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Highway 7 Pit

LEVEL 1 AND 2 HYDROGEOLOGICAL ASSESSMENT

Drain Bros. Excavating Limited

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1 Introduction

Tatham Engineering Limited (Tatham) has been retained by Drain Bros. Excavating Limited (Drain Bros) to prepare a combined Level 1 and Level 2 Hydrogeological Assessment in support of an Aggregate Resources Act (ARA) Class A Above Water licence for the proposed Highway 7 Pit located on Part Lot 15 Concession 6 and Part Lot 14 Concession 5 in the Township of Asphodel-Norwood, County of Peterborough, hereafter referred to as the "Proposed Pit" or "Site", as shown in Figure 1.

Tatham has prepared this combined Level 1 and Level 2 Hydrogeological Assessment for the Proposed Pit in accordance with the relevant Ministry of Natural Resources (MNR) Standards including the *Aggregate Resources of Ontario Technical Reports and Information Standards,* dated August 2020 (Technical Reports Information Standards). This combined Level 1 and Level 2 Hydrogeological Assessment was completed to assess the potential impact of the Proposed Pit on the aquifers, surface water features, springs, and discharge areas in the vicinity of the Proposed Pit lands and ultimately evaluate potential mitigation measures.

1.1 SITE DESCRIPTION

The Proposed Pit will comprise Part Lot 15 Concession 6 and Part Lot 14 Concession 5, Township of Asphodel-Norwood, County of Peterborough. The Proposed Pit lands are primarily tree covered and bound by Sand Road and undeveloped areas to the south, undeveloped wetlands and wooded areas to the north and west, and an existing mineral aggregate operation (Licence #3399) to the east.

1.2 STUDY AREA DESCRIPTION

The surrounding lands primarily consist of agricultural and/or rural residential properties, existing aggregate operations, undeveloped wetlands and wooded areas, and surface water features.

Numerous wetlands and surface water features are present throughout the study area, including provincially significant, non-provincially significant, and unevaluated wetlands.

Based upon Asphodel-Norwood Interactive Mapping and available MECP water well records, it is our understanding properties in the vicinity of the Site are serviced by private water supply wells.

1.3 SITE DEVELOPMENT

The Proposed Pit consists of a Class A Above Water Pit with a proposed licensed area of 35.2 ha and a proposed extraction area of 25.0 ha.

Proposed operations have been divided into two phases of extraction, with Phase 1 comprising 5.7 ha of extraction area located to the east of Cooper Line, immediately adjacent to the existing licenced pit (Licence #3399), and Phase 2 comprising 19.3 ha of extraction area located to the west of Cooper Line. Extraction will be initiated in Phase 1 and continue through to Phase 2 via an existing access road, as shown in Figure 2.

The depth of extraction will remain at least 1.5 m above the maximum predicted groundwater level at elevations of 197.1 to 203.8 m asl.

The main Site access will be from Highway 7 utilizing an existing driveway. Aggregate materials will be processed on-site within close proximity of the active pit working faces.

The Proposed Pit will have a maximum extraction limit of 350,000 tonnes per year.

On-site drainage of undisturbed areas will continue as per the existing drainage patterns while drainage within the extracted areas will be contained within the proposed extraction limits and ultimately infiltrate through the pit floor.

1.4 ASSESSMENT OBJECTIVES

This assessment was conducted to fulfill the requirements of a Level 1 and Level 2 Hydrogeological Assessment for the licensing of a Class A Pit Above Water under the ARA.

Level 1 and Level 2 assessment reports are presented here together. The initial step is to complete a preliminary screening of the area surrounding the Site to identify any potential impacts which may result from the proposed above water pit activities on:

- Water wells, including private water wells, municipal/communal/industrial, geothermal and agricultural wells. Where a Proposed Pit is within a Well Head Protection Area (WHPA) for Quantity (Q1 or Q2) as outlined in the applicable Source Water Protection Plan, the applicable Source Water Protection Policies and mitigation measures are to be incorporated and implemented as part of the proposed site plans;
- Groundwater aquifers;
- Watercourses and surface waterbodies;
- Springs; and
- Discharge areas.

If the preliminary screening exercise identifies a potential impact to one of the above receptors, further assessment to quantify the potential impact and ultimately assess the significance and need for mitigation measures will be required. This impact assessment must include:

- A description of the local geology, hydrogeology and surface water systems supported by field and technical data;
- A description of the proposed water diversion, discharge, storage, and/or drainage facilities;
- A water budget outlining how water will be managed on-site; and
- A detailed description of the potential impacts to receptors within the zone of influence of the Proposed Pit, both negative and positive, and the proposed mitigation measures to reduce or eliminate the potential impacts.

Based on an initial screening, as summarized in Table 1, an assessment to quantify the potential impacts resulting from the Proposed Pit and an assessment of the significance and need for mitigation measures is required.

Table 1: Evaluation of need for Level 2 Hydrogeological Assessment

POTENTIAL GROUNDWATER AND SURFACE WATER FEATURES	INITIAL SCREENING CONSIDERATIONS	NEED TO QUANTIFY IMPACTS
Water Wells	Water wells are located immediately adjacent to the Site. Water wells in the area are primarily constructed in the limestone bedrock; however, water wells could be constructed in the overlying sand and gravel unit.	Further assessment is required to quantify any potential impacts to water wells in the area.
Springs	Springs were not noted within the Site limits; however, the Ouse River and its tributary are suspected to be groundwater fed. As such, upward hydraulic gradients resulting in springs within the Ouse River channel are anticipated.	Further assessment is required to assess the potential impact on groundwater contribution to Ouse River and its tributary.
Groundwater Aquifers	Sand and gravel extraction is to be focused to the esker formations and will not extend below the water table.	Further assessment is not needed as the proposed extraction will not extend below the water table.
Surface Water Features	Ouse River is located to the south of the Site, and a tributary of Ouse River runs north adjacent to the Proposed Pit lands. A Non-Provincially Significant Wetland (PSW) is located immediately north of the Proposed Pit lands.	Further assessment is required to assess the potential impact a reduction in surface water levels may have of the surface water features.
Discharge to Surface Water	On-site drainage of undisturbed areas will continue as per existing patterns and drainage of the extracted areas will be contained within the proposed extraction limits to ultimately infiltrate through the pit floor.	Further assessment is not needed as off-site discharge will not be generated.

POTENTIAL GROUNDWATER AND SURFACE WATER FEATURES	INITIAL SCREENING CONSIDERATIONS	NEED TO QUANTIFY IMPACTS
Water Diversion, Storage and Drainage Facilities On-Site	On-site drainage of undisturbed areas will continue as per existing patterns and drainage of the extracted areas will be contained within the proposed extraction limits to ultimately infiltrate through the pit floor.	Further assessment is not needed as water diversion, storage and/or drainage facilities on-site are not proposed.
Water Balance	There is a potential for the proposed extraction to impact the existing infiltration and/or runoff conditions on-site.	Further assessment is needed to evaluate changes in the water balance. An assessment of the site-wide water balance is included in each development scenario as part of this report.
Source Water Protection	There are no municipal water wells within at least a 3.0 km radius.	Further assessment is not needed as the Site does not fall within a Well Head Protection Area (WHPA) and no municipal water wells are located within at least 3.0 km of the Proposed Pit lands.

2 Site Setting

2.1 PHYSIOGRAPHY AND GEOLOGY

The Site lies within the physiographic region known as the Peterborough Drumlin Field, comprising eskers throughout the southern portion of the Proposed Pit lands and drumlinized till plains to the north (Chapman and Putnam, 2007), as shown in Figure 3.

Ontario Geological Survey (OGS) quaternary geology mapping indicates the Site consists of glaciofluvial ice-contact deposits comprising primarily sand and gravel. The area is identified as having esker, kame and end moraine formations (OGS, 2000).

OGS Paleozoic geology mapping indicates the Site is underlain by Ordovician Verulam Formation limestone and shale of the Simcoe Group (Armstrong & Dodge, 2007). The Verulam Formation overlies the Bobcaygeon Formation and is comprised of interbedded limestones and shales.

2.2 TOPOGRAPHY

The landscape throughout the Site is dominated by elongated ridges and eskers, formed as a result of glacial melt comprising coarse sand and gravel deposits. The eskers have resulted in what appears to be rolling hills across the Site ranging in elevations from approximately 200 to 225 m above sea level (asl) as shown in Figure 4. Drainage across the Site will follow local topography and flow to lower lying areas, eventually entering the adjacent wetlands and/or watercourse.

2.3 HYDROLOGY

The Site is located within the Ouse River watershed with the main branch of the river located south of the Site flowing east to west and a tributary of the Ouse River to the north of the Site flowing west to east. There is a highpoint running through the Site which splits drainage from the Site. The north half of the Site drains north to the tributary of the Ouse River while the south half of the Site drains south to the main branch of the Ouse River. Using the Ontario Watershed Information Tool (OWIT), the drainage area of the tributary to the north was calculated to be 785 ha at 7th line. The drainage area of the main branch to the south has a drainage area of 15,121 ha where drainage from the Site enters the Ouse River upstream of the 5th Line easement.

A non-provincially significant and unevaluated wetland is located immediately north of the extraction limits of the Proposed Pit lands, and a larger provincially significant wetland is located to the south of Sand Road approximately 200 to 400 m south of the Proposed Pit lands. The identified catchment areas are shown on Figure 5.

2.4 HYDROGEOLOGY

2.4.1 Regional Hydrogeology

The regional hydrogeology of an area is controlled by the geometry of the geological features which influence the distribution and movement of groundwater. Groundwater is the water found underground in the voids of geological units (both consolidated and unconsolidated materials). Geological units which store and transmit groundwater are called aquifers and are relied upon as a source of potable drinking water in many areas across the province, including within the Township of Asphodel-Norwood. Groundwater movement within an aquifer is controlled by topography, hydraulic head potential, hydraulic conductivity, and porosity.

MECP Water Well Records

To assess the nature of groundwater resources as well as the history of well usage in the area, Ministry of the Environment, Conservation and Parks (MECP) water well records were reviewed for a 500 m radius surrounding the Site as presented in Figure 6, and a summary of the MECP water well records are provided in Appendix A.

It is noted the location details provided on MECP water well records should be reviewed as approximate as the accuracy of the well locations of the individual well records are variable and can be unreliable. In Figure 6 there are multiple water well records identified on the Proposed Pit lands when in fact these water wells are not present on the Proposed Pit lands. The water well records have been reviewed and utilized at a regional scale rather than at a site-specific scale. The on-site borehole and monitoring well details discussed in Section 3.1.1 and 4.0 should be relied on for site-specific details.

A total of 26 MECP well records were reviewed within 500 m of the Site. Of the 26 records, 23 records indicated domestic water well usage, two records indicated livestock and domestic water well usage and one well record did not indicate its use type.

In general, stratigraphy noted from the well records primarily indicated layers of sand and clay with variable gravel contents overlying shale or limestone bedrock. Bedrock was noted in 18 well records at depths of 0.9 to 25.0 m. A general regional cross section running northwest to southeast is shown in Figure 7. Based on the well records the majority of local residential wells are constructed in the limestone bedrock, with fresh water encountered at depths of 2.7 to 28.0 m. It is noted one of the well records indicated the well screen was constructed within a gravel unit overlying the limestone bedrock at a depth of 18.5 m (Water Well Record # 5110822).

In general, there were eight water wells identified to have been constructed and screened in the overburden, and the remaining 18 water wells were identified to have been constructed as open

holes in the underlying bedrock. Pumping test details were provided for all well records and are summarized in Table 2.

In summary:

- The overburden wells had pumping tests carried out for 30 minutes to 4 hours for rates of less than 1 Gallon per minute (GPM) to 100 GPM, and static water levels ranging from 2.7 to 17.7 m below ground surface (bgs) were drawn down to depths of 4.0 to 18.6 m bgs resulting in 0 to 5.5 m of drawdown in the wells.
- The bedrock wells had pumping tests carried out for 1 to 4 hours for rates of less than 1 GPM to 15 GPM, and static water levels ranging from 1.5 to 11.6 m bgs were drawn down to depths of 2.1 to 24.4 m bgs resulting in 0 to 19.8 m of drawdown in the wells.

Regulated Water Use: Permit To Take Water

Groundwater and surface water takings in the province are governed by the Ontario Water Resource Act (OWRA) and Water Taking Regulation O.Reg. 387/04. Under these regulations, a Permit to Take Water (PTTW) is required if the total water taking exceeds 50,000 L per day.

A review of the permitted PTTW water takings for both groundwater and surface water within a 1 km radius of the Site was completed, which included water takings for industrial, commercial, municipal, and agricultural properties. The results indicated there were no active PTTWs within 1 km of the Site.

2.4.2 Source Water Protection

The Clean Water Act (The Act) was established to provide a baseline for how to conduct drinking water source protection (CWA, S.O. 2006, Chapter 22). The Act was ratified by the Legislative Assembly of Ontario in 2006 and focuses on protecting current and potential future sources of residential drinking water. The OWRA, the Environmental Protection Act (EPA), and other applicable federal/provincial/municipal laws remain the primary legislation for protecting the quality and quantity of all of Ontario's water resources.

The Site is located within the Otonabee-Peterborough Source Protection Area; one of five SPAs in the Trent Conservation Coalition Source Protection Region. The Otonabee-Peterborough SPA is under the jurisdiction of the Otonabee Conservation Authority and encompasses roughly 3,365 km^2 and includes portions of 12 different municipalities. This SPA includes the Otonabee Region watershed and portions of the Municipality of Highlands East, Municipality of Trent Lakes, Township of Havelock-Belmont-Methuen, and Township of North Kawartha (Otonabee Conservation, 2025). Approximately 67% of the population obtains potable drinking water from 11 municipal water supply systems including three surface water systems and eight groundwater

supply wells. The remaining 33% of the population relies on private water wells and/or lake sources (Trent Conservation Coalition Source Protection Region, 2025).

Intake Protection Zone

The northern portion of the Site, and the majority of the eastern portion of the proposed limit of extraction are within an Intake Protection Zone (IPZ) 3 for the Hasting Municipal Surface Water System, as shown in Figure 8. An IPZ 3 indicates contaminants released in this area may reach the intake pipe during and/or after large storms.

Well Head Protection Area

The Site does not lie within a Well Head Protection Area (WHPA) and the closest municipal water supply well is located within the Town of Norwood, approximately 3.5 km northeast of the Site as shown in Figure 9.

Significant Groundwater Recharge Areas and Highly Vulnerable Aquifers

A Significant Groundwater Recharge Area (SGRA) is defined as a geographical location where a large volume of water readily infiltrates the ground and replenishes an aquifer at a rate significantly higher than the average for the surrounding area. Similarly, a Highly Vulnerable Aquifer (HVA) is an area identified as being susceptible to contamination as a result of surficial activities. SGRAs and HVAs are subject to the rules outlined in the *Technical Rules for Development of an Assessment Report* within The Act. In general, the determination of an SGRA and HVA uses hydrogeological modelling and data from Tier I, II and III water budgets, which account for the geology, soils, land cover and topography of the area.

The majority of the Site has been identified as both an SGRA and HVA, as shown in Figures 10 and 11, respectively. The classification of the Site as both a SGRA and HVA indicates high permeability soils which allow for significant groundwater recharge, as well as high potential for aquifer contamination due to the rapid flow of water from ground surface to the underlying aquifer.

Table 2: MECP Pumping Test Details

WELL ID	WATER WELL RECORD	SCREENED/ OPEN DEPTH (m)	STATIC WATER LEVEL (m)	PUMPING RATE (GPM)	PUMPING TEST DURATION (HR:MIN)	FINAL WATER LEVEL (m)	TOTAL DRAWDOWN (m)	AVAILABLE DRAWDOWN (m)
OVERBURDEN WELLS								
3	5100098	Open to 9.8	7.3	<1	0:30	7.3	0	2.4
4	5100101	Open to 7.6	5.8	7	2:00	5.8	0	1.8
5	5107455	Open to 13.1	4.6	8	4:00	9.1	4.6	4.0
8	5110822	18.6 to 19.8	17.7	6	3:00	18.6	0.9	1.2
10	5111273	Open to 12.2	7.6	8	2:30	10.7	3.0	1.5
12	5113958	Open to 9.1	2.7	6	2:30	8.2	5.5	0.9
17	5115143	Open to 11.3	6.1	8	1:30	6.1	0	5.2
19	5115900	Open to 4.6	2.7	100	0:30	4.0	1.2	0.6
BEDROCK WELLS								
1	5100096	Open to 6.4	4.9	2	1:00	4.9	0	1.5
2	5100097	Open to 8.6	1.8	10	2:00	4.9	3.0	3.7
6	5108939	Open to 19.2	11.0	15	4:00	15.2	4.3	4.0
7	5109232	Open to 14.3	3.3	2	2:00	13.7	10.4	0.6
9	5111272	Open to 7.6	1.2	8	1:10	6.1	4.9	1.5
11	5113510	Open to 15.2	9.1	3	2:30	13.7	4.6	1.5
13	5114744	Open to 18.3	9.1	12	1:45	16.8	7.6	1.5
14	5114555	24.4 to 25.6	4.6	5	2:00	24.4	19.8	1.2
15	5114656	16.8 to 18.0	1.5	3	1:00	16.5	14.9	1.5

WELL ID	WATER WELL RECORD	SCREENED/ OPEN DEPTH (m)	STATIC WATER LEVEL (m)	PUMPING RATE (GPM)	PUMPING TEST DURATION (HR:MIN)	FINAL WATER LEVEL (m)	TOTAL DRAWDOWN (m)	AVAILABLE DRAWDOWN (m)
16	5114951	Open to 28.7	11.6	--	1:00	23.8	12.2	4.9
18	5115804	Open to 24.4	7.6	<1	2:00	24.4	16.8	0
20	5116942	Open to 14.0	4.3	5	1:00	6.1	1.8	7.9
21	5117244	Open to 10.7	0.9	3	3:00	4.9	4.0	5.8
22	5120247	Open to 18.3	6.7	2	1:00	18.0	11.3	0.3
23	5120491	Open to 19.2	6.1	3	2:00	18.3	12.2	0.9
24	5120564	Open to 14.9	2.7	12	1:00	4.9	2.1	10.0
25	7174442	Open to 19.8	5.5	2	1:00	16.5	11.0	3.4
26	7175297	Open to 10.7	1.5	12	1:00	2.1	0.6	8.5

3 Procedures and Methodology

To assess the potential impacts of the Proposed Pit on the nearby groundwater and surface water resources, an in-depth understanding of baseline groundwater and surface water characteristics is required. Among the data for analysis are borehole logs, water level data, water quality data, and other flows/levels controlling groundwater flow and interaction with surface waters.

Our field work program was designed to build upon the regional geological and hydrogeological setting (refer to Section 2) to provide a comprehensive characterization of the Site. The comprehensive characterization provides the foundation for our assessment and ultimately guides the design and recommendation of the long-term monitoring program.

3.1 GROUNDWATER

3.1.1 Borehole Drilling and Monitoring Well Installation

The borehole drilling and monitoring well installation program was designed to allow for a detailed characterization of the groundwater regime.

Seven boreholes, BH/MW 24-1 through 24-5, BH/MW24-6A and BH/MW24-6B, were advanced by Choice Sonic Drilling Ltd. between May 22 and 23, 2024 to depths of 5.2 to 14.6 m below existing grade. Monitoring wells were installed in all boreholes and were constructed with 50 mm PVC riser pipe and 3.0 m long slotted screens. Annular space was filled with filter sand surrounding the well screen and 0.3 m above the well screen. The remaining annular space was backfilled with bentonite chips. All monitoring wells were finished with monument casings.

All monitoring wells were surveyed on July 23, 2024 using a Trimble R12i GNSS receiver, connected to the CANNET GNSS network via built in GNSS integrated antenna. The receiver is connected to a TSC7 controller using Trimble Access software for data collection. This equipment provides an accuracy of 8 mm horizontally and 15 mm vertically. Elevations provided reference the CGVD28 datum.

Monitoring well locations are presented in Figure 12, construction details are summarized in Table 3, and borehole logs are provided in Appendix B.

Table 3: Monitoring Well Construction Details

MONITORING WELL ID	GROUND SURFACE (m asl)	DEPTH (m bgs)	SCREENED ELEVATION (m asl)
BH/MW24-1	203.5	8.0	195.5 – 198.5
BH/MW24-2	204.6	11.0	193.6 – 196.6
BH/MW24-3	213.7	13.0	200.7 – 203.7
BH/MW24-4	204.2	6.0	198.2 – 201.2
BH/MW24-5	208.1	10.0	198.1 – 201.1
BH/MW24-6A	204.5	5.5	199.0 – 202.0
BH/MW24-6B	204.4	8.5	195.9 – 198.9

3.1.2 Groundwater Level Monitoring

On-Site Monitoring Wells

Groundwater level monitoring on-site began in June 2024. All wells were equipped with an automatic pressure transducer recording continuously on a 4-hour frequency. The pressure transducer is calibrated using manual groundwater measurements and a barometric pressure transducer.

The results of the continuous groundwater level monitoring are provided on individual hydrographs for each monitoring well location presented in Appendix C and discussed further in Section 4.2.

The continuous water level data has been used to assess the aquifer response to precipitation events, establish the seasonally high groundwater table elevation, and to determine the local groundwater flow direction.

Private Water Wells

A door-to-door water well survey was conducted in June 2024 by Tatham representatives. A water well survey provides information about the existing domestic water well usage including water quantity and water quality details. A total of 25 properties were identified and visited. Of the 25 properties, eight responded to our survey questions. Results of the water well survey are summarized in Table 4.

Table 4: Summary of Water Well Survey Results

MUNICIPAL ADDRESS	TYPE OF WELL	APPROXIMATE DEPTH OF WELL (m)	APROXIMATE CONSTRUCTION DATE	ANY WATER QUANTITY/QUALITY CONCERNS?	TREATMENT UTILIZED
2166 Asphodel 7th Line	Drilled	30.0	1990	No concerns, very hard water	Iron Remover – Not Operational
2171 Asphodel 7th Line	Dug	9.5	2002	No concerns, mild hardness	UV Filter, Water Softener
2158 Asphodel 7th Line	Drilled	19.8	1986	No concerns	UV Filter, Water Softener
946 Sand Road	Drilled	61.0	1984	No concerns	Water Softener
925 Sand Road	Drilled	Unknown	Unknown	No concerns, mild hardness	Water Softener
890 Sand Road	Drilled	21.3	1982	No concerns	NA
795 Sand Road	Dug	4.5	1970	No concerns, mild hardness	UV Filter, Water Softener
2109 Asphodel 5th Line	Dug	4.0	1984	No concerns, doesn't drink – contaminated from nearby farmers field	NA

Given the proposed extraction on-site will not extend into the groundwater and the majority of wells in the area are constructed within the limestone bedrock, no further groundwater level monitoring at the private water wells identified was carried out as part of this investigation.

3.1.3 Groundwater Quality Monitoring

Groundwater quality samples representative of the shallow overburden aquifer were collected from BH/MW24-1, 24-2, 24-4, 24-5 and 24-6B on June 13 and October 30, 2024. A water quality sample was not obtained for BH/MW24-3 as the well was dry nor was a water quality sample collected at BH/MW24-6A as BH/MW24-6B had more available water for sampling, and the A and B screened intervals are within the same aquifer unit.

The groundwater quality monitoring program provides a baseline of the natural chemical signature of the groundwater on-site within the shallow overburden aquifer and provides details regarding potential seasonal water quality variability. The samples were submitted for chemical analysis of metals, alkalinity, pH, conductivity, bicarbonate and major anions and compared to the applicable Ontario Drinking Water Quality Standards (ODWQS).

Prior to sampling, all monitoring wells were developed via use of LDPE tubing and foot valves. The wells were developed by removal of at least three well volumes of groundwater or the well going dry three times.

Samples were collected using LDPE tubing and were placed directly into pre-cleaned laboratory supplied bottles and/or vials with analytical test group specific preservatives, as required. Dedicated nitrile gloves were used during sample collection and handling and non-dedicated equipment was decontaminated via Alconox cleaning solution. Samples were field filtered for select parameters and submitted to Caduceon Environmental Laboratories, a CALA accredited lab, for the analysis of dissolved metals, major anions, and general chemistry.

Laboratory results are presented in Appendix D and are discussed further in Section 4.2.

3.2 SURFACE WATER

3.2.1 Piezometer and Surface Water Monitor Installation

Three drive-point piezometers, designated MP1 through MP3, were installed within the wetland by Tatham representatives on June 11 and 14, 2024. The piezometers were installed to monitor the groundwater surface water interactions. Two additional locations, MP4 and MP5, did not have drive-point piezometers installed and were utilized solely for visual inspections to note whether ponded water was encountered throughout the year.

Three streamflow monitoring locations were installed within the bed of the Ouse River tributary, designated SW1 to SW3, to facilitate surface water level and flow monitoring.

Installation details are summarized in Table 5 and illustrated in Figure 12.

All drive-point piezometer and surface water monitors were surveyed on July 23, 2024 using a Trimble R12i GNSS receiver, connected to the CANNET GNSS network via built in GNSS integrated antenna. The receiver is connected to a TSC7 controller using Trimble Access software for data collection. This equipment provides an accuracy of 8 mm horizontally and 15 mm vertically. Elevations provided reference the CGVD28 datum.



Table 5: Surface Water Monitor Details

PIEZOMETER ID	GROUND SURFACE ELEVATION (m asl)	PIEZOMETER DEPTH (m)	MONITORING
MP1	203.0	0.93	Water Levels, and Water Quality
MP2	202.1	0.92	Water Levels, and Water Quality
MP3	200.1	0.82	Water Levels, and Water Quality
MP4	--	--	Visual Water Level
MP5	--	--	Visual Water Level
SW1	198.9	--	Water Level, and Streamflow
SW2	203.5	--	Water Level, and Streamflow
SW3	204.9	--	Water Level, and Streamflow

3.2.2 Surface Water Monitoring

Water Level Monitoring

To quantify the potential groundwater surface water contribution within the wetland, MP1 through MP3 were equipped with an automatic pressure transducer recording continuously on a 4-hour frequency. The pressure transducer is calibrated using manual water level measurements and a barometric pressure transducer. Manual water levels were measured both inside and outside the drive-point piezometers and results were compared to assess the surface water groundwater interaction.

The results of the continuous water level monitoring are provided on individual hydrographs for each monitoring location presented in Appendix E and discussed further in Section 4.3.

Water Quality Monitoring

Monthly manual measurements of electrical conductivity, pH, and temperature were collected at MP1 through MP3, MP4 and MP5 if water was encountered, and SW1 through SW3 utilizing a handheld Hanna combo pen.

The results of the water quality monitoring are discussed in Section 4.3.



Streamflow Monitoring

The streamflow monitoring locations (SW1 through SW3) were equipped with a continuously recording pressure transducer and data logger which records water depth and temperature on 15-minute intervals. During regular site visits, manual water depth, streamflow and temperature measurements are taken to calibrate the data collected by the monitoring devices to the field measurements. A rating curve has been developed for each streamflow monitoring location by plotting the manual in-situ streamflow measurements against the manual in-situ water depth measurements collected to create a water depth/streamflow relationship. The rating curve is used to convert the water depth data collected by the continuously recording pressure transducer and data logger to streamflow.

The results of the continuous streamflow monitoring are provided on individual hydrographs for each monitoring location presented in Appendix E and discussed further in Section 4.3.

4 Data Assessment and Results

The findings of the field program outlined in Section 3 were utilized to assess the on-site stratigraphy and derive baseline conditions for the groundwater/surface water systems including seasonal high levels, direction of flow, and water quality. The established baseline conditions serve as a benchmark for evaluating future conditions to assess and quantify any changes resulting from the Proposed Pit.

4.1 STRATIGRAPHY

Stratigraphy at the Site was inferred from borehole logs. Generally, stratigraphy on-site was described as layers of sand over sand and gravel, over a silty sand till, over a lower sand unit and/or limestone bedrock. The esker formations are comprised of the sand, and sand and gravel deposits, with the lower lying areas having thinner sand/sand and gravel units and in some instances silty sand till at surface.

Details of ground conditions are further presented within borehole logs in Appendix B and a site-specific cross section A-A' is presented in Figure 13.

4.2 CLIMATE

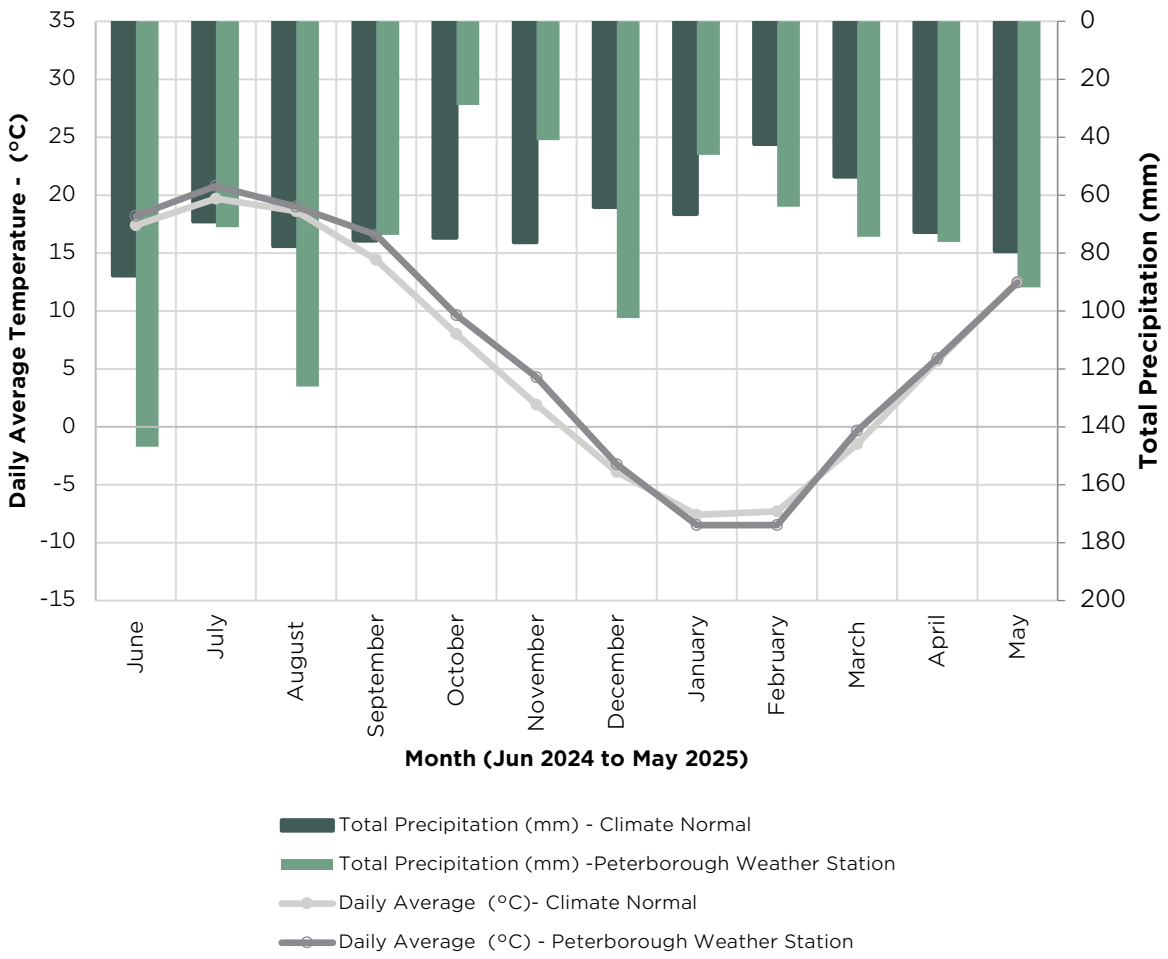
Recent weather data was obtained from the nearest available weather station to the Site, the Peterborough Trentu Farm weather station (Climate ID 6166257), which is located 22 km northwest of the Site. The data was compared to climate normal data (1991 -2020) from the Peterborough composite station, which consolidates data from individual stations (Climate ID, 6166415, 6166418, and 6166420) into one climate normal dataset.

A comparison of the climate normal relative to weather station data obtained over the groundwater and surface water monitoring period (June 2024 to May 2025) is summarized in Table 6 and shown in Graph 1.

Overall, the monitoring period was more wet compared to the climate normal as the total precipitation for the climate normal is 840 mm compared to 943 mm over the monitoring period. However, the fall months of September to November 2024 and January 2025 were drier than the climate normal as seen in Graph 1. Average daily temperatures were higher over June to December 2024, and March to May 2025. From January to February 2025, the temperatures experienced were colder than the climate normal.

Table 6: Summary of Climate Data

MONTH (SUMMER 2024 TO SPRING 2025)	DAILY AVERAGE (°C)		TOTAL PRECIPITATION (MM)	
	CLIMATE NORMAL	PETERBOROUGH COMPOSITE STATION	CLIMATE NORMAL	PETERBOROUGH COMPOSITE STATION
June	17.4	18.2	87.8	146.9
July	19.7	20.8	69.1	71.1
August	18.6	19.0	77.6	126.1
September	14.4	16.6	75.7	73.7
October	8	9.6	74.7	28.9
November	1.9	4.3	76.3	41
December	-3.9	-3.2	64.1	102.5
January	-7.6	-8.5	66.5	46.1
February	-7.3	-8.5	42.3	64
March	-1.5	-0.3	53.6	74.4
April	5.7	5.9	72.7	76.2
May	12.5	12.5	79.4	91.9
Total			**839.8**	**942.8**



Graph 1. Summary of climate normal data compared to the Peterborough composite station over the monitoring period.

4.3 GROUNDWATER

4.3.1 On-Site Groundwater Levels

Continuous groundwater level data measured at BH/MW24-1 through BH/MW24-5, BH/MW24-6A and BH/MW24-6B were compared to recorded precipitation events to illustrate the shallow aquifers response to precipitation events and are presented in Appendix C. It is noted BH/MW24-3 was dry for the duration of the monitoring period and a hydrograph has not been prepared.

Groundwater levels were monitored between June 2024 and May 2025. Seasonal fluctuations were noted at all monitoring wells illustrating higher groundwater levels during the spring and fall months and lower groundwater levels during the summer and winter months. The water levels in BH/MW24-4 show a bit more variability with a peak in the groundwater levels also noted between January and February.

The maximum groundwater elevations for each monitoring well location is presented in Table 7 and shown in Figure 14.

Table 7: Highest Groundwater Elevation

WELL ID	HIGHEST GROUNDWATER ELEVATION (m asl)
BH/MW24-1	197.1
BH/MW24-2	198.7
BH/MW24-3	Dry at 200.7
BH/MW24-4	203.8
BH/MW24-5	199.4
BH/MW24-6A/B	200.1

Groundwater contour maps have been prepared for July and October 2024 (summer and fall), and January and April 2025 (winter and spring), as shown in Figures 15 to 18. It has been interpreted groundwater flow within the overburden aquifer is to the southeast throughout the year.

4.3.2 Groundwater Quality

Groundwater samples were collected from all on-site monitoring wells on June 13 and October 30, 2024. Samples were compared to the ODWQS, Results of the June and October sampling events indicated all analyzed parameters met the ODWQS with the exception of the following parameters:

- Hardness (as CaCO3) exceeded the Operation Guidelines (OG) in all samples.
- Manganese exceeded the Aesthetic Objective (AO) in BH/MW24-1 during both the June and October sampling events, BH23-2 during the June sampling event, and BH/MW24-6B during the fall sampling event.
- Sodium exceeded the Maximum Allowable Concentration (MAC) trigger warning in BH/MW24-1 during the spring sampling event. The trigger warning is established so water well users on sodium-restricted diets are made aware of the elevated sodium concentrations.
- Nitrate exceeded the MAC in BH/MW24-2 during the spring sampling event.
- Aluminum exceeded the OG in BH/MW24-6B during the fall sampling event.

Generally, the water quality is typical of groundwater from overburden aquifers in Southern Ontario. The groundwater samples indicated compliance as compared to the ODWQS MACs, with the exception of Sodium which is considered to be a trigger warning rather than a true MACs, and nitrate in BH/MW24-2.

BH/MW24-2 is situated within an active agricultural operation, and the elevated nitrates are attributed to the on-going agricultural activities. It is not anticipated the proposed aggregate activities would contribute additional nitrate to the groundwater system, however, if a potable water well is to be constructed on-site water treatment may be required in order to reduce the nitrate concentrations.

Copies of the certificates of analysis are provided in Appendix D.

4.4 SURFACE WATER

4.4.1 Wetland Monitors

Water Level Monitoring

Hydrographs have been prepared for MP1, MP2 and MP3 utilizing data collected between June 2024 and May 2025, as presented within Appendix E.

In general, groundwater and surface water levels within the wetland are lowest during dry summer months, and highest in the spring months. At MP1 and MP2 groundwater and surface levels are consistently above existing grades indicating a continuous/year-round hydroperiod. At MP3 surface water levels are observed above existing grades during the winter and spring; however, during the late summer and fall months the wetland feature was observed to be dry indicating a hydroperiod extending from December to August.

Based on the groundwater and surface water level measurements recorded at MP1 through MP3 it appears the wetlands monitored on-site in the vicinity of MP1 and MP2 are groundwater fed throughout the year, however, the wetlands in the vicinity of MP3 appear to be both a losing and gaining wetland system, with groundwater contributions to the wetland (gaining system) during the winter and spring months but the wetlands also contribute water to the groundwater system (losing system) during the summer and fall months. At MP3 surface water appears to pond at surface through the identified hydroperiod and then slowly infiltrate into the underlying soils.

Water Quality

Surface water quality monitoring was carried out at MP1 through MP3 monthly from July 2024 to May 2025. It is noted water quality monitoring was not carried out during the June 2024 Site visit as the monitoring locations had just been installed.

The results of the manual surface water monitoring are summarized in Table 8.

Table 8: Summary of Wetland Water Quality

Date	pH / Electrical Conductivity (µs/cm) / Temperature (°C)		
	MP1	MP2	MP3
July 2024	7.32 / 447 / 18.2	7.05 / 479 / 19.2	7.15 / 1,298 / 20.0
August 2024	7.24 / 577 / 21.1	6.87 / 553 / 18.1	Dry
September 2024	6.94 / 397 / 19.1	6.71 / 511 / 14.4	Dry
October 2024	6.41 / 480 / 14.2	7.09 / 448 / 11.4	Dry
November 2024	7.27 / 437 / 6.2	7.73 / 339 / 7.1	Dry
December 2024	Not Measured	Not Measured	7.42 / 1,401 / 1.5
January 2025	Frozen	Frozen	Frozen
February 2025	Frozen	Frozen	Frozen
March 2025	7.08 / 355 / 1.6	7.54 / 364 / 0.9	6.84 / 1,585 / 1.2
April 2025	7.11 / 322 / 7.2	7.65 / 332 / 7.5	6.92 / 1,425 / 6.9
May 2025	7.02 / 420 / 12.6	7.02 / 489 / 13.6	7.02 / 1,553 / 13.3

Note:
Frozen represents a condition where a water sample could not be collected.

In general, the pH across the monitoring sites ranged from 6.41 to 7.65, the electrical conductivity at MP1 and MP2 ranged from 322 to 577 µS/cm compared to MP3 which ranged from 1,298 to 1,585 µS/cm, and temperature ranged from frozen to 21.1°C.

As groundwater flows through the subsurface, the interaction of the groundwater with the surrounding soil and rock results in higher concentrations of dissolved minerals and salts which ultimately results in a higher electrical conductivity. As such electrical conductivities can be reviewed qualitatively to assess whether a surface water feature is receiving groundwater, as the electrical conductivity of groundwater is typically higher. The higher electrical conductivity observed at MP3 is a further indication the groundwater contribution to the wetland at this location may be more significant than the groundwater contribution at MP1 and MP2 where a generally lower electrical conductivity is measured.

4.4.2 Ouse River Tributary Monitoring

Water Level Monitoring

Hydrographs have been prepared for SW1, SW2, and SW3 utilizing data collected between June 2024 and May 2025, as presented within Appendix E.

The continuous surface water level data shows water level elevations have ranged between approximately 199.2 to 200.1 m asl at SW1, 203.5 to 204.5 m asl at SW2, and 205.0 to 205.2 at SW3. In general water levels are highest in during the spring months and lowest during the summer and fall.

Streamflow Monitoring

A rating curve has been developed for each streamflow monitoring location by plotting the manual in-situ streamflow measurements against the manual in-situ water depth measurements collected to create a water depth/streamflow relationship. The rating curves have been used to convert the water depth data collected by the continuously recording pressure transducer and data logger to streamflow.

Based on the results of the continuous streamflow monitoring, flow rates within the adjacent tributary have varied between no flow or insufficient flow to measure to 62,400 L/min at SW1, no flow or insufficient flow to measure to 2,008 L/min at SW2, and no flow or insufficient flow to measure to 22,036 L/min at SW3. Peak flows were observed at each location following large precipitation events, with the most significant peak flows observed during the spring freshet in March and April 2025.

Water Quality

Surface water quality monitoring was carried out at SW1 through SW3 monthly from July 2024 to May 2025. It is noted water quality monitoring was not carried out during the June 2024 Site visit as the monitoring locations had just been installed.

The results of the manual surface water monitoring are summarized in Table 9.



Table 9: Summary of Surface Water Quality

Date	PH / Electrical Conductivity (µs/cm) / Temperature		
	SW1	SW2	SW3
July 2024	7.31 / 567 / 18	7.67 / 688 / 17.2	Not Measured
August 2024	7.38 / 753 / 19.2	Dry	7.38 / 615 / 17.8
September 2024	7.26 / 775 / 16	Dry	7.46 / 562 / 16.5
October 2024	7.58 / 553 / 11.1	Dry	Not Measured
November 2024	7.92 / 558 / 5.6	Dry	8.00 / 460 / 5.6
December 2024	7.67 / 725 / 0.3	7.10 / 705 / 1.6	8.07 / 529 / 0.2
January 2025	Frozen	Frozen	Frozen
February 2025	Frozen	Frozen	Frozen
March 2025	7.46 / 500 / 1.0	7.61 / 671 / 3.5	7.32 / 576 / 2.5
April 2025	7.12 / 480 / 6.5	7.54 / 633 / 5.5	7.92 / 366 / 5.5
May 2025	7.18 / 589 / 13.9	7.45 / 612 / 13.8	7.24 / 466 / 13.8

Note:
Frozen represents a condition where a water sample could not be collected.

In general, the pH across the monitoring sites ranged from 7.1 to 8.07, the electrical conductivity ranged from 366 to 775 µS/cm, and temperature ranged from 0.2 to 19.2ºC.

The electrical conductivities observed at SW1 through SW3 are more consistent with the surface water fed wetlands at MP1 and MP2 and indicate the Ouse River tributary is likely reliant on surface water more than groundwater.

5 Watershed and Feature-Based Water Budgets

As part of the impact assessment in support of the Proposed Pit, water budgets were prepared to assess the change in runoff and infiltration resulting from extraction. Specifically, a water budget was prepared for the wetlands watershed to identify the change in runoff and infiltration resulting from extraction, and a monthly feature-based water budget was prepared for the wetland to assess the impact the reduction in surface water runoff to the wetland has on the wetlands hydroperiod. The water budgets are summarized in the following sections.

5.1 CLIMATE NORMAL DATA

Monthly precipitation and temperature climate normal data from 1981 to 2010 was obtained from Environment Canada's Peterborough Environment Canada Weather Station, located approximately 39 km southwest of the Proposed Pit as described in Section 4.2. A summary of the climate normal data used in the water budgets is provided in Graph 1 and Table 6.

5.2 WETLAND WATERSHED WATER BUDGETS

A water budget was prepared for the wetlands watershed to identify the change in runoff and infiltration resulting from extraction. The wetland watershed was delineated using the available LiDAR topographic data as shown on Figure 5. Using the Thornthwaite and Mather method, the annual water surplus was calculated by subtracting the potential evapotranspiration from the total precipitation. From the climate normal data, the average annual precipitation for the area is 840 mm and through the water balance a water surplus of approximately 261 mm was calculated.

Infiltration factors from the Ministry of Environment and Energy (MOEE) Hydrogeological Technical Information Requirements for Land Development Applications (1995) were used to estimate the portion of the water surplus attributed to infiltration, and consequently to runoff. The infiltration factors consider the slope, soils, and land cover of the watershed. The infiltration factors were determined under both existing and proposed conditions. Under proposed conditions, it was assumed 100% of the water surplus will infiltrate through the excavation pit floor, with no surface runoff leaving the excavation.

The results of the wetland watershed water budget are summarized in Table 10 and provided in Appendix F for reference.



Table 10: Summary of Wetland Watershed Water Budget Results

	WETLAND 1
Watershed ID	101
Precipitation (mm)	840
Water Surplus (mm)	261
Water Surplus (m^3)	2,014,998
Drainage Area (ha)	753.7
Extraction Area (ha)	17.5
Existing Infiltration Factor	0.45
Existing Infiltration (m^3)	869,970
Existing Runoff (m^3)	1,145,028
Proposed Infiltration Factor	0.45
Proposed Infiltration (m^3)	895,077
Proposed Runoff (m^3)	1,119,921
Change in Infiltration (m^3)	+25,107
Change in Runoff (m^3)	-25,107

As illustrated in Table 10, the infiltration in the wetland's watershed will increase as the precipitation falling within the extraction area will be contained in the extraction footprint and infiltrate. As such, the runoff to the wetland will be reduced under proposed conditions.

5.3 MONTHLY FEATURE-BASED WATER BUDGET

A monthly feature-based water budget was prepared for the wetland to assess the impact the reduction in surface water runoff under proposed conditions has on the wetlands hydroperiod. The same wetland watershed delineation completed for the wetland watershed water budget was used for the monthly feature-based water budget. However, the wetland boundary was also delineated and treated separate from the remaining watershed in the monthly feature-based water budget. Specifically, the surface runoff from the remaining watershed was calculated and added to the wetland water surplus to estimate the monthly wetland storage volume, water

depth and surface area. The available wetland characteristics (storage volume, depth, area) were estimated from the available LiDAR topographic data.

The Thornthwaite and Mather method predicts the annual water surplus by subtracting the potential evapotranspiration from the total precipitation. From the climate normal data, the average annual precipitation for the area is 840 mm and through the water balance a water surplus of approximately 261 mm was calculated. The hydraulic conductivity of the soils within the wetland was used to estimate the infiltration in the wetland and the monthly wetland storage volume was calculated by adding the water surplus and subtracting the water deficit and wetland infiltration from the wetland storage from the previous month.

The results of the monthly featured-based water budget are summarized in Table 11 and provided in Appendix F for reference.

Table 11: Summary of Monthly Feature-Based Water Budget Results

	WETLAND 1
Watershed ID	101
Precipitation (mm)	840
Water Surplus (mm)	261
Water Surplus (m^3)	2,014,998
Drainage Area (ha)	753.7
Existing Wetland Storage (m^3)	177,377 – 548,310
Existing Depth of Water (m)	0.32 -1.00
Proposed Wetland Storage (m^3)	176,950 – 548,310
Proposed Depth of Water (m)	0.32 – 1.00
Change in Wetland Storage (%)	0%

As illustrated in Table 11, the reduction in runoff draining to the wetland will result in a minor reduction in overall wetland storage volume. However, the wetland will continue to fill with water seasonally and the hydroperiod will be maintained as the wetland will continue to hold water year-round.

Based on the monitoring data collected, Wetland 1 is groundwater supported. The monthly feature-based water budget does not account for groundwater contributions to the wetland. As such, the monthly feature-based water budget is considered conservative and the changes in wetland storage are expected to be less than estimated due to the seasonal groundwater contributions to the wetland. Given the infiltration within the wetland's watershed will increase, and extraction is to occur a minimum of 1.5 m above the seasonally high groundwater levels with no dewatering, the groundwater contributions to the wetland are expected to be maintained, if not slightly increased due to the increase in infiltration within the extraction area.

6 Assessment of Potential Impacts of Proposed Pit

A comprehensive evaluation of the Site was completed utilizing the groundwater, surface water, and wetland monitoring programs, and the domestic water well survey as outlined in the previous sections to assess potential impacts to the groundwater and surface water systems. Additionally, water budgets were prepared for the existing, extraction and rehabilitation conditions. Changes to the water budgets at the Site can influence groundwater levels and affect interactions with surface water features, such as streams and wetlands.

6.1 POTENTIAL INTERFERENCE WITH LOCAL GROUNDWATER REGIME

6.1.1 Groundwater Levels

The proposed aggregate extraction activities will occur at an elevation at least 1.5 m above the established seasonally high-water table elevation within the Proposed Pit lands. The water levels on-site represent water levels within the upper overburden aquifer, and domestic water wells in the vicinity of the Proposed Pit installed within the overburden aquifer will have similar water levels.

As discussed in Section 5, infiltration on-site is anticipated to increase during extraction activities and as part of the rehabilitation of the Site. As per the site plans, drainage of the extracted areas will be contained on-site and will infiltrate into the pit floor. As such, potential interference with the local groundwater regime is considered low risk during the extraction condition.

6.1.2 Groundwater Quality

The Ontario Stone, Sand, and Gravel Association (OSSGA) supported a literature review study, led by the MNR, to assess the impact of the aggregate industry and associated aggregate lands on source water protection programs. The MNR study, titled *Applied Research on Source Water Protection Issues in the Aggregate Industry*, was prepared by Blackport Hydrogeology Inc. and Golder in 2006. The study ultimately did not provide scientific evidence linking activities of the aggregate industry, such as the extraction and processing of stone, sand, and gravel, to increased threats on drinking water sources.

The study specifically found adverse effects from aggregate extraction below the water table are minimal or localized, leading to negligible impacts on the yield of nearby drinking water supplies. Additionally, the research found little evidence of water quality impacts resulting from typical aggregate extraction and processing activities. No documented instances of municipal water

supply well contamination were found to be caused by normal aggregate extraction activities (Blackport Hydrogeology Inc., & Golder Associates, 2006).

As such, it is not anticipated the Proposed Pit would have a negative impact on the regional and/or local groundwater quality.

6.2 POTENTIAL INTERFERENCE WITH DOMESTIC WATER WELLS

Similar to the potential interference with the local groundwater regime, interference with domestic water wells is not anticipated due to the proposed aggregate extraction occurring at least 1.5m above the established seasonally high water table elevation.

Based on a review of the MECP water wells within 500 m of the Site, it is anticipated the majority of domestic water wells are screened within the bedrock aquifer well below the proposed aggregate extraction.

6.3 POTENTIAL INTERFERENCE WITH SURFACE WATER FEATURES

As previously noted, a tributary of the Ouse River is located north of and adjacent to the Proposed Pit lands, traversing in a southwest-northeast orientation. A non-provincially significant wetland similarly occupies the Site north of the Proposed Pit lands.

Given extraction limits will be setback at least 30 m from any wetland and/or surface water feature, and extraction will be required to remain at least 1.5 m above the seasonal high groundwater level no direct impacts to the surrounding surface water features are anticipated.

During extraction, the pit area will be lowered below existing grade which will in turn reduce the total drainage area to the tributary of the Ouse River and wetlands to the north as well as the main branch of the river to the south. The reduction in drainage area to the tributary and the wetlands will be 19.7 ha (2.5%) while the reduction to the main branch of the river will be 27.6 ha (0.2%).

As demonstrated in the water level monitoring results at MP1 to MP3 and SW1 through SW3 (Section 4.3), the tributary and wetlands to the north can receive groundwater at various times throughout the year. However, the groundwater levels on-site will not be lowered and no impacts to the groundwater levels on-site are anticipated; groundwater contributions to the Ose River tributary and the wetland will be maintained.

Further, the minor reductions in the surface drainage areas and surface runoff are expected to have negligible impacts on the storage volumes and water levels in the wetland. While the reduction in drainage area will reduce peak flows after significant rainfall events, the baseflows in the tributary are driven by groundwater contribution and as such are not anticipated to be impacted by the minor change in drainage area.



It is anticipated the infiltration on-site will be increased during extraction operations. The Site is located within the Otonabee-Peterborough SPA covering approximately 3,365 km^2. Given the Proposed Pit covers an area of merely 0.276 km^2, roughly 0.008% of the total area of the Otonabee-Peterborough SPA, it is assumed regional increases to groundwater systems will be negligible.

With respect to potential impacts to surface water quality, silt fencing will be installed around the watercourse/wetlands to limit overland flow and prevent siltation of the adjacent lands, as shown in Figure 2. As there will be no direct runoff from the proposed extraction area to the watercourse/wetlands, and there is no discharge proposed, no impacts to water quality are anticipated.

7 Complaints Response Procedure

A comprehensive complaints response program has been established for the Site for the purpose of responding to water well interference complaints for water well users in the vicinity of the Site. The Proposed Pit is an above-water pit, and it is anticipated no groundwater interference will occur; however, the program has been prepared for due diligence purposes. The program includes the following:

- Following receipt of a complaint from a water well user, Drain Bros. will have a representative and/or an agent visit the property within 24 hours and assess the complaint.
- If deemed applicable, a licensed water well technician will be hired to complete a well inspection including a review of the well condition, pump depth, pump condition, etc.
- If deemed applicable, a hydrogeologist may be obtained to review the water well inspection data, supporting information, water level data, and on-going operations at the pit to provide an assessment of the cause of the complaint. The hydrogeologist will prepare an opinion as to the likelihood the well compliant is related to the pit operation.
- If the well interference is attributed to the pit operations/activities and the water supply is at risk, a temporary water supply (such as delivering totes of drinking water) should be made available to the water well user. In addition, if deemed necessary, a water supply well restoration program should be implemented.
- The water supply restoration program includes:
  - Step 1: Well System Rehabilitation: this includes the replacement or lowering of pumps, flushing the pump lines, well deepening, etc.
  - Step 2: Well Replacements: if system rehabilitation is not an option, the well could be replaced with a new well further from the pit.
  - Step 3: Water Treatment Considerations: appropriate water treatment will be incorporated into any restored water supply.

8 Mitigation Measures

Due to the low risks associated with the proposed aggregate extraction to the groundwater and surface water network, mitigation measures are not proposed. However, the following best practices are recommended:

- Refueling of machinery should not be conducted in areas of excavation within 5 m of the water table.
- No chemical sprays should be used in the areas of the excavation.
- Operator training should include understanding and implementing the preventative measures provided above, in addition to any on-site corporate Spill Contingency Plan.
- No aggregate extraction shall occur within 1.5 m of the established seasonally high groundwater elevation.

9 Proposed Groundwater and Surface Water Monitoring Program

It is recommended the long-term groundwater and surface water level monitoring continue. The following outlines the recommended long-term groundwater and surface water monitoring program:

- The continuation of monitoring the on-site monitoring wells BH/MW24-1 through BH/MW24-5, BH/MW24-6A and BH/MW24-6B. The monitoring includes continuous water level measurements and quarterly manual groundwater levels for the first two years of operations. After the first two years, it is recommended monitoring be reduced to semi-annually. Automatic dataloggers should be used to record continuous data and a barometric pressure transducer should be utilized to correct the dataloggers for fluctuations due to atmospheric pressure.
- The continuation of monitoring the on-site surface water locations SW1 through SW3. The monitoring includes continuous water level monitoring and quarterly manual surface water levels/flows for the first two years of operations. After the first two years, it is recommended the monitoring be reduced to semi-annually. An automatic datalogger should be used to record continuous data and a barometric pressure transducer utilized to correct fluctuations due to atmospheric pressure.
- The continuation of monitoring the on-site piezometer locations MP1 through MP3. The monitoring includes continuous level monitoring and quarterly manual water level measurements for the first two years of operation. After the first two years, it is recommended monitoring be reduced to semi-annually. An automatic datalogger should be used to record continuous data and a barometric pressure transducer utilized to correct fluctuations due to atmospheric pressure.
- The continuation of groundwater quality monitoring at the on-site monitoring wells BH/MW24-1 through BH/MW24-5, BH/MW24-6A, and BH/MW24-6B. Annual water quality samples should be collected from all on-site monitoring wells and be analyzed by a CALA accredited laboratory for Metals, alkalinity, pH, conductivity, bicarbonate, and major anions. Additionally, once extraction on-site initiates, groundwater quality monitoring should include the analysis of O.Reg. 153/04, as amended, PHCs and Oil and Grease.

10 Summary and Conclusions

This combined Level 1 and 2 Hydrogeological Assessment was completed to support the proposed Highway 7 Pit in Norwood. The Proposed Pit will be completed in two phases located on Part Lot 15 Concession 6 and Part Lot 14 Concession 5, Township of Asphodel-Norwood, County of Peterborough.

The Proposed Pit consists of a Class A Pit Above Water license. This investigation was primarily completed to assess the potential impact of the Proposed Pit on aquifers, surface water features, springs, and discharge areas in the vicinity of the Proposed Pit and ultimately evaluate potential mitigation measures. The conclusions are presented below:

- The area surrounding the Site primarily comprises agricultural lands, rural residential properties, other aggregate operations, undeveloped forests, and occasional commercial lands. Numerous wetlands and surface water features are also present throughout the study area, including provincially significant, non-provincially significant, and unevaluated wetlands
- The Site lies within the physiographic region known as the Peterborough Drumlin Field, comprising eskers throughout the southern portion of the Proposed Pit lands and drumlinized till plains to the north (Chapman and Putnam, 2007). OGS quaternary geology mapping indicates the Site consists of glaciofluvial ice-contact deposits comprising primarily sand and gravel deposits. The area is identified as having esker, kame and end moraine formations (OGS, 2000).
- The Site is underlain by Ordovician Verulam Formation limestone and shale of the Simcoe Group (Armstrong & Dodge, 2007). The Verulam formation overlies the Bobcaygeon formation and is comprised of interbedded limestones and shales.
- The landscape throughout the Site is dominated by elongated ridges, eskers, formed as a result of glacial melt comprising coarse sand and gravel deposits. The eskers have resulted in what appears to be rolling hills across the Site ranging in elevations from 200 to 225 m above sea level. Drainage across the Site is anticipated to follow local topography and flow to lower lying areas, eventually entering the adjacent wetlands and/or watercourse.
- The Site is located within the Ouse River watershed with the main branch of the river located south of the Site flowing east to west and a tributary of Ouse River north of the Site flowing southwest to northeast. There is a highpoint running through the Site which splits the drainage from the Site. The north half of the Site drains north to the tributary of the Ouse River while the south half of the Site drains south to the main branch of Ouse River. Using

the OWIT, the drainage area of the tributary was calculated to be 785 ha at 7th line. The drainage area of the main branch is 15,121 ha where drainage from the Site enters the Ouse River upstream of the 5th line easement.

- A non-provincially significant and unevaluated wetland is located immediately north of the proposed extraction limits of the Proposed Pit lands, and a larger provincially significant wetland is located to the south of Sand Road approximately 200 to 400 m south of the Proposed Pit lands.
- A total of 26 MECP well records were reviewed within 500 m of the Site. Of the 26 records, 23 records indicated domestic water well usage, two records indicated livestock and domestic water well usage and one well record did not indicate its use type. In general, stratigraphy noted from the well records primarily indicated layers of sand and clay with variable gravel contents overlying shale or limestone bedrock. Bedrock was noted in 18 well records at depths of 0.9 to 25.0 m. Domestic water wells are anticipated to be screened within the limestone bedrock, with fresh water encountered at depths of 2.7 to 28.0 m. Pumping test details were provided for all well records and were carried out for 30 minutes to 4 hours at rates of less than 1 Gallon per minute (GPM) to 100 GPM, and static water levels ranging from 1 to 17.5 m below ground surface (bgs) were drawn down to depths of 2 to 24 m bgs resulting in 0 to 19.8 m of drawdown in the wells.
- The Site is located within the Otonabee-Peterborough Source Protection Area. The northern portion of the Site, and the majority of the eastern portion of the Proposed Pit lands are within an IPZ 3 for the Hasting Municipal Surface Water System, and the Site is not located within a WHPA.
- The majority of the Site has been identified as both a SGRA and HVA. The classification of the Site as both a SGRA and HVA indicates high permeability soils which allow for significant groundwater recharge, as well as high potential for aquifer contamination due to the rapid flow of water from ground surface to the underlying aquifer.
- Stratigraphy on-site was described as layers of sand, and sand and gravel, over a silty sand till, over a lower sand unit and/or limestone bedrock. The esker formations are comprised of the sand, and sand and gravel deposits, with the lower lying areas having thinner sand/sand and gravel units and in some instances silty sand till right at surface.
- Seasonal fluctuations were noted at all monitoring wells, with exception of BH/MW24-3, which was consistently dry, illustrating higher groundwater levels during the spring and fall months and lower groundwater levels during the summer and winter months. The maximum predicted groundwater level on-site ranges from 197.1 to 200.1 m asl.

- It has been interpreted groundwater flow within the overburden aquifer is to the southeast throughout the year.
- Generally, the water quality is typical of groundwater from overburden aquifers in Southern Ontario. The groundwater samples indicated compliance as compared to the ODWQS MACs, with the exception of sodium which is considered to be a trigger warning rather than a true MACs, and nitrate at BH/MW24-2. BH/MW24-2 is situated within an active agricultural operation, and the elevated nitrates are attributed to the on going agricultural activities. The proposed aggregate activities are not anticipated to contribute additional nitrate to the groundwater system, however, if a potable water well is to be constructed on-site water treatment may be required to reduce nitrate concentrations.
- In general, groundwater and surface water levels within the wetland are lowest during dry summer months and highest in the spring months. At MP1 and MP2, groundwater and surface levels are consistently above existing grades indicating a continuous/year-round hydroperiod. At MP3 surface water levels are observed above existing grades during the winter and spring; however, during the late summer and fall months the wetland feature was observed to be dry indicating a hydroperiod extending from December to August. Based on the groundwater and surface water level measurements recorded at MP1 through MP3 it appears the wetlands monitored on-site in the vicinity of MP1 and MP2 are groundwater fed throughout the year, however, the wetlands in the vicinity of MP3 appear to be both a losing and gaining wetland system, where groundwater contributes to the wetlands (gaining system) during the winter and spring months but the wetlands also contribute water to the groundwater system (losing system) during the summer and fall months. At MP3 surface water appear to pond at surface through the identified hydroperiod and then slowly infiltrate into the underlying soils.
- The continuous surface water level data shows water level elevations have ranged between approximately 199.2 to 200.1 m asl at SW1, 203.5 to 204.5 m asl at SW2, and 205.0 to 205.2 at SW3. In general water levels are highest in during the spring months and lowest during the summer and fall.
- Based upon the calculated stage-discharge data, flow rates within the adjacent tributary have varied between no flow or insufficient flow to measure to 62,400 L/min at SW1, no flow or insufficient flow to measure to 2,008 L/min at SW2, and no flow or insufficient flow to measure to 22,036 L/min at SW3. Peak flows were observed at each location following large precipitation events, with the most significant peak flows observed during March and April 2025. Based on the flow monitoring surface water flows from SW3 west towards SW1, with SW2 joining the main tributary.



- Water budgets were prepared for the existing, extraction and rehabilitation conditions. The water budget results predict infiltration is expected to increase and consequently surface runoff is expected to decrease from existing to proposed conditions as precipitation falling within the extraction footprint will be contained in the extraction area and will infiltrate through the pit floor. The decrease in runoff to the on-site wetland will result in a minor reduction in the overall wetland storage volume. However, the wetland will continue to fill with water seasonally and the hydroperiod will be maintained as the wetland will continue to hold water year-round.

Based on the findings of this assessment, no adverse effects to the groundwater and surface water resources and their users are anticipated as a result of the operation and rehabilitation of the Proposed Pit.

11 Site Plan Recommendations

Based on the above findings the following conditions are recommended to be included on the site plans:

- Water levels shall be collected continuously with automatic water level transducers, with manual measurements collected quarterly for the first two years of operations, and annually afterwards at the following groundwater monitors: BH/MW24-1, BH/MW24-2, BH/MW24-3, BH/MW24-4, BH/MW24-5, BH/MW24-6B, MP1, MP2 and MP3.
- Water levels and streamflow shall be collected continuously with automatic water level transducers March through November, collected quarterly for the first two years of operations, and annually afterwards at the following surface water monitors: SW1, SW2, and SW3.
- Annual water quality sampling for Metals, alkalinity, pH, conductivity, bicarbonate, major anions, Oil and Grease and Petroleum Hydrocarbons shall be conducted at the following groundwater monitors: BH/MW24-1, BH/MW24-2, BH/MW24-3, BH/MW24-4, BH/MW24-5, and BH/MW24-6B.
- If a well complaint is received by the licensee, the following actions should be taken by the licensee:
    - Notify the MNR and MECP.
    - Ensure a Certified Well Inspector (i.e. licensed water well technician) and/or qualified hydrogeologist visits the site within 24 hours of receiving the complaint to investigate. The Certified Well Inspector and/or hydrogeologist shall complete a well inspection including a review of the pump, well condition, pump depth and condition, etc.
    - Temporary water supply shall be provided by the licensee to the well owner within 48 hours of receiving the complaint and thereafter until such time as the cause of the disruption has been determined.
    - If the well complaint cannot be definitively determined to not be a result of the pit operations after the initial site visit, a hydrogeologist shall review the water well inspection report and supporting information, water level data and on-going operations at the pit to provide an assessment of the cause of the complaint. The hydrogeologist shall prepare an opinion letter to be provided to the MNR, MECP, and the complainant as to the likelihood the well complaint is related to the pit operation



- If the well complaint is considered to be a result of the pit operations the following water supply restoration program shall be initiated at the expense of the licensee to the satisfaction of MECP:
  - Step 1: Well system rehabilitation: this includes the replacement or lowering of pumps, flushing the pump lines, well deepening, etc.
  - Step 2: Well Replacements: if system rehabilitation is not an option, the well could be replaced with a new well further from the pit.
  - Step 3: Water treatment considerations: appropriate water treatment will be incorporated into any restored water supply.

- Silt fencing shall be installed around the watercourse/wetlands to limit overland flow and prevent siltation of the adjacent lands.
- Refueling of machinery shall not be conducted in areas of excavation within 5 m of the water table.
- Aggregate extraction shall remain at minimum 1.5 m above the established seasonally high groundwater elevation.
- No chemical sprays shall be used in the areas of the excavation.
- Operator training shall include understanding and implementing the preventative measures provided above, in addition to any on-site corporate Spill Contingency Plan.
- Excess soil to be utilized for rehabilitation shall be imported to site in accordance with Ontario Regulation 244/97 under the Aggregate Resources Act.

12 References

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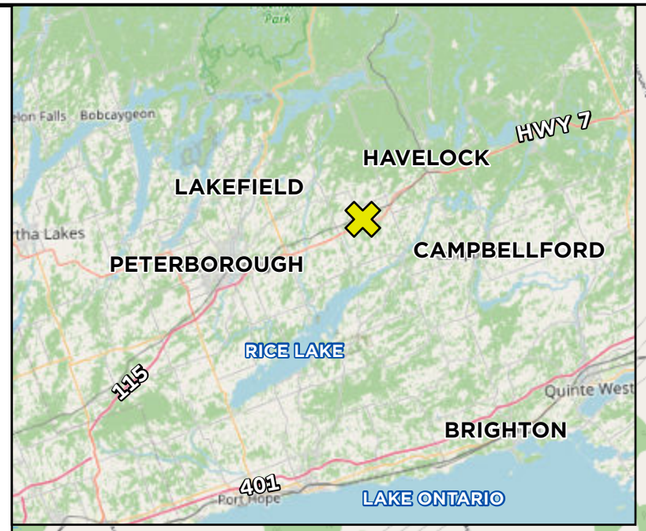
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N



NOTES:
1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N
2. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENSE – ONTARIO.

LEGEND

- LICENSE BOUNDARY
- EXISTING LICENSED PIT #3399
- PROPOSED LIMIT OF EXTRACTION
- OTHER LAND OWNED BY DRAIN BROS.
- WETLAND
- WATERCOURSE

3399

OUSE RIVER TRIBUTARY

OUSE RIVER

0 495 990 1,980 METERS

TATHAM ENGINEERING

HIGHWAY 7 PIT
LEVEL 1 AND 2 HYDROGEOLOGICAL ASSESSMENT
SITE LOCATION PLAN

DWG. No. **FIG-1**

SCALE: 1:25,000 | DRAWN: AO | DATE: JUN. 2026 | JOB NO. 424399

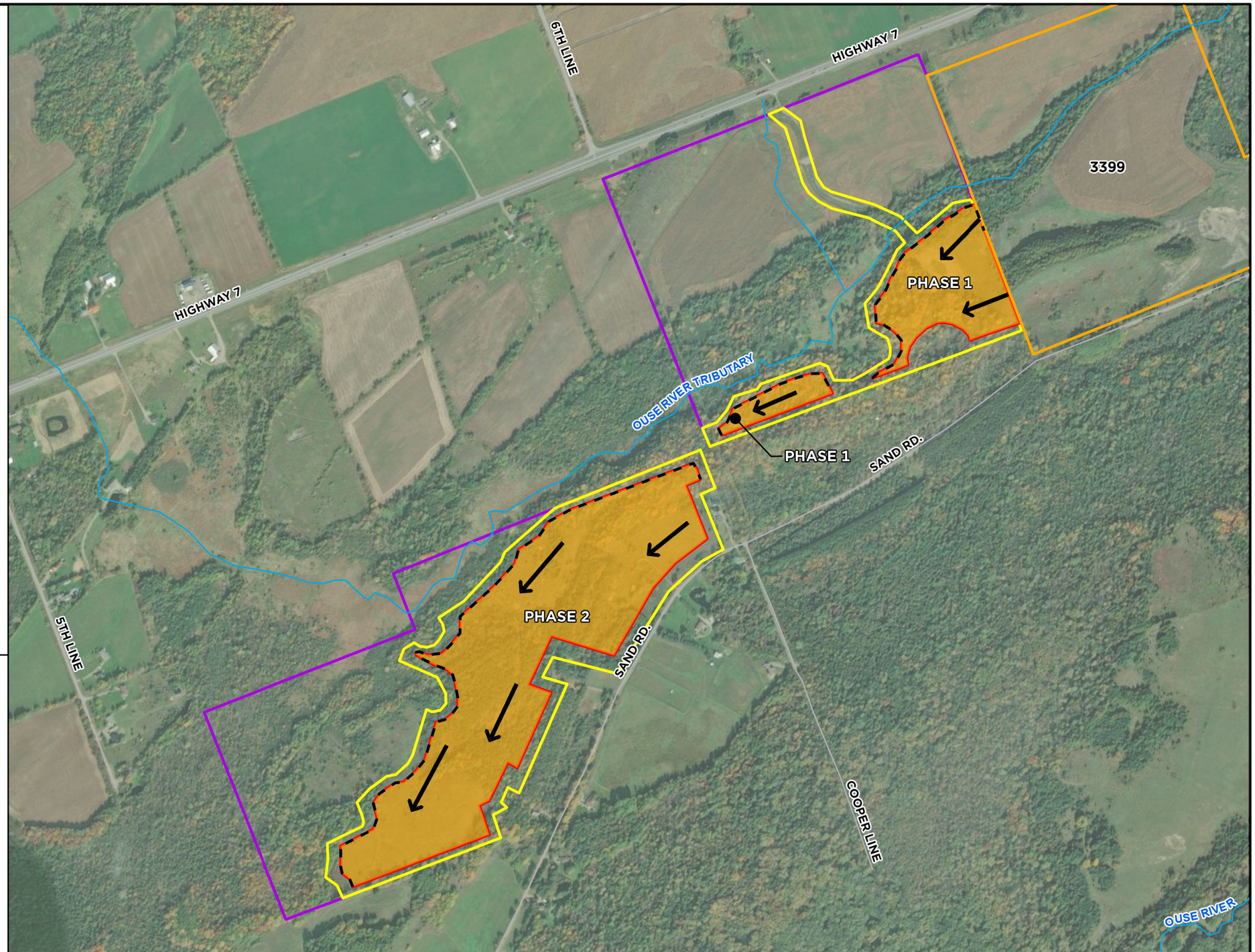
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N

NOTES:
1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N
2. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENSE – ONTARIO.

LEGEND

- LICENSE BOUNDARY
- EXISTING LICENSED PIT #3399
- PROPOSED LIMIT OF EXTRACTION
- PROPOSED PHASES OF EXTRACTION
- OTHER LAND OWNED BY DRAIN BROS.
- DIRECTION OF EXTRACTION
- WATERCOURSE
- ROADS
- SILT FENCING



0 155 310 620 METERS

TATHAM ENGINEERING

HIGHWAY 7 PIT
LEVEL 1 AND 2 HYDROGEOLOGICAL ASSESSMENT
MINING PHASING PLAN

DWG. No. **FIG-2**

SCALE: 1:8,000 | DRAWN: AO | DATE: SEP. 2025 | JOB NO. 424399

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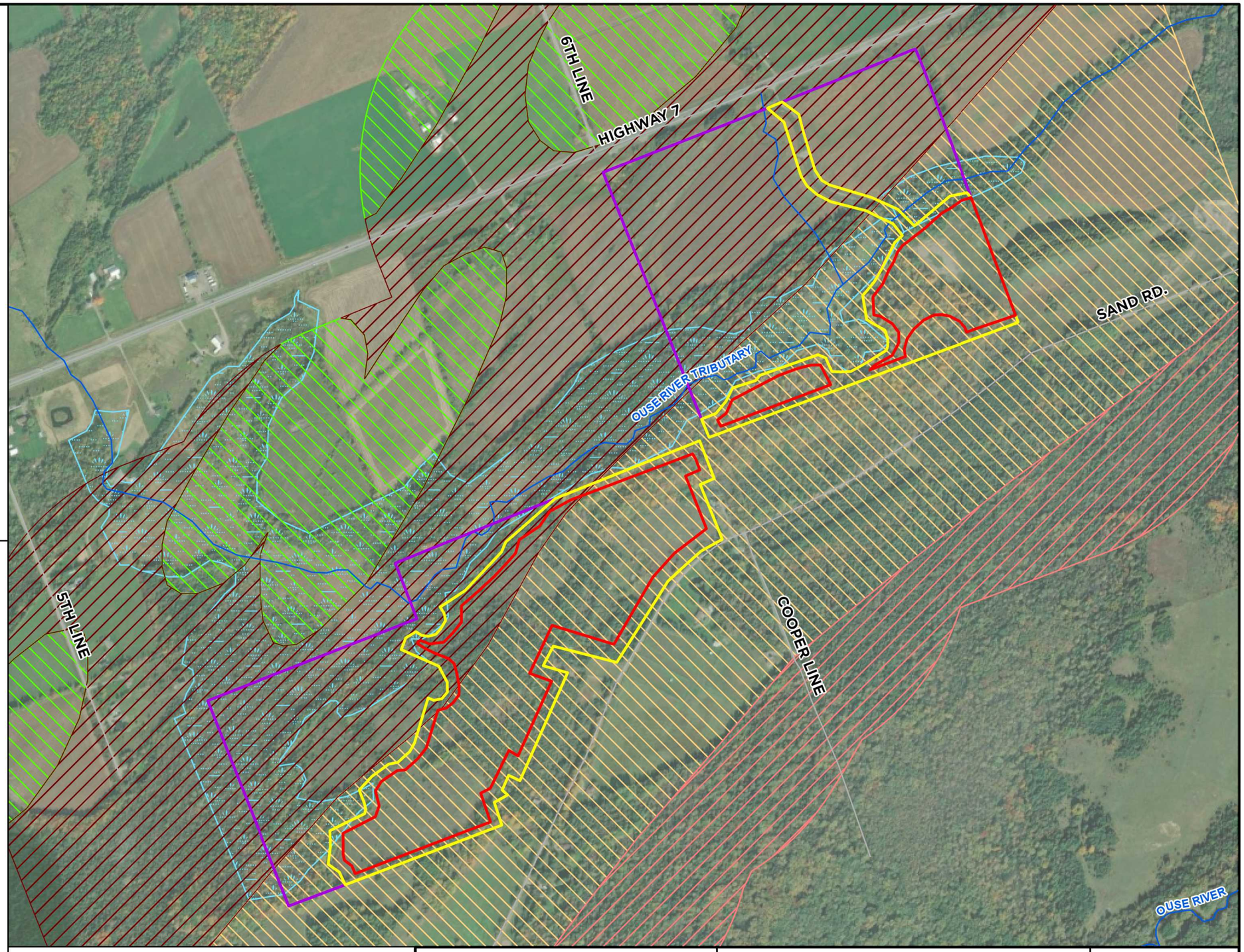
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1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N
2. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENSE – ONTARIO.
3. PHYSIOGRAPHY LAYERS DERIVED FROM CHAPMAN, L.J. AND PUTNAME, D.F., 2007. THE PHYSIOGRAPHY OF SOUTHERN ONTARIO; ONTARIO GEOLOGICAL SURVEY, MISCELLANEOUS RELEASE - DATA 228.

LEGEND

- LICENSE BOUNDARY
- PROPOSED LIMIT OF EXTRACTION
- OTHER LAND OWNED BY DRAIN BROS.
- WETLAND
- WATERCOURSE
- ROADS

PHYSIOGRAPHY

- ESKERS
- DRUMLINS
- SPILLWAYS
- TILL PLAINS (DRUMLINIZED)



0 150 300 600 METERS

TATHAM ENGINEERING

HIGHWAY 7 PIT
LEVEL 1 AND 2 HYDROGEOLOGICAL ASSESSMENT
PHYSIOGRAPHY MAPPING

DWG. No. **FIG-3**

SCALE: 1:8,000 | DRAWN: AO | DATE: JUN. 2026 | JOB NO. 424399

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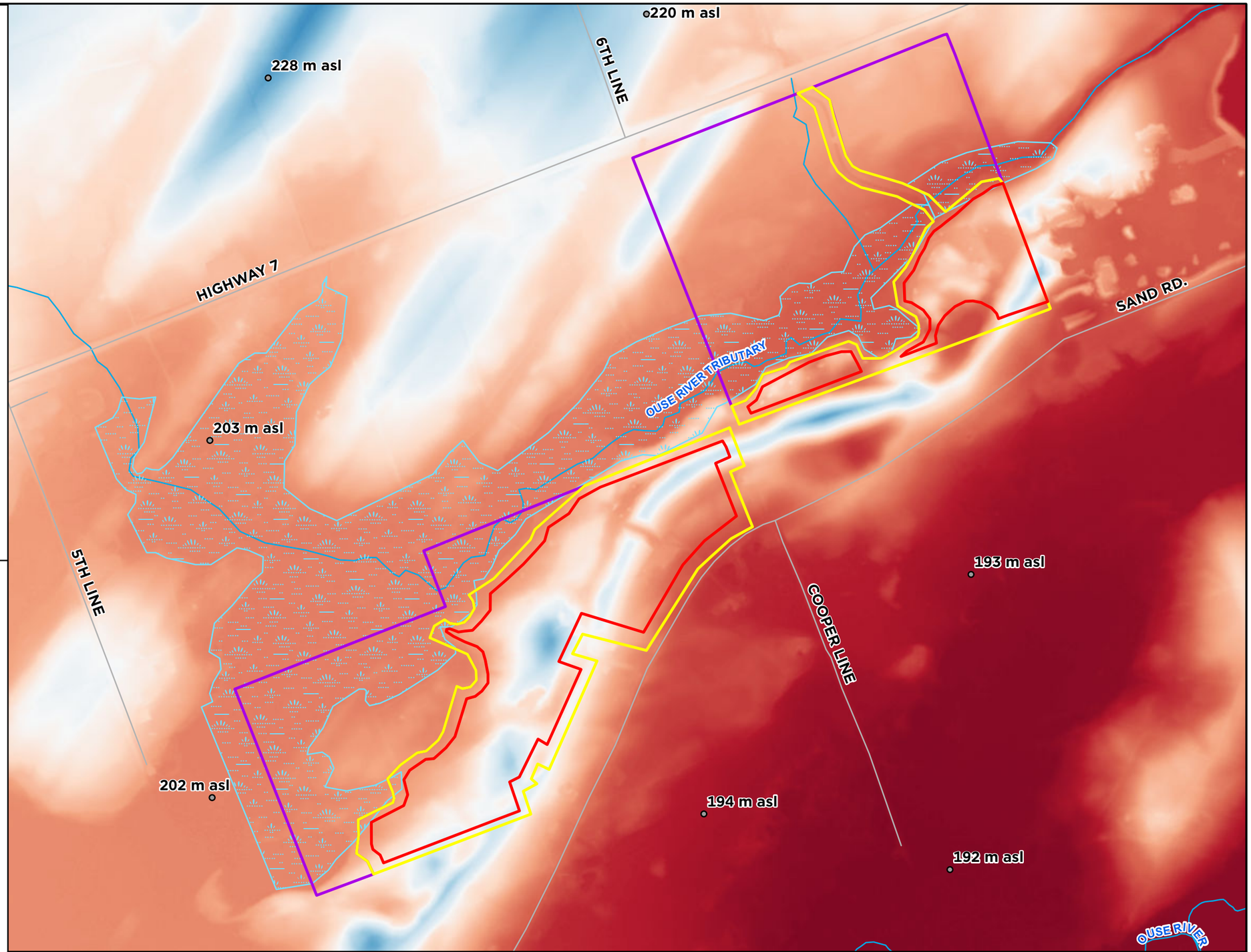
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NOTES:
1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N
2. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENSE – ONTARIO.

LEGEND

- LICENSE BOUNDARY
- PROPOSED LIMIT OF EXTRACTION
- OTHER LAND OWNED BY DRAIN BROS.
- WATERCOURSE
- WETLAND
- ROADS
- SPOT ELEVATIONS

240m
230m
220m
210m
200m
190m



0 150 300 600 METERS

TATHAM ENGINEERING

HIGHWAY 7 PIT
LEVEL 1 AND 2 HYDROGEOLOGICAL ASSESSMENT
TOPOGRAPHY AND DRAINAGE

DWG. No. **FIG-4**

SCALE: 1:8,000 | DRAWN: AO | DATE: JUN. 2026 | JOB NO. 424399

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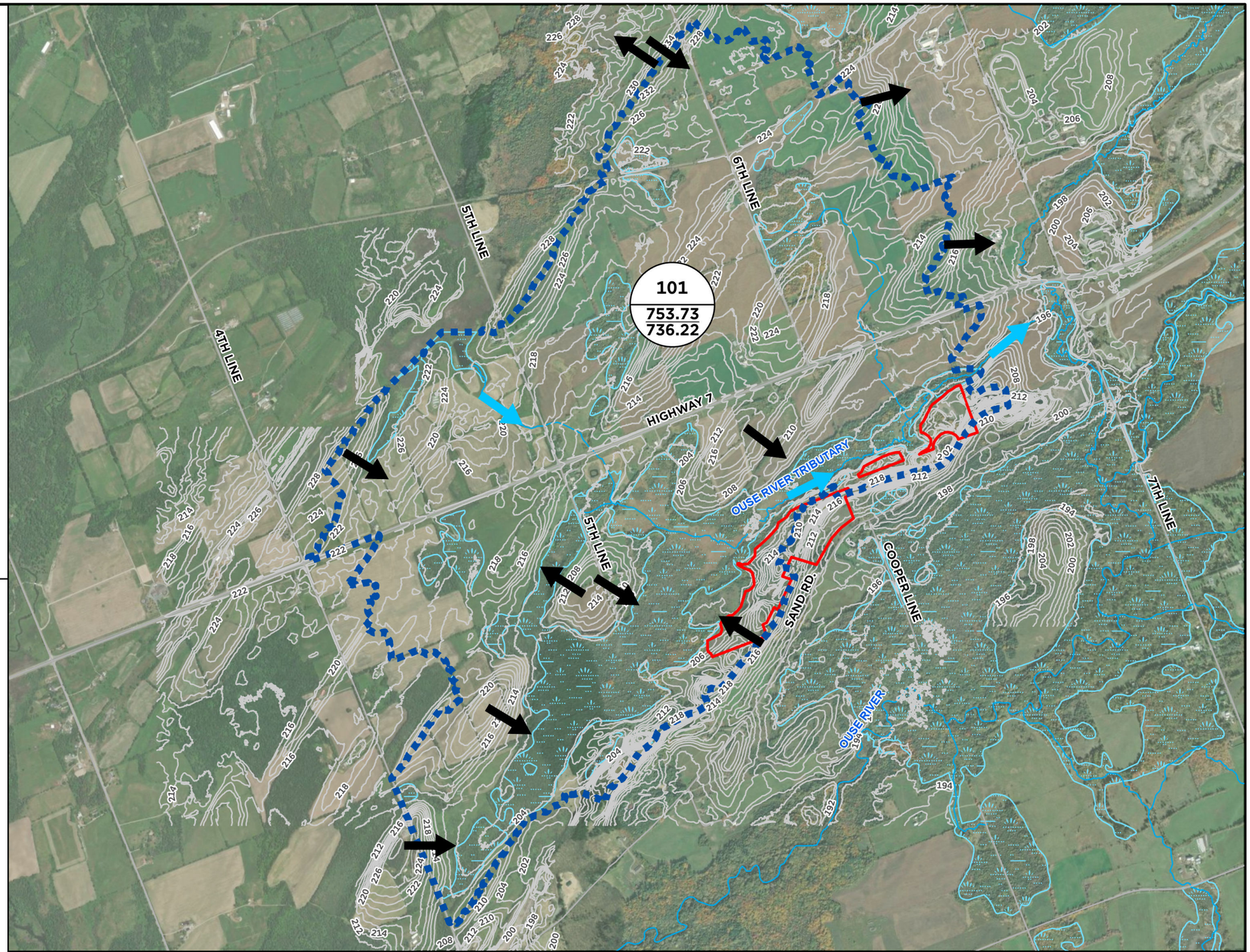
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NOTES:
1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N
2. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENSE – ONTARIO.

LEGEND

- PROPOSED LIMIT OF EXTRACTION
- CATCHMENT 101 (WETLAND 1)
- ROADS
- CONTOUR
- WETLAND
- WATERCOURSE
- DRAINAGE FLOW DIRECTION
- WATERCOURSE FLOW

101 — CATCHMENT ID
753.73 — EXISTING AREA (ha)
736.22 — PROPOSED AREA (ha)



0 400 800 1,600 METERS

TATHAM ENGINEERING

HIGHWAY 7 PIT
LEVEL 1 AND 2 HYDROGEOLOGICAL ASSESSMENT
CATCHMENT PLAN

DWG. No. **FIG-5**

SCALE: 1:20,000 | DRAWN: AO | DATE: JUN. 2026 | JOB NO. 424399

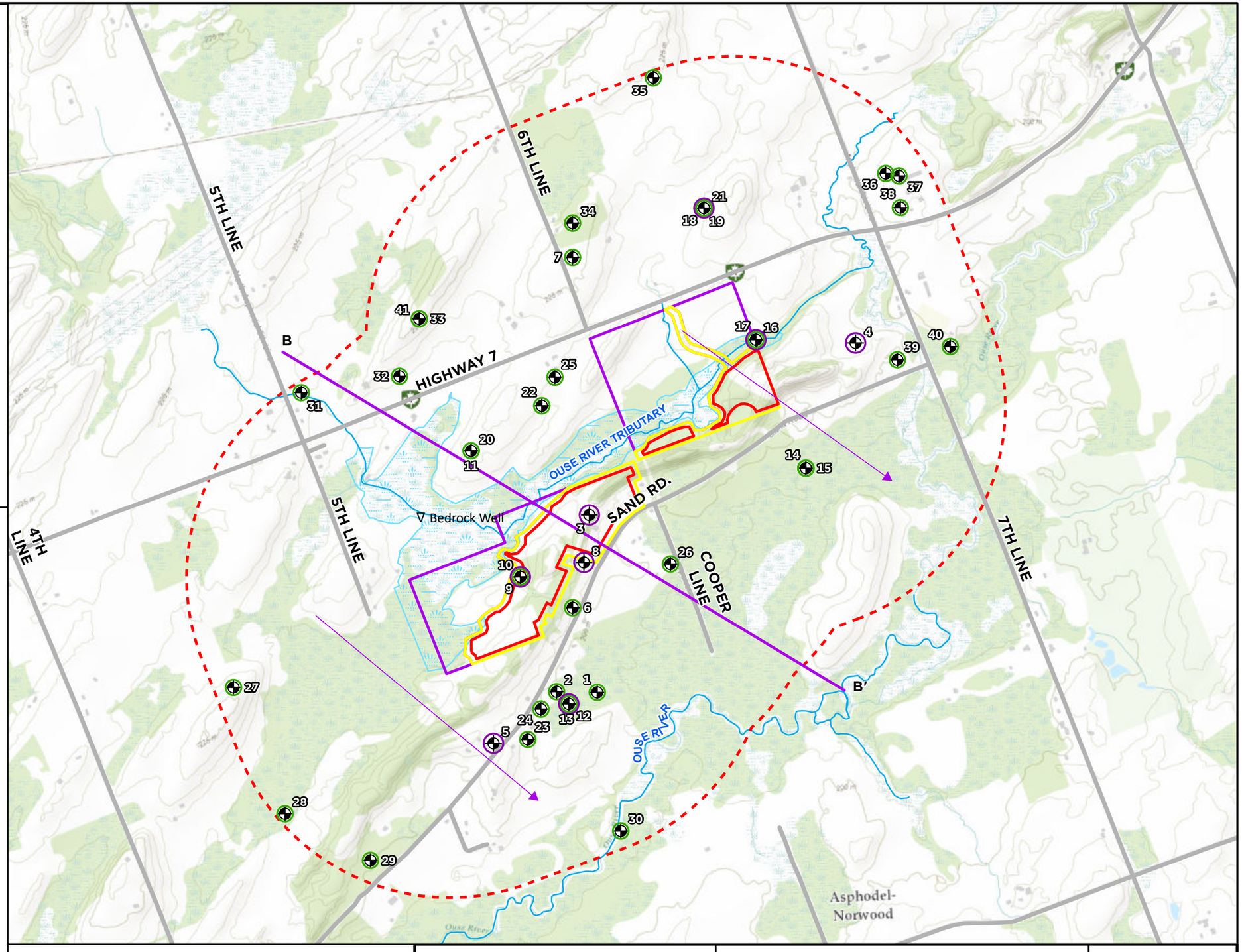
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N

NOTES:
1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N
2. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENSE – ONTARIO.

LEGEND

- LICENSE BOUNDARY
- PROPOSED LIMIT OF EXTRACTION
- OTHER LAND OWNED BY DRAIN BROS.
- STUDY AREA (1000m)
- MECP WATER WELL ID LABEL (SEE APPENDIX A)
- BEDROCK
- OVERBURDEN
- CROSS SECTION
- ROADS
- WATERCOURSE
- WETLAND
- GENERAL REGIONAL GROUNDWATER FLOW (OVERBURDEN AND BEDROCK)



0 250 500 1,000 METERS

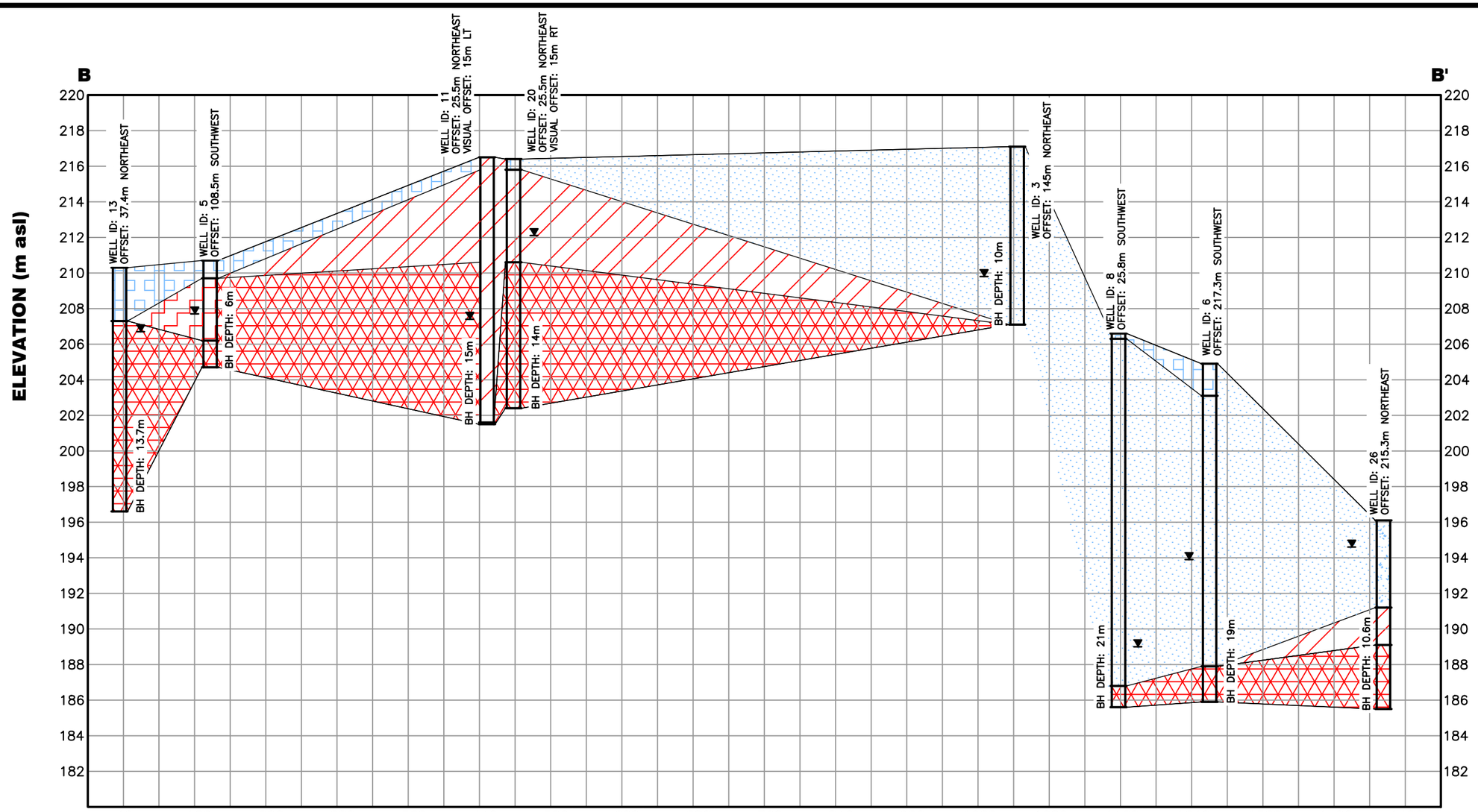
TATHAM ENGINEERING

HIGHWAY 7 PIT
LEVEL 1 AND 2 HYDROGEOLOGICAL ASSESSMENT
MECP WATER WELLS

DWG. No. **FIG-6**

SCALE: 1:17,500 | DRAWN: AO | DATE: JUN. 2026 | JOB NO. 424399

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LEGEND

- EXISTING GROUND PROFILE
- STRATIGRAPHIC CONTACT – APPROXIMATE
- STATIC WATER LEVEL
- GRAVELLY CLAY
- LIMESTONE
- HARDPAN
- SHALE
- TOPSOIL
- GRAVELLY SAND
- SAND AND GRAVEL

HORIZONTAL SCALE: 1:5000
VERTICAL SCALE: 1:250
VERTICAL EXAGGERATION: 20X

TATHAM ENGINEERING

HIGHWAY 7 PIT
LEVEL 1 AND 2 HYDROGEOLOGICAL ASSESSMENT
REGIONAL CROSS-SECTION NW-SE

No. **FIG-7**

SCALE: AS NOTED	DRAWN: HDY	DATE: SEPT 2025	JOB NO. 424399

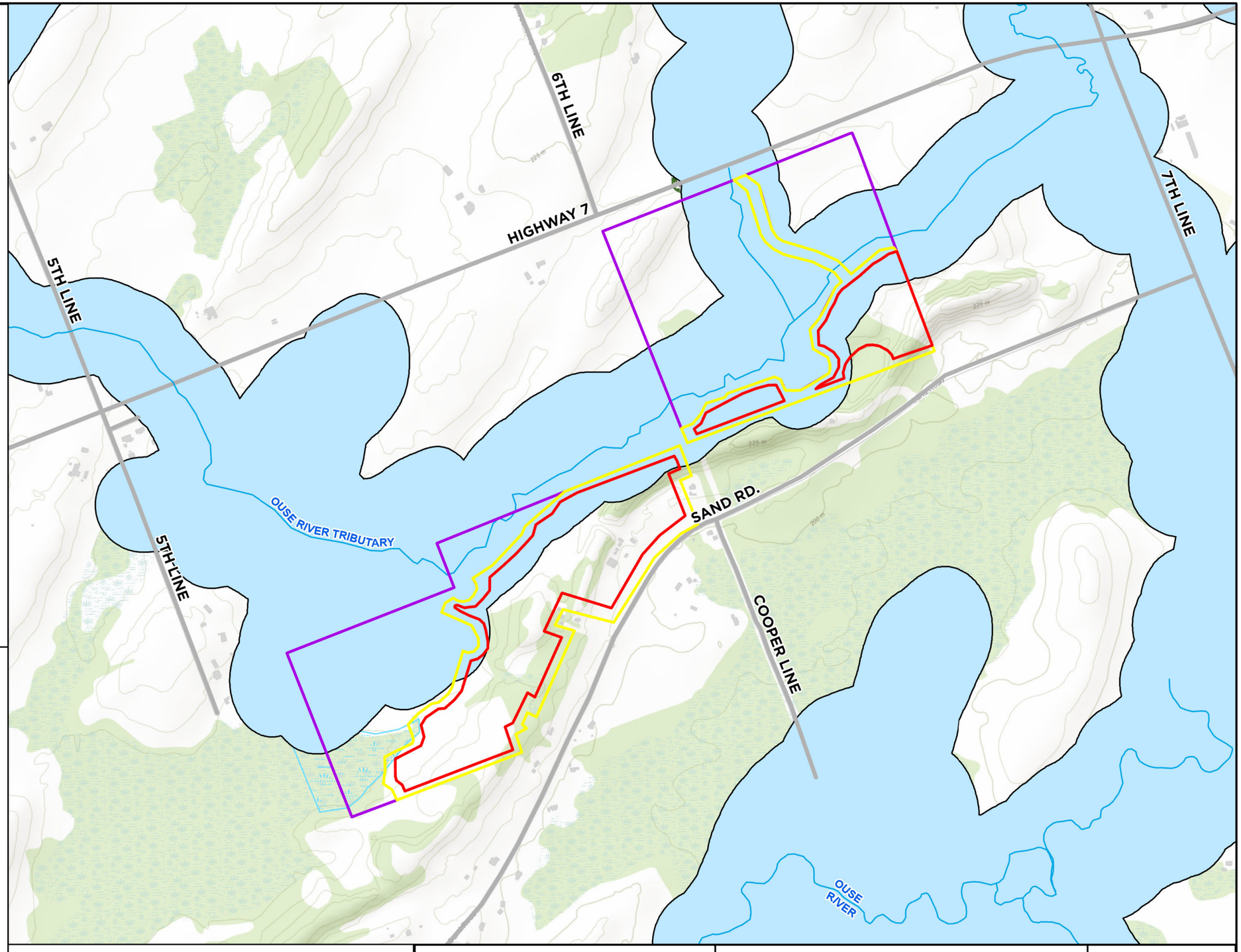
Drawing Name: 424399–Section A–A.dwg, Plotted: Sep 30, 2025

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NOTES:
1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N
2. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENSE – ONTARIO.
3. CONTAINS INFORMATION FROM THE OTONABEE-PETERBOROUGH SOURCE WATER PROTECTION PLAN.

LEGEND

- LICENSE BOUNDARY
- PROPOSED LIMIT OF EXTRACTION
- OTHER LAND OWNED BY DRAIN BROS.
- WATERCOURSE
- WETLAND
- ROADS
- INTAKE PROTECTION ZONE 3



0 200 400 800 METERS

TATHAM ENGINEERING

HIGHWAY 7 PIT
LEVEL 1 AND 2 HYDROGEOLOGICAL ASSESSMENT
INTAKE PROTECTION ZONES

DWG. No. **FIG-8**

SCALE: 1:10,000 | DRAWN: AO | DATE: JUN. 2026 | JOB NO. 424399

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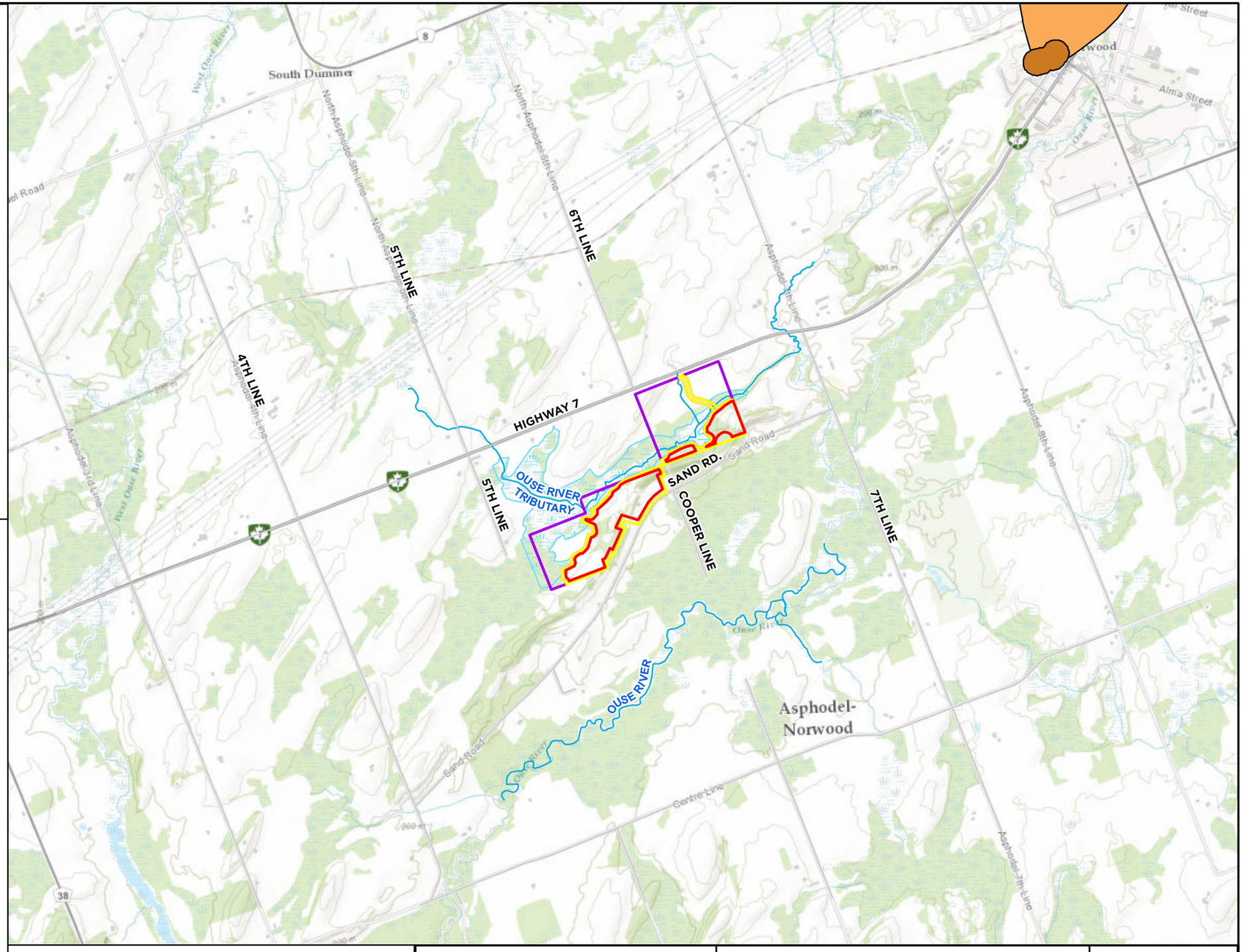
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NOTES:
1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N
2. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENSE – ONTARIO.
3. CONTAINS INFORMATION FROM THE OTONABEE-PETERBOROUGH SOURCE WATER PROTECTION PLAN.

LEGEND

- LICENSE BOUNDARY
- PROPOSED LIMIT OF EXTRACTION
- OTHER LAND OWNED BY DRAIN BROS.
- WETLAND
- WATERCOURSE
- ROADS

WELLHEAD PROTECTION AREA
- A
- B



0 600 1,200 2,400 METERS

TATHAM ENGINEERING

HIGHWAY 7 PIT
LEVEL 1 AND 2 HYDROGEOLOGICAL ASSESSMENT
WELL HEAD PROTECTION AREA

DWG. No. **FIG-9**

SCALE: 1:30,000	DRAWN: AO	DATE: JUN. 2026	JOB NO. 424399

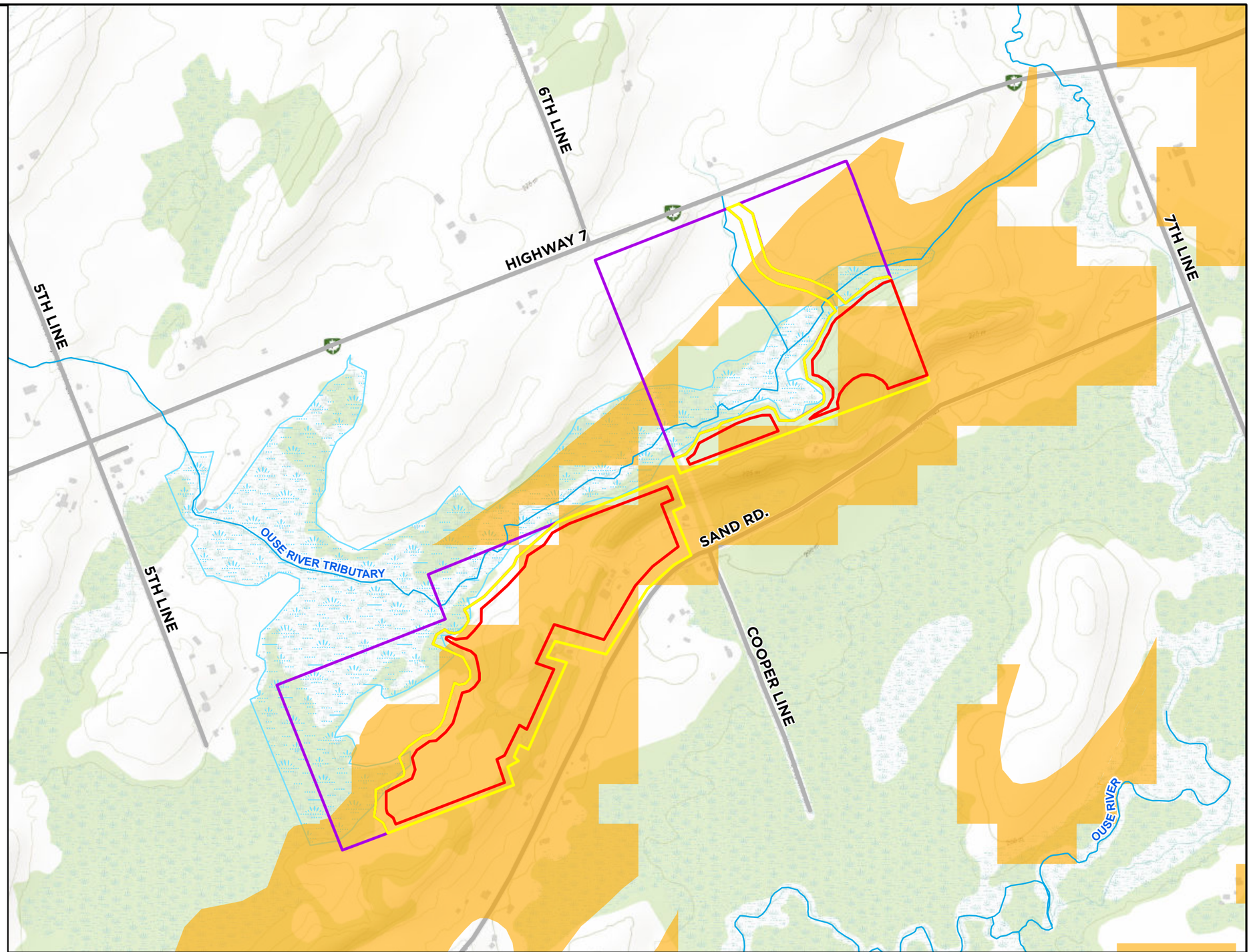
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NOTES:
1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N
2. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENSE – ONTARIO.
3. CONTAINS INFORMATION FROM THE OTONABEE-PETERBOROUGH SOURCE WATER PROTECTION PLAN.

LEGEND

- LICENSE BOUNDARY
- PROPOSED LIMIT OF EXTRACTION
- OTHER LAND OWNED BY DRAIN BROS.
- SIGNIFIGANT GROUNDWATER RECHARGE AREA
- WETLAND
- WATERCOURSE
- ROADS



0 200 400 800 METERS

TATHAM ENGINEERING

HIGHWAY 7 PIT
LEVEL 1 AND 2 HYDROGEOLOGICAL ASSESSMENT
SIGNIFICANT GROUNDWATER RECHARGE AREA

DWG. No. **FIG-10**

SCALE: 1:10,000 | DRAWN: AO | DATE: JUN. 2026 | JOB NO. 424399

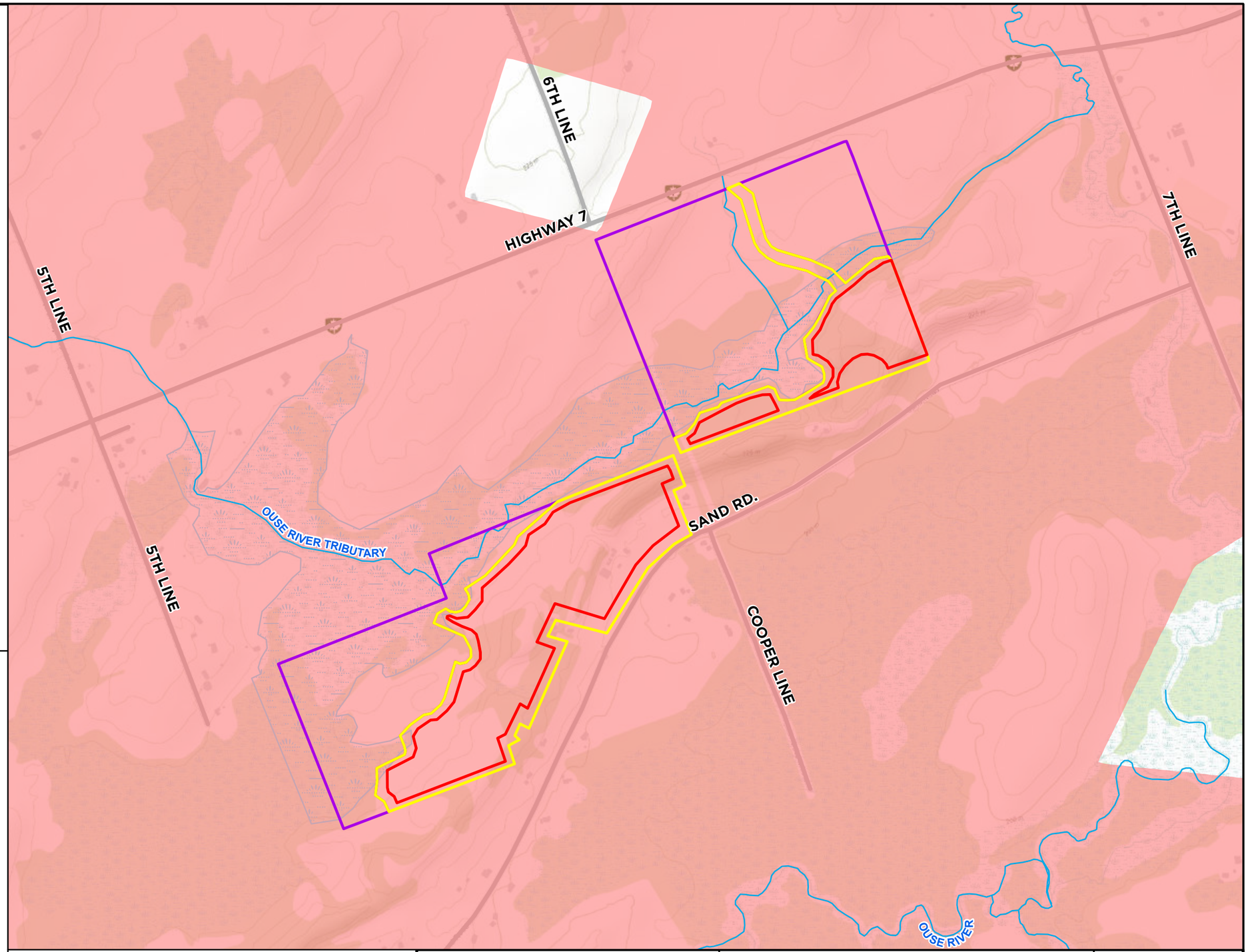
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N

NOTES:
1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N
2. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENSE – ONTARIO.
3. CONTAINS INFORMATION FROM THE OTONABEE-PETERBOROUGH SOURCE WATER PROTECTION PLAN.

LEGEND

- LICENSE BOUNDARY
- PROPOSED LIMIT OF EXTRACTION
- OTHER LAND OWNED BY DRAIN BROS.
- HIGHLY VULNERABLE AQUIFER
- WETLAND
- WATERCOURSE
- ROADS



0 200 400 800 METERS

TATHAM ENGINEERING

HIGHWAY 7 PIT
LEVEL 1 AND 2 HYDROGEOLOGICAL ASSESSMENT
HIGHLY VULNERABLE AQUIFER

DWG. No. **FIG-11**

SCALE: 1:10,000 | DRAWN: AO | DATE: JUN. 2026 | JOB NO. 424399

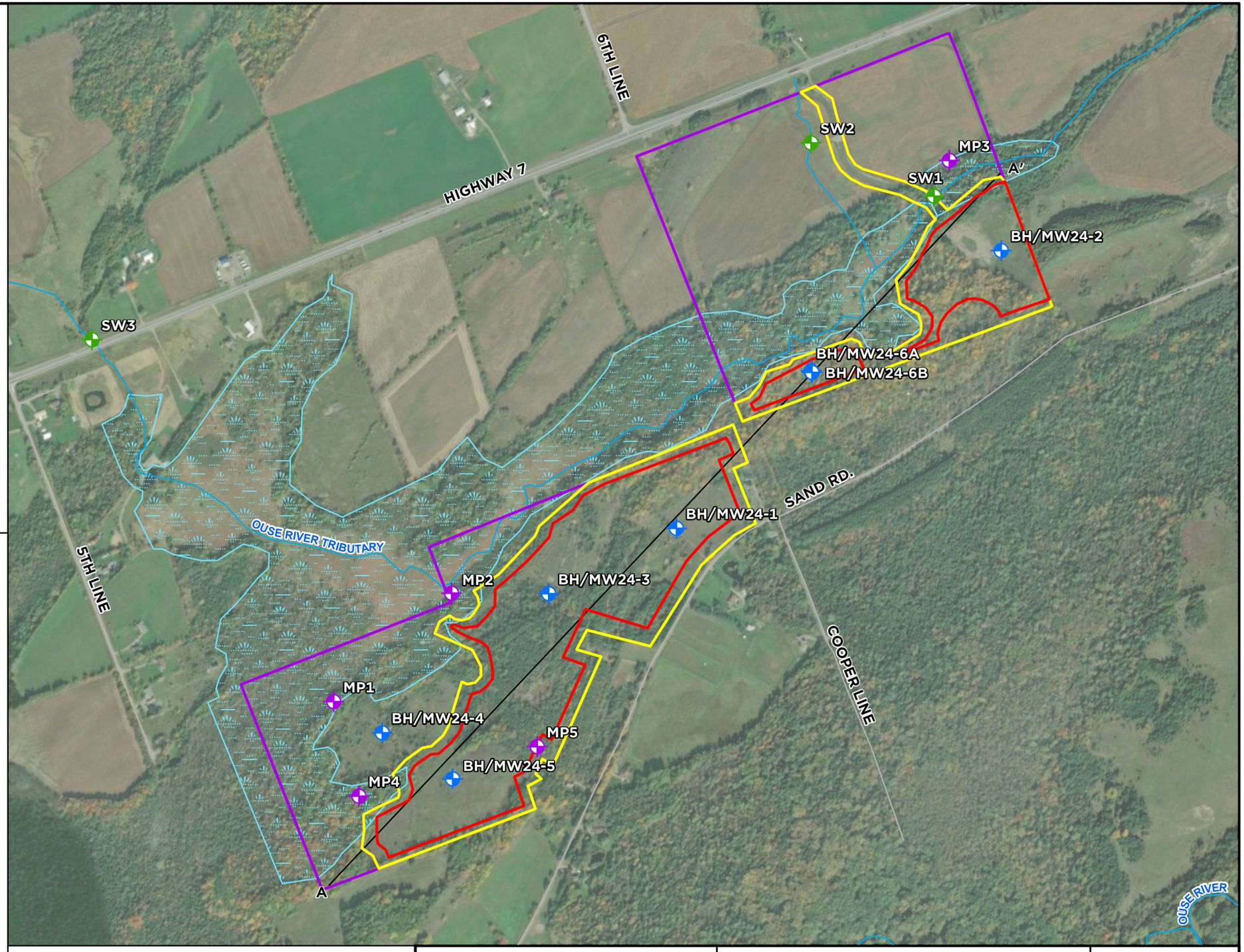
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N

NOTES:
1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N
2. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENSE – ONTARIO.

LEGEND

- LICENSE BOUNDARY
- PROPOSED LIMIT OF EXTRACTION
- OTHER LAND OWNED BY DRAIN BROS.
- MONITORING WELLS
- PIEZOMETERS
- STREAMFLOW MONITORS
- WETLAND
- WATERCOURSE
- CROSS SECTION
- ROADS



0 160 320 640 METERS

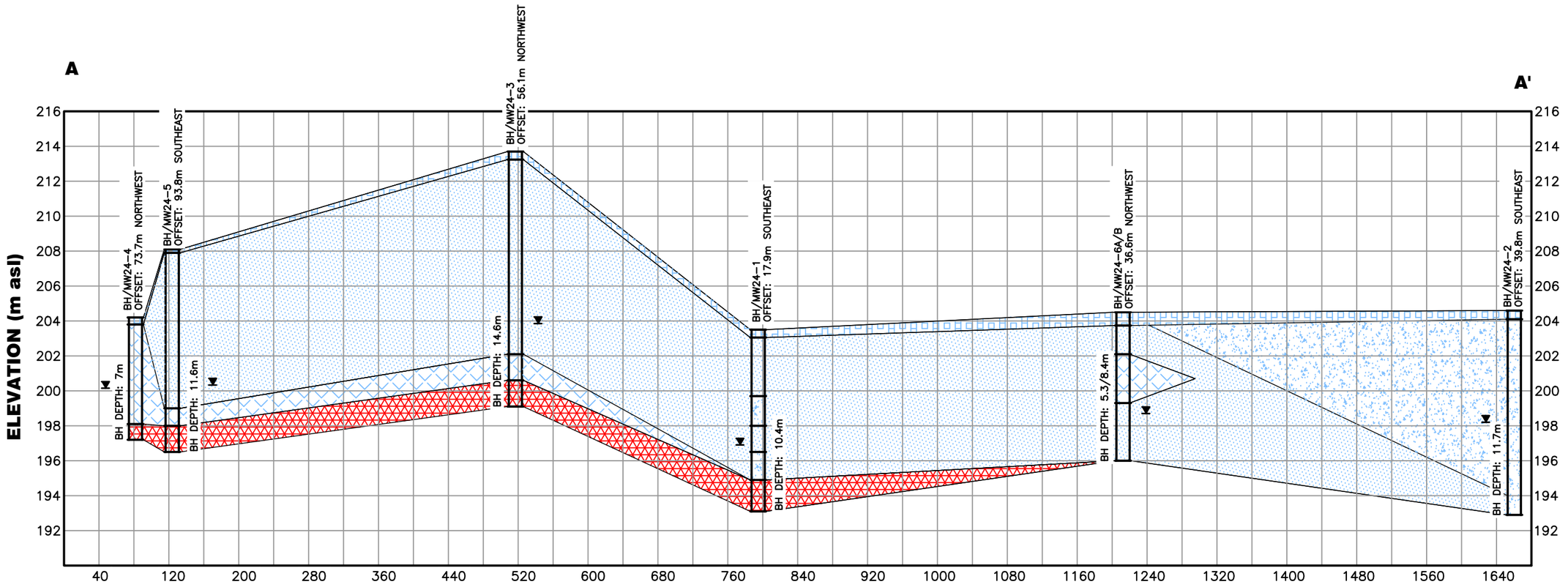
TATHAM ENGINEERING

HIGHWAY 7 PIT
LEVEL 1 AND 2 HYDROGEOLOGICAL ASSESSMENT
SITE MONITORING LOCATION PLAN

DWG. No. **FIG-12**

SCALE: 1:8,000 | DRAWN: AO | DATE: JUN. 2026 | JOB NO. 424399

Y:\2024 Projects\424399 - Sand Road Pit, Asphodel-Norwood\GIS\GIS Models\424399 - Sand Road Pit\424399 - Sand Road Pit.aprx



DISTANCE (m)

LEGEND

- WELL LOCATION NUMBER
- EXISTING GROUND PROFILE
- STRATIGRAPHIC CONTACT – APPROXIMATE
- STATIC WATER LEVEL

- TOPSOIL
- SAND
- SILTY SAND TILL
- SAND AND GRAVEL
- LIMESTONE

HORIZONTAL SCALE: 1:5000
VERTICAL SCALE: 1:250
VERTICAL EXAGGERATION: 20X

TATHAM ENGINEERING

HIGHWAY 7 PIT
LEVEL 1 AND 2 HYDROGEOLOGICAL ASSESSMENT
CROSS-SECTION A-A'

No. **FIG-13**

SCALE: AS NOTED	DRAWN: HDY	DATE: SEPT 2025	JOB NO. 424399

Drawing Name: 424399–Section A–A.dwg, Plotted: Sep 30, 2025

N

NOTES:
1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N
2. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENSE – ONTARIO.

LEGEND

- PROPOSED LIMIT OF EXTRACTION
- MONITORING WELLS
- WATERCOURSE
- ROADS

GROUNDWATER ELEVATION (m asl)

- < 198
- 198-199
- 199-200
- 200-201
- > 201



0 150 300 600 METERS

TATHAM ENGINEERING

HIGHWAY 7 PIT
LEVEL 1 AND 2 HYDROGEOLOGICAL ASSESSMENT
MAXIMUM GROUNDWATER CONTOURS

DWG. No. **FIG-14**

SCALE: 1:7,500 | DRAWN: AO | DATE: JUN. 2026 | JOB NO. 424399

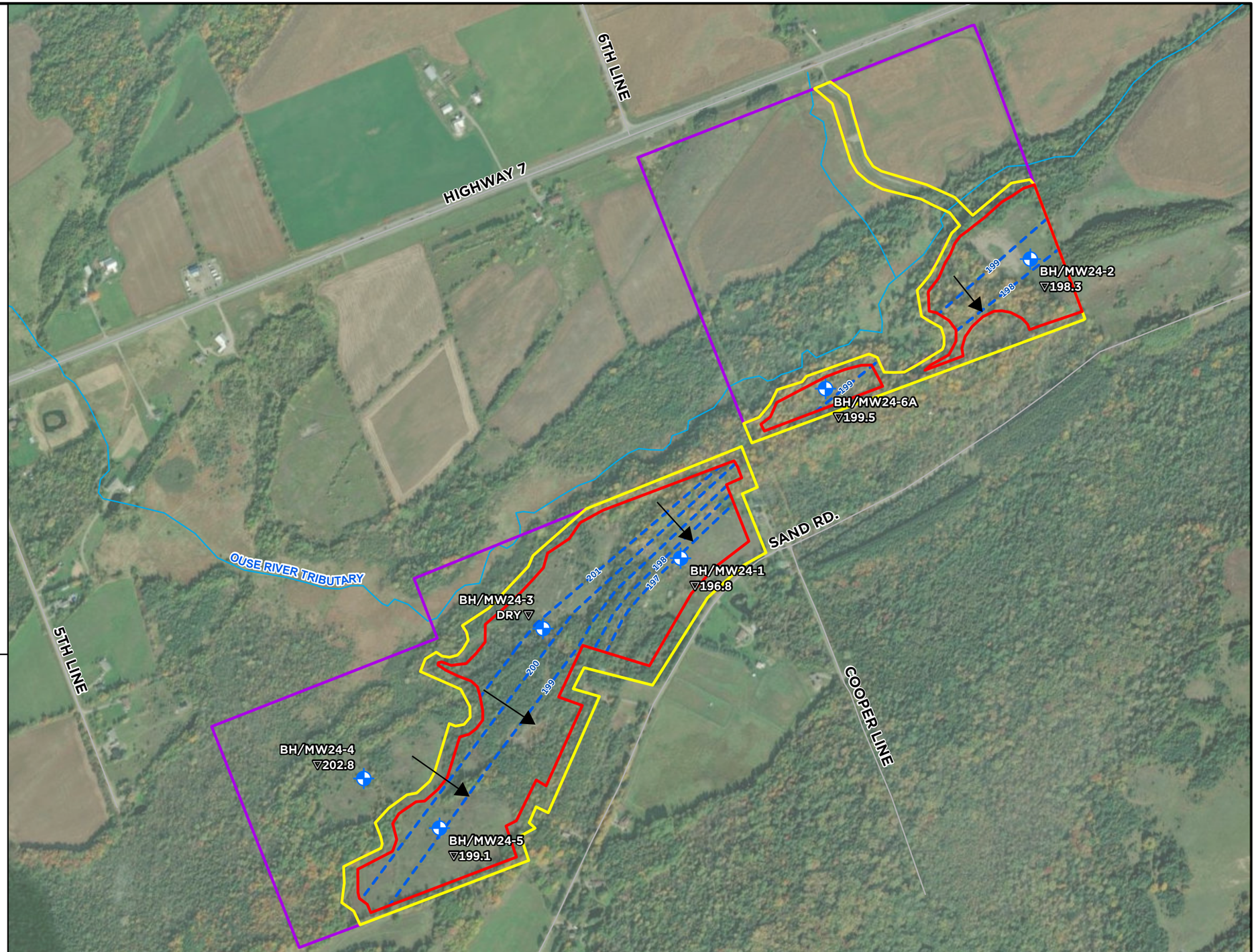
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N

NOTES:
1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N
2. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENSE – ONTARIO.

LEGEND

- LICENSE BOUNDARY
- PROPOSED LIMIT OF EXTRACTION
- OTHER LAND OWNED BY DRAIN BROS.
- WATERCOURSE
- GROUNDWATER CONTOUR
- ROADS
- MONITORING WELLS
- GROUNDWATER ELEVATION (MEASURED JULY 2024)
- GROUNDWATER FLOW DIRECTION



0 150 300 600 METERS

TATHAM ENGINEERING

HIGHWAY 7 PIT
LEVEL 1 AND 2 HYDROGEOLOGICAL ASSESSMENT
GROUNDWATER CONTOUR - JULY 2024

DWG. No. **FIG-15**

SCALE: 1:7,500 | DRAWN: AO | DATE: JUN. 2026 | JOB NO. 424399

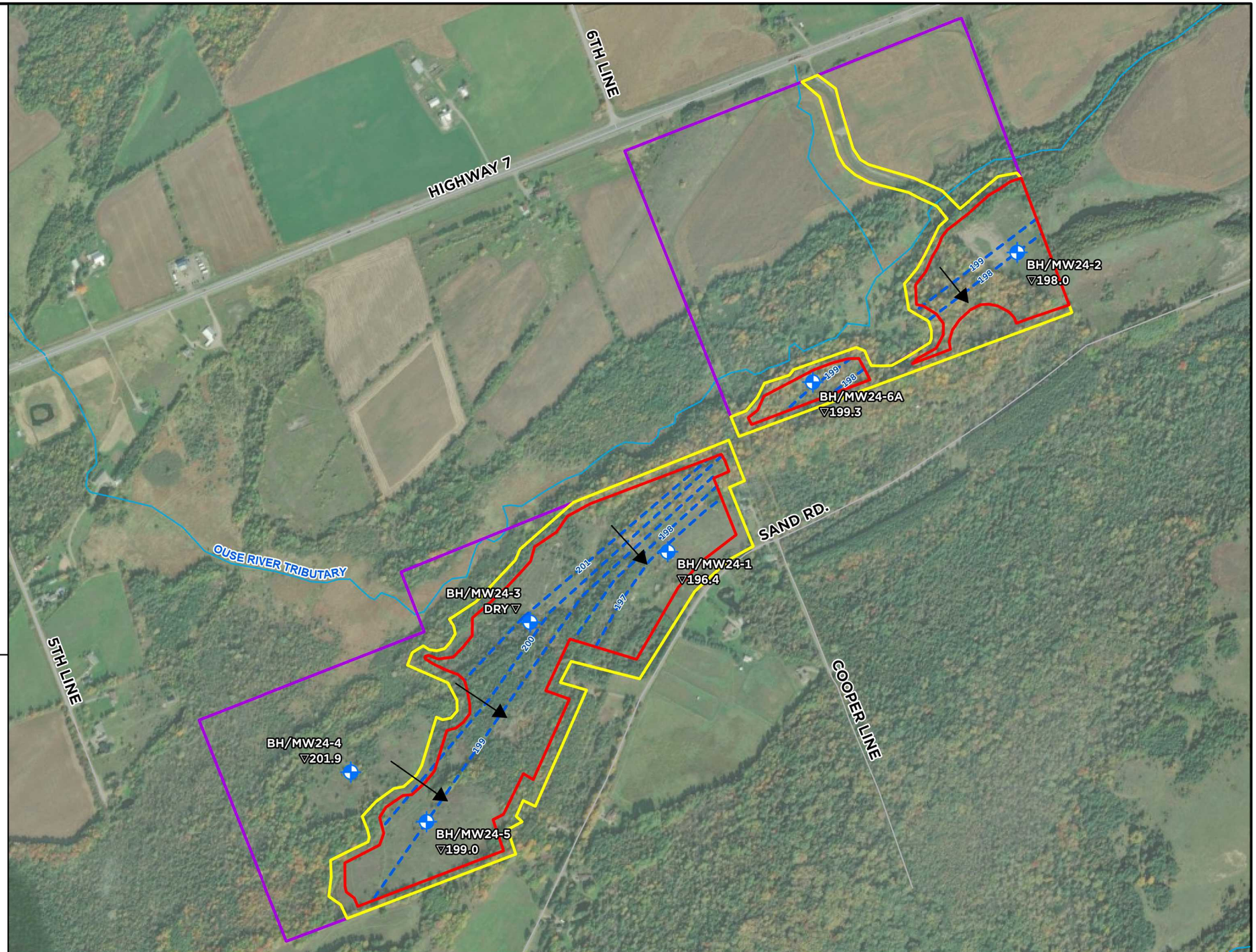
Y:\2024 Projects\424399 - Sand Road Pit, Asphodel-Norwood\GIS\GIS Models\424399 - Sand Road Pit\424399 - Sand Road Pit.aprx

N

NOTES:
1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N
2. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENSE – ONTARIO.

LEGEND

- LICENSE BOUNDARY
- PROPOSED LIMIT OF EXTRACTION
- OTHER LAND OWNED BY DRAIN BROS.
- WATERCOURSE
- GROUNDWATER CONTOUR
- ROADS
- MONITORING WELLS
- GROUNDWATER ELEVATION (MEASURED OCTOBER 2024)
- GROUNDWATER FLOW DIRECTION



0 150 300 600 METERS

TATHAM ENGINEERING

HIGHWAY 7 PIT
LEVEL 1 AND 2 HYDROGEOLOGICAL ASSESSMENT
GROUNDWATER CONTOUR - OCTOBER 2024

DWG. No. **FIG-16**

SCALE: 1:7,500 | DRAWN: AO | DATE: JUN. 2026 | JOB NO. 424399

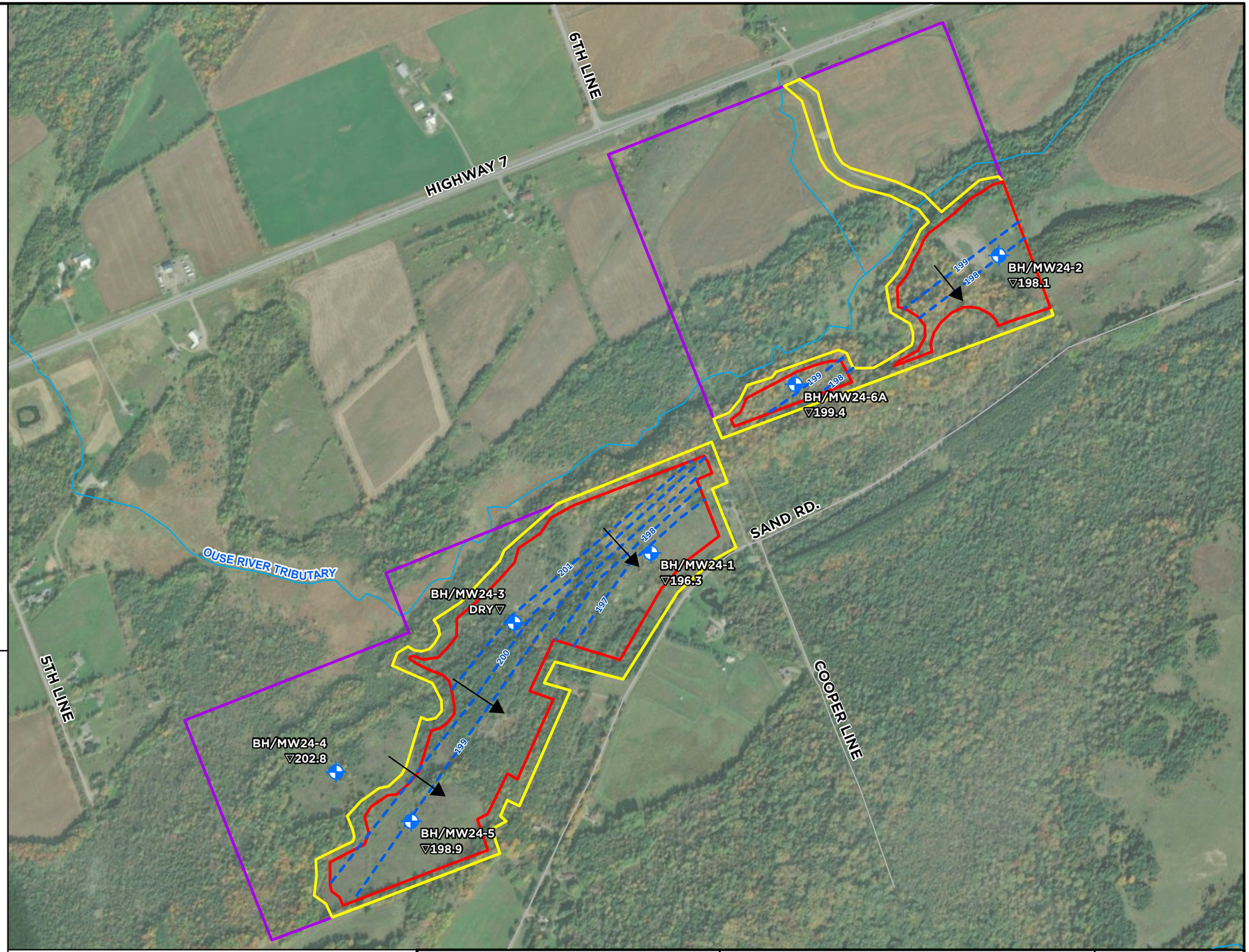
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N

NOTES:
1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N
2. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENSE – ONTARIO.

LEGEND

- LICENSE BOUNDARY
- PROPOSED LIMIT OF EXTRACTION
- OTHER LAND OWNED BY DRAIN BROS.
- WATERCOURSE
- GROUNDWATER CONTOUR
- ROADS
- MONITORING WELLS
- GROUNDWATER ELEVATION (MEASURED JANUARY 2025)
- GROUNDWATER FLOW DIRECTION



0 150 300 600 METERS

TATHAM ENGINEERING

HIGHWAY 7 PIT
LEVEL 1 AND 2 HYDROGEOLOGICAL ASSESSMENT
GROUNDWATER CONTOUR - JANUARY 2025

DWG. No. **FIG-17**

SCALE: 1:7,500 | DRAWN: AO | DATE: JUN. 2026 | JOB NO. 424399

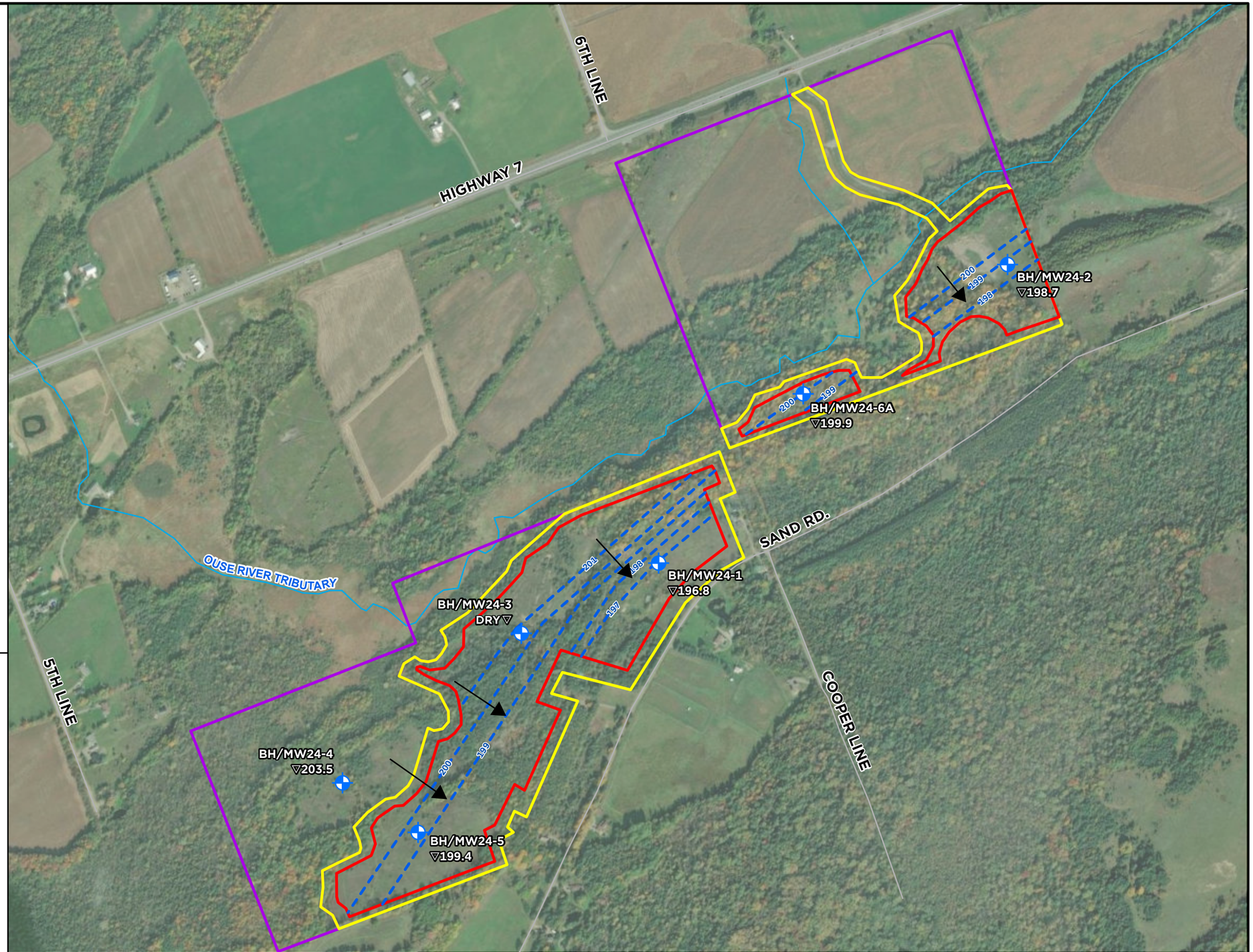
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N

NOTES:
1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N
2. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENSE – ONTARIO.

LEGEND

- LICENSE BOUNDARY
- PROPOSED LIMIT OF EXTRACTION
- OTHER LAND OWNED BY DRAIN BROS.
- WATERCOURSE
- GROUNDWATER CONTOUR
- ROADS
- MONITORING WELLS
- GROUNDWATER ELEVATION (MEASURED APRIL 2025)
- GROUNDWATER FLOW DIRECTION



0 150 300 600 METERS

TATHAM ENGINEERING

HIGHWAY 7 PIT
LEVEL 1 AND 2 HYDROGEOLOGICAL ASSESSMENT
GROUNDWATER CONTOUR - APRIL 2025

DWG. No. **FIG-18**

SCALE: 1:7,500 | DRAWN: AO | DATE: JUN. 2026 | JOB NO. 424399

Y:\2024 Projects\424399 - Sand Road Pit, Asphodel-Norwood\GIS\GIS Models\424399 - Sand Road Pit\424399 - Sand Road Pit.aprx

Appendix A:
MECP Water Well Records

TATHAM ENGINEERING

Ministry of the Environment, Conservation and Parks
Water Well Records

ID	Township Con Lot	UTM	Date Centr	Casing Dia	Water	Pump Test	Well Use	Screen Depth	Well	Formation
1	ASPHODEL TOWNSHIP CON 05 013	17 737324 4914698 W	1953/12 1343	5	FR 0020	16/16/2/1:0	DO		5100096 ()	BRWN LOAM MSND 0020 GREY QSND 0021
2	ASPHODEL TOWNSHIP CON 05 013	17 737144 4914701 W	1966/11 4814	6 6	FR 0018	6/16/10/2:0	ST DO		5100097 ()	PRDG 0012 GREY CLAY STNS SHLE 0018 GREY LMSN 0028
3	ASPHODEL TOWNSHIP CON 05 014	17 737289 4915483 W	1953/10 1343	5	FR 0030	24/24/0/0:30	DO		5100098 ()	BRWN LOAM MSND 0030 GREY QSND 0032
4	ASPHODEL TOWNSHIP CON 06 015	17 738467 4916244 W	1953/08 1343	5	FR 0024	19/19/7/2:0	ST DO		5100101 ()	GREY CLAY GRVL 0024 GREY MSND 0025
5	ASPHODEL TOWNSHIP CON 05 013	17 736865 4914473 W	1975/06 2104	6	FR 0040	15/30/8/4:0	DO		5107455 ()	BRWN GRVL HARD 0040 BRWN SAND GRVL WBRG 0043
6	ASPHODEL TOWNSHIP CON 05 014	17 737215 4915073 W	1977/02 1904	6 6	FR 0056	36/50/15/4:0	DO		5108939 ()	BRWN LOAM SNDY 0006 GRVL SNDY 0012 GREY CLAY GRVL 0024 GRVL DRY 0026 BRWN SAND 0030 BRWN CLAY GRVL 0035 GRVL DRY 0056 GRVL SILT 0057 LMSN DKCL 0063
7	ASPHODEL TOWNSHIP CON 06 016	17 737215 4916623 W	1978/11 2104	UK 0027 FR 0042 6		11/45/2/2:0	DO		5109232 ()	BLCK LOAM STNS LOOS 0002 BRWN CLAY STNS DNSE 0018 BLUE CLAY STNS DNSE 0027 GREY LMSN LYRD 0047 GREY LMSN DNSE 0047
8	ASPHODEL TOWNSHIP CON 05 014	17 737265 4915273 W	1983/04 2553	6	FR 0061	58/61/6/3:0	DO	0061 4	5110822 ()	BRWN LOAM 0001 BRWN BLDR CGVL 0065 GREY LMSN 0070

ID	Township Con Lot	UTM	Date Centr	Casing Dia	Water	Pump Test	Well Use	Screen Depth	Well	Formation
9	ASPHODEL TOWNSHIP CON 05 014	17 736984 4915209 L	1984/09 2553	6	FR 0021	4/20/8/1:10	DO		5111272 ()	BRWN LOAM SNDY 0006 BRWN FSND 0017 BRWN SHLE 0025
10	ASPHODEL TOWNSHIP CON 05 014	17 736984 4915209 L	1984/09 2553	6	FR 0040	25/35/8/2:30	DO		5111273 ()	BRWN LOAM 0001 BRWN LOAM SNDY 0006 BRWN FSND 0035 BRWN GRVL 0040
11	ASPHODEL TOWNSHIP CON 05 015	17 736766 4915767 L	1989/01 2104	6	UK 0049 UK 0050	30/45/3/2:30	DO		5113510 (50068)	BRWN STNS CLAY HARD 0025 GREY CLAY STNS HPAN 0049 BRWN SHLE MGRD 0050
12	ASPHODEL TOWNSHIP CON 05 013	17 737198 4914647 L	1989/07 6003	6	FR 0030	9/27/6/2:30	DO		5113958 (64283)	RED FSND STNS PCKD 0030
13	ASPHODEL TOWNSHIP CON 05 013	17 737198 4914647 L	1990/04 2553	6	FR 0050	30/55/12/1:45	DO		5114744 (62351)	BRWN SAND 0017 GREY HPAN 0042 GREY SHLE CLAY 0050 GREY LMSN 0060
14	ASPHODEL TOWNSHIP CON 06 014	17 738247 4915690 L	1990/02 1376	6 6	FR 0086	15/80/5/2:0	DO	0080 4	5114555 (78709)	BRWN CSND 0039 GREY LMSN ROCK 0080 GREY LMSN PORS 0086 GREY SHLE LMSN LOOS 0088
15	ASPHODEL TOWNSHIP CON 06 014	17 738247 4915690 L	1989/12 1376	6	FR 0058	5/54/3/1:0	DO	0055 4	5114656 (43854)	BRWN LOAM 0003 GREY CLAY STNS 0025 BRWN CSND SAND 0032 GREY SHLE LMSN 0052 GREY LMSN ROCK PORS 0059
16	ASPHODEL TOWNSHIP CON 06 015	17 738026 4916258 L	1990/06 4008	6	FR 0092	38/78//1:0	DO		5114951 (65284)	BRWN LOAM GRVL OBDN 0014 BRWN CLAY GRVL 0045 GREY CLAY HPAN 0081 GREY ROCK LMSN 0094
17	ASPHODEL TOWNSHIP CON 06 015	17 738026 4916258 L	1990/10 6003	6	FR 0037	20/20/8/1:30	DO		5115143 (64313)	BRWN SAND LOOS 0015 GREY GRVL SAND LOOS 0037

ID	Township Con Lot	UTM	Date Centr	Casing Dia	Water	Pump Test	Well Use	Screen Depth	Well	Formation
18	ASPHODEL TOWNSHIP CON 06 016	17 737796 4916841 L	1992/02 6398	6 6	FR 0060	25/80/0/2:0	DO		5115804 (116448)	BRWN LOAM SNDY BLDR 0032 GREY LMSN FCRD 0080
19	ASPHODEL TOWNSHIP CON 06 016	17 737796 4916841 L	1989/05 6482	36	FR 0009 FR 0015	9/13/100/:30	DO		5115900 (82076)	BRWN LOAM DNSE 0001 GREY CLAY STNS DNSE 0015
20	ASPHODEL TOWNSHIP CON 05 015	17 736766 4915767 L	1995/02 6641	6 6	FR 0020	14/20/5/1:0	DO		5116942 (144995)	BRWN LOAM 0002 CLAY BLDR 0019 GREY LMSN 0046
21	ASPHODEL TOWNSHIP CON 06 016	17 737796 4916841 L	1996/07 2104	6 6 6	FR 0021	3/16/3/3:0	DO		5117244 (163907)	BRWN CLAY STNS 0020 BRWN GRVL 0021 GREY SHLE 0024 GREY LMSN 0035
22	ASPHODEL TOWNSHIP CON 05 016	17 737079 4915966 W	2005/02 6564	6.13	52	22/59/2/1:0	DO		5120247 (Z12776) A012720	BLCK LOAM 0001 GREY CLAY STNS 0015 GREY SHLE 0017 GREY LMSN 0060
23	ASPHODEL TOWNSHIP CON 05 013	17 737017 4914490 W	2005/10 7115	5.98	FR 0063	20/60/3/2:0	DO		5120491 (Z30482) A028480	BRWN SAND 0025 GREY CLAY STNS 0043 GREY LMSN 0063
24	ASPHODEL TOWNSHIP CON 05 013	17 737075 4914624 W	2005/10 6564	6.4	FR 0048	9/16/12/1:0	DO		5120564 (Z27594) A026459	0003 SAND 0037 GREY LMSN 0049
25	ASPHODEL TOWNSHIP CON 05 015	17 737137 4916093 W	2011/09 6564	6.25 6.11	UT 0015 UT 0034	18/54/2/1:			7174442 (Z127481) A112501	BRWN CLAY STNS 0003 GREY SHLE 0012 GREY LMSN 0065

ID	Township Con Lot	UTM	Date Centr	Casing Dia	Water	Pump Test	Well Use	Screen Depth	Well	Formation
	ASPHODEL								7175297	BRWN SAND STNS PCKD 0016 GREY CLAY
	TOWNSHIP	17 737648	2011/09	6.25					(Z133102)	GRVL DNSE 0023 GREY SHLE LMSN LYRD
26	CON 05 014	4915266 W	3367	6.25	FR 0024	5/7/12/1:	DO		A113770	0031 GREY LMSN HARD 0035

TATHAM ENGINEERING

Ministry of the Environment, Conservation and Parks
Water Well Records

UTM: UTM in Zone, Easting, Northing and Datum is NAD83; L: UTM estimated from Centroid of Lot; W: UTM not from Lot Centroid
DATE CNTR: Date Work Completed and Well Contractor Licence Number
CASING DIA: Casing diameter in inches
WATER: Unit of Depth in Feet. See Table 4 for meanign of code.
PUMP TEST: Static Water Level in Feet / Water Level After Pumping in Feet / Pump Test Rate in GPM / Pump Test Duration in Hr : Min
WELL USE: See Table 3 for Meaning of Code
SCREEN: Screen Depth and Length in feet
WELL: WEL (AUDIT #) Well Tag. A: Abandonment; P: Partial Data Entry Only
FORMATION: See Table 1 and 2 for Meaning of Code

Table 1: Core Material and Descriptive Terms

BLDR BOULDERS	FCRD FRACTURED	IRFM IRON FORMATION	PORS POROUS	SOFT SOFT
BSLT BASALT	FGRD FINE-GRAINED	LIMY LIMY	PRDG PREVIOUSLY DUG	SPST SOAPSTONE
CGRD COARSE-GRAINED	FGVL FINE GRAVEL	LMSN LIMESTONE	PRDR PREV. DRILLED	STKY STICKY
CGVL COARSE GRAVEL	FILL FILL	LOAM TOPSOIL	QRTZ QUARTZITE	STNS STONES
CHRT CHERT	FLDS FELDSPAR	LOOS LOOSE	QSND QUICKSAND	STNY STONEY
CLAY CLAY	FLNT FLINT	LTCL LIGHT-COLOURED	QTZ QUARTZ	THIK THICK
CLN CLEAN	FOSS FOSILIFEROUS	LYRD LAYERED	ROCK ROCK	THIN THIN
CLYY CLAYEY	FSND FINE SAND	MARL MARL	SAND SAND	TILL TILL
CMTD CEMENTED	GNIS GNEISS	MGRD MEDIUM-GRAINED	SHLE SHALE	UNKN UNKNOWN TYPE
CONG CONGLOMERATE	GRNT GRANITE	MGVL MEDIUM GRAVEL	SHLY SHALY	VERY VERY
CRYS CRYSTALLINE	GRSN GREENSTONE	MRBL MARBLE	SHRP SHARP	WBRG WATER-BEARING
CSND COARSE SAND	GRVL GRAVEL	MSND MEDIUM SAND	SHST SCHIST	WDFR WOOD FRAGMENTS
DKCL DARK-COLOURED	GRWK GREYWACKE	MUCK MUCK	SILT SILT	WTHD WEATHERED
DLMT DOLOMITE	GVLY GRAVELLY	OBDN OVERBURDEN	SLTE SLATE	
DNSE DENSE	GYPS GYPSUM	PCKD PACKED	SLTY SILTY	
DRTY DIRTY	HARD HARD	PEAT PEAT	SNDS SANDSTONE	
DRY DRY	HPAN HARDPAN	PGVL PEA GRAVEL	SNDY SANDYOAPSTONE	

Table 2: Core Color

WHIT WHITE
GREY GREY
BLUE BLUE
GREN GREEN
YLLW YELLOW
BRWN BROWN
RED RED
BLCK BLACK
BLGY BLUE-GREY

Table 3: Well Use

DO Domestic	OT Other
ST Livestock	TH Test Hole
IR Irrigation	DE Dewatering
IN Industrial	MO Monitoring
CO Commercial	MT Monitoring TestHole
MN Municipal	
PS Public	
AC Cooling And A/C	
NU Not Used	

Table 4:Water Detail

FR Fresh	GS Gas
SA Salty	IR Iron
SU Sulphur	
MN Mineral	
UK Unknown	

Appendix B:
Borehole Logs

Tatham Engineering Ltd
645 Veterans Drive
L4N 9H8
Telephone: 7057339037

WELL NUMBER BH/MW24-1

CLIENT Drain Bros Excavating Ltd.
PROJECT NAME Sand Road Pit Expansion, Asphodel-Norwood
PROJECT NUMBER 424399
PROJECT LOCATION 3749 Highway 7 and 926 Sand Road
DATE STARTED 5/22/24 **COMPLETED** 5/22/24
GROUND ELEVATION 203.5 m **HOLE SIZE** 4.75"
DRILLING CONTRACTOR Choice Sonic Drilling Ltd.
GROUND WATER LEVELS:
DRILLING METHOD Sonic Drilling
AT TIME OF DRILLING ---
LOGGED BY NT **CHECKED BY** KG
AT END OF DRILLING ---
NOTES
AFTER DRILLING 6.11 m / Elev 197.39 m

DEPTH (m)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION		WELL DIAGRAM
					Stick Up Casing
	1		TOPSOIL: Brown, sand, trace gravel, trace organics, moist	203.05	
			0.45		
	2		SAND: Brown, sand, trace to some silt, trace gravel, moist to wet		
2					Bentonite holeplug seal
	3				
4			3.80	199.70	
	4		SAND AND GRAVEL: Brown, sand and gravel, cobbles and boulders, moist to very moist		
			Silty Sand/Fine Sand seam at 5.0 to 5.2 m		
			5.50	198.00	
6	5		SAND: Brown, sand, trace to some silt, trace gravel, moist to wet		Filter sand and 50 mm diameter slotted screen
			7.00	196.50	
	6		SAND AND GRAVEL: Brown, sand and gravel, cobbles and boulders, moist		
8			8.60	194.90	
	7		LIMESTONE		
10			10.40	193.10	
			Borehole terminated @ 10.4 m bgs		Upon completion of drilling: Cave at 8.5 m Water at 6.11 m

GENERAL BH / TP / WELL 424399 - SAND ROAD PIT BH LOGS.GPJ GINT STD CANADA LAB.GDT 6/25/25

Tatham Engineering Ltd
645 Veterans Drive
L4N 9H8
Telephone: 7057339037

WELL NUMBER BH/MW24-2

CLIENT Drain Bros Excavating Ltd.
PROJECT NAME Sand Road Pit Expansion, Asphodel-Norwood
PROJECT NUMBER 424399
PROJECT LOCATION 3749 Highway 7 and 926 Sand Road
DATE STARTED 5/22/24 **COMPLETED** 5/22/24
GROUND ELEVATION 204.6 m **HOLE SIZE** 4.75"
DRILLING CONTRACTOR Choice Sonic Drilling Ltd.
GROUND WATER LEVELS:
DRILLING METHOD Sonic Drilling
AT TIME OF DRILLING ---
LOGGED BY NT **CHECKED BY** KG
AT END OF DRILLING ---
NOTES
AFTER DRILLING 6.03 m / Elev 198.57 m

DEPTH (m)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
				Stick Up Casing
	1		TOPSOIL: Brown, sand, trace gravel, trace organics, moist	
			0.50 204.10	
			SAND AND GRAVEL: Brown, sand and gravel, cobbles and boulders, moist to wet	
2	2			
	3			
4				Bentonite holeplug seal
	4			
6				
	5			
	6			
8			First water strike at 8.5 m	
	7			Filter sand and 50 mm diameter slotted screen
10				
	8			
			11.70 192.90	
			Borehole terminated @ 11.7 m bgs	

Upon completion of drilling:
No cave
Water at 6.0 m

Tatham Engineering Ltd
645 Veterans Drive
L4N 9H8
Telephone: 7057339037

WELL NUMBER BH/MW24-3

CLIENT Drain Bros Excavating Ltd.
PROJECT NAME Sand Road Pit Expansion, Asphodel-Norwood
PROJECT NUMBER 424399
PROJECT LOCATION 3749 Highway 7 and 926 Sand Road
DATE STARTED 5/23/24 **COMPLETED** 5/23/24
GROUND ELEVATION 213.7 m **HOLE SIZE** 4.75"
DRILLING CONTRACTOR Choice Sonic Drilling Ltd.
GROUND WATER LEVELS:
DRILLING METHOD Sonic Drilling
AT TIME OF DRILLING ---
LOGGED BY NT **CHECKED BY** KG
AT END OF DRILLING ---
NOTES
AFTER DRILLING 13.13 m / Elev 200.57 m

DEPTH (m)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
				Stick Up Casing
	1		TOPSOIL: Brown, sand, trace silt, trace organics, moist	
			0.46 213.24	
			SAND: Brown, sand, trace silt, trace to some gravel to gravelly, cobbles and boulders, moist	
2	2			
	3			
4				
	4			Bentonite holeplug seal
6				
	5			
	6			
8				
	7			
10				
	8			
			11.60 202.10	Filter sand and 50 mm diameter slotted screen
12	9		SILTY SAND TILL: Brown, silty sand, trace to some gravel, trace clay, moist to wet First water strike at 12.3 m	
			13.10 200.60	
			LIMESTONE	Upon completion of drilling: No cave Water at 13.13 m
14	10			
			14.60 199.10	
			Borehole terminated @ 14.6 m bgs	

Tatham Engineering Ltd
645 Veterans Drive
L4N 9H8
Telephone: 7057339037

WELL NUMBER BH/MW24-4

CLIENT Drain Bros Excavating Ltd.
PROJECT NAME Sand Road Pit Expansion, Asphodel-Norwood
PROJECT NUMBER 424399
PROJECT LOCATION 3749 Highway 7 and 926 Sand Road
DATE STARTED 5/23/24 **COMPLETED** 5/23/24
GROUND ELEVATION 204.2 m **HOLE SIZE** 4.75"
DRILLING CONTRACTOR Choice Sonic Drilling Ltd.
GROUND WATER LEVELS:
DRILLING METHOD Sonic Drilling
AT TIME OF DRILLING ---
LOGGED BY NT **CHECKED BY** KG
AT END OF DRILLING ---
NOTES
AFTER DRILLING 1.05 m / Elev 203.15 m

DEPTH (m)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
			Stick Up Casing	
	1		0.40 TOPSOIL: Dark brown, silty clayey sand, trace organics, moist 203.80	
2	2		SILTY SAND TILL: Brown to grey, silty sand, trace to some gravel, trace to some clay with depth, cobbles and boulders, moist to wet	Bentonite holeplug seal
4	3		First water strike at 3.4 m	
6	4		6.10 198.10	Filter sand and 50 mm diameter slotted screen
	5		LIMESTONE 7.00 197.20	
			Borehole terminated @ 7.0 m bgs	

Upon completion of drilling:
No cave
Water at 1.05 m

Tatham Engineering Ltd
645 Veterans Drive
L4N 9H8
Telephone: 7057339037

WELL NUMBER BH/MW24-5

CLIENT Drain Bros Excavating Ltd.
PROJECT NAME Sand Road Pit Expansion, Asphodel-Norwood
PROJECT NUMBER 424399
PROJECT LOCATION 3749 Highway 7 and 926 Sand Road
DATE STARTED 5/23/24 **COMPLETED** 5/23/24
GROUND ELEVATION 208.1 m **HOLE SIZE** 4.75"
DRILLING CONTRACTOR Choice Sonic Drilling Ltd.
GROUND WATER LEVELS:
DRILLING METHOD Sonic Drilling
AT TIME OF DRILLING ---
LOGGED BY NT **CHECKED BY** KG
AT END OF DRILLING ---
NOTES
AFTER DRILLING 8.75 m / Elev 199.35 m

DEPTH (m)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
				Stick Up Casing
	1		0.20 TOPSOIL: Dark brown, sand, trace organics, moist 207.90	
			SAND: Brown, sand, trace silt, trace to some gravel, moist to wet	
2	2			
	3			Bentonite holeplug seal
4				
	4			
6				
	5			
	6			
8				Filter sand and 50 mm diameter slotted screen
	7		9.10 199.00 SILTY SAND TILL: Brown, sitly sand, trace to some gravel, trace clay, moist	
10			10.10 198.00	
	8		LIMESTONE	
			11.60 196.50	
			Borehole terminated @ 11.6 m bgs	Upon completion of drilling: No cave Water at 8.75 m

Tatham Engineering Ltd
645 Veterans Drive
L4N 9H8
Telephone: 7057339037

WELL NUMBER BH/MW24-6A&B

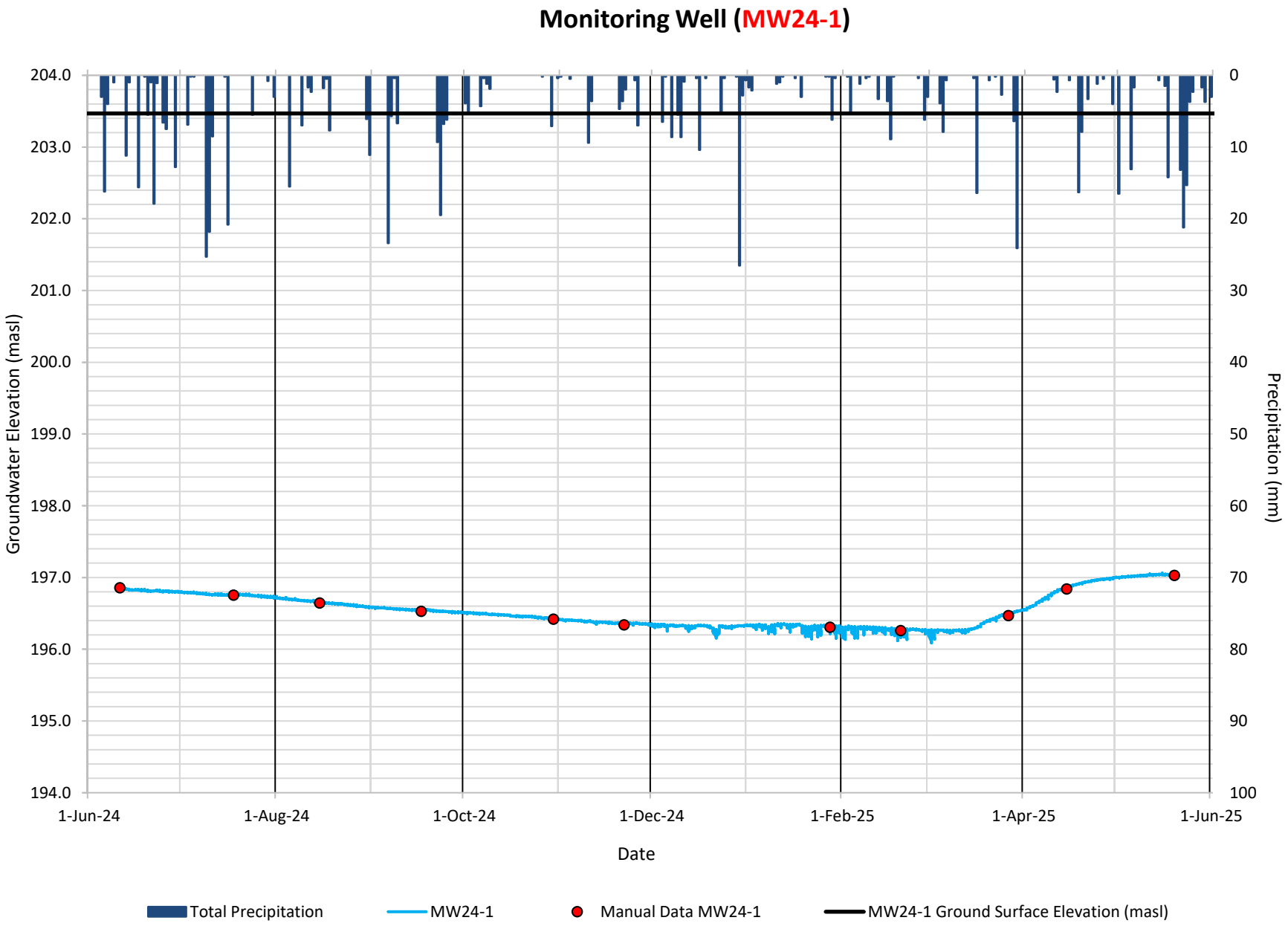
CLIENT Drain Bros Excavating Ltd.
PROJECT NAME Sand Road Pit Expansion, Asphodel-Norwood
PROJECT NUMBER 424399
PROJECT LOCATION 3749 Highway 7 and 926 Sand Road
DATE STARTED 5/22/24 **COMPLETED** 5/22/24
GROUND ELEVATION 204.5 m **HOLE SIZE** 4.75"
DRILLING CONTRACTOR Choice Sonic Drilling Ltd.
GROUND WATER LEVELS:
DRILLING METHOD Sonic Drilling
AT TIME OF DRILLING ---
LOGGED BY NT **CHECKED BY** KG
AT END OF DRILLING ---
NOTES
AFTER DRILLING 4.90 m / Elev 199.60 m(A); 4.80 / Elev 199.70 m (B)

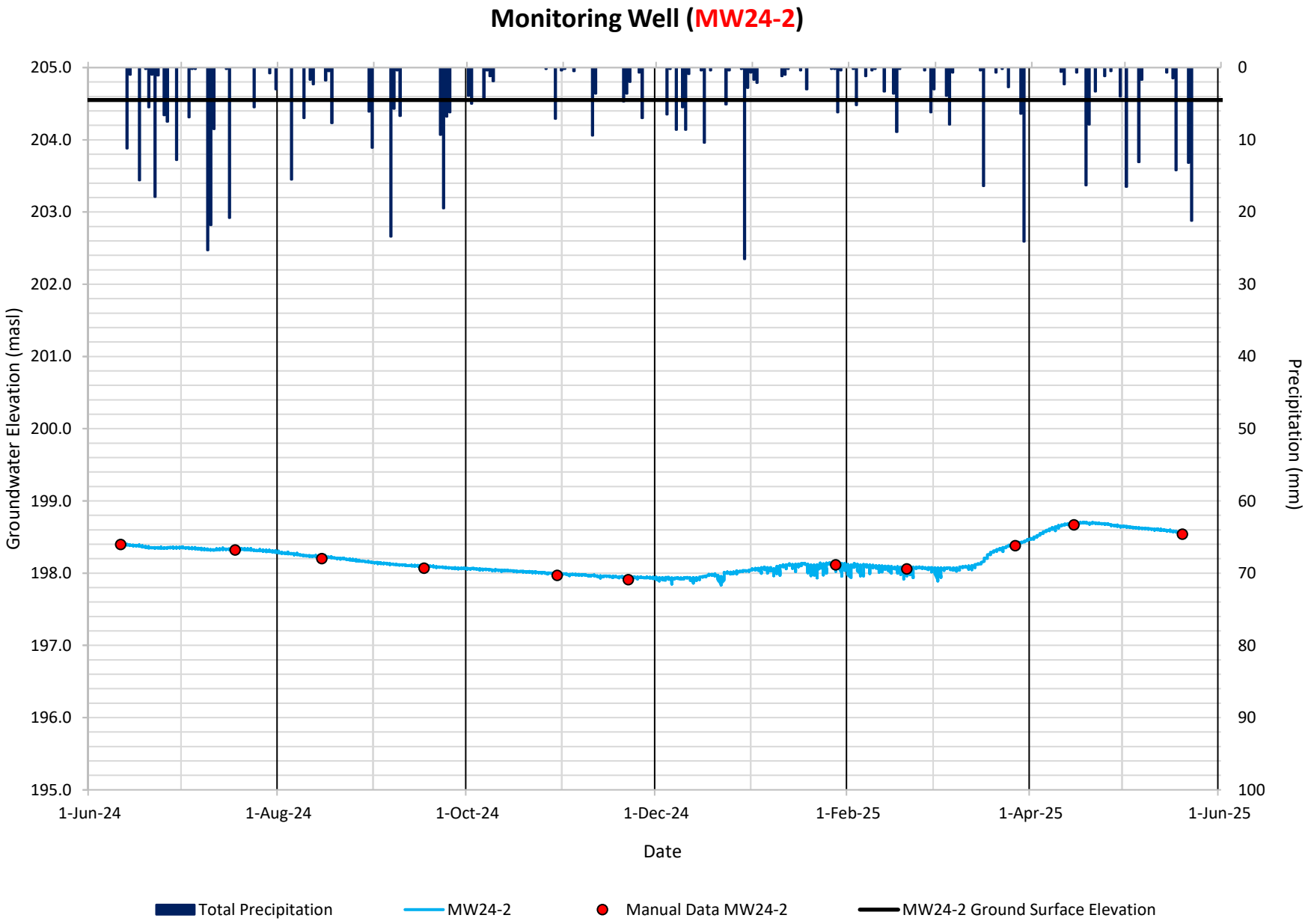
DEPTH (m)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
	1		TOPSOIL: Dark brown, sand, trace silt, trace organics, moist	Stick Up Casing
			0.76 / 203.74	Bentonite holeplug seal
2	2		SAND: Grey and brown, fine sand, moist	
			2.40 / 202.10	
4	3		SILTY SAND TILL: Brown, silty sand, trace to some gravel, trace clay, moist	
	4		5.20 / 199.30	
6	5		SAND: Brown, coarse to fine sand, trace gravel, wet	Filter sand and 50 mm slotted screens
8	6		8.50 / 196.00	

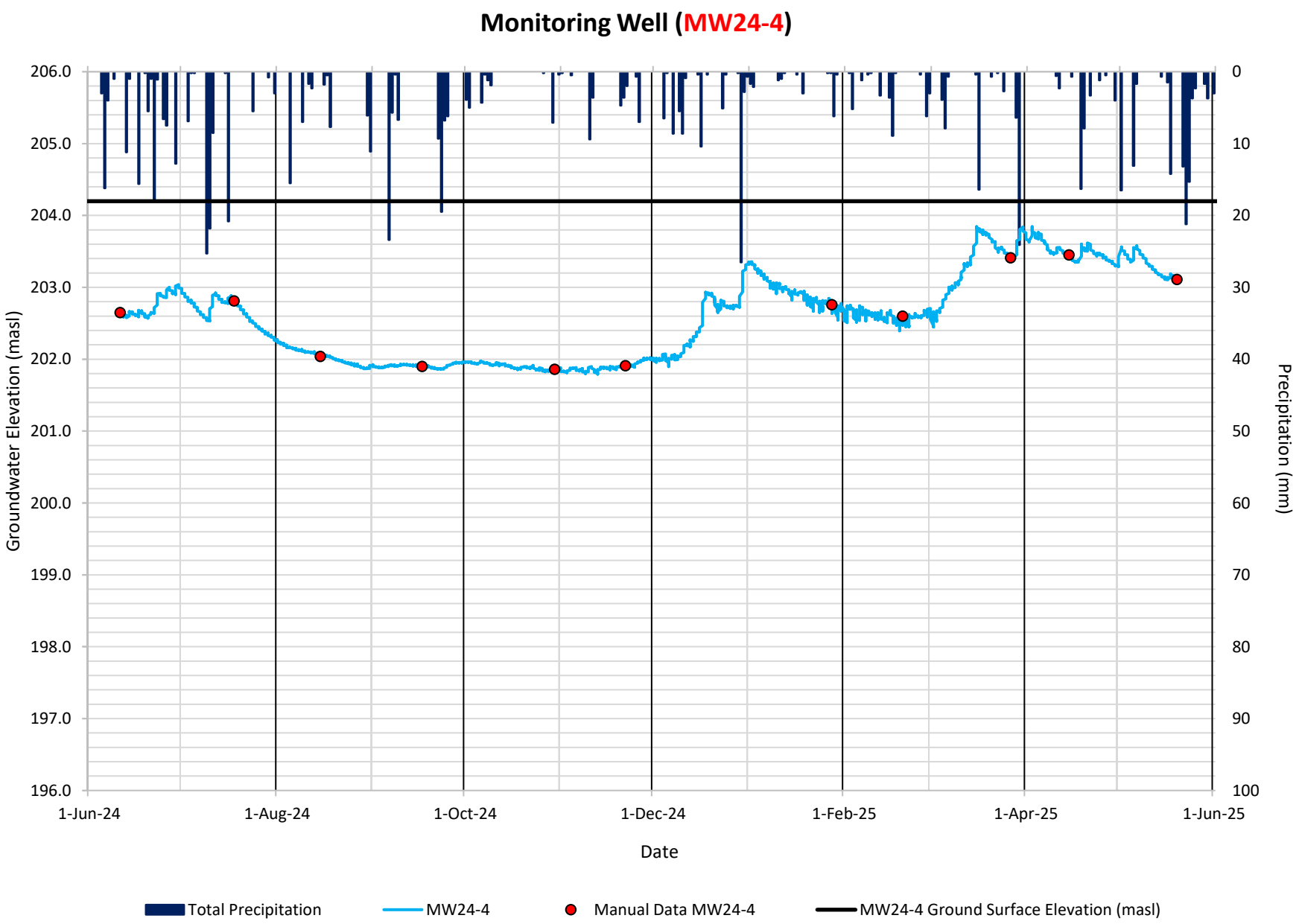
(A) Borehole terminated at 5.2 m bgs
(B) Borehole terminated at 8.5 m bgs

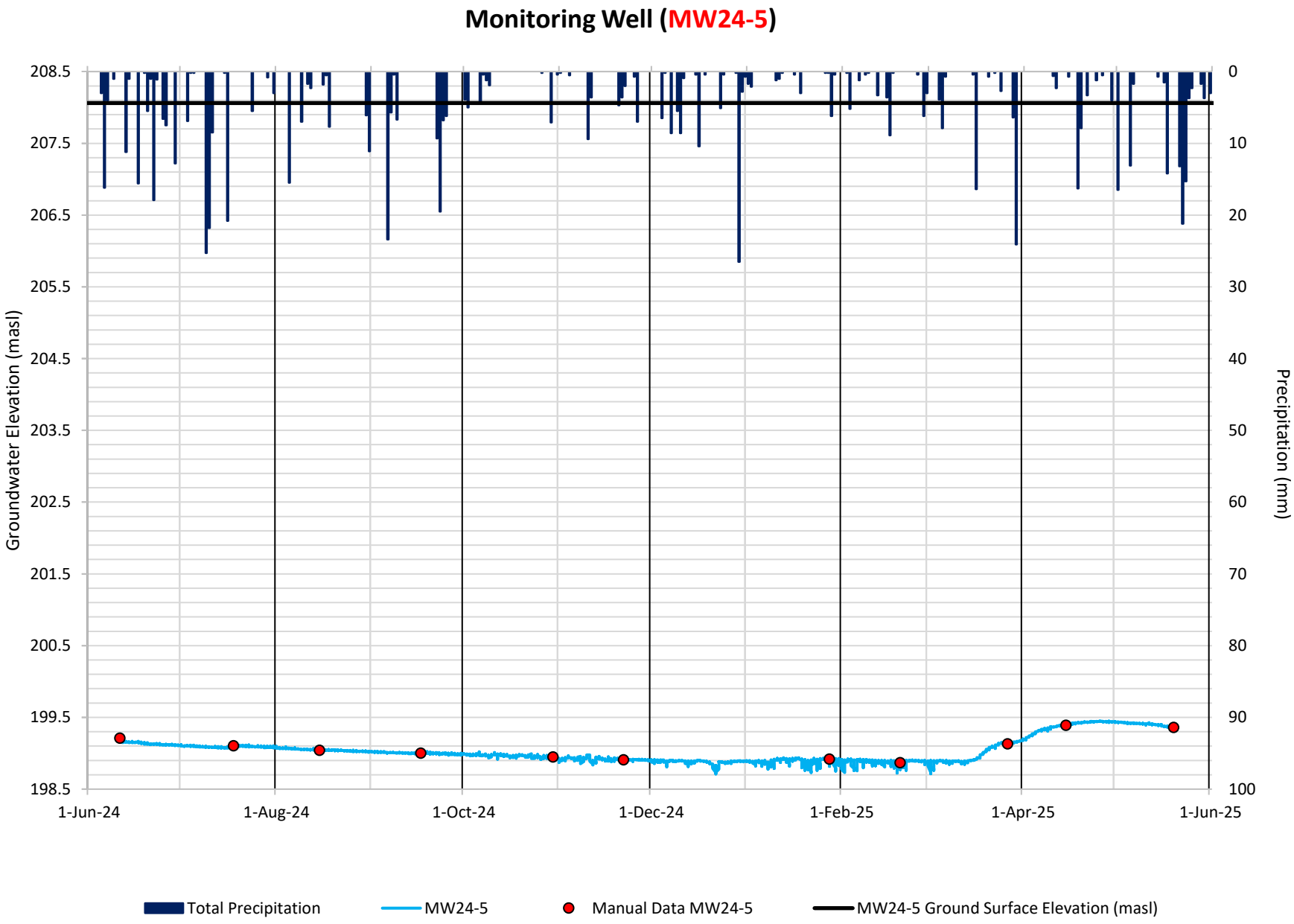
Upon completion of drilling:
No cave
Water at 4.9 m (A)
Water at 4.8 m (B)

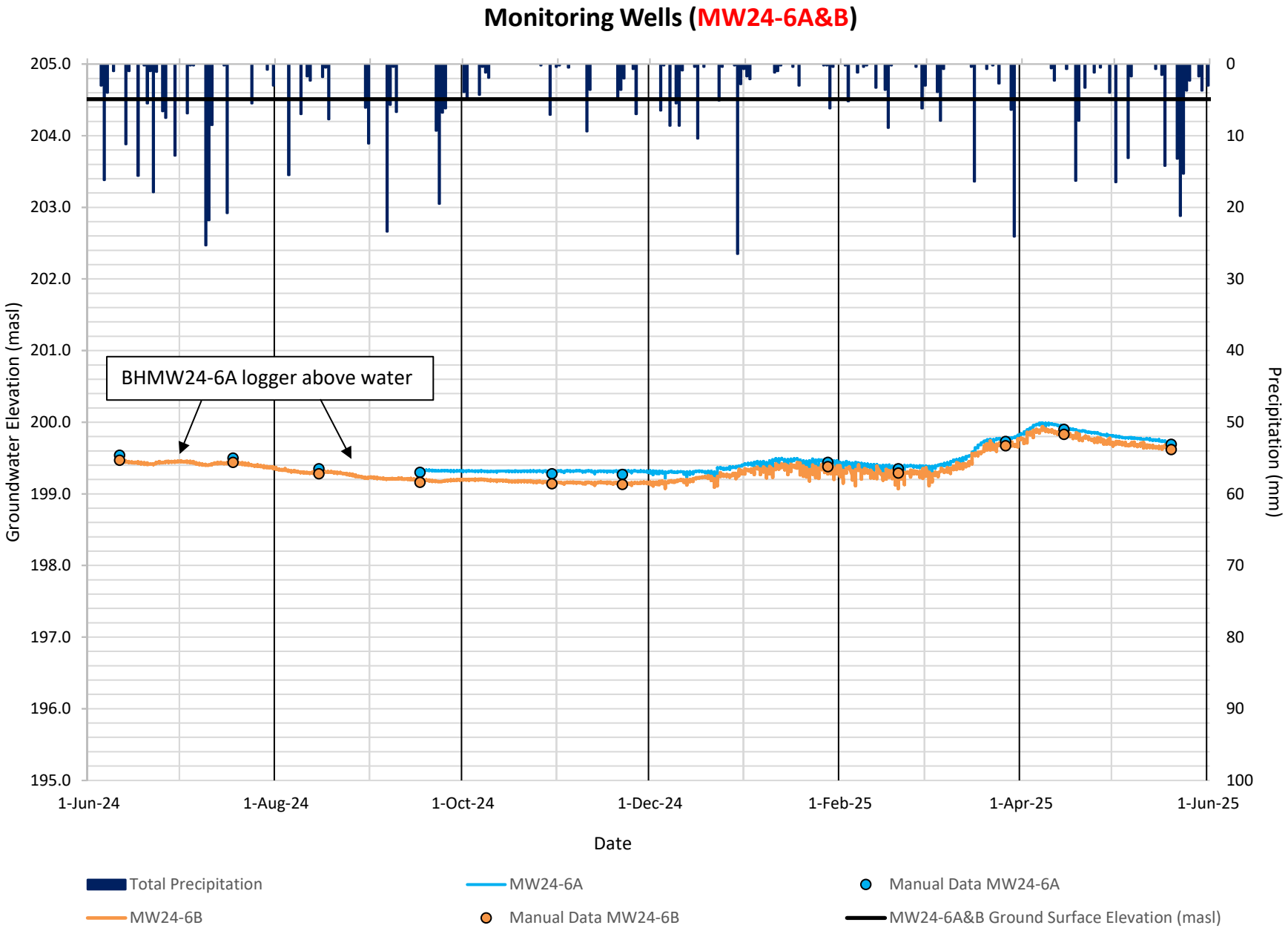
Appendix C: On-Site Monitoring Well Hydrographs


Monitoring Well (MW24-1)
Groundwater Elevation (masl)
Precipitation (mm)
204.0
203.0
202.0
201.0
200.0
199.0
198.0
197.0
196.0
195.0
194.0
0
10
20
30
40
50
60
70
80
90
100
1-Jun-24
1-Aug-24
1-Oct-24
1-Dec-24
1-Feb-25
1-Apr-25
1-Jun-25
Date
Total Precipitation
MW24-1
Manual Data MW24-1
MW24-1 Ground Surface Elevation (masl)


Monitoring Well (MW24-2)
205.0
204.0
203.0
202.0
201.0
200.0
199.0
198.0
197.0
196.0
195.0
Groundwater Elevation (masl)
0
10
20
30
40
50
60
70
80
90
100
Precipitation (mm)
1-Jun-24
1-Aug-24
1-Oct-24
1-Dec-24
1-Feb-25
1-Apr-25
1-Jun-25
Date
Total Precipitation
MW24-2
Manual Data MW24-2
MW24-2 Ground Surface Elevation


Monitoring Well (MW24-4)
206.0
205.0
204.0
203.0
202.0
201.0
200.0
199.0
198.0
197.0
196.0
Groundwater Elevation (masl)
0
10
20
30
40
50
60
70
80
90
100
Precipitation (mm)
1-Jun-24
1-Aug-24
1-Oct-24
1-Dec-24
1-Feb-25
1-Apr-25
1-Jun-25
Date
Total Precipitation
MW24-4
Manual Data MW24-4
MW24-4 Ground Surface Elevation (masl)


Monitoring Well (MW24-5)
Groundwater Elevation (masl)
Precipitation (mm)
208.5
207.5
206.5
205.5
204.5
203.5
202.5
201.5
200.5
199.5
198.5
0
10
20
30
40
50
60
70
80
90
100
1-Jun-24
1-Aug-24
1-Oct-24
1-Dec-24
1-Feb-25
1-Apr-25
1-Jun-25
Total Precipitation
MW24-5
Manual Data MW24-5
MW24-5 Ground Surface Elevation (masl)


Monitoring Wells (MW24-6A&B)
205.0
204.0
203.0
202.0
201.0
200.0
199.0
198.0
197.0
196.0
195.0
Groundwater Elevation (masl)
0
10
20
30
40
50
60
70
80
90
100
Precipitation (mm)
BHMW24-6A logger above water
1-Jun-24
1-Aug-24
1-Oct-24
1-Dec-24
1-Feb-25
1-Apr-25
1-Jun-25
Date
Total Precipitation
MW24-6A
Manual Data MW24-6A
MW24-6B
Manual Data MW24-6B
MW24-6A&B Ground Surface Elevation (masl)

Appendix D:
Groundwater Quality Results

CADUCEON ENVIRONMENTAL LABORATORIES
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CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: -

REPORT No: 24-017544 - Rev. 0

Report To:
Tatham Engineering
115 Sandford Fleming Drive
Suite 200
Collingwood, ON L9Y 5A6

Attention: Kimberly Gardner

CADUCEON Environmental Laboratories
112 Commerce Park Dr Unit L
Barrie, ON L4N 8W8

DATE RECEIVED: 2024-Jun-13
DATE REPORTED: 2024-Jun-18
SAMPLE MATRIX: Ground Water

CUSTOMER PROJECT: 424399 - Sand Rd Pit
P.O. NUMBER:

Analyses	Qty	Site Analyzed	Authorized	Date Analyzed	Lab Method	Reference Method
Anions (Liquid)	5	OTTAWA	PCURIEL	2024-Jun-14	A-IC-01	SM 4110B
Cond/pH/Alk Auto (Liquid)	5	OTTAWA	SLOZO	2024-Jun-17	COND-02/PH-02/ALK-02	SM 2510B/4500H/2320B
ICP/MS (Liquid)	5	OTTAWA	AOZKAYMAK	2024-Jun-17	D-ICPMS-01	EPA 200.8
ICP/OES (Liquid)	5	OTTAWA	APRUDYVUS	2024-Jun-17	D-ICP-01	SM 3120B

R.L. = Reporting Limit
NC = Not Calculated
Test methods may be modified from specified reference method unless indicated by an *

Michelle Dubien
Data Specialist

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Parameter	Units	R.L.	Limits	DWG	Client I.D.	MW 24-1	MW 24-2	MW 24-4	MW 24-5
					Sample I.D.	24-017544-1	24-017544-2	24-017544-3	24-017544-4
					Date Collected	2024-Jun-12	2024-Jun-12	2024-Jun-12	2024-Jun-12
						-	-	-	-
Alkalinity(CaCO3) to pH4.5	mg/L	5	500	OG		172	238	229	189
Bicarbonate (as CaCO3)	mg/L	5				172	238	229	189
Conductivity @25°C	uS/cm	1				410	732	463	370
pH @25°C	pH units	-	8.5	OG		7.39	7.46	7.51	7.69
Chloride	mg/L	0.5	250	AO		10.8	27.3	1.0	1.8
Nitrate (N)	mg/L	0.05	10.0	MAC		<0.05	13.1	0.07	0.12
Nitrite (N)	mg/L	0.05	1.0	MAC		<0.05	<0.05	<0.05	<0.05
Sulphate	mg/L	1	500	AO		21	48	9	6
Hardness (as CaCO3)	mg/L as CaCO3	0.02	100	OG		150	360	234	172
Aluminum	mg/L	0.01	0.1	OG		0.03	0.04	0.03	0.03
Barium	mg/L	0.001	1	MAC		0.031	0.059	0.025	0.042
Bismuth	mg/L	0.02				<0.02	<0.02	<0.02	<0.02
Boron	mg/L	0.005	5	MAC		0.087	0.010	0.008	0.009
Calcium	mg/L	0.02				48.0	125	88.1	63.8
Iron	mg/L	0.005	0.3	AO		<0.005	0.065	<0.005	<0.005
Lithium	mg/L	0.005				<0.005	<0.005	<0.005	<0.005
Magnesium	mg/L	0.02				7.29	11.6	3.40	2.95
Manganese	mg/L	0.001	0.05	AO		0.080	0.107	0.045	0.017
Phosphorus	mg/L	0.1				<0.1	<0.1	<0.1	<0.1
Potassium	mg/L	0.1				2.8	1.3	0.5	0.9
Silicon	mg/L	0.01				3.95	2.96	3.35	3.32



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Data Specialist

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Parameter	Units	R.L.	Limits	DWG	Client I.D.	MW 24-1	MW 24-2	MW 24-4	MW 24-5
					Sample I.D.	24-017544-1	24-017544-2	24-017544-3	24-017544-4
					Date Collected	2024-Jun-12	2024-Jun-12	2024-Jun-12	2024-Jun-12
						-	-	-	-
Silica	mg/L	0.02				8.46	6.34	7.16	7.09
Sodium	mg/L	0.2	200, 20, 20	AO, WL, MAC		27.9	18.3	2.3	1.6
Strontium	mg/L	0.001				0.223	0.263	0.157	0.116
Tin	mg/L	0.05				<0.05	<0.05	<0.05	<0.05
Titanium	mg/L	0.005				<0.005	<0.005	<0.005	<0.005
Tungsten	mg/L	0.01				<0.01	<0.01	<0.01	0.20
Yttrium	mg/L	0.005				<0.005	<0.005	<0.005	<0.005
Zinc	mg/L	0.005	5	AO		<0.005	<0.005	<0.005	<0.005
Zirconium	mg/L	0.003				<0.003	<0.003	<0.003	<0.003
Antimony	mg/L	0.0001	0.006	MAC		0.0002	<0.0001	<0.0001	<0.0001
Arsenic	mg/L	0.0001	0.01	MAC		0.0004	0.0002	0.0002	0.0001
Beryllium	mg/L	0.0001				<0.0001	<0.0001	<0.0001	<0.0001
Cadmium	mg/L	0.000015	0.005	MAC		0.000048	<0.000015	<0.000015	<0.000015
Chromium	mg/L	0.001	0.05	MAC		<0.001	<0.001	<0.001	<0.001
Cobalt	mg/L	0.0001				0.0005	0.0009	0.0008	0.0006
Copper	mg/L	0.0001	1	AO		0.0046	0.0036	0.0053	0.0053
Lead	mg/L	0.00002	0.010	MAC		0.00005	0.00003	0.00005	0.00005
Molybdenum	mg/L	0.0001				0.0432	0.0004	0.0004	0.0005
Nickel	mg/L	0.0002				0.0016	0.0015	0.0017	0.0015
Selenium	mg/L	0.001	0.05	MAC		<0.001	<0.001	<0.001	<0.001
Silver	mg/L	0.0001				<0.0001	<0.0001	<0.0001	<0.0001

Michelle Dubien
Data Specialist

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Parameter	Units	R.L.	Limits	DWG	Client I.D.	MW 24-1	MW 24-2	MW 24-4	MW 24-5
					Sample I.D.	24-017544-1	24-017544-2	24-017544-3	24-017544-4
					Date Collected	2024-Jun-12	2024-Jun-12	2024-Jun-12	2024-Jun-12
						-	-	-	-
Thallium	mg/L	0.00005				<0.00005	<0.00005	<0.00005	<0.00005
Uranium	mg/L	0.00005	0.02	MAC		0.00037	0.00074	0.00032	0.00017
Vanadium	mg/L	0.0001				0.0002	0.0002	<0.0001	0.0001

Michelle Dubien
Data Specialist

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Parameter	Units	R.L.	Limits	DWG	Client I.D.: MW 24-6B Sample I.D.: 24-017544-5 Date Collected: 2024-Jun-12
					-
Alkalinity(CaCO3) to pH4.5	mg/L	5	500	OG	233
Bicarbonate (as CaCO3)	mg/L	5			233
Conductivity @25°C	uS/cm	1			456
pH @25°C	pH units	-	8.5	OG	7.59
Chloride	mg/L	0.5	250	AO	2.5
Nitrate (N)	mg/L	0.05	10.0	MAC	0.10
Nitrite (N)	mg/L	0.05	1.0	MAC	<0.05
Sulphate	mg/L	1	500	AO	4
Hardness (as CaCO3)	mg/L as CaCO3	0.02	100	OG	230
Aluminum	mg/L	0.01	0.1	OG	0.03
Barium	mg/L	0.001	1	MAC	0.053
Bismuth	mg/L	0.02			<0.02
Boron	mg/L	0.005	5	MAC	<0.005
Calcium	mg/L	0.02			86.2
Iron	mg/L	0.005	0.3	AO	<0.005
Lithium	mg/L	0.005			<0.005
Magnesium	mg/L	0.02			3.51
Manganese	mg/L	0.001	0.05	AO	0.020
Phosphorus	mg/L	0.1			<0.1
Potassium	mg/L	0.1			0.6
Silicon	mg/L	0.01			3.86

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Data Specialist

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Parameter	Units	R.L.	Limits	DWG	Client I.D.: MW 24-6B Sample I.D.: 24-017544-5 Date Collected: 2024-Jun-12
					-
Silica	mg/L	0.02			8.26
Sodium	mg/L	0.2	200, 20, 20	AO, WL, MAC	4.6
Strontium	mg/L	0.001			0.144
Tin	mg/L	0.05			<0.05
Titanium	mg/L	0.005			<0.005
Tungsten	mg/L	0.01			<0.01
Yttrium	mg/L	0.005			<0.005
Zinc	mg/L	0.005	5	AO	<0.005
Zirconium	mg/L	0.003			<0.003
Antimony	mg/L	0.0001	0.006	MAC	<0.0001
Arsenic	mg/L	0.0001	0.01	MAC	0.0002
Beryllium	mg/L	0.0001			<0.0001
Cadmium	mg/L	0.000015	0.005	MAC	<0.000015
Chromium	mg/L	0.001	0.05	MAC	<0.001
Cobalt	mg/L	0.0001			0.0003
Copper	mg/L	0.0001	1	AO	0.0051
Lead	mg/L	0.00002	0.010	MAC	0.00004
Molybdenum	mg/L	0.0001			0.0011
Nickel	mg/L	0.0002			0.0015
Selenium	mg/L	0.001	0.05	MAC	<0.001
Silver	mg/L	0.0001			<0.0001

Michelle Dubien
Data Specialist

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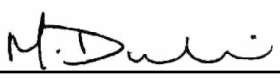
Parameter	Units	R.L.	Limits	DWG	Client I.D.	MW 24-6B
					Sample I.D.	24-017544-5
					Date Collected	2024-Jun-12
Thallium	mg/L	0.00005			-	<0.00005
Uranium	mg/L	0.00005	0.02	MAC		0.00047
Vanadium	mg/L	0.0001				0.0003

DWG - Drinking Water Guidelines
ODWS - Ontario Drinking Water Standards
AO - Aesthetic Objectives
IMAC - Interim Maximum Acceptable Concentration
MAC - Maximum Acceptable Concentration
ODWO - D-5-5 Objective
OG - Operational Guidelines
WL - Warning Level - Sodium Restricted Diets

Michelle Dubien
Data Specialist

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Summary of Exceedances		
Aesthetic Objectives		
MW 24-1	**Found Value**	**Limit**
Manganese	0.080	0.05
MW 24-2	**Found Value**	**Limit**
Manganese	0.107	0.05
Maximum Acceptable Concentration		
MW 24-1	**Found Value**	**Limit**
Sodium	27.9	20
MW 24-2	**Found Value**	**Limit**
Nitrate (N)	13.1	10.0
Operational Guidelines		
MW 24-1	**Found Value**	**Limit**
Hardness (as CaCO3)	150	100
MW 24-2	**Found Value**	**Limit**
Hardness (as CaCO3)	360	100
MW 24-4	**Found Value**	**Limit**
Hardness (as CaCO3)	234	100
MW 24-5	**Found Value**	**Limit**
Hardness (as CaCO3)	172	100
MW 24-6B	**Found Value**	**Limit**
Hardness (as CaCO3)	230	100
Warning Level - Sodium Restricted Diets		
MW 24-1	**Found Value**	**Limit**
Sodium	27.9	20



Michelle Dubien
Data Specialist

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CADUCEON ENVIRONMENTAL LABORATORIES
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CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: -

REPORT No: 24-034174 - Rev. 0

Report To:
Tatham Engineering
115 Sandford Fleming Drive
Suite 200
Collingwood, ON L9Y 5A6

Attention: Kimberly Gardner

CADUCEON Environmental Laboratories
112 Commerce Park Dr Unit L
Barrie, ON L4N 8W8

DATE RECEIVED: 2024-Oct-31
DATE REPORTED: 2024-Nov-05
SAMPLE MATRIX: Ground Water

CUSTOMER PROJECT: 424399 - Sand Rd Pit
P.O. NUMBER:

Analyses	Qty	Site Analyzed	Authorized	Date Analyzed	Lab Method	Reference Method
Anions (Liquid)	5	OTTAWA	PCURIEL	2024-Nov-01	A-IC-01	SM 4110B
Cond/pH/Alk Auto (Liquid)	5	OTTAWA	SBOUDREAU	2024-Nov-01	COND-02/PH-02/ALK-02	SM 2510B/4500H/2320B
ICP/MS (Liquid)	5	OTTAWA	AOZKAYMAK	2024-Nov-04	D-ICPMS-01	EPA 200.8
ICP/OES (Liquid)	5	OTTAWA	APRUDYVUS	2024-Nov-04	D-ICP-01	SM 3120B

R.L. = Reporting Limit
NC = Not Calculated
Test methods may be modified from specified reference method unless indicated by an *

Michelle Dubien
Data Specialist

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Final Report

REPORT No: 24-034174 - Rev. 0

Parameter	Units	R.L.	Limits	DWG	Client I.D.	MW 24-1	MW 24-2	MW 24-4	MW 24-5
					Sample I.D.	24-034174-1	24-034174-2	24-034174-3	24-034174-4
					Date Collected	2024-Oct-30	2024-Oct-30	2024-Oct-30	2024-Oct-30
						-	-	-	-
Alkalinity(CaCO3) to pH4.5	mg/L	5	500	OG		233	250	238	191
Bicarbonate (as CaCO3)	mg/L	5				233	250	238	191
Conductivity @25°C	uS/cm	1				464	648	459	352
pH @25°C	pH units	-	8.5	OG		8.00	7.93	7.98	7.98
Chloride	mg/L	0.5	250	AO		7.9	25.3	0.9	1.2
Nitrate (N)	mg/L	0.05	10.0	MAC		0.32	8.36	0.06	0.11
Nitrite (N)	mg/L	0.05	1.0	MAC		<0.05	0.11	<0.05	<0.05
Sulphate	mg/L	1	500	AO		8	35	17	4
Hardness (as CaCO3)	mg/L as CaCO3	0.02	100	OG		252	314	238	191
Aluminum	mg/L	0.01	0.1	OG		0.02	0.05	0.03	0.03
Barium	mg/L	0.001	1	MAC		0.043	0.045	0.031	0.026
Bismuth	mg/L	0.02				<0.02	<0.02	<0.02	<0.02
Boron	mg/L	0.005	5	MAC		0.029	0.010	0.010	0.010
Calcium	mg/L	0.02				86.8	105	89.3	71.5
Iron	mg/L	0.005	0.3	AO		0.017	0.209	0.078	<0.005
Lithium	mg/L	0.005				<0.005	<0.005	<0.005	<0.005
Magnesium	mg/L	0.02				8.50	12.3	3.62	2.94
Manganese	mg/L	0.001	0.05	AO		0.059	0.037	0.047	0.004
Phosphorus	mg/L	0.1				<0.1	<0.1	<0.1	<0.1
Potassium	mg/L	0.1				1.6	1.8	0.7	0.6
Silicon	mg/L	0.01				4.24	2.99	3.45	2.90

Michelle Dubien
Data Specialist

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Final Report

REPORT No: 24-034174 - Rev. 0

Parameter	Units	R.L.	Limits	DWG	Client I.D.	MW 24-1	MW 24-2	MW 24-4	MW 24-5
					Sample I.D.	24-034174-1	24-034174-2	24-034174-3	24-034174-4
					Date Collected	2024-Oct-30	2024-Oct-30	2024-Oct-30	2024-Oct-30
						-	-	-	-
Silica	mg/L	0.02				9.07	6.41	7.38	6.20
Sodium	mg/L	0.2	200, 20, 20	AO, WL, MAC		3.3	14.6	2.8	1.3
Strontium	mg/L	0.001				0.246	0.241	0.173	0.114
Tin	mg/L	0.05				<0.05	<0.05	<0.05	<0.05
Titanium	mg/L	0.005				<0.005	<0.005	<0.005	<0.005
Tungsten	mg/L	0.01				<0.01	<0.01	<0.01	<0.01
Yttrium	mg/L	0.005				<0.005	<0.005	<0.005	<0.005
Zinc	mg/L	0.005	5	AO		<0.005	<0.005	<0.005	<0.005
Zirconium	mg/L	0.003				<0.003	<0.003	<0.003	<0.003
Antimony	mg/L	0.0001	0.006	MAC		<0.0001	<0.0001	<0.0001	<0.0001
Arsenic	mg/L	0.0001	0.01	MAC		0.0003	0.0002	0.0005	0.0001
Beryllium	mg/L	0.0001				<0.0001	<0.0001	<0.0001	<0.0001
Cadmium	mg/L	0.000015	0.005	MAC		<0.000015	<0.000015	<0.000015	<0.000015
Chromium	mg/L	0.001	0.05	MAC		<0.001	<0.001	<0.001	<0.001
Cobalt	mg/L	0.0001				0.0005	0.0004	0.0004	0.0001
Copper	mg/L	0.0001	1	AO		0.0006	0.0017	<0.0001	0.0003
Lead	mg/L	0.00002	0.010	MAC		<0.00002	0.00007	<0.00002	<0.00002
Molybdenum	mg/L	0.0001				0.0062	0.0001	0.0005	0.0002
Nickel	mg/L	0.0002				0.0016	0.0007	0.0010	0.0006
Selenium	mg/L	0.001	0.05	MAC		<0.001	<0.001	<0.001	<0.001
Silver	mg/L	0.0001				<0.0001	<0.0001	<0.0001	<0.0001

Michelle Dubien
Data Specialist

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Final Report

REPORT No: 24-034174 - Rev. 0

				Client I.D.	MW 24-1	MW 24-2	MW 24-4	MW 24-5
				Sample I.D.	24-034174-1	24-034174-2	24-034174-3	24-034174-4
				Date Collected	2024-Oct-30	2024-Oct-30	2024-Oct-30	2024-Oct-30
Parameter	**Units**	**R.L.**	**Limits**	**DWG**	-	-	-	-
Thallium	mg/L	0.00005			<0.00005	<0.00005	<0.00005	<0.00005
Uranium	mg/L	0.00005	0.02	MAC	0.00037	0.00044	0.00036	0.00012
Vanadium	mg/L	0.0001			0.0003	0.0002	0.0002	0.0002

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Data Specialist

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Parameter	Units	R.L.	Limits	DWG	Client I.D.: MW 24-6B Sample I.D.: 24-034174-5 Date Collected: 2024-Oct-30
					-
Alkalinity(CaCO3) to pH4.5	mg/L	5	500	OG	261
Bicarbonate (as CaCO3)	mg/L	5			261
Conductivity @25°C	uS/cm	1			541
pH @25°C	pH units	-	8.5	OG	8.00
Chloride	mg/L	0.5	250	AO	19.6
Nitrate (N)	mg/L	0.05	10.0	MAC	0.15
Nitrite (N)	mg/L	0.05	1.0	MAC	<0.05
Sulphate	mg/L	1	500	AO	5
Hardness (as CaCO3)	mg/L as CaCO3	0.02	100	OG	**285**
Aluminum	mg/L	0.01	0.1	OG	**0.18**
Barium	mg/L	0.001	1	MAC	0.055
Bismuth	mg/L	0.02			<0.02
Boron	mg/L	0.005	5	MAC	0.008
Calcium	mg/L	0.02			106
Iron	mg/L	0.005	0.3	AO	0.268
Lithium	mg/L	0.005			<0.005
Magnesium	mg/L	0.02			4.92
Manganese	mg/L	0.001	0.05	AO	**0.124**
Phosphorus	mg/L	0.1			<0.1
Potassium	mg/L	0.1			1.0
Silicon	mg/L	0.01			3.90

Michelle Dubien
Data Specialist

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Parameter	Units	R.L.	Limits	DWG	Client I.D.: MW 24-6B Sample I.D.: 24-034174-5 Date Collected: 2024-Oct-30
					-
Silica	mg/L	0.02			8.35
Sodium	mg/L	0.2	200, 20, 20	AO, WL, MAC	14.1
Strontium	mg/L	0.001			0.204
Tin	mg/L	0.05			<0.05
Titanium	mg/L	0.005			<0.005
Tungsten	mg/L	0.01			<0.01
Yttrium	mg/L	0.005			<0.005
Zinc	mg/L	0.005	5	AO	<0.005
Zirconium	mg/L	0.003			<0.003
Antimony	mg/L	0.0001	0.006	MAC	<0.0001
Arsenic	mg/L	0.0001	0.01	MAC	0.0006
Beryllium	mg/L	0.0001			<0.0001
Cadmium	mg/L	0.000015	0.005	MAC	<0.000015
Chromium	mg/L	0.001	0.05	MAC	<0.001
Cobalt	mg/L	0.0001			0.0007
Copper	mg/L	0.0001	1	AO	0.0015
Lead	mg/L	0.00002	0.010	MAC	0.00037
Molybdenum	mg/L	0.0001			0.0011
Nickel	mg/L	0.0002			0.0017
Selenium	mg/L	0.001	0.05	MAC	<0.001
Silver	mg/L	0.0001			<0.0001

Michelle Dubien
Data Specialist

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Parameter	Units	R.L.	Limits	DWG	Client I.D.	MW 24-6B
					Sample I.D.	24-034174-5
					Date Collected	2024-Oct-30
Thallium	mg/L	0.00005			-	<0.00005
Uranium	mg/L	0.00005	0.02	MAC		0.00052
Vanadium	mg/L	0.0001				0.0013

DWG - Drinking Water Guidelines
ODWS - Ontario Drinking Water Standards
AO - Aesthetic Objectives
IMAC - Interim Maximum Acceptable Concentration
MAC - Maximum Acceptable Concentration
ODWO - D-5-5 Objective
OG - Operational Guidelines
WL - Warning Level - Sodium Restricted Diets

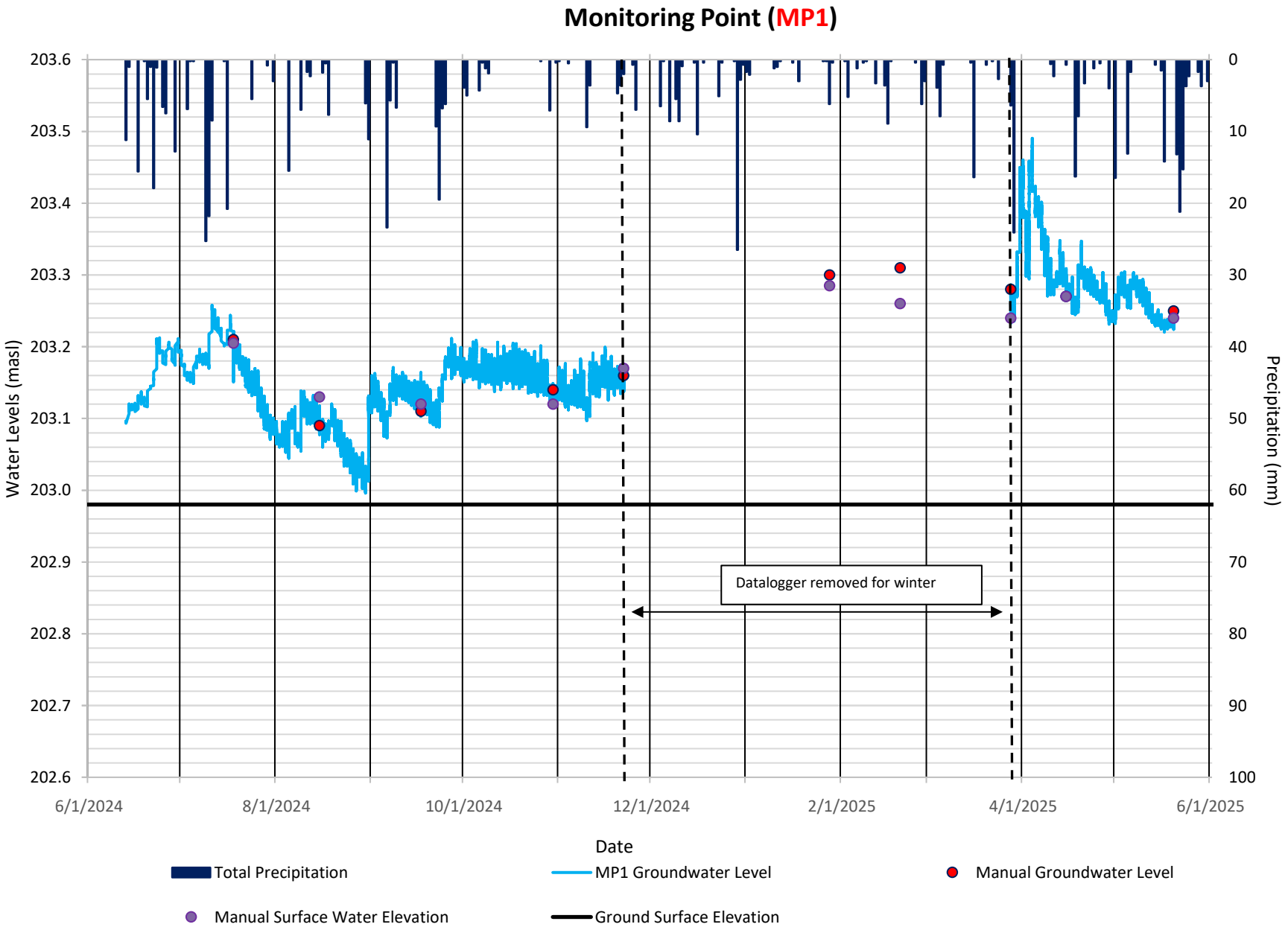
Summary of Exceedances

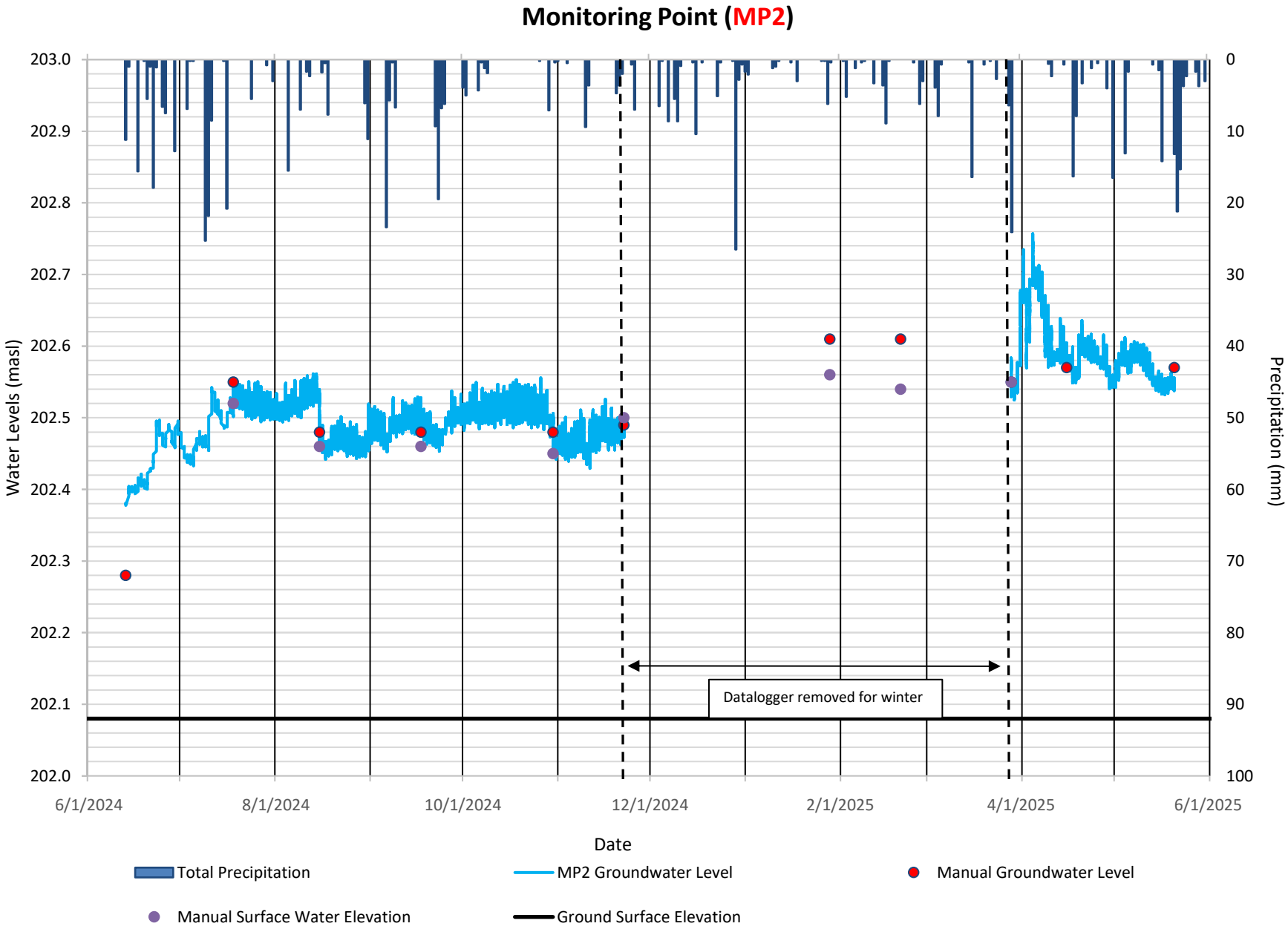
Aesthetic Objectives		
MW 24-1	**Found Value**	**Limit**
Manganese	0.059	0.05
MW 24-6B	**Found Value**	**Limit**
Manganese	0.124	0.05
Operational Guidelines		
MW 24-1	**Found Value**	**Limit**
Hardness (as CaCO3)	252	100
MW 24-2	**Found Value**	**Limit**
Hardness (as CaCO3)	314	100
MW 24-4	**Found Value**	**Limit**
Hardness (as CaCO3)	238	100
MW 24-5	**Found Value**	**Limit**
Hardness (as CaCO3)	191	100
MW 24-6B	**Found Value**	**Limit**
Hardness (as CaCO3)	285	100
Aluminum	0.18	0.1

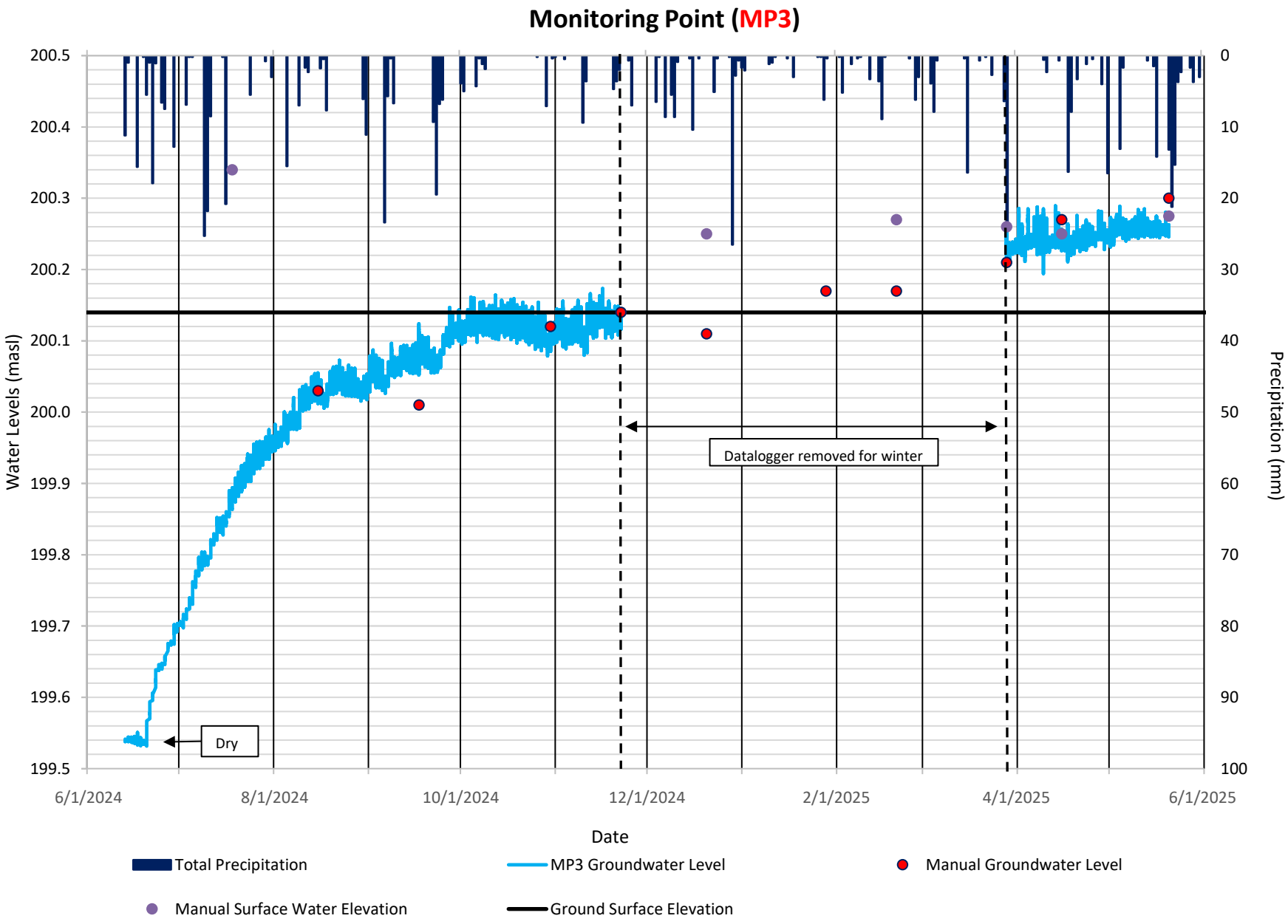
Michelle Dubien
Data Specialist

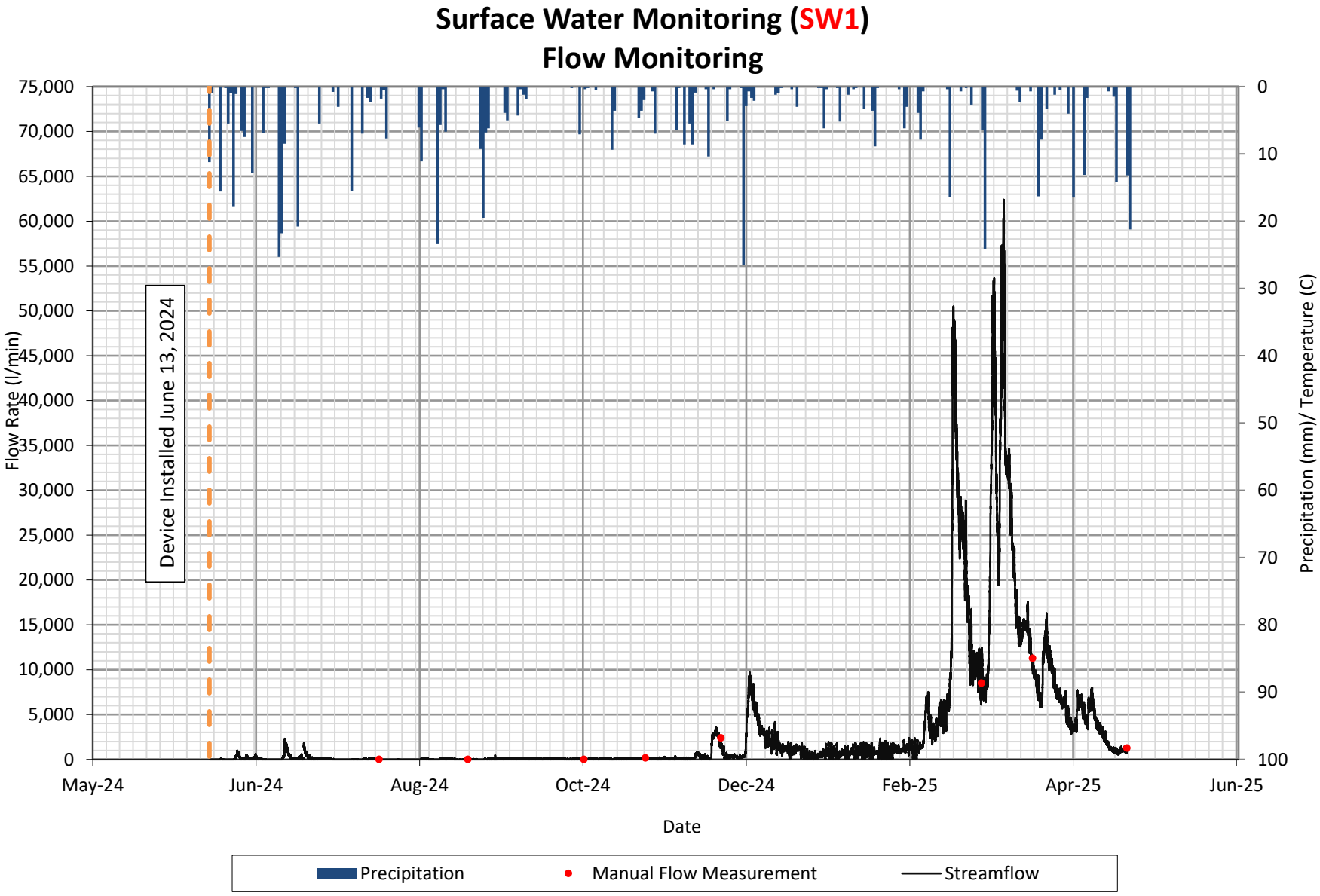
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Appendix E: Wetland and Surface Water Hydrographs and Ratings Curve

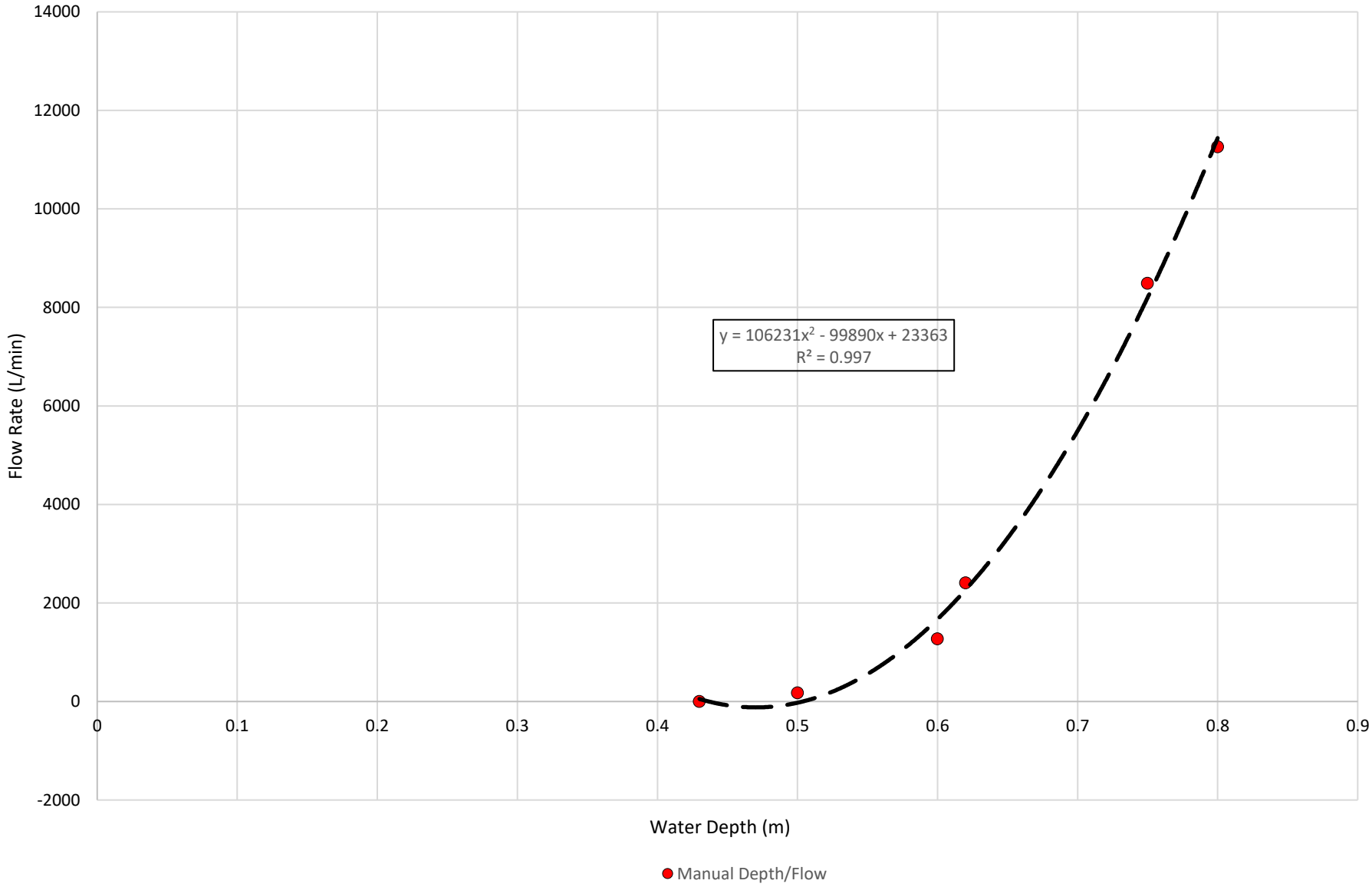

Monitoring Point (MP1)
Water Levels (masl)
Precipitation (mm)
203.6
203.5
203.4
203.3
203.2
203.1
203.0
202.9
202.8
202.7
202.6
0
10
20
30
40
50
60
70
80
90
100
6/1/2024
8/1/2024
10/1/2024
12/1/2024
2/1/2025
4/1/2025
6/1/2025
Datalogger removed for winter
Date
Total Precipitation
MP1 Groundwater Level
Manual Groundwater Level
Manual Surface Water Elevation
Ground Surface Elevation

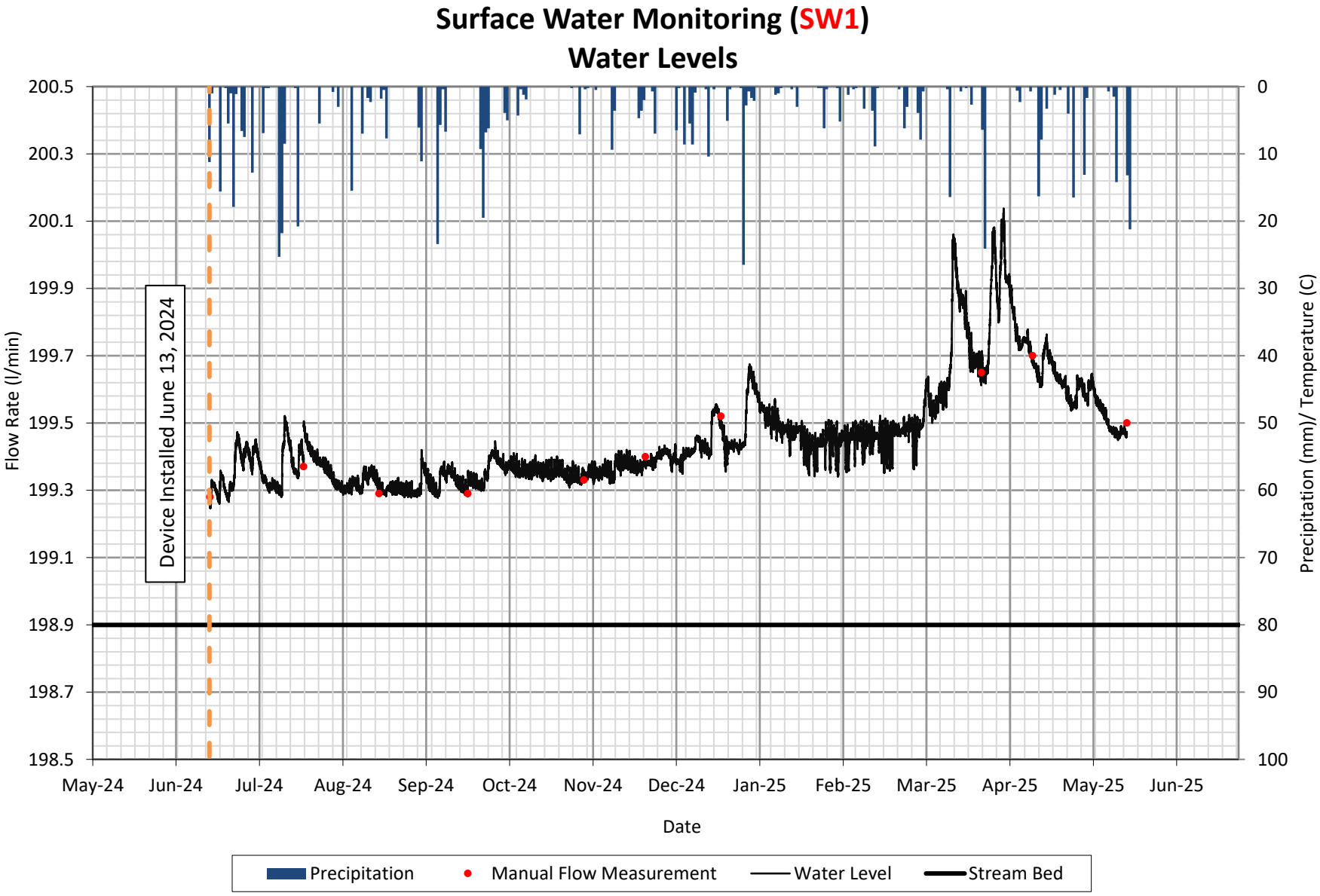

Monitoring Point (MP2)
Water Levels (masl)
Precipitation (mm)
203.0
202.9
202.8
202.7
202.6
202.5
202.4
202.3
202.2
202.1
202.0
0
10
20
30
40
50
60
70
80
90
100
6/1/2024
8/1/2024
10/1/2024
12/1/2024
2/1/2025
4/1/2025
6/1/2025
Date
Datalogger removed for winter
Total Precipitation
MP2 Groundwater Level
Manual Groundwater Level
Manual Surface Water Elevation
Ground Surface Elevation

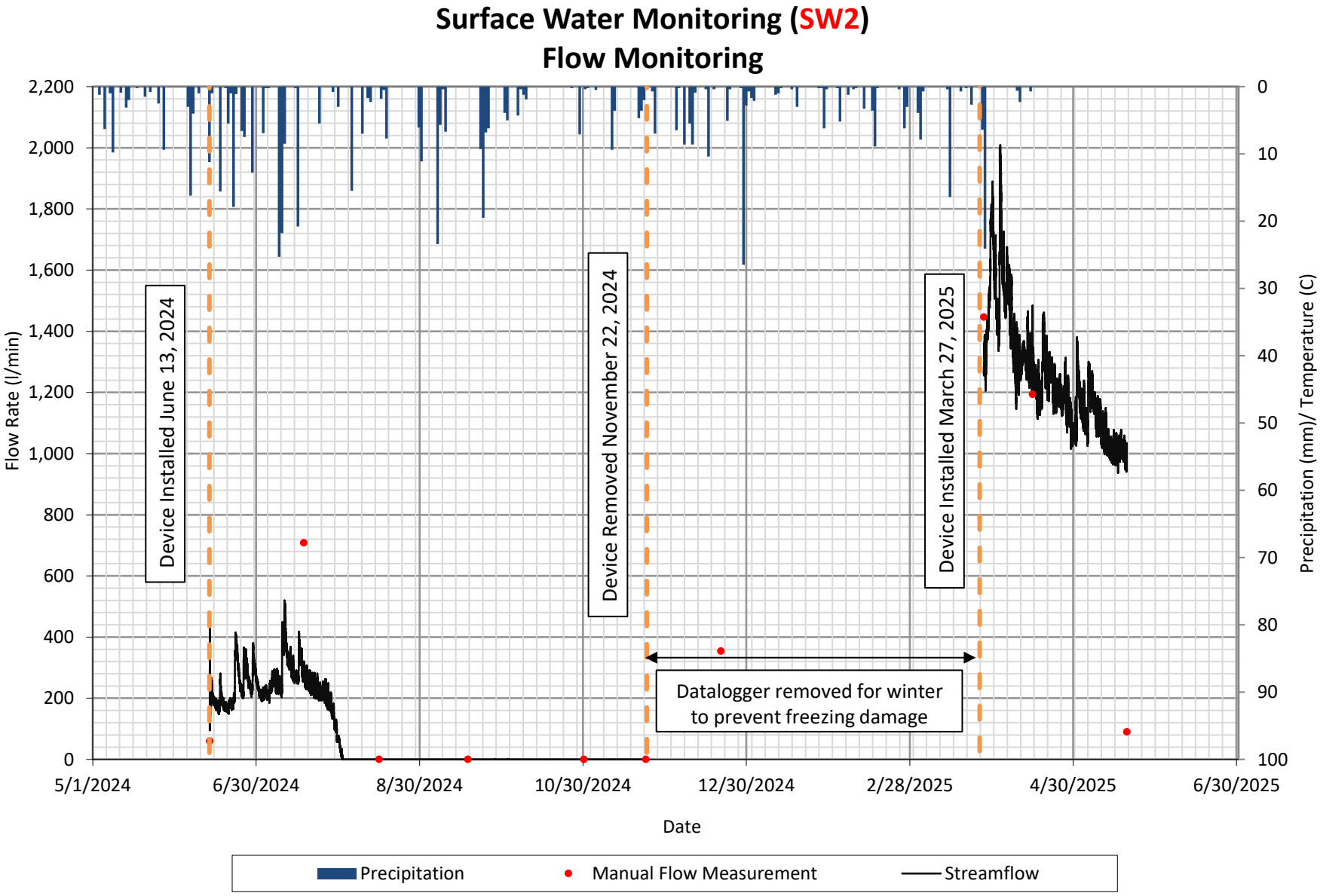

Monitoring Point (MP3)
Water Levels (masl)
Precipitation (mm)
200.5
200.4
200.3
200.2
200.1
200.0
199.9
199.8
199.7
199.6
199.5
0
10
20
30
40
50
60
70
80
90
100
6/1/2024
8/1/2024
10/1/2024
12/1/2024
2/1/2025
4/1/2025
6/1/2025
Date
Dry
Datalogger removed for winter
Total Precipitation
MP3 Groundwater Level
Manual Groundwater Level
Manual Surface Water Elevation
Ground Surface Elevation


Surface Water Monitoring (SW1)
Flow Monitoring
Flow Rate (l/min)
75,000
70,000
65,000
60,000
55,000
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
Precipitation (mm)/ Temperature (C)
0
10
20
30
40
50
60
70
80
90
100
Device Installed June 13, 2024
May-24
Jun-24
Aug-24
Oct-24
Dec-24
Feb-25
Apr-25
Jun-25
Date
Precipitation
Manual Flow Measurement
Streamflow

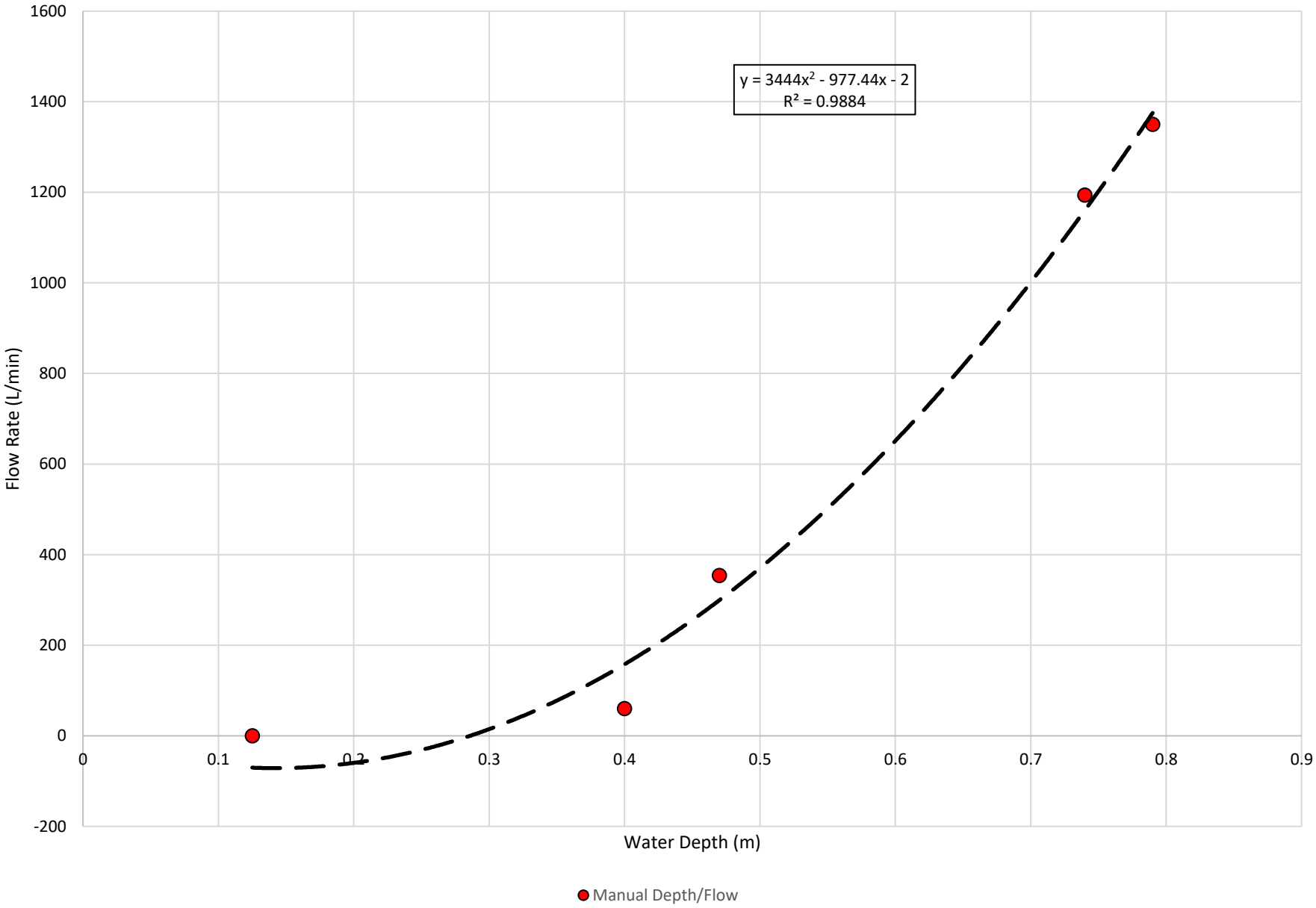
SW1 STREAMFLOW RATING CURVE

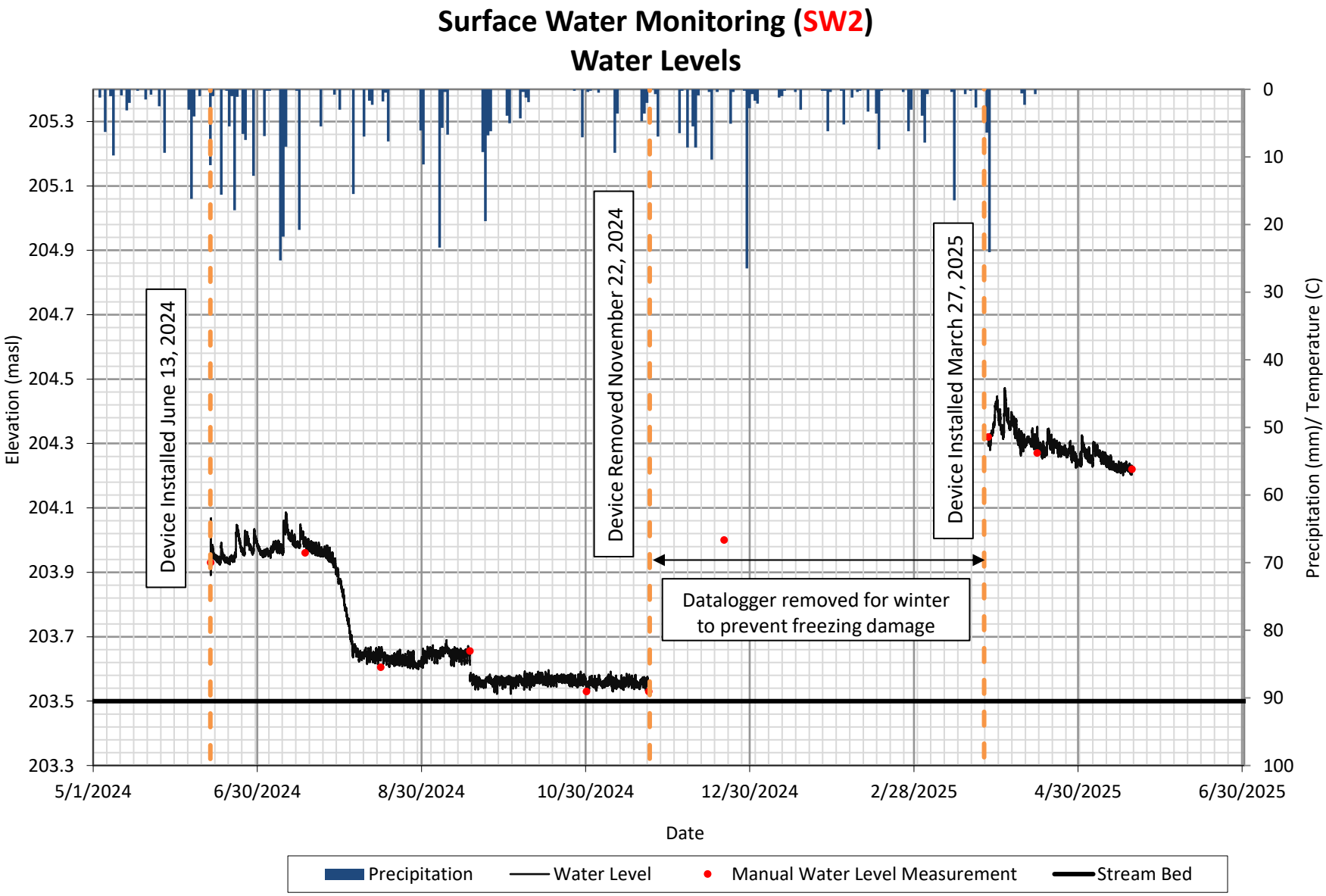


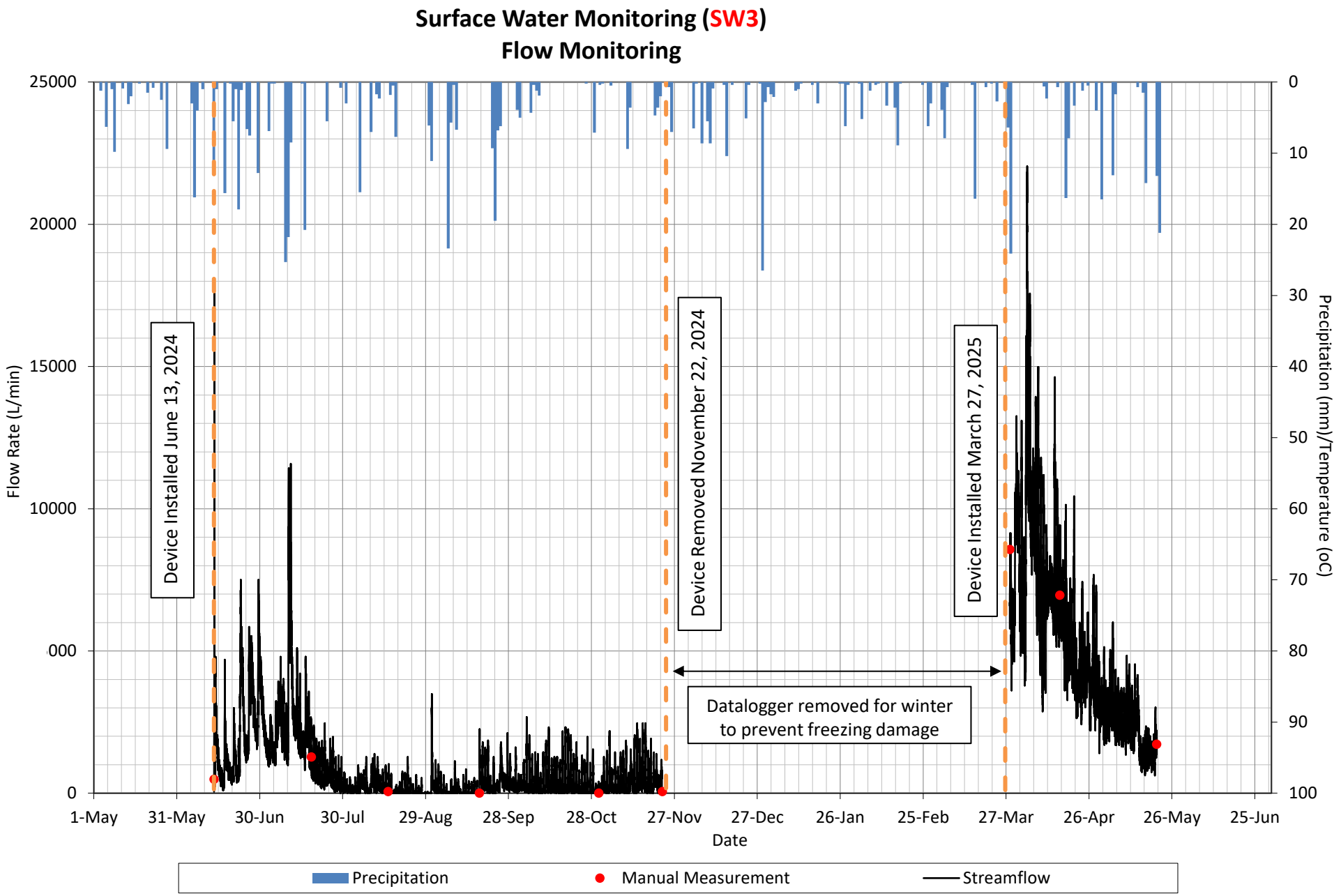

Surface Water Monitoring (SW1)
Water Levels
Flow Rate (l/min)
200.5
200.3
200.1
199.9
199.7
199.5
199.3
199.1
198.9
198.7
198.5
Precipitation (mm)/ Temperature (C)
0
10
20
30
40
50
60
70
80
90
100
May-24
Jun-24
Jul-24
Aug-24
Sep-24
Oct-24
Nov-24
Dec-24
Jan-25
Feb-25
Mar-25
Apr-25
May-25
Jun-25
Date
Device Installed June 13, 2024
Precipitation
Manual Flow Measurement
Water Level
Stream Bed


Surface Water Monitoring (SW2)
Flow Monitoring
Flow Rate (l/min)
Precipitation (mm)/ Temperature (C)
Date
2,200
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
0
10
20
30
40
50
60
70
80
90
100
5/1/2024
6/30/2024
8/30/2024
10/30/2024
12/30/2024
2/28/2025
4/30/2025
6/30/2025
Device Installed June 13, 2024
Device Removed November 22, 2024
Device Installed March 27, 2025
Datalogger removed for winter to prevent freezing damage
Precipitation
Manual Flow Measurement
Streamflow

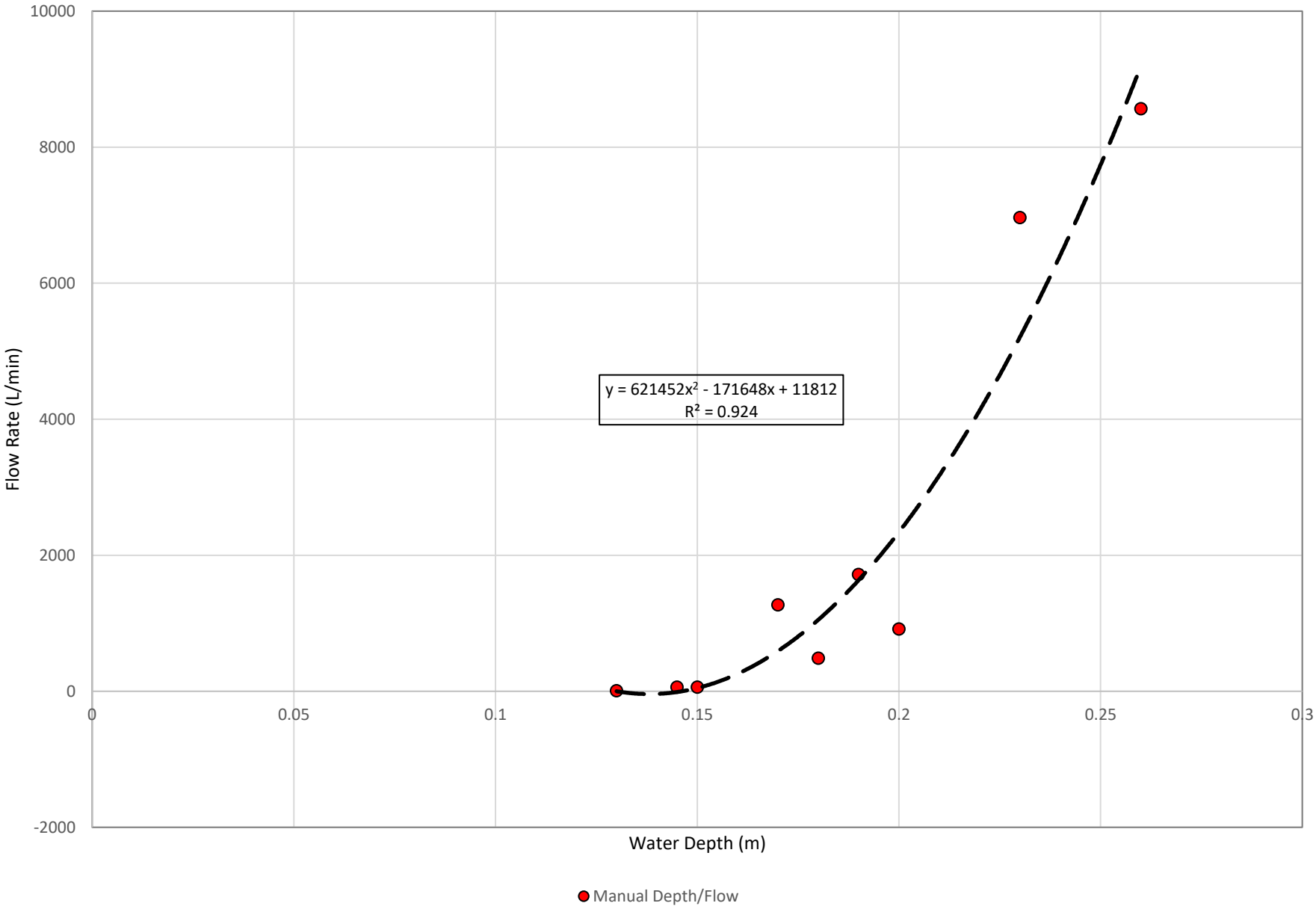
SW2 STREAM FLOW RATING CURVE

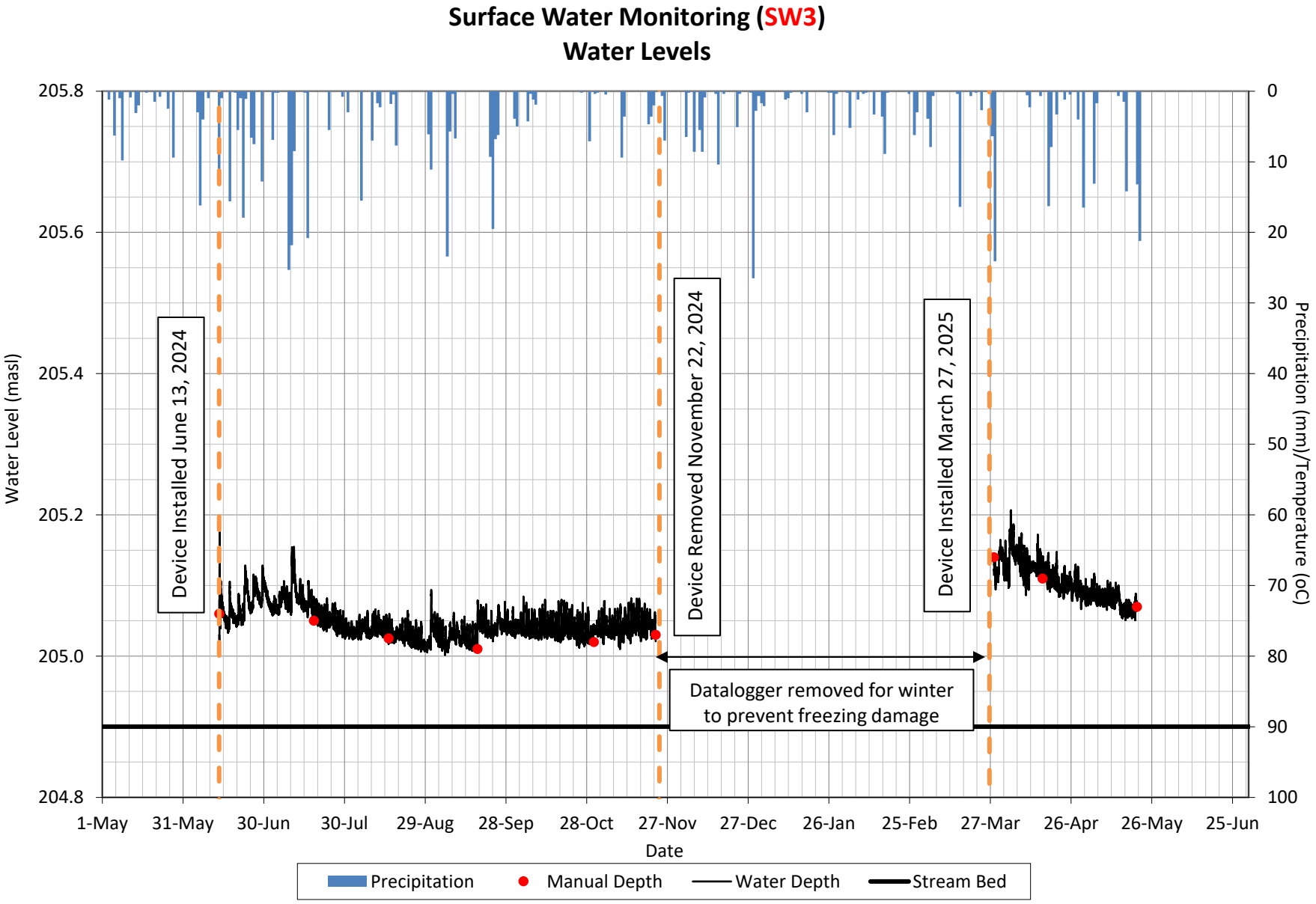



Surface Water Monitoring (SW2)
Water Levels
Elevation (masl)
205.3
205.1
204.9
204.7
204.5
204.3
204.1
203.9
203.7
203.5
203.3
Precipitation (mm)/ Temperature (C)
0
10
20
30
40
50
60
70
80
90
100
5/1/2024
6/30/2024
8/30/2024
10/30/2024
12/30/2024
2/28/2025
4/30/2025
6/30/2025
Date
Device Installed June 13, 2024
Device Removed November 22, 2024
Device Installed March 27, 2025
Datalogger removed for winter to prevent freezing damage
Precipitation
Water Level
Manual Water Level Measurement
Stream Bed


Surface Water Monitoring (SW3)
Flow Monitoring
Flow Rate (L/min)
Precipitation (mm)/Temperature (oC)
25000
20000
15000
10000
000
0
0
10
20
30
40
50
60
70
80
90
100
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
26-Jan
25-Feb
27-Mar
26-Apr
26-May
25-Jun
Date
Device Installed June 13, 2024
Device Removed November 22, 2024
Device Installed March 27, 2025
Datalogger removed for winter to prevent freezing damage
Precipitation
Manual Measurement
Streamflow

SW3 STREAMFLOW RATING CURVE




Surface Water Monitoring (SW3)
Water Levels
Water Level (masl)
Precipitation (mm)/Temperature (oC)
205.8
205.6
205.4
205.2
205.0
204.8
0
10
20
30
40
50
60
70
80
90
100
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
26-Jan
25-Feb
27-Mar
26-Apr
26-May
25-Jun
Date
Device Installed June 13, 2024
Device Removed November 22, 2024
Device Installed March 27, 2025
Datalogger removed for winter to prevent freezing damage
Precipitation
Manual Depth
Water Depth
Stream Bed

Appendix F:
Water Balance

TATHAM ENGINEERING

Catchment 101 Water Budget

Pre to Post Exraction Comparison

Project Details

Sand Road Pit, Asphodel-Norwo	424400

Prepared By	Reviewed By	
Jonathan Paul	John Gore	2026-06-23

Existing Catchment Details

Catchment ID	101
Total Area (ha)	753.73
Pervious (ha)	741.56
Impervious (ha)	12.17

Extraction / Rehabilitation Catchment Details

Catchment ID	Undisturbed Area	Extraction Area	Total
Total Area (ha)	736.22	17.51	753.73
Pervious (ha)	724.05	17.51	741.56
Impervious (ha)	12.17	0.00	12.17

Infiltration Factor

Catchment ID	101	
Infiltration Factor	Pervious	Impervious
Topography	0.15	0.0
Soil	0.15	0.0
Land Cover	0.15	0.0
Infiltration Facto	0.45	0.0

Undisturbed Area		Extraction Area	
Pervious	Impervious	Pervious	Impervious
0.15	0.0	-	0.0
0.15	0.0	-	0.0
0.15	0.0	-	0.0
0.45	0.0	1.00	0.0

Water Budget

Catchment ID	101		Total
Water Budget	Pervious	Impervious	
Water Surplus (r	1,933,267	81,731	**2,014,998**
Infiltration (m^3)	869,970	0	**869,970**
Runoff (m^3)	1,063,297	81,731	**1,145,028**

Undisturbed Area		Extraction Area		Total
Pervious	Impervious	Pervious	Impervious	
1,887,618	81,731	45,649	0	**2,014,998**
849,428	0	45,649	0	**895,077**
1,038,190	81,731	0	0	**1,119,921**

Summary

	Runoff	Infiltration
Existing Conditions (m^3)	1,145,028	869,970
Extraction/Rehab. Condition (m^3	1,119,921	895,077
Proposed Change (m^3)	-25,107	25,107
Proposed Change (%)	-2%	3%

Infiltration Factors

Topography	Flat Land, average slope < 0.6 m/km	0.3
	Rolling Land, average slope 2.8 m to 3.8 m/km	0.2
	Hilly Land, average slope 28 m to 47 m/km	0.1
Soils	Tight impervious clay	0.1
	Medium combinations of clay and loam	0.2
	Open Sandy loam	0.4
Cover	Cultivated Land	0.1
	Woodland	0.2

Additional Notes

No impervious factors are applied as impervious surfaces such as roads, driveways, and parking lots are not proposed during extraction / rehabilitation.

The infiltration factor for the extraction area is 1.0 as the extraction pit retains water and prevents any runoff

Monthly Feature-Based Water Budget

Wetland 1: Existing Conditions

Project Details

Sand Road Pit, Asphodel-Norwood	424399

Prepared By	Reviewed By	
Jonathan Paul	John Gore	2026-06-23

Water Budget Details

Methodology	Thornthwaite Method
Climate Data & Source	Peterborough Composite Station
	Climate Normal 1991-2020, Climate IDs 6166420, 6166418, 6166415)
Thornthwaite Coefficient	1.044

Month	Temp (°C)	Precip (mm)	Heat Index	PET (mm)	Daylight Factor	Days	Average Day Length	Evapotranspiration (mm)	Surplus (mm)	Deficit (mm)	Infiltration (mm)	Wetland Storage (m^3)	Wetland Depth (m)	Wetland Surface Area (m^2)
Jan.	-7.6	66.5	0.0	0.0	0.81	31	9.367	0.0	66.5	0.0	2.7	548,310	1.00	1,096,620
Feb.	-7.3	42.3	0.0	0.0	0.82	28	10.507	0.0	42.3	0.0	2.4	548,310	1.00	1,096,620
Mar.	-1.5	53.6	0.0	0.0	1.03	31	11.946	0.0	53.6	0.0	2.7	548,310	1.00	1,096,620
Apr.	5.7	72.7	1.2	27.2	1.12	30	13.449	30.4	42.3	0.0	2.6	548,310	1.00	1,096,620
May	12.5	79.4	4.0	61.7	1.27	31	14.730	78.2	1.2	0.0	2.7	464,541	0.85	929,083
Jun.	17.4	87.8	6.6	87.1	1.28	30	15.385	111.7	0.0	-23.9	2.6	358,397	0.65	716,794
Jul.	19.7	69.1	8.0	99.2	1.30	31	15.060	128.6	0.0	-59.5	2.7	264,316	0.48	528,632
Aug.	18.6	77.6	7.3	93.4	1.20	31	13.938	112.1	0.0	-34.5	2.7	203,659	0.37	407,319
Sep.	14.4	75.7	5.0	71.5	1.04	30	12.502	74.5	1.2	0.0	2.6	177,377	0.32	354,754
Oct.	8	74.7	2.0	38.7	0.95	31	11.010	36.7	38.0	0.0	2.7	321,012	0.59	642,024
Nov.	1.9	76.3	0.2	8.6	0.81	30	9.688	7.0	69.3	0.0	2.6	548,310	1.00	1,096,620
Dec.	-3.9	64.1	0.0	0.0	0.77	31	8.994	0.0	64.1	0.0	2.7	548,310	1.00	1,096,620
Total	**-**	**840**	**34.3**	**487.3**	**-**	**365**	**-**	**579.1**	**378.5**	**-117.8**	**31.4**	**5,079,163**	**-**	**10,158,326**

Equations

$$PET = 16\left(\frac{L}{12}\right)\left(\frac{N}{30}\right)\left(\frac{10T_d}{I}\right)^{\alpha}$$ Where

PET is the estimated potential evapotranspiration (mm/month)

T_d is the average daily temperature (degrees Celsius; if this is negative, use 0) of the month being calculated

N is the number of days in the month being calculated

L is the average day length (hours) of the month being calculated

$\alpha = (6.75 \times 10^{-7})I^3 - (7.71 \times 10^{-5})I^2 + (1.792 \times 10^{-2})I + 0.49239$

$I = \sum_{i=1}^{12}\left(\frac{T_{m_i}}{5}\right)^{1.514}$ is a heat index which depends on the 12 monthly mean temperatures T_{m_i}.[1]

Catchment Parameters

Hydraulic Conductivity =	0.09	mm/day	Based on assumed K value for Silty Sand Till (10^-9 m/s) (Freeze and Cherry)
Existing Catchment Area =	7,537,300	m^2	Existing catchment area including wetland =753.73 ha
Wetland Depth =	1.00	m	Based on LIDAR calculations and field monitoring data
Wetland Area =	1,096,620	m^2	Area of the wetland within the catchment at a depth of 1.00 m of water (109.66 ha)
Wetland Volume =	548,310	m^3	Based on LIDAR calculations
Infiltration Factor =	0.45		MOE Infiltration factor of wetland

Monthly Feature-Based Water Budget

Wetland 1: Extraction and Rehabilitation Scenario

Project Details

Sand Road Pit, Asphodel-Norwood	424399

Prepared By	Reviewed By	
Jonathan Paul	John Gore	2026-06-23

Water Budget Details

Methodology	Thornthwaite Method
Climate Data & Source	Peterborough Composite Station
	Climate Normal 1991-2020, Climate IDs 6166420, 6166418, 6166415)
Thornthwaite Coefficient	1.044

Month	Temp (°C)	Precip (mm)	Heat Index	PET (mm)	Daylight Factor	Days	Average Day Length	Evapotranspiration (mm)	Surplus (mm)	Deficit (mm)	Infiltration (mm)	Wetland Storage (m^3)	Wetland Depth (m)	Wetland Surface Area (m^2)
Jan.	-7.6	66.5	0.0	0.0	0.81	31	9.367	0.0	66.5	0.0	2.8	548,310	1.00	1,096,620
Feb.	-7.3	42.3	0.0	0.0	0.82	28	10.507	0.0	42.3	0.0	2.5	548,310	1.00	1,096,620
Mar.	-1.5	53.6	0.0	0.0	1.03	31	11.946	0.0	53.6	0.0	2.8	548,310	1.00	1,096,620
Apr.	5.7	72.7	1.2	27.2	1.12	30	13.449	30.4	42.3	0.0	2.7	548,310	1.00	1,096,620
May	12.5	79.4	4.0	61.7	1.27	31	14.730	78.2	1.2	0.0	2.8	464,291	0.85	928,582
Jun.	17.4	87.8	6.6	87.1	1.28	30	15.385	111.7	0.0	-23.9	2.7	358,092	0.65	716,185
Jul.	19.7	69.1	8.0	99.2	1.30	31	15.060	128.6	0.0	-59.5	2.8	264,003	0.48	528,005
Aug.	18.6	77.6	7.3	93.4	1.20	31	13.938	112.1	0.0	-34.5	2.8	203,352	0.37	406,705
Sep.	14.4	75.7	5.0	71.5	1.04	30	12.502	74.5	1.2	0.0	2.7	176,950	0.32	353,900
Oct.	8	74.7	2.0	38.7	0.95	31	11.010	36.7	38.0	0.0	2.8	316,914	0.58	633,827
Nov.	1.9	76.3	0.2	8.6	0.81	30	9.688	7.0	69.3	0.0	2.7	548,310	1.00	1,096,620
Dec.	-3.9	64.1	0.0	0.0	0.77	31	8.994	0.0	64.1	0.0	2.8	548,310	1.00	1,096,620
Total	**-**	**840**	**34.3**	**487.3**	**-**	**365**	**-**	**579.1**	**378.5**	**-117.8**	**32.9**	**5,073,462**	**-**	**10,146,924**

Equations

$$PET = 16\left(\frac{L}{12}\right)\left(\frac{N}{30}\right)\left(\frac{10T_d}{I}\right)^{\alpha}$$ Where

PET is the estimated potential evapotranspiration (mm/month)

T_d is the average daily temperature (degrees Celsius; if this is negative, use 0) of the month being calculated

N is the number of days in the month being calculated

L is the average day length (hours) of the month being calculated

$$\alpha = (6.75 \times 10^{-7})I^3 - (7.71 \times 10^{-5})I^2 + (1.792 \times 10^{-2})I + 0.49239$$

$$I = \sum_{i=1}^{12}\left(\frac{T_{m_i}}{5}\right)^{1.514}$$ is a heat index which depends on the 12 monthly mean temperatures T_{m_i}.[1]

Catchment Parameters

Hydraulic Conductivity =	0.09 mm/day	Based on assumed K value for Silty Sand Till (10^-9 m/s) (Freeze and Cherry)
Proposed Catchment Area	7,362,200 m^2	Post development catchment area including wetland = 736.22 ha
Wetland Depth =	1.00 m	Based on LIDAR calculations and field monitoring data
Wetland Area =	1,096,620 m^2	Area of the wetland within the catchment at a depth of 1.00 m of water (109.66 ha)
Wetland Volume =	548,310 m^3	Based on LIDAR calculations
Infiltration Factor =	0.45	MOE Infiltration factor of wetland

Monthly Feature-Based Water Budget

Wetland 1: Pre to Post Extraction Comparison

Project Details

Sand Road Pit, Asphodel-Norwood	424399

Prepared By	Reviewed By	
Jonathan Paul	John Gore	2026-06-23

Water Budget Details

Methodology	Thornthwaite Method
Climate Data & Source	Peterborough Composite Station
	Climate Normal 1991-2020, Climate IDs 6166420, 6166418, 6166415)
Thornthwaite Coefficient	1.044

Month	Wetland Storage (m^3) Pre-dev	Wetland Storage (m^3) Post-Dev	Change in Wetland Storage (m^3)	Wetland Depth (m) Pre-Dev.	Wetland Depth (m) Post-Dev.	Change in Wetland Depth (m)	Wetland Surface Area (m^2) Pre-Dev.	Wetland Surface Area (m^2) Post-Dev.	Change in Wetland Surface Area (m^2)	Change in Wetland Storage (%)
Jan.	548,310	548,310	0	1.00	1.00	0.00	1,096,620	1,096,620	0	0%
Feb.	548,310	548,310	0	1.00	1.00	0.00	1,096,620	1,096,620	0	0%
Mar.	548,310	548,310	0	1.00	1.00	0.00	1,096,620	1,096,620	0	0%
Apr.	548,310	548,310	0	1.00	1.00	0.00	1,096,620	1,096,620	0	0%
May	464,541	464,291	-250	0.85	0.85	0.00	929,083	928,582	-501	0%
Jun.	358,397	358,092	-305	0.65	0.65	0.00	716,794	716,185	-609	0%
Jul.	264,316	264,003	-313	0.48	0.48	0.00	528,632	528,005	-627	0%
Aug.	203,659	203,352	-307	0.37	0.37	0.00	407,319	406,705	-614	0%
Sep.	177,377	176,950	-427	0.32	0.32	0.00	354,754	353,900	-854	0%
Oct.	321,012	316,914	-4,098	0.59	0.58	-0.01	642,024	633,827	-8197	-1%
Nov.	548,310	548,310	0	1.00	1.00	0.00	1,096,620	1,096,620	0	0%
Dec.	548,310	548,310	0	1.00	1.00	0.00	1,096,620	1,096,620	0	0%
Total	**5,079,163**	**5,073,462**	**-5,701**	**-**	**-**	**-**	**10,158,326**	**10,146,924**	**-11,402**	**0%**

Summary

Pre-to-post extraction change in catchment runoff to feature	-2%
Pre-to-post change in catchment infiltration	3%
Pre-to-post extraction change in wetland storage (average)	0%