transducer data. Groundwater elevation was calculated as follows:

- Groundwater Elevation (masl) = TOC Elevation (masl) - DTW (m below TOC)

All manual water level measurements collected during each field event were recorded on DQCF02, which was provided with each quarterly data deliverable.

3.3.4 DEVIATIONS AND CHALLENGES

The following deviations and/or challenges were identified by KGS Group field staff during the Q1-Q42023 and Q1-2024 field program:

- The Solinst Levelogger transducers are suspended from aircraft cable and re-installation elevations can vary if not carefully placed exactly as before removal. The current setup is not conducive to exact re-deployment elevation and adjustment in deployment methods should be discussed.
- It was not possible to record real time pressures because the Leveloggers are deployed on aircraft wire and without direct read cables; therefore, some interpretation and adjustment was required to fit the data and create consistent hydrographs when applying the transducer elevation correction.
- The SB_MW03 wells are sealed with packers based on historical artesian conditions observed in the wells and the Solinst Levelogger transducers are suspended below the packer seals. The potential for artesian conditions below the packers as well as inability to directly read the transducer pressures while in place create challenges for interpretation of the data. Manual DTW readings after removal of the packers is used to best interpret the Levelogger data collected.

3.3.5 QUALITY ASSURANCE OF THE PRESSURE DATA

Raw exported transducer data files were not altered. KGS Group created duplicates of the transducer data files before performing the barometric compensation and exporting to Excel. Once in Excel, further data processing was performed as described in Section 3.3.2. Calculated hydraulic heads/groundwater elevations were then plotted using Grapher. Anomalous data points such as negative or positive spikes were reviewed individually against calendar dates and times to determine if there were correlations to known natural or hydrogeological events, such as weather events or aquifer pumping or if the transducer was removed from the monitoring well.

The most common type of error seen in the data were pressure measurements while the transducer was not installed in the monitoring well, essentially a measurement of atmospheric pressure. Any non-barometric compensated value of approximately 100 kPa (+/- 3 kPa) was considered as atmospheric and removed from the dataset used to generate the hydrographs.

Another type of anomalous data was observed during assessment of the hydrographs, where the assessor would identify breaks or shifts in the data that warranted investigation. The most common issue was apparent as a shift in the data set either upwards or downwards when the transducer was removed and then replaced. As mentioned above, the pressure transducers are suspended in the monitoring well on a length of aircraft cable and need to be removed from the well to download the data and to conduct water sampling. The installation method and removal/re-installation process, in addition to any other concurrent downhole activities, introduce sources of error that complicate the interpretation of transducer data. As described in Section 3.3.2, corrections based on manual depth to water measurements were applied to the data used to generate the hydrographs to account for changes in transducer elevation. These corrections were not applied universally but were based on the professional discretion of senior reviewers to provide the best quality data.

3.3.6 QA/QC OF FIELD DATA

KGS Group completed the QA/QC of the field data that was captured on Data Quality Confirmation Forms used to capture datalogger readings at the time of downloading (DQCF02)

This was completed as part of preparation of each quarterly data deliverable. Each DQCF was reviewed by a senior reviewer for formatting, consistency of information being recorded, errors in the values and identification of values that were outside of the expected ranges. Where an error was found that error was highlighted, and a note was made of the correction.

After the review was completed, the DQCF was signed off on by both the preparer and the verifier.

Identified Errors

No issues were identified in the downloaded data.

3.4 Hydraulic Head Results

Hydraulic heads were calculated for each monitoring interval using the data processing methodology described in Section 3.3.2. Table 1 provides a summary of the measured minimum and maximum groundwater hydraulic head ranges between January 1, 2023, and March 1, 2024, as measured by the pressure transducers. Table 2 summarizes the Monthly Total Precipitation for the assessment period and shown on the Appendix A hydrographs. Table 3 provides a summary of the calculated hydraulic heads for each monitoring well for each quarter based on manual DTW measurements. The calculated hydraulic heads have been plotted against time on a hydrograph for each monitoring well and site. Each hydrograph was reviewed, and out-of-range data points were filtered out from the graph data set and not shown on the hydrograph. Hydrographs are provided in Appendix A.

TABLE 1 GROUNDWATER HYDRAULIC HEAD RANGES

Interval	Hydraulic Head Ranges[1]		
	Minimum (masl)	Maximum (masl)	Amplitude (m)
SB_MW01_BR-A	278.51	279.31	0.80
SB_MW01_OB-INT	283.42	285.29	1.88
SB_MW02_BR-A	285.99	287.41	1.42
SB_MW02_BR-B	286.44	288.11	1.67
SB_MW02_BR-C	286.51	288.11	1.59
SB_MW02_OB-INT	286.55	288.20	1.65
SB_MW03_BR-A	282.20	283.43	1.23
SB_MW03_BR-B	282.67	284.00	1.33
SB_MW03_BR-C	280.80	282.20	1.39
SB_MW03_OB-INT	280.38	282.02	1.64
SB_MW04_BR-A	280.17	281.45	1.27
SB_MW04_BR-B	278.98	280.29	1.31
SB_MW04_BR-C	278.35	279.77	1.42
SB_MW04_OB-INT	278.39	279.94	1.55
SB_MW05_BR-A	275.48	276.55	1.07
SB_MW05_BR-B	275.01	276.19	1.19
SB_MW05_BR-C	274.87	275.84	0.97
SB_MW05_OB-INT	273.88	274.90	1.02
SB_MW06_BR-A	276.20	277.42	1.22
SB_MW09_BR-B	276.29	277.44	1.16
SB_MW06_BR-C	276.18	277.44	1.26
SB_MW06_OB-INT	275.81	277.01	1.20
SB_MW07_BR-A	292.91	294.36	1.45
SB_MW07_BR-B	293.07	294.44	1.37
SB_MW07_BR-C	292.89	294.36	1.47
SB_MW07_OB-INT	293.82	295.20	1.38

Note: (1) Calculated based on pressure transducer readings

3.4.1 HYDROGRAPH OBSERVATIONS

Hydraulic heads at most sites generally fluctuated between January and April of 2023, with three distinct peaks: one in January, one in February, and one in April which was also the maximum observed for the reporting period in all intervals except SB_MW03_BR-A (where the maximum corresponded with the February peak). Following the maximum peak in April, hydraulic heads decreased (with some short-term fluctuation) in all wells during the remainder of spring, throughout summer, and into early fall, reaching a minimum in late September/early October for all wells. Throughout the rest of 2023 and into Q1 2024 hydraulic heads rose again, with several smaller peaks in most wells occurring in December 2023 and January – February 2024.

The nearest weather data for 2023/2024 were from the Goderich station (Climate ID: 6122847) and were downloaded from the Environment and Climate Change Canada: Historical Climate Data online database (Environment and Climate Change Canada, 2024). The Goderich weather station is located approximately 42 km southwest of the South Bruce site. Daily total precipitation data were plotted on the hydrographs in Appendix A for the purposes of assessing any correlations between precipitation events and hydraulic head changes. Given the distance of Goderich station from the South Bruce site, limitations in interpreting hydraulic head changes due to precipitation events are expected. Additionally, the available data only include total precipitation measurements and do not show whether the precipitation fell as rain or snow, which would be expected to have different responses in the local groundwater levels.

In general, correlation between hydraulic heads and single precipitation events was not clear across all hydrographs. Several events; however, were followed by distinct increases in all or nearly all hydrographs. On February 9, 2023, 25.8 mm of precipitation were recorded, which corresponds cleanly with the beginning of the rising leg of the February 2023 hydrograph peak. There were also noticeable, although more variable, increases in hydraulic heads seemingly in response to significant precipitation events on October 7, 2023, and December 27, 2023, which measured 28.2 mm and 36.7 mm, respectively. General hydrograph trends are likely better explained by longer-term precipitation patterns and seasonal changes such as spring melt and increased evapotranspiration in summer.

TABLE 2 MONTHLY TOTAL PRECIPITATION

Period	Total Precipitation (mm)	Notes
January 2023	50.0	
February 2023	51.7	
March 2023	83.2	
April 2023	60.4	No data April 27
May 2023	48.0	
June 2023	28.3	
July 2023	24.6	No data July 10-24
August 2023	109.9	
September 2023	21.7	
October 2023	141.3	
November 2023	74.9	
December 2023	88.2	
January 2024	74.0	No data January 18
February 2024	14.1	

The downward trend evident across all hydrographs from mid April to the end of September 2023 is correlated with low precipitation during that period. The lack of a significant response on the hydrographs to the (relatively) high precipitation recorded during August 2023 may be due to disparities in actual precipitation at the site compared to the weather station and/or the fact that surface soils were likely quite dry, with reduced capacity to conduct infiltration down to the depth of the water table and increased storage capacity in the vadose zone, combined with high rates of evapotranspiration during the peak of the growing season.

Daily temperature data from the Goderich station (see Figure 2) also show some correlation with the hydrographs, particularly in Q1/Q2 2023. The beginning of the rising leg of each of the three distinct peaks in that period is concurrent with a period of above-zero daily average temperatures. Melting during these periods likely contributed to the observed increases in hydraulic head.

SB_MW01 – (Figure A-1): The MW01 hydrographs reflect the general trends described above; however, the changes in the bedrock interval SB_MW01_BR-A were of a much lower magnitude than in the overburden well. SB_MW01_BR-A had the lowest range between min-max hydraulic heads of all the intervals, only changing 0.8 m overall. The decline from April to September was much less consistent in the MW01 overburden interval compared to other overburden wells, with an initially rapid decline in late April – early May and then very little change from June – October.

Hydraulic heads are approximately 5.5 m higher in the overburden well at SB_MW01, compared to the bedrock interval. Generally, the overburden hydraulic head responses to rainfall events and/or melting are quicker and of a greater magnitude, compared to the hydraulic head responses in the deep bedrock well. This is likely a reflection of the more direct recharge to the overburden aquifer system versus the slower regional recharge entering the bedrock aquifer system.

SB_MW02 – (Figure A-2): The hydraulic heads in each of the monitoring intervals followed the general trends previously described. Notably, during the summer decline in hydraulic heads, the hydrographs show three spikes of approximately 15 cm or less occurring between the end of June and early August. These spikes are only reflected on the hydrographs for MW02 and MW03 and are presumably related to some highly localized events at the east edge of the study area, potentially related to irrigation.

The overburden interval and bedrock intervals MW02_BR-C and BR-B all track together very closely, with only minor differences in the shape of the hydrographs. The deep bedrock interval MW02_BR-A also has the same general shape but displays significantly more short-term variability (noise) and for the most part has lower magnitude responses. Hydraulic head in the BR-A interval is approximately 0.7 m lower than in the BR-B and BR-C bedrock intervals.

SB_MW03 – (Figure A-3): The hydraulic heads in each of the monitoring intervals followed the general trends previously described. The same spikes observed in the declining period of the MW02 hydrographs between late June – early August are also apparent in the MW03 hydrographs.

The hydraulic heads in the MW03 intervals screened in the Amherstburg formation (SB_MW03_BR-B and BR-A) were at least 1 m higher than those in the overburden and the Lucas formation (SB_MW03_OB-INT and SB_MW03_BR-C, respectively) at all times. Between the bedrock intervals BR-A and BR-B, BR-B was approximately 0.5 m higher than BR-A consistently.

SB_MW04 – (Figure A-4): The MW04 hydrographs follow the same general trends already described; however, they display much less short-term variability and overall are much smoother than most of the other well groups. The three peaks in January, February, and April are well defined, followed by a smooth decline with a gradually decreasing slope that extends until early October and then progressively rising heads until a peak shortly before the end of the monitoring period in late February.

Hydraulic heads in the deep bedrock interval SB_MW04_BR-A were the highest, approximately 1.3 m higher than the intermediate bedrock interval (BR-B), 1.8 m higher than the overburden interval (OB-INT), and 2 m higher than the shallow bedrock interval (BR-C).

SB_MW05 – (Figure A-5): The hydrographs for all intervals at well group MW05 follow the general trends already discussed. The min-max range of hydraulic heads at MW05 were among the lowest of all the groups, with the greatest range observed in the intermediate bedrock interval (BR-B), which was still less than all but two of the other intervals in the study (SB_MW01-BR-A and SB_MW06_BR-B).

Hydraulic heads were greatest in the deep bedrock interval, followed by the intermediate bedrock interval, shallow bedrock interval, and finally the overburden interval, where they were approximately 1.7 m lower than in the deep bedrock interval.

SB_MW06 – (Figure A-6): The hydrographs for all intervals at SB_MW06 follow the general trends previously discussed. Hydraulic heads in all bedrock intervals were nearly identical in Q1 2023 and the first half of Q2 2023, then diverging slightly through the second half of spring and into summer. In December 2023 the hydraulic head in the deep bedrock interval (BR-A) crosses the hydrograph of the shallow bedrock interval (BR-C). Where the head in the deep interval had been higher throughout 2023 until that point, it then dropped marginally below the head in the shallow interval; however, the intermediate interval (BR-B) remains the highest head. The overburden well had hydraulic heads approximately 0.3 to 0.5 m lower than the bedrock intervals throughout the reporting period.

The similarity of hydraulic heads in the bedrock intervals indicates a strong hydraulic connection between them. This could be due to all intervals being located within an interconnected hydraulic system which can exhibit as a hydrostatic condition, showing little to no hydraulic gradient between intervals in the bedrock.

SB_MW07 – (Figure A-7): Hydrograph trends are consistent with those already discussed. Hydraulic heads in bedrock intervals SB_MW07_BR-A and BR-C are nearly identical, potentially indicating hydraulic connectivity between the intervals, however the intermediate bedrock interval SB_MW07_BR-B shows higher hydraulic heads overall which demonstrates a dampened hydraulic connection with the surrounding bedrock intervals.

The hydraulic head in the overburden interval varies from 0.5 to 0.7 m higher than in the intermediate bedrock interval, which is 0.1 to 0.2 m higher than in the shallow and deep bedrock intervals.

TABLE 3 GROUNDWATER LEVEL MEASUREMENTS SUMMARY

Interval	Ground Elevation (masl)	TOC Elevation (masl)	Q1 2023			Q2 2023		
			Test Date and Time (dd/mm/yyyy hh:mm)	Water Level (mbgs)	Hydraulic Head (masl)	Test Date and Time (dd/mm/yyyy hh:mm)	Water Level (mbgs)	Hydraulic Head (masl)
SB_MW01_BR-A	288.69	289.59	03/03/2023 17:05	9.61	279.08	07/06/2023 09:55	9.92	278.77
SB_MW01_OB-INT	288.75	289.7	03/03/2023 17:10	4.42	284.33	07/06/2023 10:35	4.72	284.03
SB_MW02_BR-A	291.37	291.75	28/02/2023 11:50	4.36	287.01	06/06/2023 09:35	4.74	286.63
SB_MW02_BR-B	291.37	291.76	28/02/2023 11:55	3.68	287.70	06/06/2023 09:40	4.13	287.24
SB_MW02_BR_R-B	291.12	291.49	28/02/2023 12:00	3.69	287.43	06/06/2023 09:45	4.09	287.03
SB_MW02_BR-C	291.37	291.77	28/02/2023 12:05	3.71	287.66	06/06/2023 09:50	4.14	287.23
SB_MW02_OB-INT	291.75	292.5	28/02/2023 12:10	3.98	287.77	06/06/2023 09:55	4.47	287.28
SB_MW03_BR-A	282.3	284.08	04/03/2023 11:05	0.10	282.20	07/06/2023 09:15	0.40	281.90
SB_MW03_BR-B	282.3	284.76	04/03/2023 11:10	-1.01	283.31	07/06/2023 09:20	-0.71	283.01
SB_MW03_BR-C	282.3	284.88	04/03/2023 11:15	0.75	281.55	07/06/2023 09:25	1.10	281.20
SB_MW03_OB-INT	282.36	283.16	04/03/2023 11:20	1.10	281.26	07/06/2023 09:30	1.45	280.91
SB_MW04_BR-A	284.66	285.54	01/03/2023 10:30	3.65	281.01	06/06/2023 18:45	3.96	280.70
SB_MW04_BR-B	284.66	285.56	01/03/2023 10:35	4.89	279.77	06/06/2023 18:50	5.16	279.50
SB_MW04_BR-C	284.66	285.49	01/03/2023 10:40	5.40	279.26	06/06/2023 18:55	5.71	278.96
SB_MW04_OB-INT	284.43	285.29	01/03/2023 10:45	5.09	279.34	06/06/2023 19:00	5.40	279.03
SB_MW05_BR-A	277.78	278.46	02/03/2023 10:55	1.73	276.05	06/06/2023 19:40	1.88	275.90
SB_MW05_BR-B	277.78	278.44	02/03/2023 11:00	2.07	275.71	06/06/2023 19:45	2.32	275.46
SB_MW05_BR-C	277.78	278.47	02/03/2023 11:05	2.34	275.44	06/06/2023 19:50	2.58	275.20
SB_MW05_OB-INT	277.92	278.7	02/03/2023 11:10	3.47	274.45	06/06/2023 19:55	3.79	274.13
SB_MW06_BR-A	286.29	287.05	01/03/2023 16:15	9.30	276.99	07/06/2023 18:15	9.61	276.68
SB_MW09_BR-B	286.71	287.43	01/03/2023 17:05	9.70	277.01	07/06/2023 18:20	9.98	276.73
SB_MW06_BR-C	286.29	287.1	01/03/2023 16:15	9.30	276.99	07/06/2023 18:25	9.64	276.65
SB_MW06_OB-INT	286.46	287.37	01/03/2023 16:15	9.92	276.54	07/06/2023 18:30	10.24	276.22
SB_MW07_BR-A	301.65	302.14	03/03/2023 09:35	7.79	293.86	07/06/2023 19:00	8.06	293.60
SB_MW07_BR-B	301.65	302.16	03/03/2023 09:40	7.67	293.98	07/06/2023 19:05	7.89	293.76
SB_MW07_BR-C	301.65	302.14	03/03/2023 09:45	7.81	293.84	07/06/2023 19:10	8.06	293.59
SB_MW07_OB-INT	301.96	302.69	03/03/2023 09:50	7.17	294.79	07/06/2023 19:15	7.35	294.61

TABLE 3 GROUNDWATER LEVEL MEASUREMENTS SUMMARY

Interval	Q3 2023			Q4 2023			Q1 2024		
	Test Date and Time (dd/mm/yyyy hh:mm)	Water Level (mbgs)	Hydraulic Head (masl)	Test Date and Time (dd/mm/yyyy hh:mm)	Water Level (mbgs)	Hydraulic Head (masl)	Test Date and Time (dd/mm/yyyy hh:mm)	Water Level (mbgs)	Hydraulic Head (masl)
SB_MW01_BR-A	12/09/2023 09:55	10.05	278.64	22/11/2023 15:40	9.87	278.82	29/02/2024 12:00	9.63	279.06
SB_MW01_OB-INT	12/09/2023 10:00	5.02	283.73	22/11/2023 16:05	4.62	284.13	29/02/2024 12:10	3.93	284.82
SB_MW02_BR-A	12/09/2023 16:30	5.21	286.16	21/11/2023 16:35	4.72	286.65	29/02/2024 10:35	4.30	287.07
SB_MW02_BR-B	12/09/2023 16:40	4.70	286.67	21/11/2023 17:00	4.28	287.09	29/02/2024 10:45	3.72	287.65
SB_MW02_BR_R-B	12/09/2023 17:05	4.60	286.52	21/11/2023 16:45	4.10	287.02	29/02/2024 11:05	3.62	287.50
SB_MW02_BR-C	12/09/2023 16:50	4.81	286.56	21/11/2023 17:05	4.21	287.16	29/02/2024 10:55	3.79	287.58
SB_MW02_OB-INT	12/09/2023 16:55	5.04	286.71	21/11/2023 17:10	4.54	287.21	29/02/2024 11:05	3.88	287.88
SB_MW03_BR-A	12/09/2023 15:15	0.52	281.78	22/11/2023 09:00	0.47	281.83	28/02/2024 10:10	0.12	282.18
SB_MW03_BR-B	12/09/2023 15:25	-0.51	282.81	22/11/2023 09:10	-0.81	283.12	28/02/2024 10:20	-1.26	283.56
SB_MW03_BR-C	12/09/2023 15:35	1.14	281.16	22/11/2023 10:35	0.79	281.51	28/02/2024 12:45	0.26	282.04
SB_MW03_OB-INT	12/09/2023 15:45	1.58	280.78	22/11/2023 12:05	1.27	281.09	28/02/2024 14:50	0.74	281.62
SB_MW04_BR-A	13/09/2023 15:30	4.40	280.26	21/11/2023 09:20	4.13	280.53	27/02/2024 17:45	3.61	281.05
SB_MW04_BR-B	13/09/2023 15:40	5.61	279.05	21/11/2023 12:45	5.40	279.26	27/02/2024 18:00	4.83	279.83
SB_MW04_BR-C	13/09/2023 15:50	6.21	278.45	21/11/2023 14:00	6.03	278.63	27/02/2024 18:05	5.34	279.32
SB_MW04_OB-INT	13/09/2023 16:00	5.94	278.49	21/11/2023 15:20	5.79	278.64	27/02/2024 18:35	5.01	279.42
SB_MW05_BR-A	13/09/2023 10:00	2.18	275.60	21/11/2023 17:30	1.96	275.82	27/02/2024 19:00	1.66	276.12
SB_MW05_BR-B	13/09/2023 11:30	2.58	275.20	21/11/2023 17:40	2.43	275.35	27/02/2024 19:10	2.04	275.74
SB_MW05_BR-C	13/09/2023 13:05	2.84	274.94	21/11/2023 17:50	2.58	275.20	27/02/2024 19:20	2.31	275.47
SB_MW05_OB-INT	13/09/2023 09:25	3.95	273.97	21/11/2023 18:00	3.72	274.20	27/02/2024 19:30	3.72	274.20
SB_MW06_BR-A	13/09/2023 17:15	10.01	276.28	22/11/2023 14:40	9.76	276.53	27/02/2024 11:10	9.31	276.98
SB_MW09_BR-B	13/09/2023 17:45	10.34	276.37	22/11/2023 15:00	10.11	276.60	27/02/2024 15:30	9.64	277.07
SB_MW06_BR-C	13/09/2023 17:25	10.04	276.25	22/11/2023 14:30	9.78	276.51	27/02/2024 13:30	9.30	276.99
SB_MW06_OB-INT	13/09/2023 17:35	10.57	275.89	22/11/2023 14:50	10.37	276.09	27/02/2024 14:40	9.95	276.51
SB_MW07_BR-A	13/09/2023 16:15	8.60	293.05	22/11/2023 15:35	8.23	293.42	29/02/2024 11:20	7.78	293.87
SB_MW07_BR-B	13/09/2023 16:25	8.43	293.22	22/11/2023 15:25	8.06	293.59	29/02/2024 11:30	7.57	294.08
SB_MW07_BR-C	13/09/2023 16:35	8.62	293.03	22/11/2023 15:20	8.24	293.41	29/02/2024 11:40	7.78	293.87
SB_MW07_OB-INT	13/09/2023 16:45	7.99	293.97	22/11/2023 15:45	7.81	294.15	29/02/2024 11:50	7.03	294.93

3.4.2 VERTICAL GROUNDWATER GRADIENTS

Vertical groundwater gradients were calculated between monitoring intervals at each monitoring well location using the manually measured groundwater elevations. Gradients were calculated as the difference in hydraulic heads between two monitoring intervals divided by the vertical distance between the middle of each interval:

$$\frac{(Hydraulic\ Head_{Interval\ B} - Hydraulic\ Head_{Interval\ A})}{|Middle\ of\ Interval\ B\ Elev. - Middle\ of\ Interval\ A\ Elev.|}$$

A positive result implies that (in the absence of any confining layers) water will move from B -> A, whereas a negative result would suggest flow from A -> B.

Groundwater is considered to move vertically from an interval of higher hydraulic head to an interval of lower hydraulic head, except where an aquitard is present. Table 4 summarizes the vertical groundwater gradients between monitoring intervals at each well group.

Generally, vertical gradient directions remained consistent throughout 2023/Q1-2024 except for:

- SB_MW04_OB-INT to BR-C: Downward gradient from interval OB-INT to interval BR-C in all quarters except for Q3 and Q4 2023, when gradient was hydrostatic.
- SB_MW06_BR-C to SB_MW09_BR-B: Hydrostatic in Q1 2023, upward gradient from BR-B to BR-C in Q2, Q3, and Q4 2023 and Q1 2024.

In the upper monitoring intervals between overburden and bedrock, vertical gradients were downward in well groups SB_MW01, SB_MW02, SB_MW04, and SB_MW07 along the south of the site (i.e., an overburden to bedrock recharge condition, where vertical hydraulic interconnection would account for this to occur), with the exception of SB_MW04 in Q4 2023, when the gradient was interpreted to be effectively hydrostatic. In the well groups on the northern portion of the site (SB_MW03, SB_MW05, and SB_MW06) vertical gradients were upward from shallow bedrock intervals to overburden (i.e., a bedrock aquifer discharge condition, where vertical hydraulic interconnection would account for this to occur).

Vertical gradients between the Amherstburg and Lucas bedrock formations were consistently upward from Amherstburg to Lucas, except in SB_MW02, where gradients were small and variable. Between the Amherstburg and Bois Blanc formations, gradients were downward in well groups SB_MW02 and SB_MW06, and upward in groups SB_MW04 and SB_MW05. For well groups with two intervals screened in the Amherstburg formation, SB_MW03 and SB_MW07 exhibited downward vertical gradients, while SB_MW06 showed an upward vertical gradient within the same formation.

TABLE 4 GROUNDWATER VERTICAL GRADIENTS SUMMARY

Interval	Formation	Q1 2023			Q2 2023			Q3 2023		
		Hydraulic Head (masl)	Groundwater Gradient (m/m)	Gradient Description	Hydraulic Head (masl)	Groundwater Gradient (m/m)	Gradient Description	Hydraulic Head (masl)	Groundwater Gradient (m/m)	Gradient Description
SB_MW01_OB-INT	Overburden	284.33	0.169	Downward gradient from OB to A	284.03	0.169	Downward gradient from OB to A	283.73	0.164	Downward gradient from OB to A
SB_MW01_BR-A	Lucas Formation	279.08			278.77			278.64		
SB_MW02_OB-INT	Overburden	287.77	0.013	Downward gradient from OB to C	287.28	0.006	Downward gradient from OB to C	286.71	0.018	Downward gradient from OB to C
SB_MW02_BR-C	Lucas Formation	287.66	<0.001	Hydrostatic, no vertical gradient interpreted between C and B	287.23	<0.001	Hydrostatic, no vertical gradient interpreted between C and B	286.56	-0.002	Hydrostatic, no vertical gradient interpreted between B and C
SB_MW02_BR-B	Amherstburg Formation	287.70	0.049	Downward gradient from B to A	287.24	0.044	Downward gradient from B to A	286.67	0.037	Downward gradient from B to A
SB_MW02_BR-A	Bois Blanc Formation	287.01			286.63			286.16		
SB_MW03_OB-INT	Overburden	281.26	-0.032	Upward gradient from C to OB	280.91	-0.031	Upward gradient from C to OB	280.78	-0.043	Upward gradient from C to OB
SB_MW03_BR-C	Lucas Formation	281.55	-0.115	Upward gradient from B to C	281.20	-0.118	Upward gradient from B to C	281.16	-0.107	Upward gradient from B to C
SB_MW03_BR-B	Amherstburg Formation	283.31	0.052	Downward gradient from B to A	283.01	0.052	Downward gradient from B to A	282.81	0.048	Downward gradient from B to A
SB_MW03_BR-A	Amherstburg Formation	282.20			281.90			281.78		
SB_MW04_OB-INT	Overburden	279.34	0.006	Downward gradient from OB to C	279.03	0.005	Downward gradient from OB to C	278.49	0.002	Hydrostatic, no vertical gradient interpreted between OB and C
SB_MW04_BR-C	Lucas Formation	279.26	-0.031	Upward gradient from B to C	278.96	-0.033	Upward gradient from B to C	278.45	-0.036	Upward gradient from B to C
SB_MW04_BR-B	Amherstburg Formation	279.77	-0.038	Upward gradient from A to B	279.50	-0.036	Upward gradient from A to B	279.05	-0.037	Upward gradient from A to B
SB_MW04_BR-A	Bois Blanc Formation	281.01			280.70			280.26		
SB_MW05_OB-INT	Overburden	274.45	-0.051	Upward gradient from C to OB	274.13	-0.055	Upward gradient from C to OB	273.97	-0.050	Upward gradient from C to OB
SB_MW05_BR-C	Lucas Formation	275.44	-0.012	Upward gradient from B to C	275.20	-0.012	Upward gradient from B to C	274.94	-0.012	Upward gradient from B to C
SB_MW05_BR-B	Amherstburg Formation	275.71	-0.014	Upward gradient from A to B	275.46	-0.018	Upward gradient from A to B	275.20	-0.016	Upward gradient from A to B
SB_MW05_BR-A	Bois Blanc Formation	276.05			275.90			275.60		
SB_MW06_OB-INT	Overburden	276.54	-0.015	Upward gradient from C to OB	276.22	-0.014	Upward gradient from C to OB	275.89	-0.012	Upward gradient from C to OB
SB_MW06_BR-C	Amherstburg Formation	276.99	<0.001	Hydrostatic, no vertical gradient interpreted between C and B	276.65	-0.003	Upward gradient from B to C	276.25	-0.004	Upward gradient from B to C
SB_MW09_BR-B	Amherstburg Formation	277.01	0.002	Hydrostatic, no vertical gradient interpreted between B and A	276.73	0.004	Downward gradient from B to A	276.37	0.006	Downward gradient from B to A
SB_MW06_BR-A	Bois Blanc Formation	276.99			276.68			276.28		
SB_MW07_OB-INT	Overburden	294.79	0.038	Downward gradient from OB to C	294.61	0.041	Downward gradient from OB to C	293.97	0.038	Downward gradient from OB to C
SB_MW07_BR-C	Lucas Formation	293.84	-0.005	Upward gradient from B to C	293.59	-0.006	Upward gradient from B to C	293.03	-0.006	Upward gradient from B to C
SB_MW07_BR-B	Amherstburg Formation	293.98	0.005	Downward gradient from B to A	293.76	0.006	Downward gradient from B to A	293.22	0.007	Downward gradient from B to A
SB_MW07_BR-A	Amherstburg Formation	293.86			293.60			293.05		

TABLE 4 GROUNDWATER VERTICAL GRADIENTS SUMMARY

Interval	Formation	Q4 2023			Q1 2024		
		Hydraulic Head (masl)	Groundwater Gradient (m/m)	Gradient Description	Hydraulic Head (masl)	Groundwater Gradient (m/m)	Gradient Description
SB_MW01_OB-INT	Overburden	284.13	0.171	Downward gradient from OB to A	284.82	0.186	Downward gradient from OB to A
SB_MW01_BR-A	Lucas Formation	278.82			279.06		
SB_MW02_OB-INT	Overburden	287.21	0.006	Downward gradient from OB to C	287.88	0.035	Downward gradient from OB to C
SB_MW02_BR-C	Lucas Formation	287.16	0.001	Hydrostatic, no vertical gradient interpreted between C and B	287.58	-0.001	Hydrostatic, no vertical gradient interpreted between B and C
SB_MW02_BR-B	Amherstburg Formation	287.09	0.032	Downward gradient from B to A	287.65	0.041	Downward gradient from B to A
SB_MW02_BR-A	Bois Blanc Formation	286.65			287.07		
SB_MW03_OB-INT	Overburden	281.09	-0.047	Upward gradient from C to OB	281.62	-0.047	Upward gradient from C to OB
SB_MW03_BR-C	Lucas Formation	281.51	-0.104	Upward gradient from B to C	282.04	-0.099	Upward gradient from B to C
SB_MW03_BR-B	Amherstburg Formation	283.12	0.060	Downward gradient from B to A	283.56	0.065	Downward gradient from B to A
SB_MW03_BR-A	Amherstburg Formation	281.83			282.18		
SB_MW04_OB-INT	Overburden	278.64	<0.001	Hydrostatic, no vertical gradient interpreted between OB and C	279.42	0.007	Downward gradient from OB to C
SB_MW04_BR-C	Lucas Formation	278.63	-0.038	Upward gradient from B to C	279.32	-0.031	Upward gradient from B to C
SB_MW04_BR-B	Amherstburg Formation	279.26	-0.039	Upward gradient from A to B	279.83	-0.037	Upward gradient from A to B
SB_MW04_BR-A	Bois Blanc Formation	280.53			281.05		
SB_MW05_OB-INT	Overburden	274.20	-0.052	Upward gradient from C to OB	274.20	-0.067	Upward gradient from C to OB
SB_MW05_BR-C	Lucas Formation	275.20	-0.007	Upward gradient from B to C	275.47	-0.012	Upward gradient from B to C
SB_MW05_BR-B	Amherstburg Formation	275.35	-0.019	Upward gradient from A to B	275.74	-0.015	Upward gradient from A to B
SB_MW05_BR-A	Bois Blanc Formation	275.82			276.12		
SB_MW06_OB-INT	Overburden	276.09	-0.014	Upward gradient from C to OB	276.51	-0.016	Upward gradient from C to OB
SB_MW06_BR-C	Amherstburg Formation	276.51	-0.004	Upward gradient from B to C	276.99	-0.003	Upward gradient from B to C
SB_MW09_BR-B	Amherstburg Formation	276.60	0.006	Downward gradient from B to A	277.07	0.006	Downward gradient from B to A
SB_MW06_BR-A	Bois Blanc Formation	276.53			276.98		
SB_MW07_OB-INT	Overburden	294.15	0.030	Downward gradient from OB to C	294.93	0.043	Downward gradient from OB to C
SB_MW07_BR-C	Lucas Formation	293.41	-0.006	Upward gradient from B to C	293.87	-0.007	Upward gradient from B to C
SB_MW07_BR-B	Amherstburg Formation	293.59	0.007	Downward gradient from B to A	294.08	0.008	Downward gradient from B to A
SB_MW07_BR-A	Amherstburg Formation	293.42			293.87		

3.4.3 GROUNDWATER HYDRAULIC HEADS AND LOCAL GROUNDWATER FLOW

Groundwater hydraulic heads were determined through manual measurements taken each field event, as described in Section 3.3.3. Those measurements were plotted on a site map, with groundwater hydraulic head contours developed across the site, as seen on Figures B1 to B10 in Appendix B. Contours were generated using a point kriging method in the program Surfer, with 10 m node spacing in both X and Y. Two contour maps were generated for each of the five monitoring events in the reporting period. One showing groundwater elevations in the overburden and a second showing hydraulic heads in the bedrock, specifically in the Amherstburg Formation. Where two monitoring intervals at one well group are within the Amherstburg Formation, as is the case for SB_MW03_BR-A, SB_MW03_BR-B, SB_MW09_BR-B, SB_MW06_BR-C, SB_MW07_BR-A and SB_MW07_BR-B, an average of the hydraulic heads from both intervals was used. Geological formations and hydraulic heads for each monitoring interval and event are included in Table 4.

Since SB_MW01_BR-A is within the Lucas Formation and there are no deeper bedrock monitoring intervals at the SB_MW01 location, it was not considered in generating the bedrock groundwater contour maps.

Generally, overburden groundwater contours follow the topography across the site, with topographic highs at SB_MW07 and SB_MW02 correlating with higher overburden groundwater elevations, and topographic lows at SB_MW05, SB_MW04, and SB_MW06 correlating with lower overburden groundwater elevations. Notably, SB_MW03 sits in a small depression relative to the surrounding area and has a water table that is much closer to surface than the other well groups. The average depth to water (below ground surface) in the overburden based on all quarterly measurements during the reporting period is 1.23 m in SB_MW03_OB-INT, while the second shallowest is SB_MW05_OB-INT at 3.73 m, and the overall average based on all overburden intervals is 4.76 m.

Overburden groundwater flow is generally northward, with northeastward flow toward Teeswater River from the west of the site, and northwestward flow toward Teeswater River and a topographic low (from SB_MW04 to SB_MW05) from the east of the site. The Teeswater River flows north in the region, ultimately discharging to the Saugeen River at Paisley, Ontario.

Bedrock groundwater flow in the Amherstburg formation mirrors the same trends as seen in the overburden groundwater flow. Bedrock groundwater flows generally north across the site, with localized northeasterly flow at the west of the site and localized northwesterly flow at the east of the site.

There is little variation in groundwater contours between quarterly monitoring events, with the overall shape of the contours and the interpreted flow direction remaining nearly unchanged, and the main differences are evident only as higher or lower groundwater tables in the area.

3.5 Groundwater Temperatures

Temperature data recorded by the pressure transducers were plotted against time, with data from all the intervals plotted together according to formation (Overburden, Lucas, Amherstburg, and Bois Blanc). The data were reviewed for outliers, and these were filtered out of the plotted values. Nearly all the anomalous data points corresponded to monitoring events when the transducers were temporarily removed from the well to conduct sampling and logged a reading while in air. All groundwater temperature plots are included in Appendix C.

Overburden – (Figure C-1): Generally, groundwater temperatures in the overburden wells followed the seasonal air temperature trends, albeit with a significant time lag. Whereas average air temperatures reached their minimum in January/February of 2023, the overburden groundwater temperatures in most intervals did not reach their minimum until June/July 2023, a lag of approximately five months. The lag between the peak air temperatures (July 2023) and the peak groundwater temperatures (January/February 2024) in most wells was 6-7 months.

The temperature data from SB_MW06_OB-INT are notable for how little variation they showed compared to the temperature variations observed in the other overburden monitoring wells. While the other overburden wells each had a range of at least 0.8 °C, SB_MW06_OB-INT only changed by approximately 0.3 °C. Conversely, SB_MW01_OB-INT showed greater and irregular temperature changes than any of the other intervals. The changes seen in the temperature profile for SB_MW01_OB-INT were also reflected on its hydrograph. Particularly, the three drops in the temperature plot in January, February, and April 2023 were very closely aligned with the three peaks in its hydrograph during that period. This was presumably due to an influx of precipitation that was colder than groundwater, causing the observed drop in temperature and then dissipation as the colder water blended into the groundwater regime. The fact that this type of response wasn't seen on any of the other temperature plots suggests that SB_MW01_OB-INT is in a body of groundwater with little temperature buffering capacity and the hydraulic connection to precipitation as recharge is greater compared to other overburden monitoring wells in the study area. The data from SB_MW03_OB-INT and SB_MW01_OB-INT also stand out due to the high magnitude of their minimum and maximum values, as well as the fact that the lag between air temperature min/max and the following groundwater min/max in these intervals is approximately 2 months less than the others.

Bedrock Formations (Figures C-2, C-3, C-4): Groundwater temperatures in the bedrock monitoring intervals showed less variability than in the overburden wells, with lower min/max ranges and negligible short-term fluctuations (i.e., displaying only seasonal trends). In general, the temperatures displayed a periodical fluctuation, although with variable peak/trough values and timings. Each well group had a characteristic temperature profile that was, in most cases, consistent across the different monitoring intervals in the group.

In some instances, the absolute maximum or minimum recorded during the reporting period was concurrent with the beginning or end cutoff of the data; however, it was not always clear whether those points were the true peak/trough values of the seasonal temperature swings. In those cases, distinction is made between absolute maximum/minimum and peak/trough values. That distinction was based on visual assessment of the slope of the graphs. If the slope at the beginning or end cutoff appeared to be zero, that point was interpreted to be either a peak or a trough.

<u>SB_MW01:</u> The only bedrock interval at MW01 showed minimal changes throughout the reporting period, with a min/max range of approximately 0.12 °C. The absolute minimum value of 9.08 °C was concurrent with the start of the reporting period (January 1, 2023), followed by a peak (and the absolute maximum) of 9.20 °C in June 2023, and a trough of 9.12 °C in November 2023.

<u>SB_MW02:</u> The temperatures in the bedrock intervals at well group SB_MW02 aligned very closely with each other. MW02_BR-C and MW02_BR-A were essentially identical – rarely differing by more than 0.01 °C – with the first peak of 9.24 °C occurring in April 2023, followed by a trough of 8.82 °C in October 2023, and a

second peak of 9.25 °C concurrent with the end of the reporting period on February 29, 2024. The min/max range was 0.43 °C.

SB_MW02_BR-B had a temperature profile that was relatively close to intervals SB_MW-02_BR-A and BR-C; however, the seasonal temperature changes were more pronounced. The first peak of 9.28 °C occurred in April 2023, the trough of 8.73 in October 2023, and the second peak (and absolute maximum) of 9.30 °C concurrent with the end of the reporting period on February 29, 2024. The min/max range was 0.57 °C.

SB_MW03: The temperature data from the bedrock intervals at well group SB_MW03 showed more noise (i.e., greater fluctuations between consecutive data points over a short duration of time – visually represented on the graph as a jagged line) than the other groups. Intervals SB_MW03_BR-B and BR-C followed each other closely, while the deep interval SB_MW03_BR-A was markedly different and did not resemble the normal periodic seasonal fluctuations of the other bedrock wells.

SB_MW03_BR-C had a first peak (and absolute maximum) of 9.91 °C concurrent with the start of the reporting period on January 1, 2023, followed by a trough (and absolute minimum) of 8.86 °C in June 2023, and a second peak of 9.80 °C in November 2023, with a min/max range of 1.05 °C.

SB_MW03_BR-B had a first peak (and absolute maximum) of 9.93 °C concurrent with the start of the reporting period on January 1, 2023, followed by a trough (and absolute minimum) of 8.88 °C in May 2023, and a second peak of 9.78 °C in November 2023, with a min/max range of 1.05 °C.

SB_MW03_BR-A temperature profile was flatter, with minimal variance between the min and max values. The first peak (and absolute maximum) of 9.42 °C occurred in February 2023, followed by several months of near-constant temperatures until mid April, and then a sudden drop to a trough (and absolute minimum) of 9.19 °C in mid May. Temperatures then climbed gradually to 9.28 °C in late July, after which they changed very little until late November, when they suddenly dropped 0.04 degrees to 9.26 °C before rising slowly to 9.36 °C at the end of the reporting period. The min/max range was 0.23 °C.

SB_MW04: The temperature profiles in all the bedrock intervals at well group SB_MW04 tracked each other closely.

SB_MW04_BR-C had a first peak of 8.49 °C in March 2023, followed by a trough (and absolute minimum) of 8.00 °C in August 2023, and a second peak (and absolute maximum) of 8.50 °C in February 2024, with a min/max range of 0.50 °C.

SB_MW04_BR-B had a first peak of 8.51 °C in February 2023, followed by a trough (and absolute minimum) of 7.99 °C in August 2023, and a second peak (and absolute maximum) of 8.53 °C in February 2024, with a min/max range of 0.54 °C.

SB_MW04_BR-A had a first peak of 8.53 °C in February 2023, followed by a trough (and absolute minimum) of 7.96 °C in August 2023, and a second peak (and absolute maximum) of 8.55 °C in February 2024, with a min/max range of 0.59 °C.

SB_MW05: The temperature profiles in all the bedrock intervals at well group SB_MW05 tracked each other closely.

SB_MW05_BR-C had a first peak (and absolute maximum) of 9.13 °C in March 2023, followed by a trough (and absolute minimum) of 8.75 °C in September 2023, and reached 9.02 °C while nearing a second peak at the end of the reporting period. The min/max range was 0.38 °C.

SB_MW05_BR-B had a first peak (and absolute maximum) of 9.13 °C in March 2023, followed by a trough (and absolute minimum) of 8.75 °C in September 2023, and reached 9.01 °C while nearing a second peak at the end of the reporting period. The min/max range was 0.38 °C.

SB_MW05_BR-A had a first peak (and absolute maximum) of 9.25 °C in February 2023, followed by a trough (and absolute minimum) of 8.73 °C in August 2023, and reached 9.13 °C while nearing a second peak at the end of the reporting period. The min/max range was 0.52 °C.

<u>SB_MW06:</u> At the SB_MW06 well group, intervals SB_MW06_BR-A and SB_MW06_BR-C were nearly identical, rarely differing by more than 0.01 °C; however, interval SB_MW09_BR-B had a very different profile and generally higher temperatures than the other two intervals. All the intervals in the well group had extremely small temperature changes throughout the reporting period.

SB_MW06_BR-C had a first peak of 7.58 °C concurrent with the start of the reporting period in January 2023, followed by a trough of 7.54 °C in April 2023, then reached a second peak (and absolute maximum) of 7.59 °C in September 2023, and finally dropped to the absolute minimum of 7.51 °C while approaching a second trough at the end of the reporting period. The min/max range was 0.08 °C.

SB_MW09_BR-B had its absolute minimum of 7.56 °C concurrent with the start of the reporting period, then rose to a peak (and absolute maximum) of 7.63 °C in September 2023 before dropping to 7.61 °C at the end of the reporting period in February 2024. The min/max range was 0.07 °C.

SB_MW06_BR-A had a first peak of 7.58 °C concurrent with the start of the reporting period in January 2023, followed by a trough of 7.53 °C in April 2023, then reached a second peak of 7.58 °C in August/September 2023, and finally dropped to the absolute minimum of 7.50 °C while approaching a second trough at the end of the reporting period. The min/max range was 0.08 °C.

<u>SB_MW07:</u> The temperature profile in all the bedrock intervals at well group SB_MW07 tracked each other closely. Never differing by more than 0.03 °C.

SB_MW07_BR-C had a first trough (and absolute minimum) of 8.88 °C in January 2023, followed by a peak (and absolute maximum) of 8.94 °C in July/August 2023, then dropped to a second trough of 8.91 °C in January 2024. The min/max range was 0.06 °C.

SB_MW07_BR-B had a first trough (and absolute minimum) of 8.89 °C in January 2023, followed by a peak (and absolute maximum) of 8.96 °C in July/August 2023, then dropped to a second trough of 8.92 °C in December 2023/January 2024. The min/max range was 0.07 °C.

SB_MW07_BR-A had a first trough (and absolute minimum) of 8.89 °C in January 2023, followed by a peak (and absolute maximum) of 8.95 °C in July/August 2023, then dropped to a second trough of 8.92 °C in December 2023/January 2024. The min/max range was 0.06 °C.

4.0 SUMMARY

Five groundwater monitoring events were completed in the reporting period from January 1, 2023, to March 1, 2024. During these field programs KGS Group downloaded data from all 26 pressure transducers and one barologger. All pressure data was compiled into separate Quarterly Data Deliverable packages and Quarterly Data Reports as part of the final deliverables for each quarter.

5.0 REFERENCES

Environment Canada, 2017. Canadian Climate Normals. 1981-2010 Station Data.

Environment and Climate Change Canada, 2024. Daily Data Reports for Goderich Weather Station, Climate ID: 6122847 (https://climate.weather.gc.ca/climate_data/daily_data_e.html?StationID=7747).

Geofirma, 2022. APM-REP-01332-0313, Phase 2 Initial Borehole Drilling and Testing, South Bruce. WP13: Technical Report for Monitoring Well (SB_MW01) Installation at SB_BH02, Rev 0.

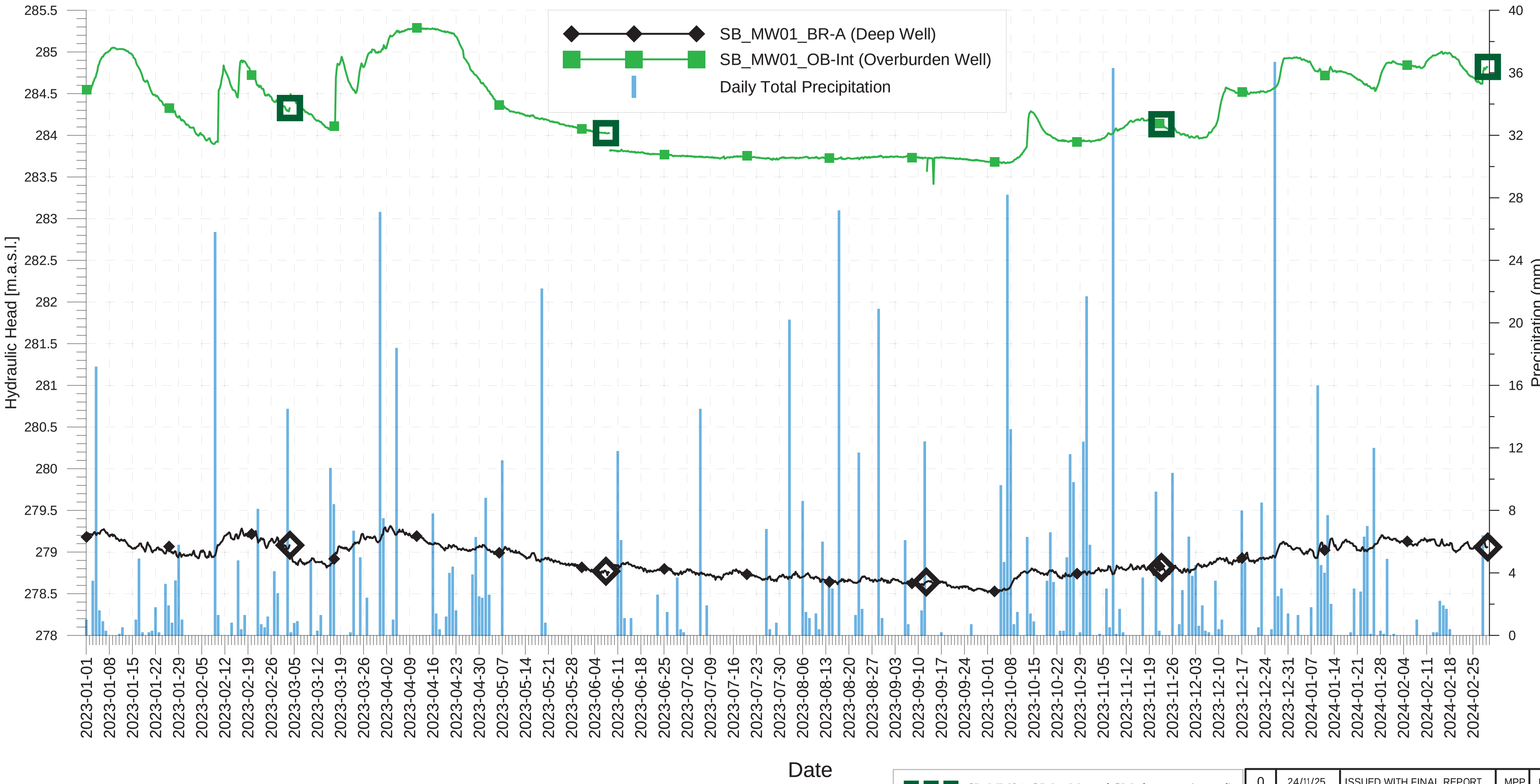
Geofirma, 2024. APM-REP-01332-0360, Shallow Groundwater Monitoring Well Network Installation at the South Bruce Site. Project Data Report for Shallow Groundwater Monitoring Well Network Installation, Rev 6.

Kottek, M., Grieser, J., Beck, C., Rudolf, B., & Rubel, F. (2006). World Map of the Köppen-Geiger Climate Classification Updated. Meteorologische Zeitschrift, 15, 259–263. https://doi.org/10.1127/0941-2948/2006/0130

Nuclear Waste Management Organization (NWMO), 2023. Confidence in Safety – South Bruce Site – 2023 Update. NWMO-TR-2023-08.

APPENDIX A

Hydrographs



Notes:
1. SB_MW01_BR-A transducer installed at 269.48 m.a.s.l. as of September 12, 2022.
2. SB_MW01_OB-Int transducer installed at 281.87 m.a.s.l. as of September 12, 2022.
3. Precipitation data collected from Environment Canada Goderich Station, located approximately 42 km southwest of the site.

NO.	YY/MM/DD	DESCRIPTION	DESIGN BY	CHECKED BY
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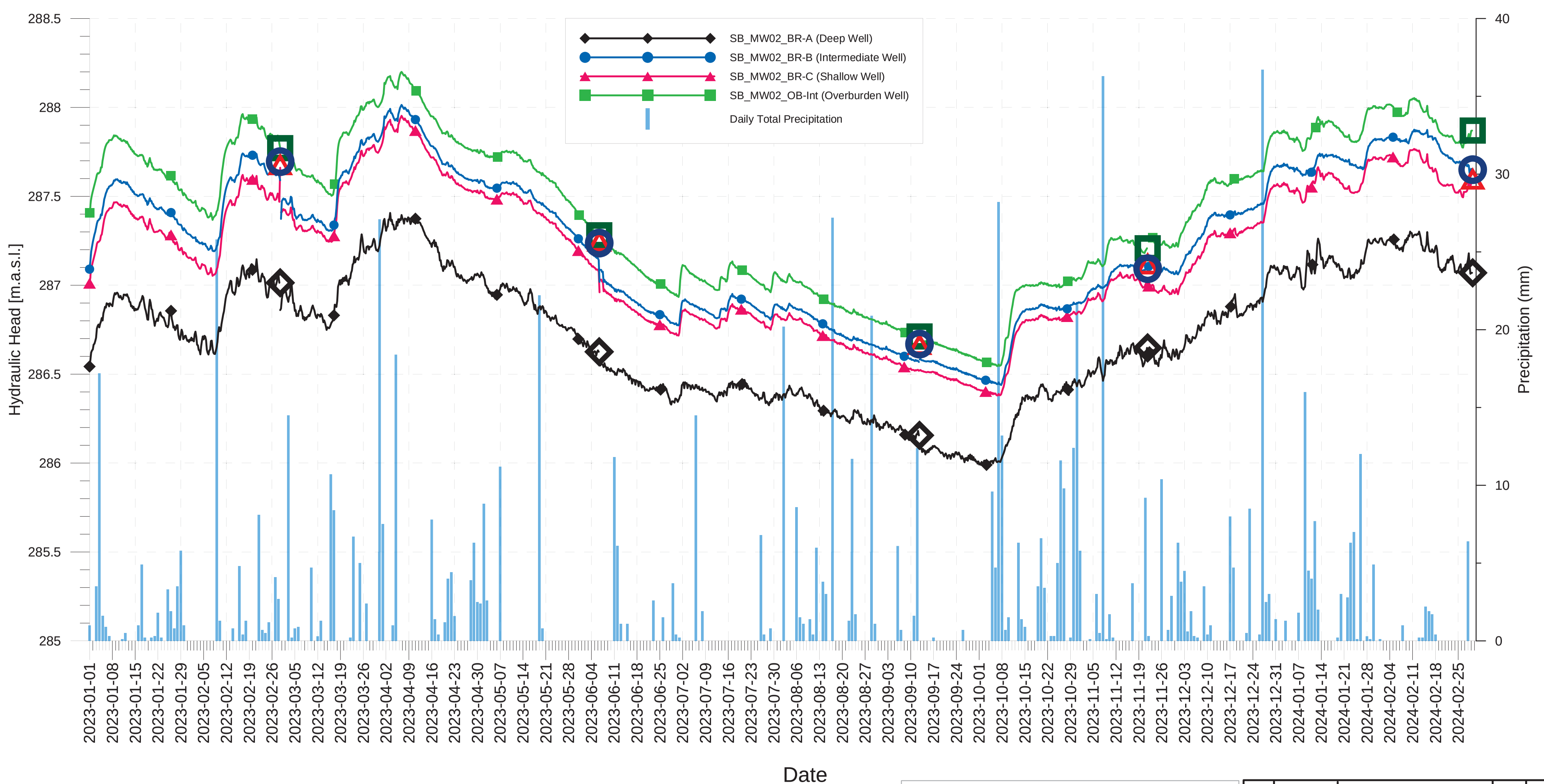
SHALLOW GROUNDWATER MONITORING NETWORK, SOUTH BRUCE AREA

HYDRAULIC HEADS AT SB_MW01 WELL NEST

NOVEMBER 2024 | FIGURE A-1 | REV: 0



Notes:
1. SB_MW02_BR-A transducer installed at 276.90 m.a.s.l. as of September 16, 2022.
2. SB_MW02_BR-B transducer installed at 278.26 m.a.s.l. as of September 16, 2022.
3. SB_MW02_BR-C transducer installed at 276.77 m.a.s.l. as of September 16, 2022.
4. SB_MW02_OB-Int transducer installed at 282.56 m.a.s.l. as of September 16, 2022.
5. Precipitation data collected from Environment Canada Goderich Station, located approximately 42 km southwest of the site.

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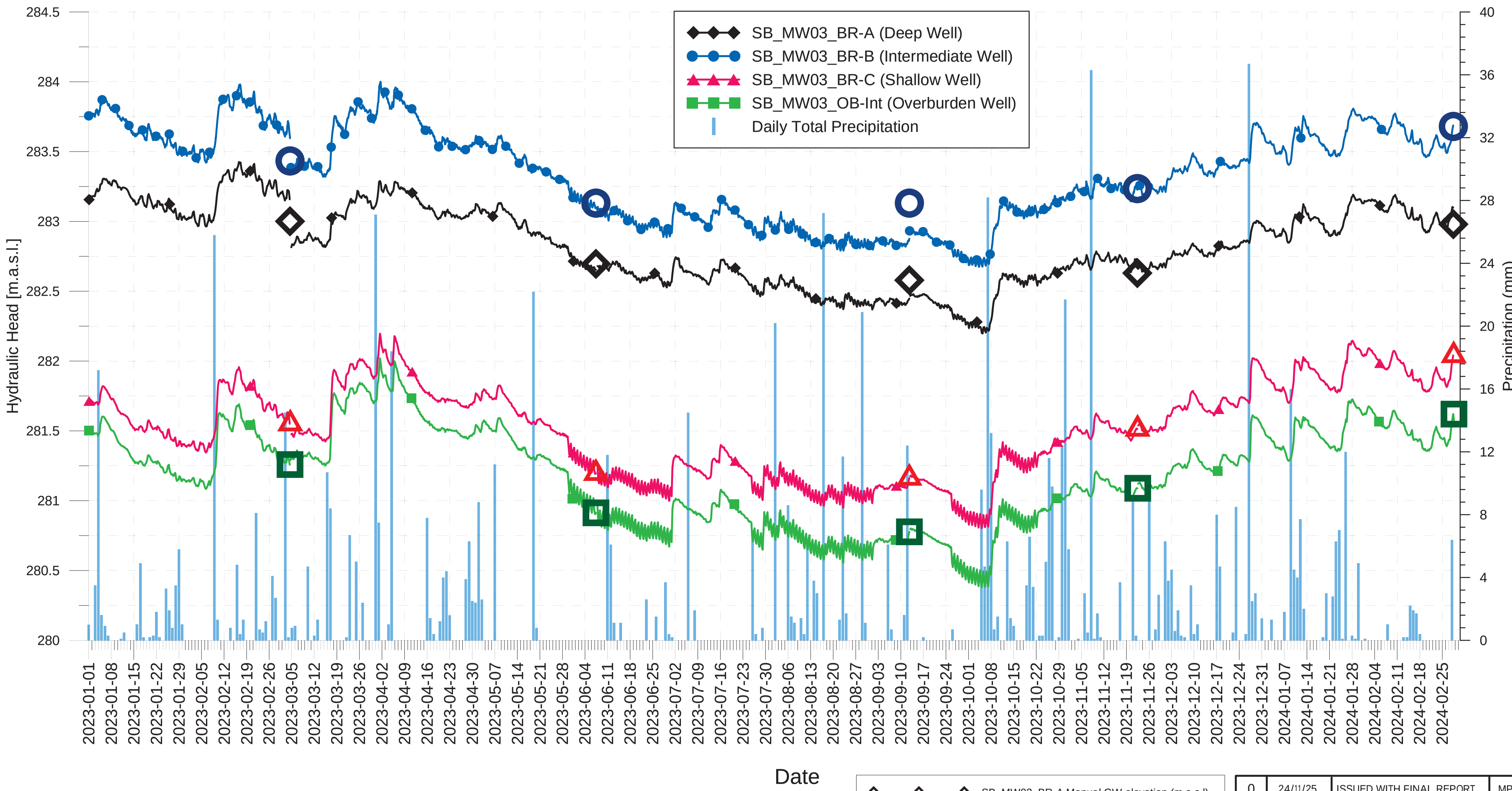
HYDRAULIC HEADS AT SB_MW02 WELL NEST

NOVEMBER 2024 | FIGURE A-2 | REV: 0



Notes:
1. SB_MW03_BR-A transducer installed at 271.96 m.a.s.l. as of September 15, 2022.
2. SB_MW03_BR-B transducer installed at 273.17 m.a.s.l. as of September 15, 2022.
3. SB_MW03_BR-C transducer installed at 272.88 m.a.s.l. as of September 15, 2022.
4. SB_MW03_OB-Int transducer installed at 276.11 m.a.s.l. as of September 15, 2022.
5. Precipitation data collected from Environment Canada Goderich Station, located approximately 42 km southwest of the site.

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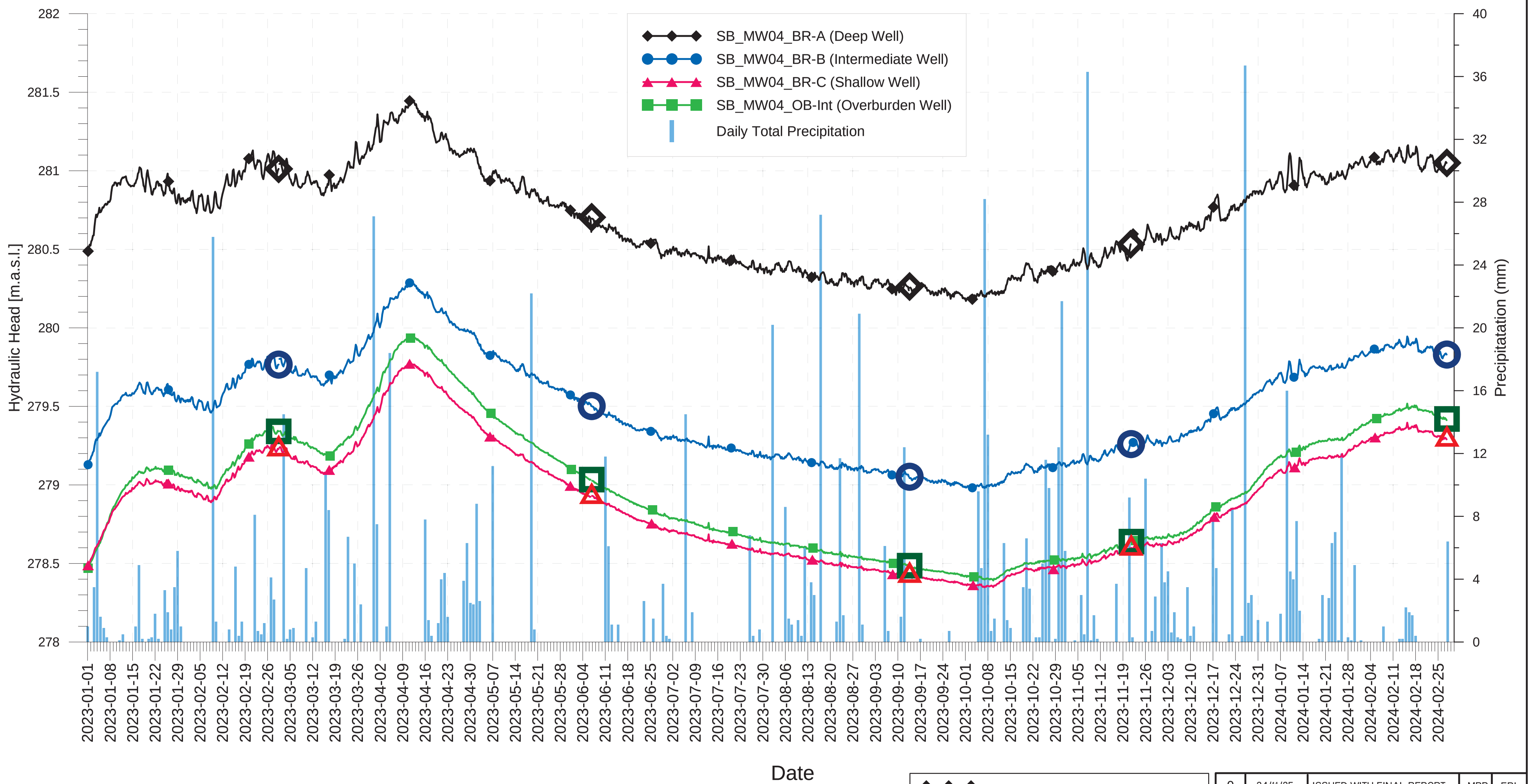
SHALLOW GROUNDWATER MONITORING NETWORK, SOUTH BRUCE AREA

HYDRAULIC HEADS AT SB_MW03 WELL NEST

NOVEMBER 2024 | FIGURE A-3 | REV: 0



Notes:
1. SB_MW04_BR-A transducer installed at 270.54 m.a.s.l. as of September 13, 2022.
2. SB_MW04_BR-B transducer installed at 269.33 m.a.s.l. as of September 13, 2022.
3. SB_MW04_BR-C transducer installed at 268.61 m.a.s.l. as of September 13, 2022.
4. SB_MW04_OB-Int transducer installed at 274.31 m.a.s.l. as of September 13, 2022.
5. Precipitation data collected from Environment Canada Goderich Station, located approximately 42 km southwest of the site.

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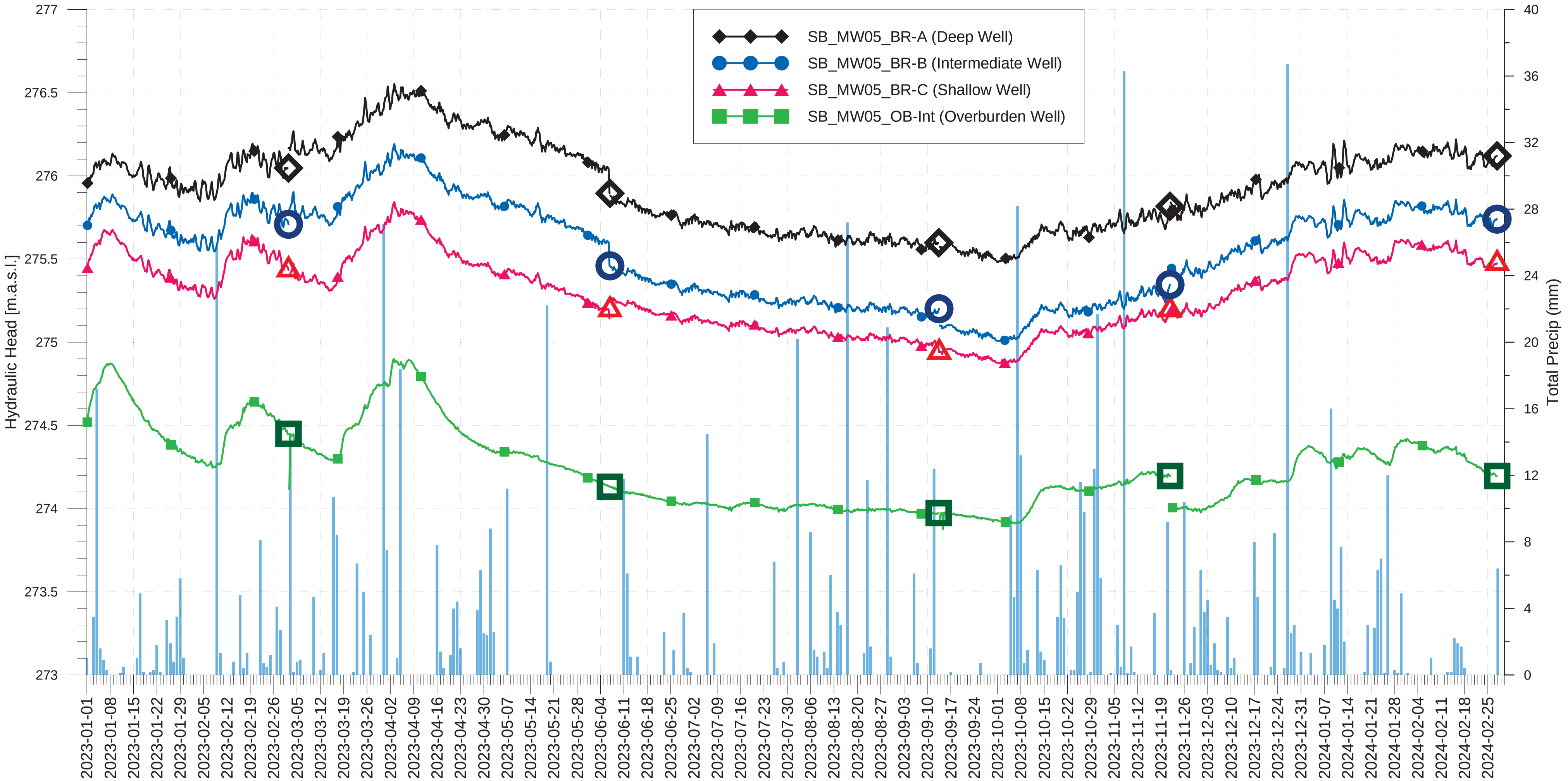
HYDRAULIC HEADS AT SB_MW04 WELL NEST

NOVEMBER 2024 | FIGURE A-4 | REV: 0



Notes:
1. SB_MW05_BR-A transducer installed at 266.33 m.a.s.l. as of September 13, 2022.
2. SB_MW05_BR-B transducer installed at 265.45 m.a.s.l. as of September 13, 2022.
3. SB_MW05_BR-C transducer installed at 265.50 m.a.s.l. as of September 13, 2022.
4. SB_MW05_OB-Int transducer installed at 269.69 m.a.s.l. as of September 13, 2022.
5. Precipitation data collected from Environment Canada Goderich Station, located approximately 42 km southwest of the site.

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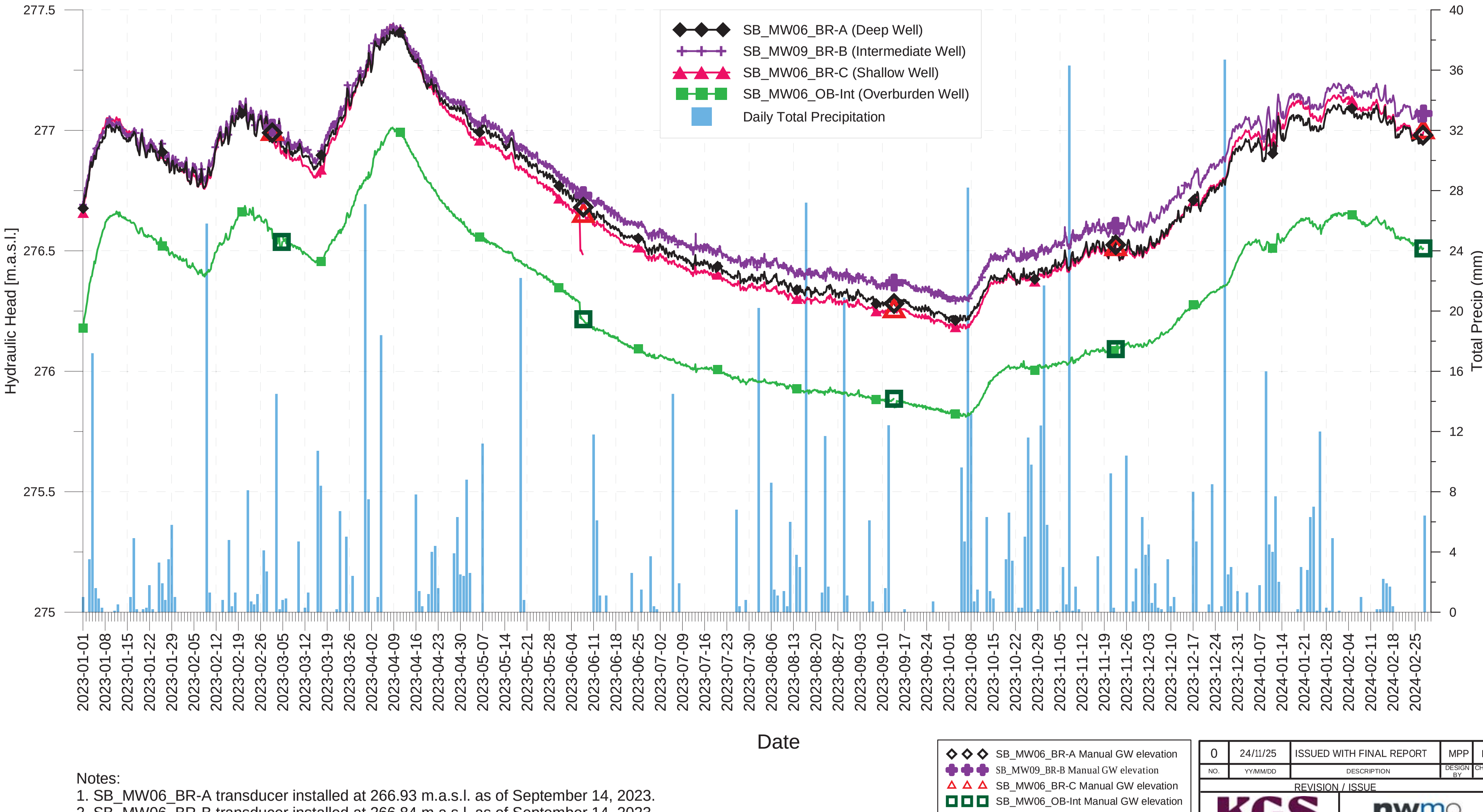
SHALLOW GROUNDWATER MONITORING NETWORK, SOUTH BRUCE AREA

HYDRAULIC HEADS AT SB_MW05 WELL NEST

NOVEMBER 2024 | FIGURE A-5 | REV: 0



Notes:
1. SB_MW06_BR-A transducer installed at 266.93 m.a.s.l. as of September 14, 2023.
2. SB_MW06_BR-B transducer installed at 266.84 m.a.s.l. as of September 14, 2023.
3. SB_MW06_BR-C transducer installed at 266.94 m.a.s.l. as of September 14, 2023.
4. SB_MW06_OB-Int transducer installed at 273.62 m.a.s.l. as of September 14, 2023.
5. Precipitation data collected from Environment Canada Goderich Station, located approximately 42 km southwest of the site.

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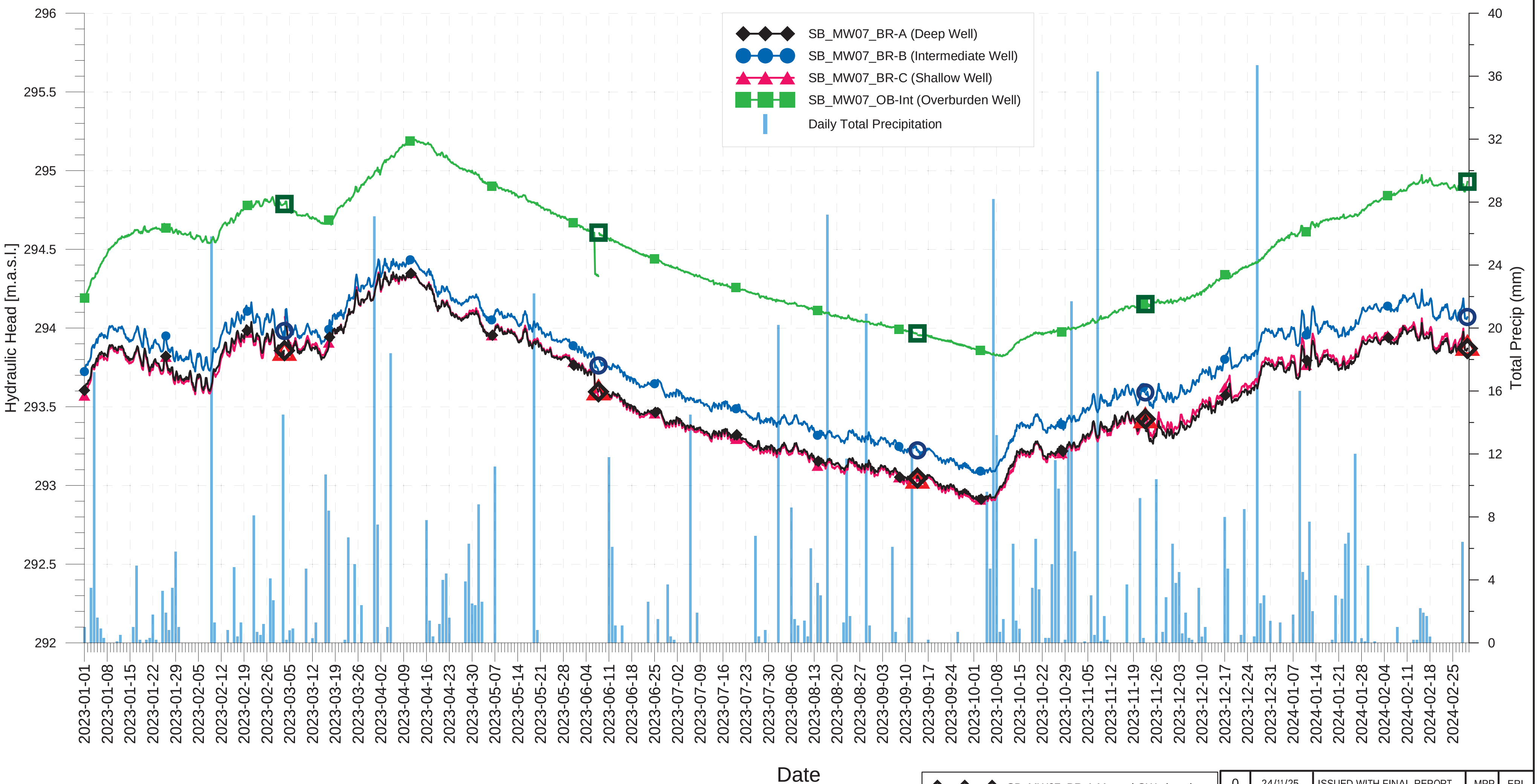
HYDRAULIC HEADS AT SB_MW06 WELL NEST

NOVEMBER 2024 | FIGURE A-6 | REV: 0



Notes:
1. SB_MW07_BR-A transducer installed at 283.24 m.a.s.l. as of September 17, 2022.
2. SB_MW07_BR-B transducer installed at 284.21 m.a.s.l. as of September 17, 2022.
3. SB_MW07_BR-C transducer installed at 283.20 m.a.s.l. as of September 17, 2022.
4. SB_MW07_OB-Int transducer installed at 292.94 m.a.s.l. as of September 17, 2022.
5. Precipitation data collected from Environment Canada Goderich Station, located approximately 42 km southwest of the site.

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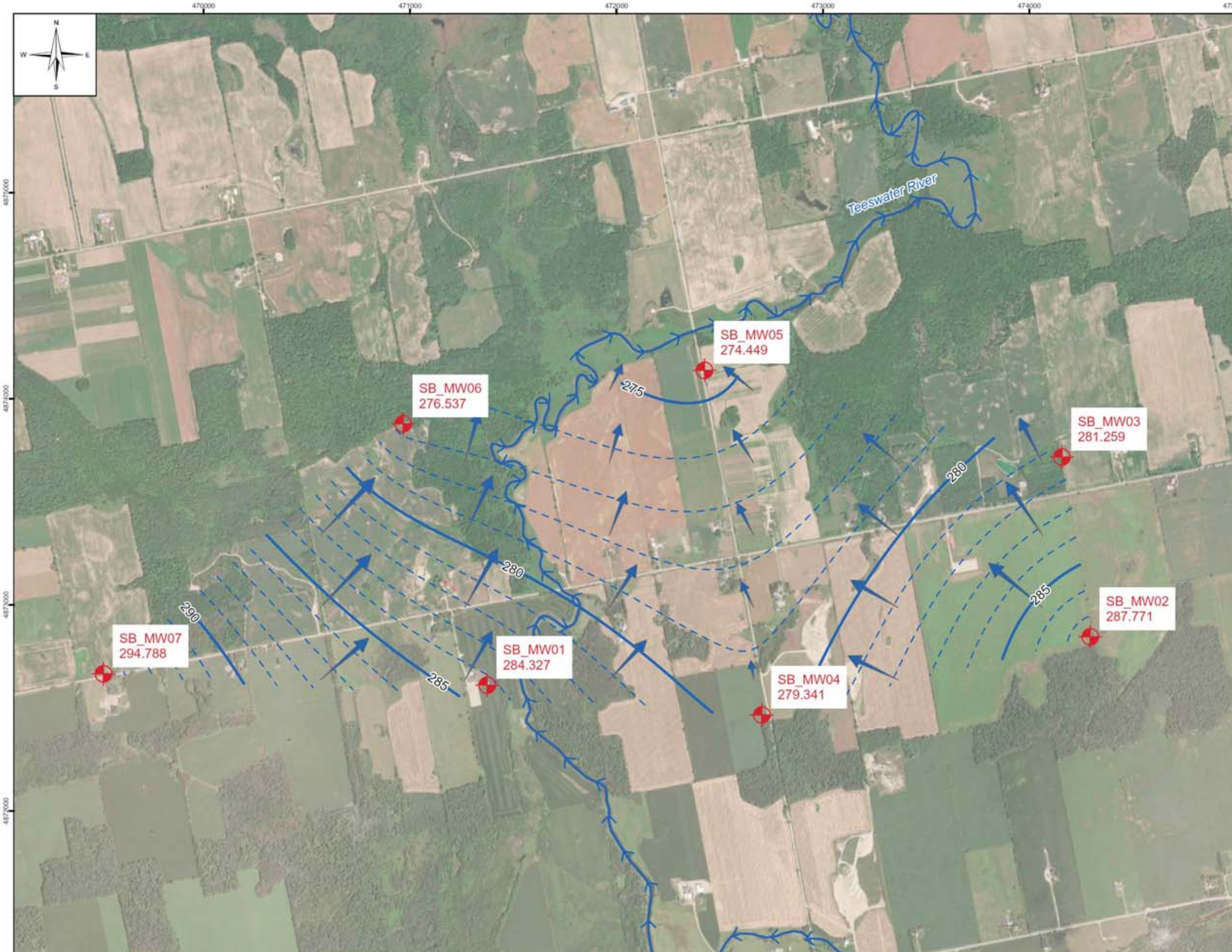
HYDRAULIC HEADS AT SB_MW07 WELL NEST

NOVEMBER 2024 | FIGURE A-7 | REV: 0

APPENDIX B

Groundwater Contours



LEGEND:

- Monitoring Well
- Terrestrial River
- 1m GW Contour
- 5m GW Contour
- GW Flow Direction

NOTES:
1. All units are metric and in metres unless otherwise specified. Transverse Mercator Projection, NAD 1983, Zone 17. Elevations are in metres above sea level (MSL).

180 0 180 360 540 720
Metres
SCALE: 1:18,000 METRIC 11"x17"

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SOUTH BRUCE PRESSURE DATA ANNUAL REPORT

Q1 2023 OVERBURDEN GROUND WATER CONTOURS

NOVEMBER 2024 | FIGURE B1 | REV. 0

Portions of data Produced by KGS Group, under Licence with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2024.

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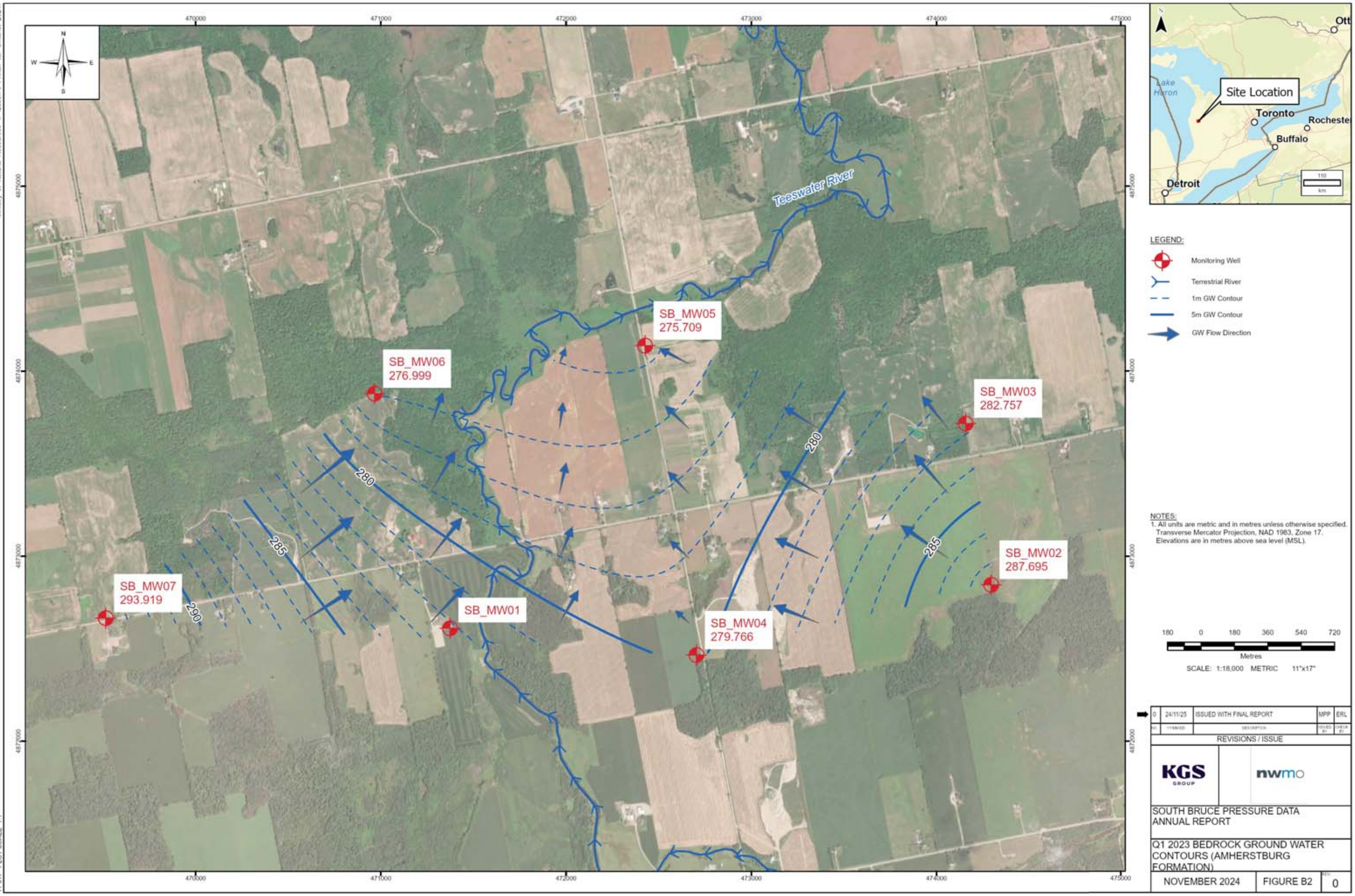

Portions of data Produced by KGS Group, under Licence with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2024.

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11"x17" PLOT SCALE 1:1

LEGEND:

- Monitoring Well
- Terrestrial River
- 1m GW Contour
- 5m GW Contour
- GW Flow Direction

NOTES:
1. All units are metric and in metres unless otherwise specified. Transverse Mercator Projection, NAD 1983, Zone 17. Elevations are in metres above sea level (MSL).

SCALE: 1:18,000 METRIC 11"x17"

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SOUTH BRUCE PRESSURE DATA ANNUAL REPORT

Q2 2023 OVERBURDEN GROUND WATER CONTOURS

NOVEMBER 2024 | FIGURE B3 | REV. 0

Portions of data Produced by KGS Group, under Licence with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2024.

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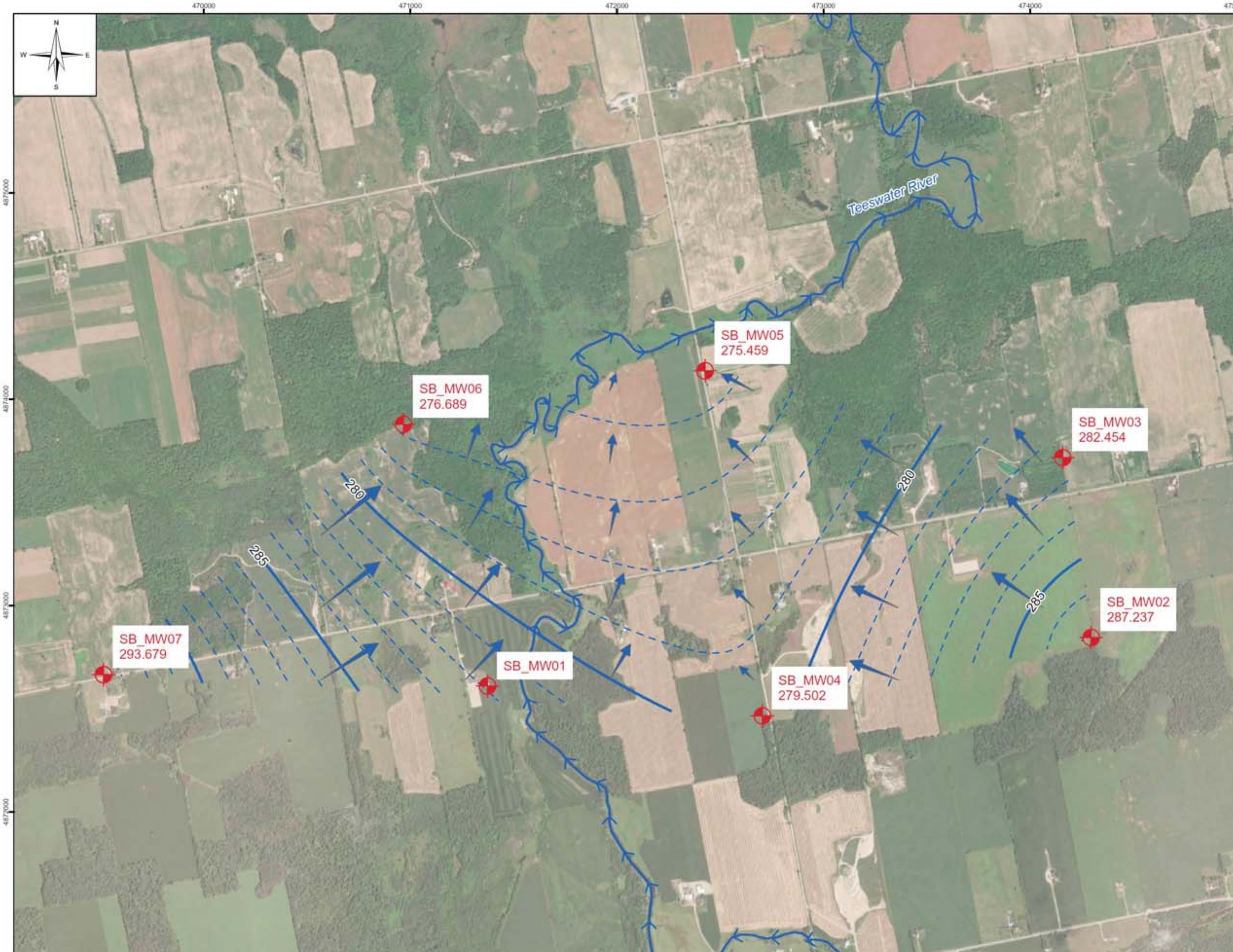

LEGEND:

- Monitoring Well
- Terrestrial River
- 1m GW Contour
- 5m GW Contour
- GW Flow Direction

NOTES:
1. All units are metric and in metres unless otherwise specified. Transverse Mercator Projection, NAD 1983, Zone 17. Elevations are in metres above sea level (MSL).

180 0 180 360 540 720

Metres

SCALE: 1:18,000 METRIC 11"x17"

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SOUTH BRUCE PRESSURE DATA ANNUAL REPORT

Q2 2023 BEDROCK GROUND WATER CONTOURS (AMHERSTBURG FORMATION)

NOVEMBER 2024 | FIGURE B4 | REV. 0

Portions of data Produced by KGS Group, under Licence with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2024

FileName: R:\Projects\2022\22-3836-001\Design\GIS\DATA\ArcPro\GW Contours\GW Contours.aprx 22-3836-001
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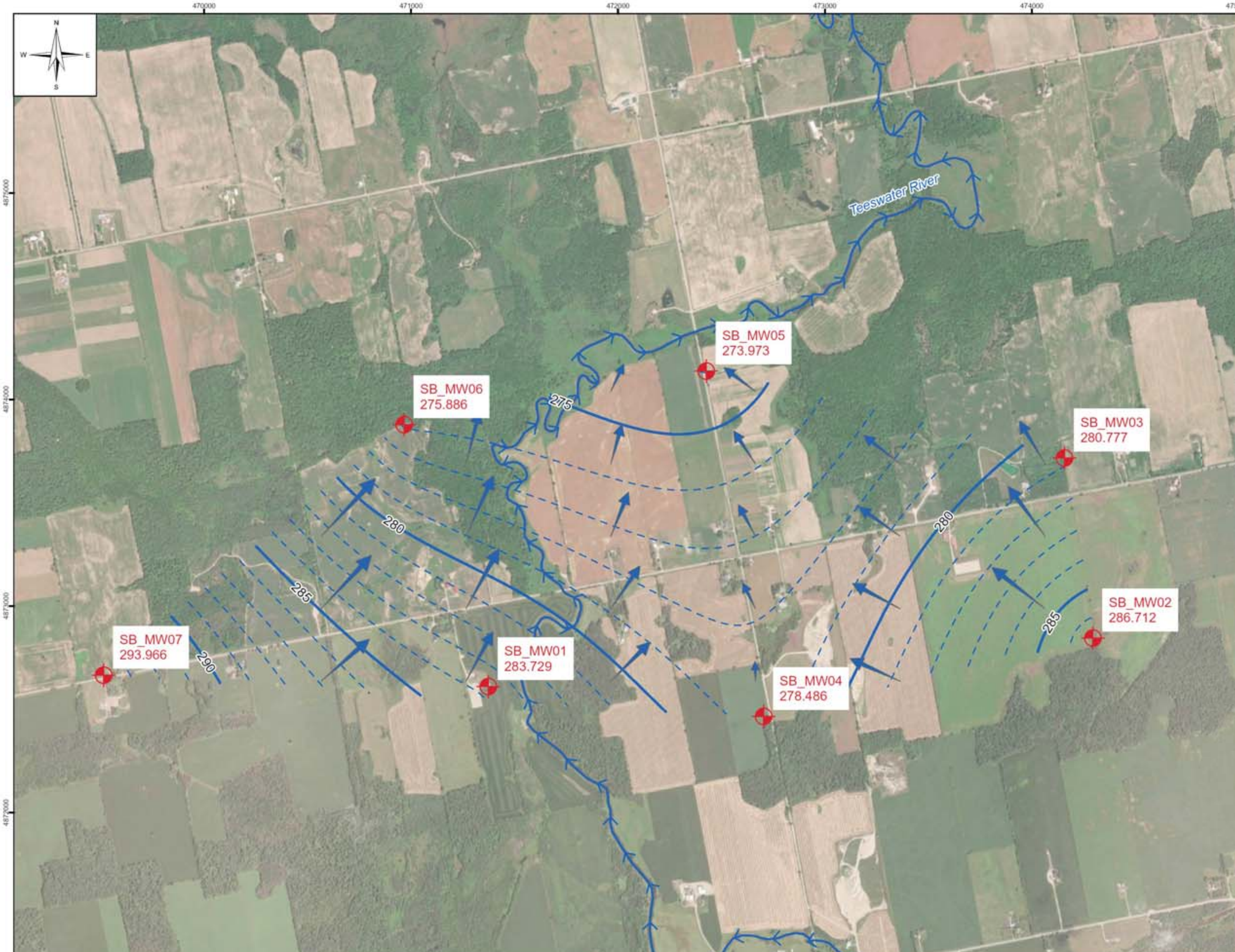

LEGEND:

- Monitoring Well
- Terrestrial River
- 1m GW Contour
- 5m GW Contour
- GW Flow Direction

NOTES:
1. All units are metric and in metres unless otherwise specified. Transverse Mercator Projection, NAD 1983, Zone 17. Elevations are in metres above sea level (MSL).

180 0 180 360 540 720
Metres
SCALE: 1:18,000 METRIC 11"x17"

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SOUTH BRUCE PRESSURE DATA ANNUAL REPORT

Q3 2023 OVERBURDEN GROUND WATER CONTOURS

NOVEMBER 2024 | FIGURE B5 | REV. 0

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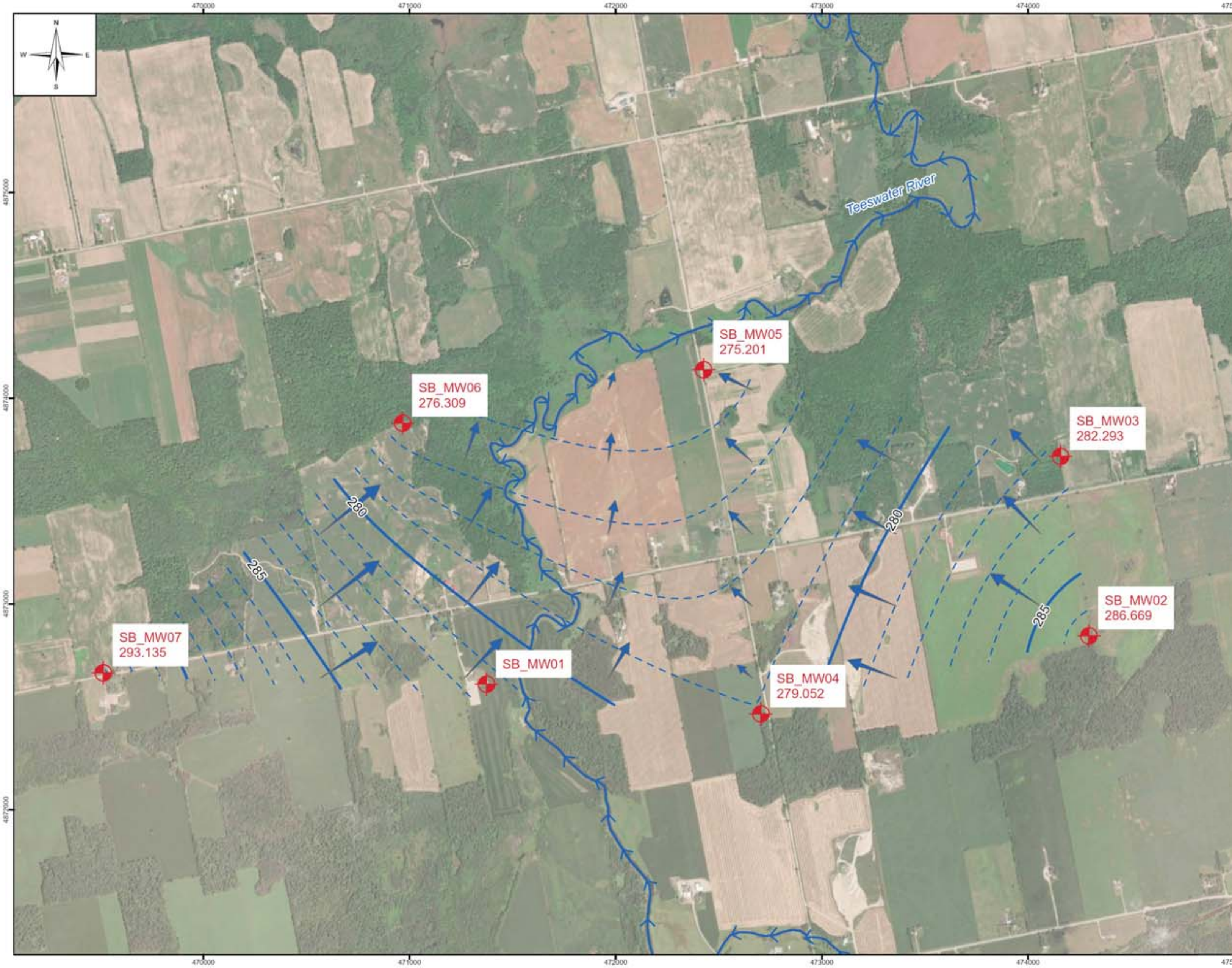
FileName: R:\Projects\2022\22-3836-001\Design\GIS\DATA\ArcPro\GW Contours\GW Contours.aprx 22-3836-001
11"x17" PLOT SCALE 1:1



LEGEND:

- Monitoring Well
- Terrestrial River
- 1m GW Contour
- 5m GW Contour
- GW Flow Direction

NOTES:
1. All units are metric and in metres unless otherwise specified. Transverse Mercator Projection, NAD 1983, Zone 17. Elevations are in metres above sea level (MSL).

180 0 180 360 540 720
Metres
SCALE: 1:18,000 METRIC 11"x17"

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SOUTH BRUCE PRESSURE DATA ANNUAL REPORT

Q3 2023 BEDROCK GROUND WATER CONTOURS (AMHERSTBURG FORMATION)

NOVEMBER 2024 | FIGURE B6 | REV. 0

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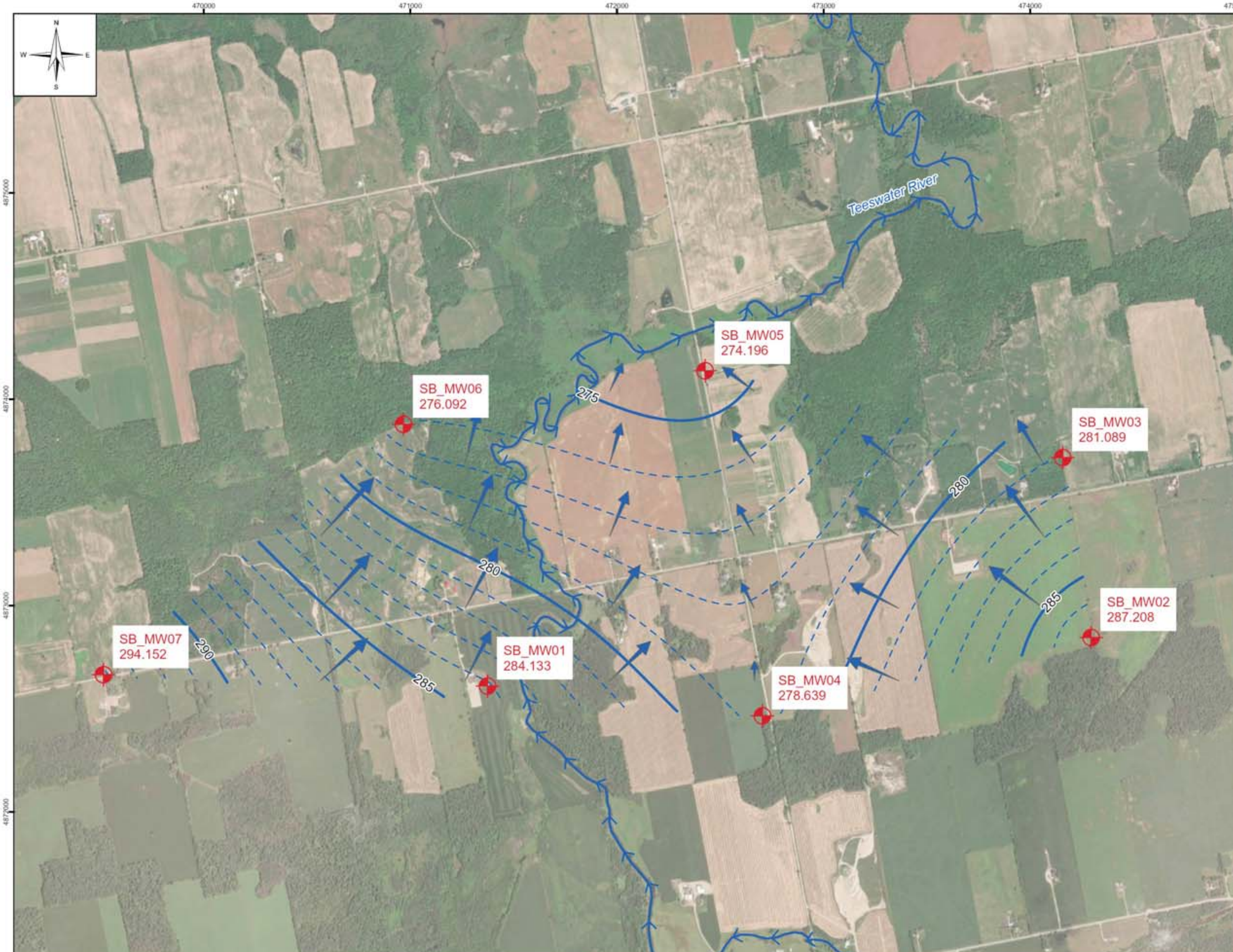
11"x17" PLOT SCALE 1:1



LEGEND:

- Monitoring Well
- Terrestrial River
- 1m GW Contour
- 5m GW Contour
- GW Flow Direction

NOTES:
1. All units are metric and in metres unless otherwise specified. Transverse Mercator Projection, NAD 1983, Zone 17. Elevations are in metres above sea level (MSL).

180 0 180 360 540 720
Metres
SCALE: 1:18,000 METRIC 11"x17"

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SOUTH BRUCE PRESSURE DATA ANNUAL REPORT

Q4 2023 OVERBURDEN GROUND WATER CONTOURS

NOVEMBER 2024 | FIGURE B7 | REV. 0

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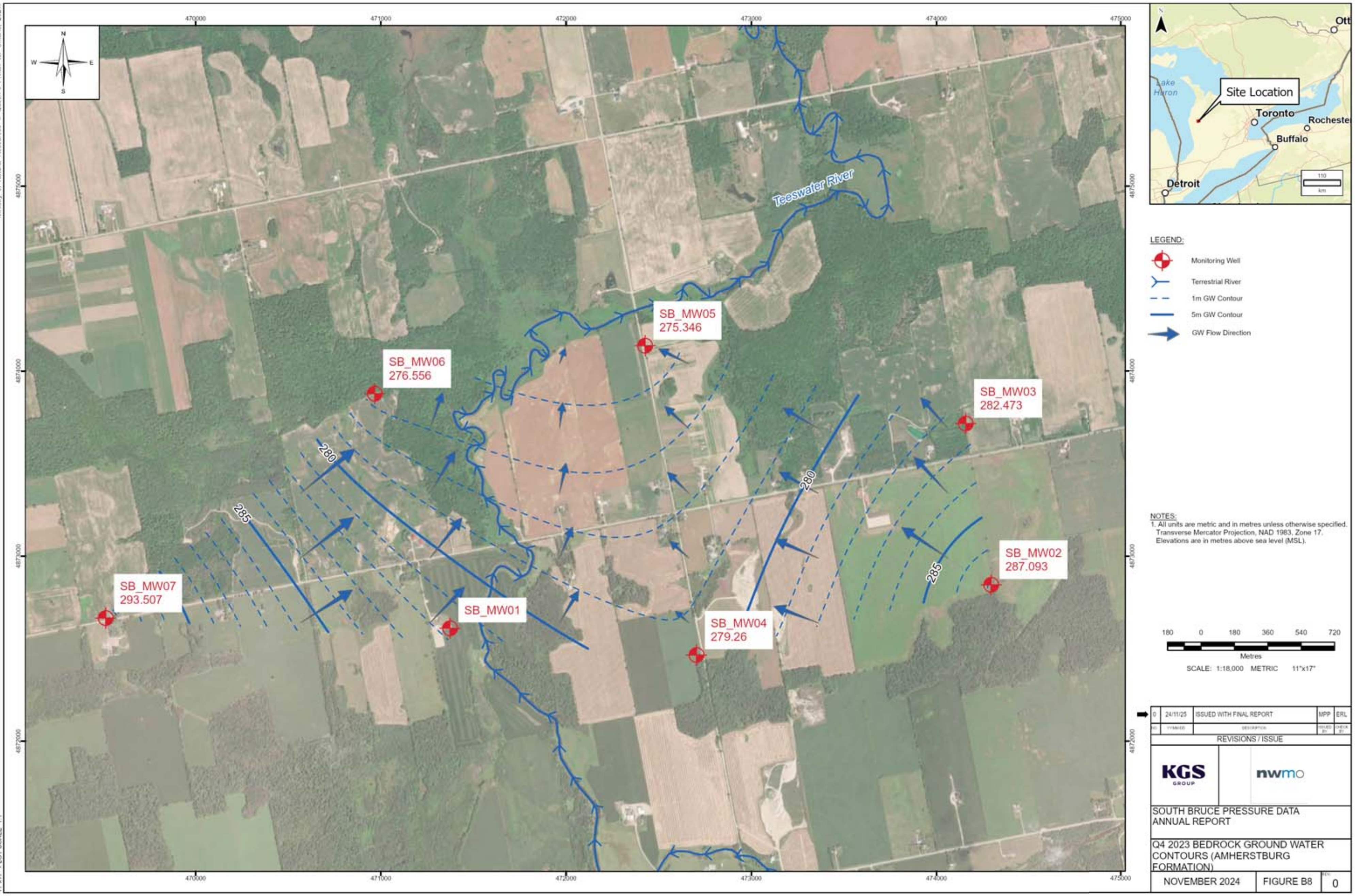
FileName: R:\Projects\2022\22-3836-001\Design\GIS\DATA\ArcPro\GW Contours\GW Contours.aprx 22-3836-001
11"x17" PLOT SCALE 1:1



LEGEND:

- Monitoring Well
- Terrestrial River
- 1m GW Contour
- 5m GW Contour
- GW Flow Direction

NOTES:
1. All units are metric and in metres unless otherwise specified. Transverse Mercator Projection, NAD 1983, Zone 17. Elevations are in metres above sea level (MSL).

180 0 180 360 540 720
Metres
SCALE: 1:18,000 METRIC 11"x17"

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SOUTH BRUCE PRESSURE DATA ANNUAL REPORT

Q4 2023 BEDROCK GROUND WATER CONTOURS (AMHERSTBURG FORMATION)

NOVEMBER 2024 | FIGURE B8 | REV. 0

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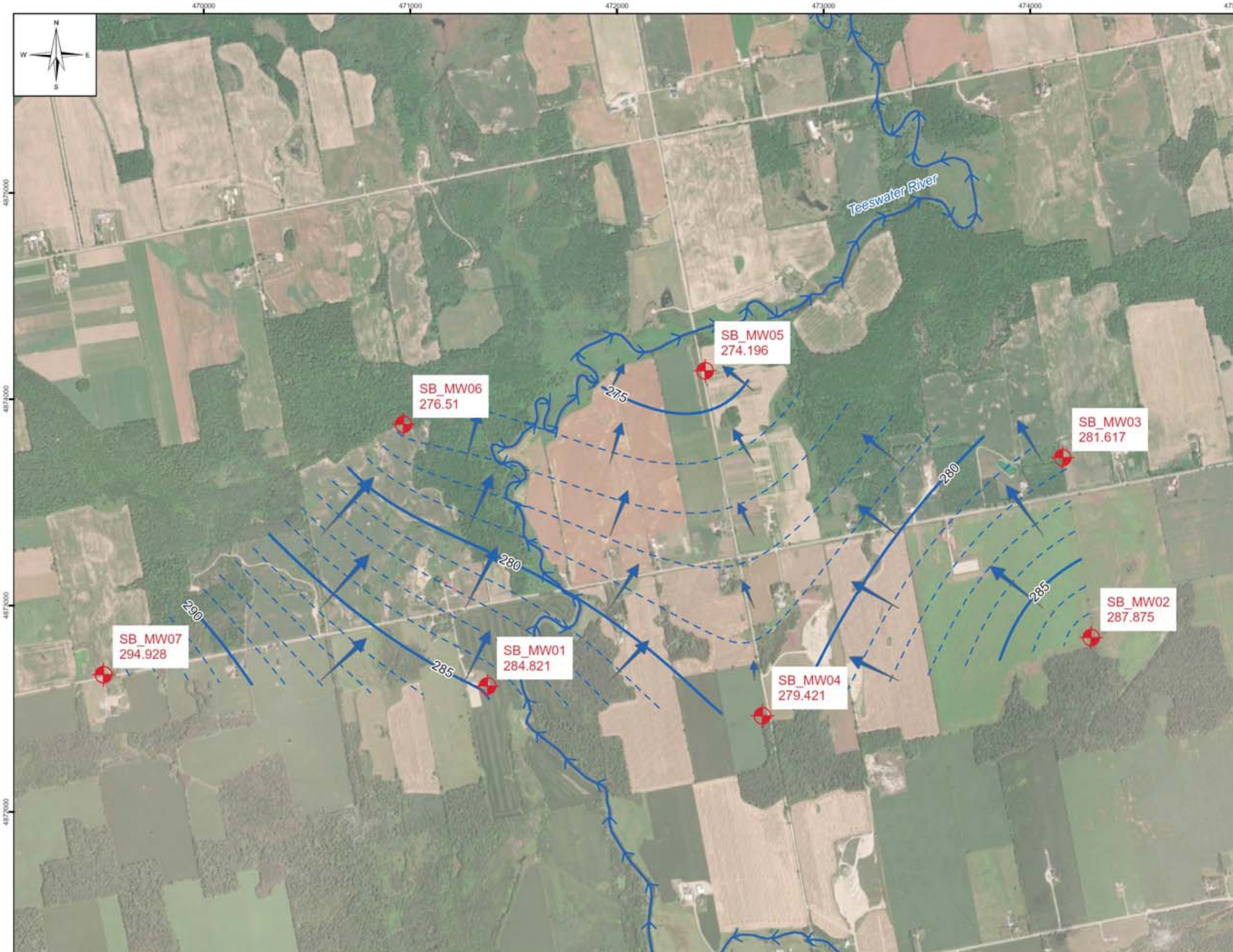
FileName: R:\Projects\2022\22-3836-001\Design\GIS\DATA\ArcPro\GW Contours\GW Contours.aprx 22-3836-001
11"x17" PLOT SCALE 1:1



LEGEND:

- Monitoring Well
- Terrestrial River
- 1m GW Contour
- 5m GW Contour
- GW Flow Direction

NOTES:
1. All units are metric and in metres unless otherwise specified. Transverse Mercator Projection, NAD 1983, Zone 17. Elevations are in metres above sea level (MSL).

180 0 180 360 540 720
Metres
SCALE: 1:18,000 METRIC 11"x17"

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SOUTH BRUCE PRESSURE DATA ANNUAL REPORT

Q1 2024 OVERBURDEN GROUND WATER CONTOURS

NOVEMBER 2024 | FIGURE B9 | REV. 0

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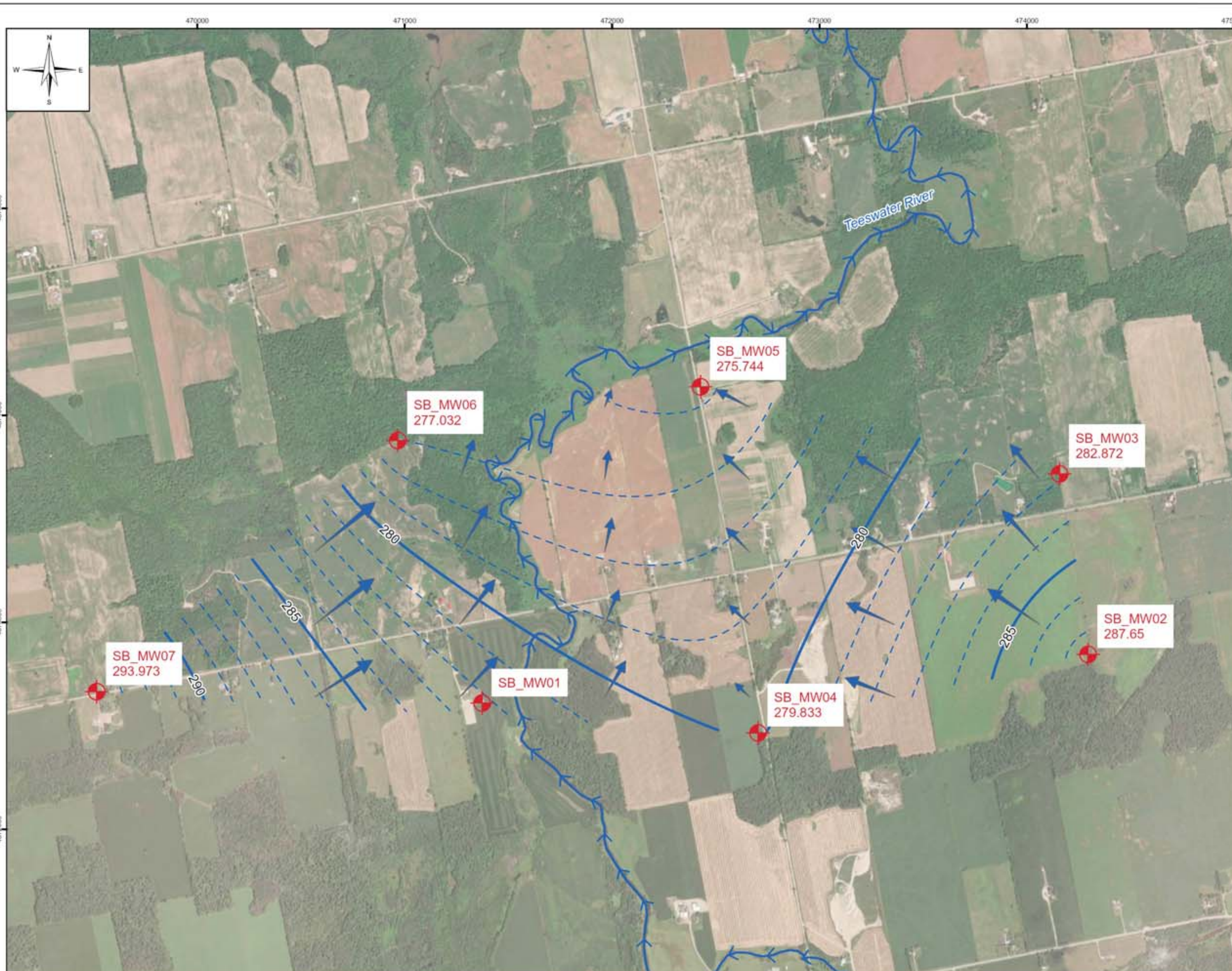
11"x17" PLOT SCALE 1:1



LEGEND:
- Monitoring Well
- Terrestrial River
- 1m GW Contour
- 5m GW Contour
- GW Flow Direction

NOTES:
1. All units are metric and in metres unless otherwise specified. Transverse Mercator Projection, NAD 1983, Zone 17. Elevations are in metres above sea level (MSL).

180 0 180 360 540 720

Metres

SCALE: 1:18,000 METRIC 11"x17"

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SOUTH BRUCE PRESSURE DATA ANNUAL REPORT

Q1 2024 BEDROCK GROUND WATER CONTOURS (AMHERSTBURG FORMATION)

NOVEMBER 2024 | FIGURE B10 | 0

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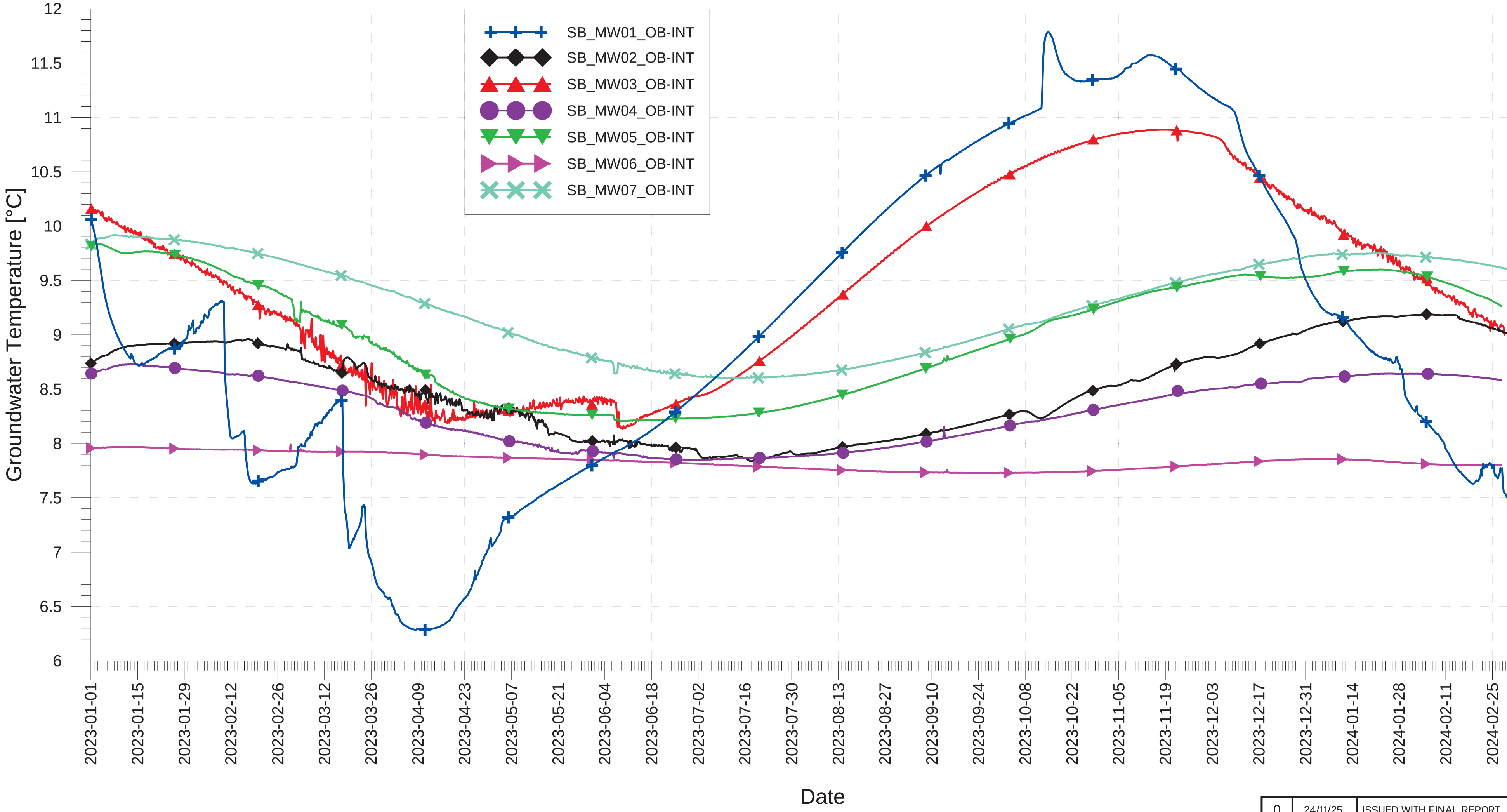
11"x17" PLOT SCALE 1:1

APPENDIX C

Groundwater Temperature Graphs



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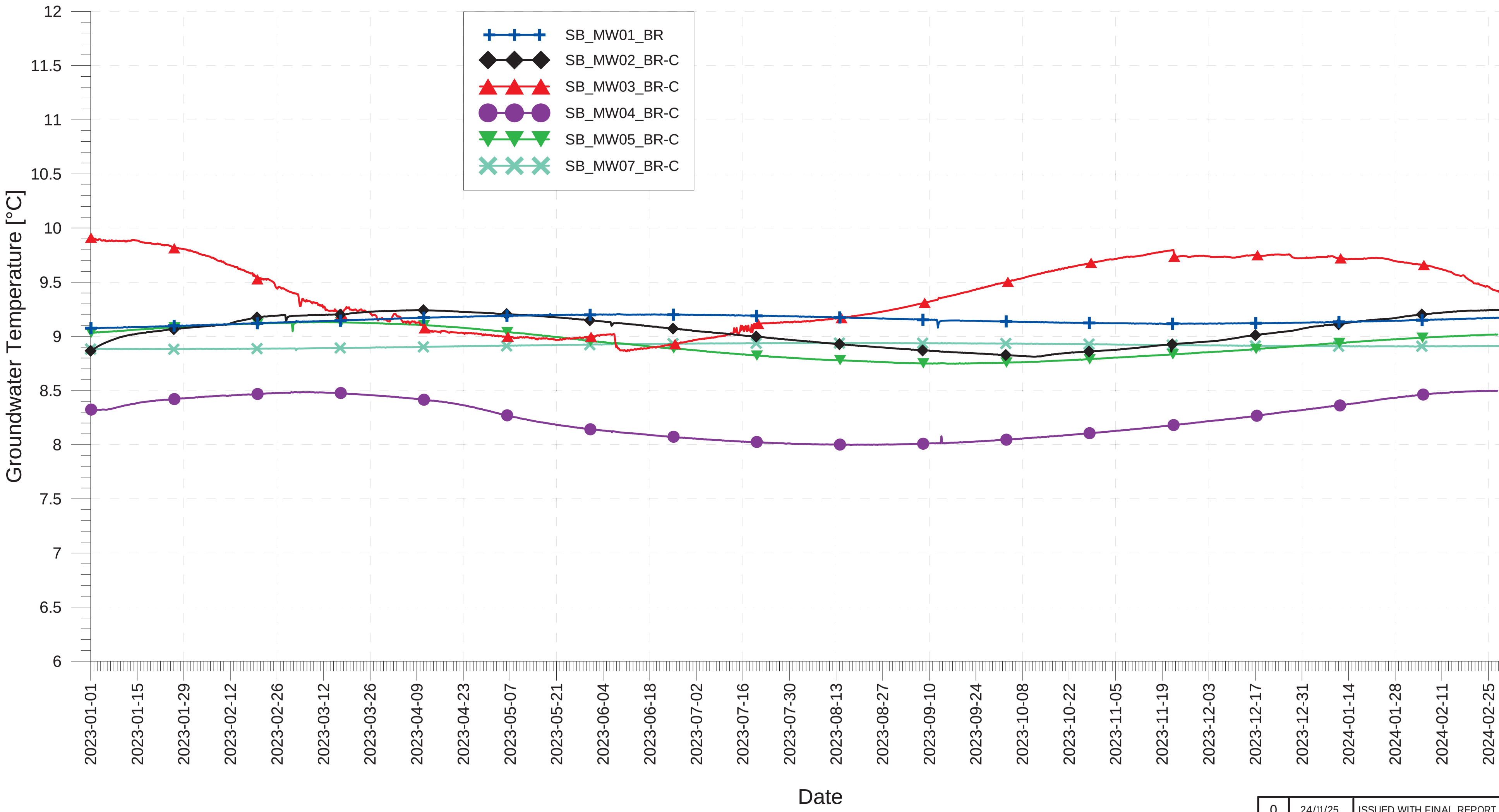
SHALLOW GROUNDWATER MONITORING NETWORK, SOUTH BRUCE AREA

GROUNDWATER TEMPERATURES IN OVERBURDEN

NOVEMBER 2024 | FIGURE C-1 | REV: 0



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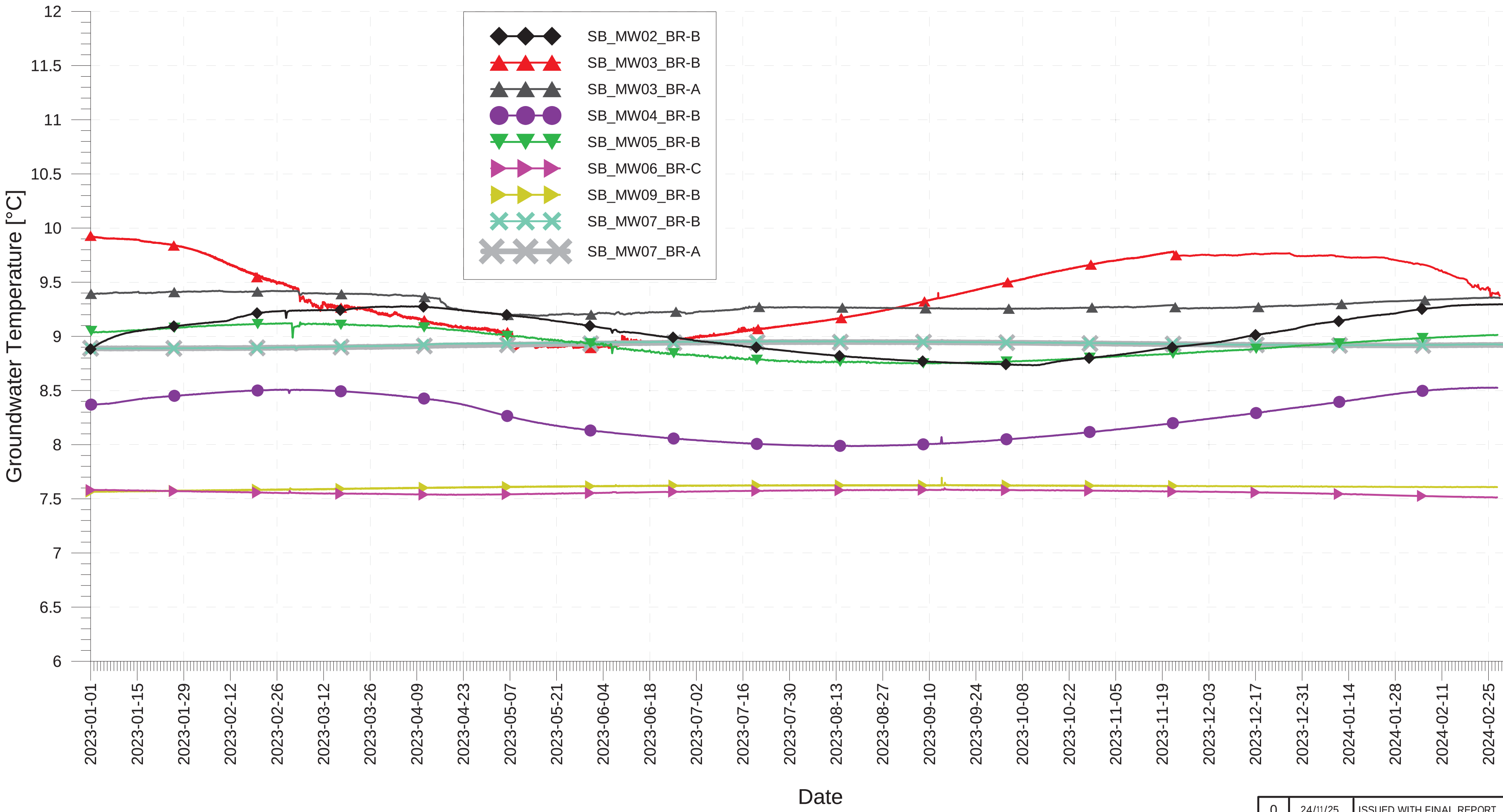
SHALLOW GROUNDWATER MONITORING NETWORK, SOUTH BRUCE AREA

GROUNDWATER TEMPERATURES IN LUCAS FORMATION

NOVEMBER 2024 | FIGURE C-2 | REV: 0



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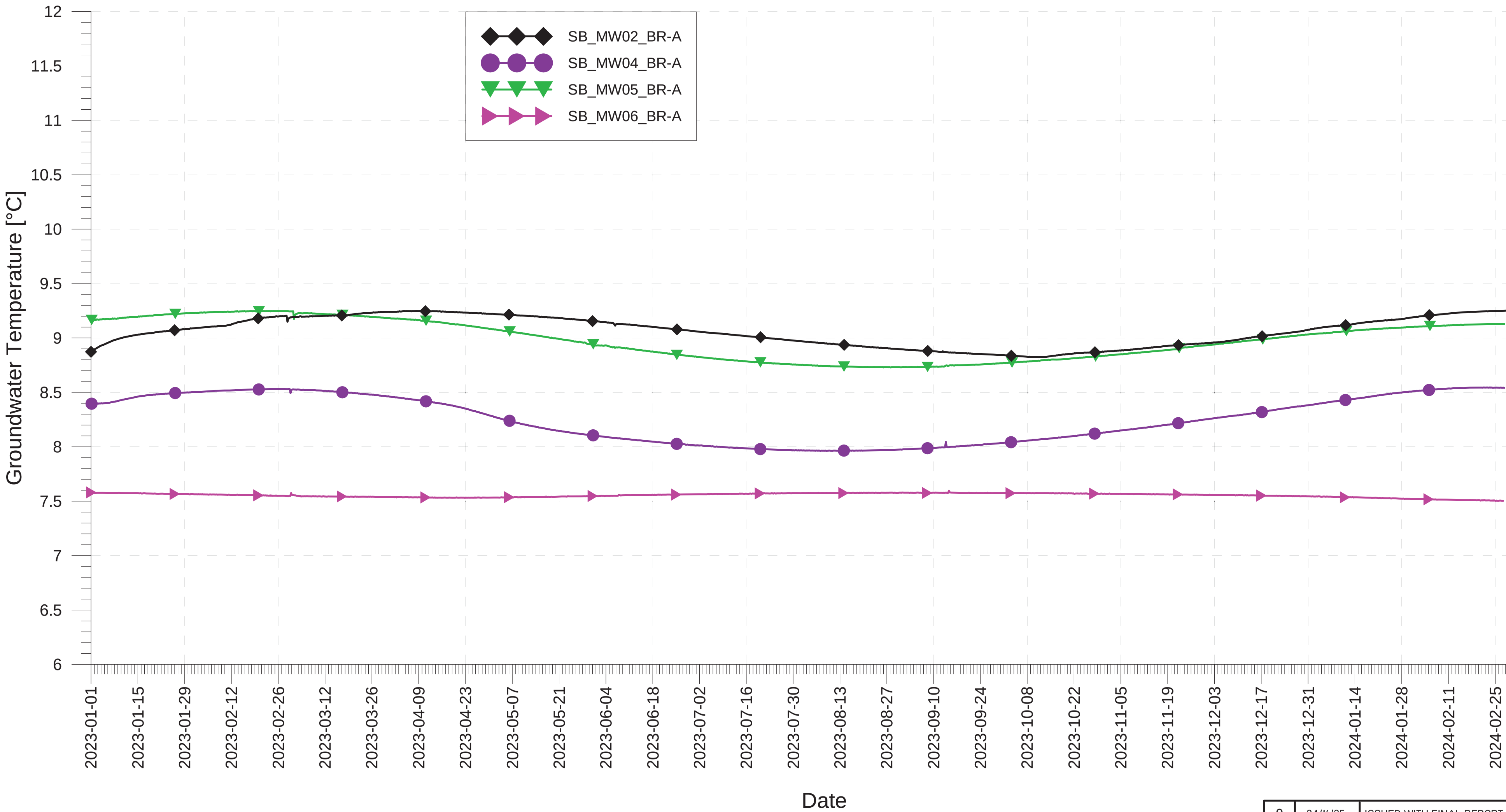
SHALLOW GROUNDWATER MONITORING NETWORK, SOUTH BRUCE AREA

GROUNDWATER TEMPERATURES IN AMHERSTBURG FORMATION

NOVEMBER 2024 | FIGURE C-3 | REV: 0



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SHALLOW GROUNDWATER MONITORING NETWORK, SOUTH BRUCE AREA

GROUNDWATER TEMPERATURES IN BOIS BLANC FORMATION

NOVEMBER 2024	FIGURE C-4	REV: 0

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Experience in Action