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Proposed Norwood Pit Extension

LEVEL 1 AND 2 HYDROGEOLOGICAL ASSESSMENT

Drain Bros. Excavating Limited

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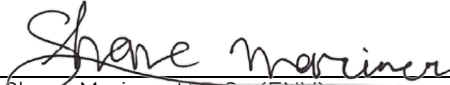
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Document Contents

1	Introduction	1
1.1	Site Description	1
1.2	Study Area Description	1
1.3	Site Development	2
1.4	Assessment Objectives.....	3
2	Site Setting	6
2.1	Physiography and Geology	6
2.2	Topography	6
2.3	Environmental Features	6
2.4	Hydrology	6
2.5	Hydrogeology	7
3	Procedures and Methodology.....	13
3.1	Groundwater	13
3.2	Surface Water	16
4	Data Assessment and Results	18
4.1	Stratigraphy	18
4.2	Climate	18
4.3	Groundwater	20
4.4	Surface Water	22
5	Watershed and Feature-Based Water Budgets	26
5.1	Climate Normal Data	26
5.2	Wetland Watershed Water Budgets.....	26
5.3	Monthly feature-based Water Budget	27
6	Assessment of Potential Impacts of the Proposed Pit Extension.....	30

6.1	Potential Interference with Local Groundwater Regime	30
6.2	Potential Interference with Domestic Water Wells and/or Municipal Water Wells	31
6.3	Potential Interference with Surface Water Features	31
7	Complaints Response Program	33
8	Mitigation Measures.....	34
9	Recommended Compliance Monitoring Program.....	35
10	Summary and Conclusions	36
11	Site Plan Recommendations.....	40
12	References	42

Tables

Table 1: Evaluation of need for Level 2 Hydrogeological Assessment	4
Table 2: MECP Bedrock Water Well Pumping Test Details	11
Table 3: Monitoring Well Construction Details.....	14
Table 4: Summary of Water Well Survey Results	15
Table 5: Surface Water Monitor Details.....	16
Table 6: Summary of Climate Data.....	19
Table 7: Highest Groundwater Elevation.....	21
Table 8: Summary of Wetland Water Quality	23
Table 9: Summary of Ouse River Tributary Water Quality	24
Table 10: Summary of Wetland Watershed Water Budget Results	27
Table 11: Summary of Monthly Feature-Based Water Budget Results.....	28

Figures

Figure 1: Site Location Plan	43
Figure 2: Mining Phasing Plan.....	44
Figure 3: Physiographic Mapping	45
Figure 4: Topography and Drainage.....	46
Figure 5: Wetland Catchment Areas	47
Figure 6: MECP Water Well Records.....	48
Figure 7: Regional Cross Section NW-SE.....	49

Figure 8: Intake Protection Zones 50

Figure 9: Well Head Protection Area..... 51

Figure 10: Significant Groundwater Recharge Area 52

Figure 11: Highly Vulnerable Aquifer 53

Figure 12: Site Monitoring Location Plan 54

Figure 13: Cross Section A-A' 55

Figure 14: Maximum Predicted Groundwater Level..... 56

Figure 15: Groundwater Contour – July 2024 57

Figure 16: Groundwater Contour – October 2024 58

Figure 17: Groundwater Contour – January 2025..... 59

Figure 18: Groundwater Contour – April 2025 60

Appendices

Appendix A: MECP Water Well Records

Appendix B: Borehole Logs

Appendix C: On-Site Monitoring Well Hydrographs

Appendix D: Groundwater Quality Results

Appendix E: Wetland and Surface Water Hydrographs and Ratings Curve

Appendix F: Water Balance

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 Pit Above Water licence to allow for an extension to the existing Norwood Pit (Licences #3270, #624622) located on Part Lot 1 Concession 11, Part Lot 2 Concession 11, Part Lot 1 Concession 12, and Part Lot 2 Concession 12, in the Township of Douro-Dummer, County of Peterborough, hereafter referred to as the “Proposed Pit Extension” or “Site” as shown in Figure 1.

Tatham has prepared this combined Level 1 and Level 2 Hydrogeological Assessment for the Proposed Pit Extension 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 extension on the to aquifers, surface water features, springs, and discharge areas in the vicinity of the Proposed Pit Extension and ultimately evaluate potential mitigation measures.

1.1 SITE DESCRIPTION

The existing Norwood Pit (Licences #3270, #624922) is located on the north side of Dummer Asphodel Road, east of 11th Line Road South Dummer and west of the historical location of Dummer 12th Line Road in the Township of Duoro-Dummer, which has been realigned recently and now bisects the eastern portion of License #624922. The Proposed Pit Extension is located east of the existing Norwood Pit licenced areas #3270 and #624922 on Part Lot 1 Concession 11, Part Lot 2 Concession 11, Part Lot 1 Concession 12, and Part Lot 2 Concession 12, Township of Douro-Dummer, County of Peterborough. The Proposed Pit Extension lands are primarily comprised of agricultural fields and/or forests and wetlands and bound by the existing Norwood Pit licenced areas #3270 and #624922 to the west, and a mixture of agricultural lands and rural residential properties to the east, south and north.

1.2 STUDY AREA DESCRIPTION

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

Additionally, the Proposed Pit Extension lands and the lands to the southwest of the existing Norwood Pit are considered to be Areas of Natural and Scientific Interest (ANSI) as a regionally significant earth science feature.

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. It is understood municipal water supply wells are located within the Town of Norwood, approximately 4 km southwest of the Site, and are interpreted to solely service the Town of Norwood.

1.3 SITE DEVELOPMENT

The Proposed Pit Extension consists of a Class A Above Water Pit with a licenced area of approximately 36.7 ha and an extractable area of approximately 28.1 ha.

The existing Norwood licenced areas #624922 will be extended toward the east to encompass the Proposed Pit Extension, as shown in Figure 2. Dummer 12th Line Road, which separates the Proposed Pit Extension from the existing Norwood Pit licenced areas #624922 and #3270, was realigned in 2025 to traverse through the western portion of Norwood Pit licenced area #624922 in a northeast-southwest orientation.

Operations have been divided into two phases of extraction, with Phase 1 comprising 17.6 ha of extraction area located immediately east of the realigned Asphodel 12th Line and the existing licenced area #624922, and Phase 2 comprising 10.5 ha of extraction area located to the east Phase 1, continuing east of Dummer 12th Line Road. Extraction will be initiated in Phase 1 and will continue through to Phase 2.

The depth of extraction will remain at least 1.5 m above the maximum predicted groundwater level at elevations of approximately 221.0 to 224.7 m asl.

The main Site access will be from South Dummer 11th Line Road utilizing the existing Norwood Pit. Aggregate materials will be processed on-site within close proximity to the active pit working faces.

The Proposed Pit Extension will have a combined tonnage limit with the existing Norwood Pit license #642922 of 227,000 tonnes per year. License #624922 currently has a tonnage limit of 227,000 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 to 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 Extension 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	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 north of the Site, and tributaries of the Ouse River are located to the south of the Site. The Site is similarly surrounded by Provincially Significant Wetlands (PSW), non-PSW, and unevaluated wetlands.	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 drainage 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	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	The closest municipal wells are located in the Town of Norwood approximately 4.8 km to the southwest. The Site does fall within the Well Head Protection Area (WHPA) resulting from these wells.	Further assessment is needed to assess the potential impact to the municipal water supply wells.

2 Site Setting

2.1 PHYSIOGRAPHY AND GEOLOGY

The Site lies within the physiographic region known as the Dummer Moraines, comprising till moraines and eskers (Chapman and Putnam, 2007), as shown in Figure 3.

Ontario Geological Survey (OGS) quaternary geology mapping indicates the eskers on-site generally consists of glaciofluvial ice-contact deposits comprising primarily gravel and sand, where as the till moraines generally consist of sand till (OGS, 2000).

OGS Paleozoic geology mapping indicates the Site is underlain by Ordovician Bobcaygeon limestone of the Simcoe Group (Armstrong & Dodge, 2007). The Verluam Formation overlies the Bobcaygeon Formation which overlies the Gull River Formation.

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 225 to 240 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 ENVIRONMENTAL FEATURES

Several unevaluated wetlands surround the Proposed Pit Extension lands, a larger PSW is noted approximately 250 m to the northwest of the Site in the vicinity of Ouse River, and another PSW is noted 880 m to the southeast of the Site towards Belmont Township 11th Line. Further a non-PSW is noted about 1.0 km to the south of the Site.

It is noted although the Site is surrounded by wetland and surface water features, no surface water features were identified within the extraction limits of the Proposed Pit Extension lands.

2.4 HYDROLOGY

The Site is located within the Ouse River watershed with the main branch of the river located northwest of the Site flowing north to south and a tributary of the Ouse River to the south of the Site flowing east to west. There is a highpoint running through the Site which splits drainage from the Site. The north half of the Site drains northwest to the main branch of the Ouse River while the south half of the Site drains south to the tributary of the Ouse River. Using the Ontario Watershed Information Tool (OWIT), the drainage area of the Ouse River to the north was calculated to be 7,250 ha where drainage from the Site enters the Ouse River. The drainage area

of the tributary to the south has a drainage area of 225 ha at Highway 7. The identified catchment areas are shown in Figure 5.

2.5 HYDROGEOLOGY

2.5.1 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 Douro-Dummer. 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 viewed as approximate as the accuracy of the well locations on the individual well records are variable and can be unreliable. As shown in Figure 6, multiple water well records were identified on the Proposed Pit Extension lands; however, these locations are inaccurate and these water wells are in fact not present on the Proposed Pit Extension 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 33 MECP well records were reviewed within 500 m of the Site. Of the 33 records, 27 records indicated domestic water well usage, one record indicated livestock water well usage, one record indicated 'not in use', and four well records did not specify their water well usage type.

In general, stratigraphy noted from the well records primarily indicates layers of sand and clay with variable gravel contents overlying shale, limestone or granite bedrock. Bedrock was noted in 31 of the records at surface or at depths of up to 17.4 m. A general regional cross section running northwest to southeast is shown in Figure 7. Based on well records the majority of local domestic water wells are constructed in the limestone and/or granite bedrock, with fresh water

encountered at depths of 5.2 to 96.0 m. Screen details were not provided for any of the water well records which is indicative of wells constructed within the bedrock.

Pumping test details were provided for 29 of the well records and are summarized in Table 2.

In summary, pumping tests were carried out for 10 min to 20.5 hours at rates less than 1 Gallon per Minute (GPM) to 20 GPM, with static water levels of 0.9 to 48.8 m below ground surface (bgs) being drawn down to between 2.5 and 99.1 m resulting in 0 to 94.8 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. A Permit to Take Water (PTTW) is required by the regulation if the total water takings exceed 50,000 L of water 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 includes water takings for industrial, commercial, municipal, and agricultural properties. The results indicated there was one active PTTW for the Site for the on-going aggregate washing operations at the existing Norwood Pit as summarized below:

- PTTW 1702-B9TQBW: Issued to Drain Bros. Excavating Limited for aggregate washing purposes, located at Lot 1 & 2, Concession 11, Township of Douro-Dummer, this permit allows for the groundwater takings from an on-site dugout pond at a rate of 6,000 L/min for a period of 12 hours per day for 170 days per year, for a total taking of 5,000,000 L/day. The PTTW expires February 29, 2029.

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 km² 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

Portions along the northern and southern limits of the Proposed Pit Extension lands 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 closest municipal drinking water supply well is located within the Town of Norwood approximately 4.8 km southwest of the Site. The majority of the Proposed Pit Extension lands lie within an WHPA, with the western and central portion of the Proposed Pit Extension lands being located within an WHPA-B and WHPA-C indicating time of travel to the well within the aquifer is 2 to 5 years. The remaining WHPA is identified as a WHPA-D indicating time of travel to the well within the aquifer is 25 years, as shown in Figure 9.

The WHPA assessment from the Norwood municipal wells identified the following threats to drinking water in the area:

- Improperly maintained septic systems;
- Unsafe handling or storage of contaminants such as paints, fuel, motor oils, solvents, paint removers, adhesives, stains, oils and/or metal cleaner;
- Application of pesticides and fertilizers;
- Livestock pasturing, grazing and confinement;
- Application of road salt and/or stockpiling of salt-impacted snow from roadways; and
- Water fowl in watercourses.

It is noted the WHPA identifies groundwater depletion is not a threat in this area.

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 entirety 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 highly permeable soils which allow for significant groundwater recharge, as well as high potential for aquifer contamination due to rapid flow of water from ground surface to the underlying aquifer.

Table 2: MECP Bedrock Water Well 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)
1	5113748	Open to 13.4	1.5	6	1:20	10.7	9.1	2.7
2	5114350	Open to 10.4	4.0	14	1:15	6.1	2.1	4.3
3	5114824	Open to 45.7	2.4	4	1:00	43.3	40.8	2.4
4	5115686	Open to 97.5	5.2	4	2:00	97.5	92.4	0
5	5116098	Open to 99.1	4.3	3	2:00	99.1	94.8	0
6	7321875	Open to 25.6	4.3	4	2:00	6.7	2.4	19.9
7	5100172	Open to 8.8	0.9	15	0:10	7.6	6.7	1.2
11	5101212	Open to 18.3	3.0	5	1:00	7.6	4.6	10.7
12	5114932	Open to 89.9	5.5	5	20:30	76.2	70.7	13.7
13	5114999	Open to 103.6	--	4	2:30	--	--	--
14	5115144	Open to 64.0	48.8	<1	--	61.0	12.2	3.0
15	5115614	Open to 22.9	4.0	2	1:30	18.9	14.9	4.0
16	5120427	Open to 19.8	2.7	2	1:00	18.0	15.2	1.8
17	5106083	Open to 5.8	0.9	5	0:30	3.0	2.1	2.7
18	7103840	Open to 16.8	5.5	4	1:00	13.1	7.6	3.7
20	5116991	Open to 36.6	12.8	2	6:00	35.0	22.3	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)
21	5118663	Open to 25.9	7.9	5	2:00	23.5	15.5	2.4
22	5106494	Open to 15.5	5.5	10	0:30	9.1	3.7	6.4
23	5114836	Open to 19.8	7.6	10	3:00	19.8	12.2	0
24	5115537	Open to 9.1	5.5	--	--	6.1	0.6	3.0
25	5111933	Open to 44.2	13.7	1	2:30	46.7	29.0	1.5
26	5116064	Open to 16.8	6.1	20	1:30	7.6	1.5	9.1
27	5114639	Open to 30.5	5.5	5	2:30	30.5	25.0	0
28	5117227	Open to 22.9	1.5	--	2:00	5.5	4.0	17.4
29	5101220	Open to 11.3	7.9	4	1:30	7.9	0	3.4
30	5109984	Open to 21.3	11.6	20	1:00	13.4	1.8	7.9
31	7111412	Open to 12.2	1.5	6	1:00	3.7	2.1	8.5
32	5115618	Open to 15.2	9.4	15	1:00	11.3	1.8	4.0
33	5108262	Open to 6.1	1.5	15	2:00	2.4	0.9	3.7

3 Procedures and Methodology

To assess the potential impacts of the Proposed Pit Extension 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.

Five boreholes, designated BH/MW24-1 through BH/MW24-5, were advanced by Choice Sonic Drilling Ltd. on May 24 and 27, 2024, to depths of 4.3 to 15.9 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 and construction details are summarized in Table 3. Borehole logs are presented 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	228.0	9.0	219.0 - 222.0
BH/MW24-2	223.4	6.0	217.4 - 220.4
BH/MW24-3	225.4	4.0	221.4 - 224.4
BH/MW24-4	224.5	7.0	217.5 - 220.5
BH/MW24-5	238.7	14.0	224.7 - 227.7

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, 5 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	DEPTH OF WELL (m)	APPROXIMATE CONSTRUCTION DATE	ANY WATER QUANTITY/ QUALITY CONCERNS?	TREATMENT UTILIZED
2546 Asphodel 12 th Line	Drilled	Unknown	2018	Very Hard, Sulfur Smell	Reverse Osmosis System, Water Softener
2573 Asphodel 12 th Line	Dug	Unknown	Pre-1994	Poor quality, does not drink water	UV Filter
2582 Asphodel 12 th Line	Dug	5 to 6	Unknown	Very high iron, very high water levels around the well	UV Filter, Iron Filter, Water Softener
11 Dummer 12 th Line	Drilled	Unknown	Unknown	-	Filtration
4882 Highway 7	Drilled	-21	1988 - 1996	-	Water Softener

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 or granite 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, BH/MW24-2 and BH/MW24-4 on June 13 and October 30, 2024. BH/MW24-3 and BH/MW24-5 were both dry at the time of sampling.

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

Four drive-point piezometers, designated MP1 through MP4, were installed within each of the wetlands by Tatham representatives on June 11 and 14, 2024 to evaluate the wetland hydroperiods and monitor the groundwater surface water interactions.

One streamflow monitoring location was installed within the bed of the Ouse River Tributary, designated SW1, to facilitate surface water level and flow monitoring.

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

All drive-point piezometers 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	WETLAND ID	GROUND SURFACE ELEVATION (m asl)	PIEZOMETER DEPTH (m)	MONITORING
MP1	Wetland 1	222.1	0.95	Water Level and Water Quality
MP2	Wetland 2	222.2	0.70	Water Level and Water Quality
MP3	Wetland 3	224.8	0.70	Water Level and Water Quality
MP4	Wetland 4	219.7	0.73	Water Level and Water Quality



PIEZOMETER ID	WETLAND ID	GROUND SURFACE ELEVATION (m asl)	PIEZOMETER DEPTH (m)	MONITORING
SW1	--	218.8	--	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 MP4 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 MP4 and SW1 utilizing a handheld Hanna combo pen.

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

Streamflow Monitoring

The streamflow monitoring location SW1 was fitted with a continuously recording pressure transducer and datalogger 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 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 datalogger to streamflow.

The results of the continuous streamflow monitoring at SW1 are provided on the hydrograph 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 Extension.

4.1 STRATIGRAPHY

Stratigraphy at the Site was inferred from borehole logs. Generally, stratigraphy on-site was described as layers of sand, and sand and gravel overlying a silty sand till, over a lower sand and gravel unit over limestone bedrock. The esker formations which comprise the Site consist of sand, and sand and gravel deposits, with lower lying areas having thinner sand/sand and gravel units.

Details of ground conditions are further presented within borehole logs in Appendix B and Site-specific cross sections 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 25 km west 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.

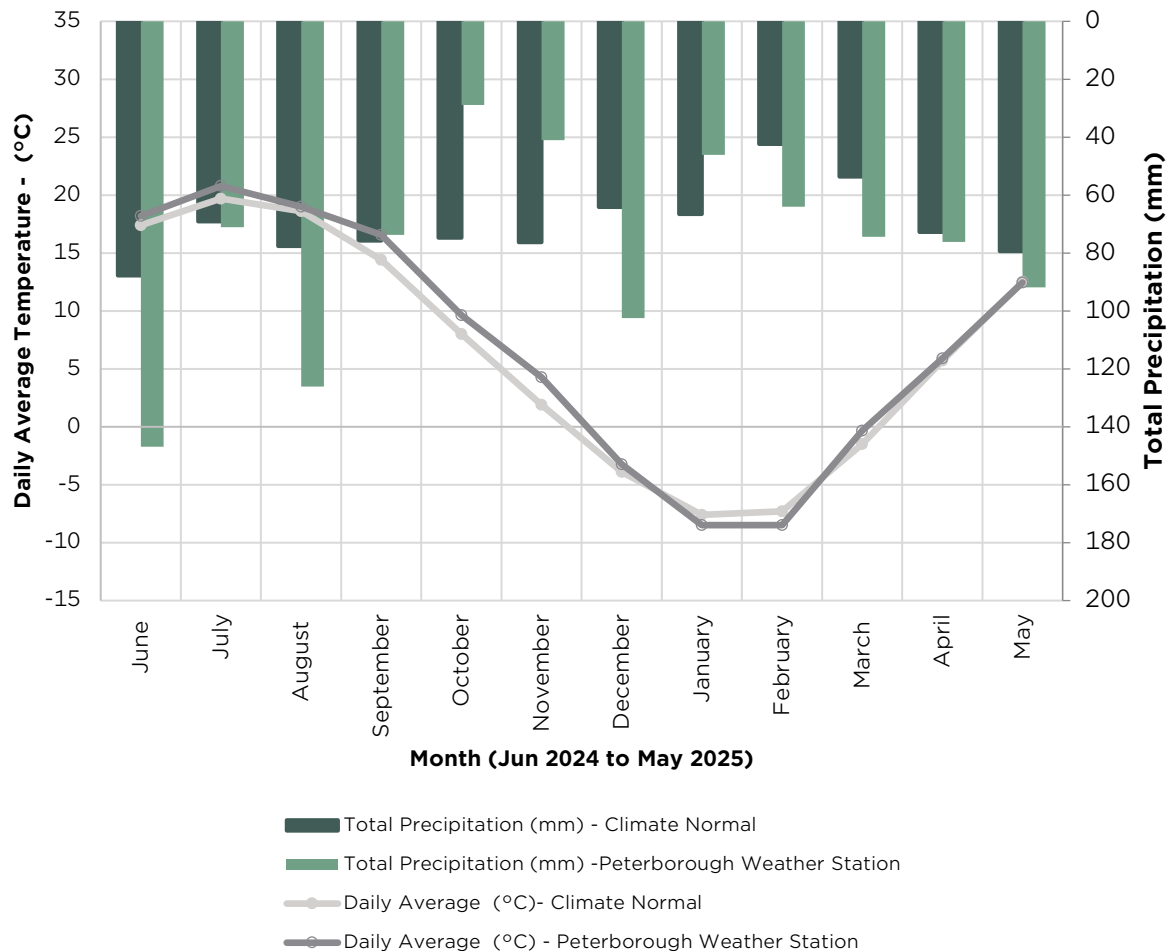
Overall, the monitoring period was more wet compared to the climate normal as the total precipitation for the climate normal is 840 mm compared to 943 mm over the monitoring period. However, the fall months of September to November 2024 and January 2025 were drier than the climate normal as seen in Graph 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 are compared to recorded precipitation events to illustrate the shallow aquifers response to precipitation events and are presented within Appendix C. It is noted BH/MW24-3 and BH/MW24-5 were consistently dry and hydrographs have 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/MW24-2 show a bit more variability, with a peak in groundwater levels also noted between March and May. The maximum groundwater elevations for each monitoring well are presented in Table 7 and shown in Figure 14.



Table 7: Highest Groundwater Elevation

WELL ID	HIGHEST GROUNDWATER ELEVATION (m asl)
BH/MW24-1	223.1
BH/MW24-2	221.0
BH/MW24-3	Dry at 221.4
BH/MW24-4	222.7
BH/MW24-5	Dry at 224.7

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 the groundwater flow within the overburden aquifer is to the southwest 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 Operational Guideline (OG) in all samples.
- Iron exceeded the Aesthetic Objective (AO) at BH/MW24-1 during both the June and October sampling events
- Manganese exceeded the AO at BH/MW 24-1 during both sampling events, and at BH/MW24-2 during the October sampling event
- Nitrate exceeded the Maximum Acceptable Concentration (MAC) at BH/MW 24-2 during both sampling events

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 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 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 through MP4 utilizing data collected between June 2024 and May 2025, as presented within Appendix E.

In general, groundwater levels within the wetland are lowest during dry summer months, and remain high through the fall, winter and spring.

At all four MP locations, surface water levels are consistently above existing grades indicating a continuous/year-round hydroperiod.

Based on the groundwater and surface water level measurements recorded at MP1 through MP4, both surface water and groundwater levels are fairly similar. The field measurements indicate the wetlands are both groundwater fed (gaining system) and surface water fed (losing system) with spring groundwater contributions being more significant. At MP1 the wetlands appear to be groundwater fed during the winter months but surface water fed throughout the remainder of the year. At MP2 the wetlands appear to be groundwater fed during the winter and spring months and surface water fed throughout the remainder of the year. At MP3 and MP4 the wetlands appear to be primarily surface water fed with some groundwater contribution during the spring months.

Water Quality

Surface water quality monitoring was conducted at MP1 through MP4 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	MP4
July 2024	6.98 / 184 / 18.3	6.82 / 339 / 24.8	6.82 / 457 / 22.3	6.96 / 588 / 23.2
August 2024	6.74 / 255 / 18.8	6.50 / 386 / 22.8	Dry	7.04 / 504 / 18.2
September 2024	6.75 / 195 / 16.8	7.25 / 338 / 18.5	Dry	Dry
October 2024	6.89 / 214 / 13.7	6.63 / 340 / 13.5	Dry	7.11 / 438 / 10.9
November 2024	8.03 / 121 / 6.5	7.80 / 249 / 5.9	Dry	8.15 / 354 / 5.5
December 2024	Frozen	Frozen	Frozen	Frozen
January 2025	Frozen	Frozen	Frozen	Frozen
February 2025	Frozen	Frozen	Frozen	Frozen
March 2025	7.25 / 438 / 4.2	Frozen	7.30 / 416 / 3.1	7.21 / 432 / 0.8
April 2025	8.15 / 185 / 7.9	7.96 / 325 / 4.0	7.95 / 405 / 6.5	8.01 / 345 / 4.5
May 2025	6.73 / 163 / 12.6	7.11 / 325 / 16.2	7.46 / 435 / 20.0	6.98 / 390 / 11.6

Note:

Frozen and Dry represent conditions where water samples could not be collected.

In general, the pH across the monitoring sites ranged from 6.50 to 8.15, the electrical conductivity ranged from 121 to 588 µs/cm, and temperatures ranged from frozen to 24.8°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 generally low electrical conductivity values at MP1 through MP4 indicate the surface water contribution may be more significant than the groundwater contribution, as the electrical conductivity of groundwater is typically higher.



4.4.2 Ouse River Tributary Monitoring

Water Level Monitoring

A hydrograph has been prepared for SW1 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 219.2 to 219.8 m asl and the monitoring location remains wet year-round. In general water levels are highest during the spring months and lowest during the summer and fall.

Streamflow Monitoring

A rating curve has been developed for the 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 has been used to convert the water depth data collected by the continuously recording pressure transducer and datalogger 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 6,633 L/min at SW1. The hydrograph shows the tributary experiences small responses following large precipitation events, while the most significant peak flows occurred during the spring freshet in March and April 2025.

Water Quality

Surface water quality monitoring was carried out at SW1 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 quality monitoring are summarized in Table 9.

Table 9: Summary of Ouse River Tributary Water Quality

DATE	pH	ELECTRICAL CONDUCTIVITY (μ S/CM)	TEMPERATURE
July 2024	7.70	756	24.8
August 2024	7.38	802	19.4
September 2024	7.35	825	18.5
October 2024	6.38	625	11.1



DATE	pH	ELECTRICAL CONDUCTIVITY (μ S/CM)	TEMPERATURE
November 2024	7.22	1,209	7.0
December 2024		Frozen	
January 2025		Frozen	
February 2025		Frozen	
March 2025	7.25	480	1.0
April 2025	8.19	593	4.5
May 2025	6.96	484	10.6

In general, the pH within SW1 ranged from 6.38 to 8.19, electrical conductivity ranged from 480 to 1,209 μ S/cm, and temperature ranged from frozen conditions to 24.8°C.

The electrical conductivities observed at SW1 are consistently higher than those observed in the wetlands at MP1 through MP4 indicating groundwater contribution to the Ouse River Tributary may be more significant than noted within the surrounding wetlands.



5 Watershed and Feature-Based Water Budgets

As part of the impact assessment in support of the proposed Pit Extension, water budgets were prepared to assess the change in runoff and infiltration resulting from extraction. Specifically, a water budget was prepared for each wetland's watershed to identify the change in runoff and infiltration resulting from extraction, and a monthly feature-based water budget was prepared for each wetland to assess the impact the reduction in surface water runoff to each 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 Extension 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 watershed of each wetland to identify the change in runoff and infiltration resulting from extraction. The watershed of each wetland was delineated using the available LiDAR topographic data as shown in 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 separately for each wetland's watershed under 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 budgets are summarized in Table 10 and provided in Appendix F for reference.



Table 10: Summary of Wetland Watershed Water Budget Results

	WETLAND 1	WETLAND 2	WETLAND 3	WETLAND 4
Watershed ID	101	102	103	104
Precipitation (mm)	840	840	840	840
Water Surplus (mm)	261	261	261	261
Water Surplus (m ³)	17,311	184,231	67,052	104,306
Drainage Area (ha)	6.6	69.4	25.7	40.0
Extraction Area (ha)	4.0	13.0	2.1	0.4
Existing Infiltration Factor	0.65	0.55	0.65	0.60
Existing Infiltration (m ³)	11,252	98,334	43,584	62,584
Existing Runoff (m ³)	6,059	85,897	23,468	41,723
Proposed Infiltration Factor	0.65	0.55	0.65	0.60
Proposed Infiltration (m ³)	14,938	113,597	45,537	63,043
Proposed Runoff (m ³)	2,372	70,634	21,516	41,264
Change in Infiltration (m ³)	+3,686	+15,263	+1,953	+459
Change in Runoff (m ³)	-3,686	-15,263	-1,953	-459

As illustrated in Table 10, the infiltration in each 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 each wetland will be reduced under proposed conditions.

5.3 MONTHLY FEATURE-BASED WATER BUDGET

A monthly feature-based water budget was prepared for each 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 each 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 budgets are summarized in Table 11 and provided in Appendix F for reference.

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

	WETLAND 1	WETLAND 2	WETLAND 3	WETLAND 4
Watershed ID	101	102	103	104
Precipitation (mm)	840	840	840	840
Water Surplus (mm)	261	261	261	261
Water Surplus (m ³)	17,311	184,231	67,052	104,306
Drainage Area (ha)	6.6	69.4	25.7	40.0
Existing Wetland Storage (m ³)	54 - 1,976	354 - 17,842	136 - 23,024	465 - 16,379
Existing Depth of Water (m)	0.01 - 0.33	0.01 - 0.30	0.01 - 0.59	0.03 - 0.60
Proposed Wetland Storage (m ³)	42 - 1,976	349 - 17,842	134 - 23,024	460 - 16,379
Proposed Depth of Water (m)	0.01 - 0.33	0.01 - 0.30	0.01 - 0.59	0.03 - 0.60
Change in Wetland Storage (%)	-14%	-3%	-2%	0%

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

Based on the monitoring data collected, Wetlands 1 through 4 are seasonally groundwater supported. The monthly feature-based water budgets do not account for groundwater



contributions to each wetland. As such, the monthly feature-based water budgets are considered conservative and the changes in wetland storage are expected to be less than estimated due to the seasonal groundwater contributions to each wetland. Given the infiltration within each 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 each 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 the Proposed Pit Extension

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 Level

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 Extension 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 Extension installed within the overburden aquifer will have similar water levels.

As discussed in Section 5, infiltration on-site is anticipated to increase during extraction and as part of 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 and post extraction.

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 Extension would have a negative impact on the regional and/or local groundwater quality.

6.2 POTENTIAL INTERFERENCE WITH DOMESTIC WATER WELLS AND/OR MUNICIPAL 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 1.5 m above the established seasonally high-water table elevation.

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

Based on the source water protection mapping completed for the Norwood municipal wells, the potential groundwater threats are quality related rather than quantity. The primary quality concern pertaining to the Proposed Pit Extension is the use of equipment and storage of fuels on-site. To prevent the potential contamination to the municipal aquifer as a result of equipment use and/or storage of fuels, on site best management mitigation measures are proposed as summarized in Section 8.0 and fuel storage restrictions will be included in the site plan for the Proposed Pit Extension.

6.3 POTENTIAL INTERFERENCE WITH SURFACE WATER FEATURES

As previously noted, the Ouse River is located 1.5 km to the northwest of the Site and tributaries of the Ouse River surround the Site.

Several unevaluated wetlands surround the Proposed Pit Extension lands, a larger PSW is noted approximately 250 m northwest of the Site in the vicinity of the Ouse River, and another PSW is noted 880 m southeast of the Site towards Belmont Township 11th Line. Further a non-PSW is noted about 1.0 km south of the Site.

Given extraction limits will be setback at least 15 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 main branch of Ouse River and wetlands to the northwest as well as the tributary to the south. The reduction in drainage area to the main branch and the wetlands will be 15.2 ha (0.2%) while the reduction to the tributary will be 16.3 ha (7.2%).



As demonstrated in the water level monitoring results at MP1 to MP4 and SW1 (Section 4.3), the tributary and wetlands are both groundwater and surface water fed, and during the spring groundwater contributions appear to be more significant. The minimal response in streamflow at SW1 following significant rainfall events further indicates the tributary is predominantly groundwater fed at this location. As the groundwater levels on-site will not be lowered and no impacts to the groundwater levels on-site are anticipated, groundwater contributions to the Ouse River Tributary and the wetlands will be maintained.

The minor reductions in surface drainage areas and runoff are expected to have negligible impacts on the storage volumes and water levels in each wetland. While the reduction in surface 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 surface 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 km². Given the Proposed Pit Extension covers an area of merely 0.315 km², roughly 0.009% 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 shall 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 Program

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 Extension 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 complaint 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 Recommended Compliance Monitoring Program

It is recommended long-term groundwater and surface water level monitoring continue, and future compliance monitoring be combined with the existing monitoring program.

Recommended monitoring:

- The continuation of monitoring the on-site monitoring wells BH/MW24-1, BH/MW24-2, BH/MW24-3, BH/MW24-4, BH/MW25-5. The monitoring includes continuous water level measurements and quarterly manual groundwater levels for the first two years of operations. After the first two years, monitoring shall be reduced to semi-annually. Automatic dataloggers shall be used to record continuous data and a barometric pressure transducer shall be utilized to correct the dataloggers for fluctuations due to atmospheric pressure.
- The continuation of monitoring the on-site surface water location SW1. 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, the monitoring shall be reduced to semi-annually. An automatic datalogger shall 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, MP2, MP3, and MP4. The monitoring includes continuous level monitoring and quarterly manual water level measurements for the first two years of operation. After the first two years, monitoring shall be reduced to semi-annually. An automatic datalogger shall 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, BH/MW24-2, BH/MW24-3, BH/MW24-4, and BH/MW25-5. Annual water quality samples shall 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 shall 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 Pit Extension of the Norwood Pit (Licenses #3270, #624622) in Norwood. The Proposed Pit Extension will be completed as two phases located on Part Lot 1 Concession 11, Part lot 2 Concession 11, Part Lot 1 Concession 12, and Part Lot 2 Concession 12, in the Township of Douro-Dummer, County of Peterborough.

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

- The area surrounding the Site primarily consist of agricultural and/or rural residential properties, existing aggregate operations, undeveloped wetlands and wooded features, and surface water features. Numerous wetlands and surface water features are also present throughout the study area, including provincially significant, non-provincially significant, and unevaluated wetlands. Further the Proposed Pit Extension lands, and the lands to the southwest of the existing licenced areas #3340 and #7686 are considered to be an ANSI as a regionally significant earth science feature.
- The Site lies within the physiographic region known as the Dummer Moraines, comprising till moraines and eskers (Chapman and Putnam, 2007). OGS quaternary geology mapping indicates the eskers on-site generally consists of glaciofluvial ice-contact deposits comprising primarily gravel and sand, where as the till moraines generally consist of sand till (OGS, 2000).
- The Site is underlain by Ordovician Bobcaygeon limestone of the Simcoe Group (Armstrong & Dodge, 2007). The Verluam Formation overlies the Bobcaygeon Formation which overlies the Gull River Formation.
- 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 225 to 240 m above sea level (asl). 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 northwest of the Site flowing north to south and a tributary of Ouse River to the south of the Site flowing east to west. 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 main branch of Ouse River while the south half of the Site drains south to a tributary of Ouse River. Using the OWIT, the drainage area of the main branch to the north was calculated to be 7,250 ha. The drainage area of the tributary to the south has a drainage area of 225 ha at Highway 7.

- Several unevaluated wetlands surround the Proposed Pit Extension lands, a larger PSW is noted approximately 250 m northwest of the Site in the vicinity of Ouse River, and another PSW is noted 880 m southeast of the Site towards Belmont Township 11th Line. Further a non-PSW is noted about 1.0 km south of the Site. The Ouse River lies 1.5 km northwest of the Site, and tributaries of Ouse River surround the Site. It is noted although the Site is surrounded by wetland and surface water features, no surface water features were identified within the proposed extraction limits of the Proposed Pit Extension lands.
- A total of 33 MECP well records were reviewed within 500 m of the Site. Of the 33 records, 27 records indicated domestic water well usage, one record indicated livestock water well usage, one record indicated 'not in use', and four well records did not specify their water well usage type. In general, stratigraphy noted from the well records primarily indicated layers of sand and clay with variable gravel contents overlying shale, limestone or granite bedrock. Bedrock was noted in 31 of the records at surface or at depths of up to 17.4 m. Domestic water wells are anticipated to be completed within the limestone and/or granite bedrock, with fresh water encountered at depths of 5.2 to 96.0 m. Pumping test details were provided for 29 of the well records and were carried out for 10 min to 20.5 hours at rates less than 1 Gallon per Minute (GPM) to 20 GPM, with static water levels of 0.9 to 48.8 m being drawn down to between 2.5 and 99.1 m resulting in 0 to 94.8 m of drawdown in the wells.
- The Site is located within the Otonabee-Peterborough Source Protection Area. Portions along the northern and southern limits of the Proposed Pit Extension lands are within an IPZ 3 for the Hasting Municipal Surface Water System.
- The closest municipal drinking water supply well is located within the Town of Norwood approximately 4.8 km southwest of the Site. The majority of the Proposed Pit Extension lands lie within a WHPA, with the western and central portion of the Proposed Pit Extension lands being located within a WHPA-B and WHPA-C indicating time of travel to the well within the aquifer is 2 to 5 years, and the remaining WHPA is identified as a WHPA-D indicating time of travel to the well within the aquifer is 25 years. The WHPA assessment from the Norwood municipal wells identified the following threats to drinking water in the area:



- Improperly maintained septic systems;
 - Unsafe handling or storage of contaminants such as paints, fuel, motor oils, solvents, paint removers, adhesives, stains, oils and/or metal cleaner;
 - Application of pesticides and fertilizers;
 - Livestock pasturing, grazing and confinement;
 - Application of road salt and/or stockpiling of salt-impacted snow from roadway;
 - Waterfowl in watercourses; and
 - It is noted the WHPA identifies groundwater depletion is not a threat in this area.
- The entirety of the Site has been identified as both an SGRA and HVA. The classification of the Site as both an SGRA and HVA indicates highly permeable soils which allow for significant groundwater recharge, as well as high potential for aquifer contamination due to rapid flow of water from ground surface to the underlying aquifer.
 - Stratigraphy on-site was described as layers of sand, and sand and gravel overlying a silty sand till, over a lower sand and gravel unit over limestone bedrock. The esker formations which comprise the Site consist of sand, and sand and gravel deposits, with lower lying areas having thinner sand/sand and gravel units.
 - Seasonal fluctuations were noted at all monitoring wells, with the exception of BH/MW24-3 and BH/MW24-5 which were consistently dry, illustrating higher groundwater levels during the spring and fall months and lower groundwater levels during the fall and winter months. The maximum predicted groundwater level on-site ranges from 221.0 to 224.7 m asl.
 - It has been interpreted groundwater flow within the overburden aquifer is to the southwest 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. 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.
 - In general, groundwater levels within the wetland are lowest during dry summer months, and remain high through the fall, winter and spring. At all four MP locations, surface water levels are consistently above existing grades indicating a continuous/year-round



hydroperiod. Based on the groundwater and surface water level measurements recorded at MP1 through MP4, both surface water and groundwater levels are fairly similar. The field measurements indicate the wetlands are both groundwater fed (gaining system) and surface water fed (losing system) with spring groundwater contributions being more significant. At MP1 the wetlands appear to be groundwater fed during the winter months but surface water fed throughout the remainder of the year. At MP2 the wetlands appear to be groundwater fed during the spring and winter months and surface water fed throughout the remainder of the year. At MP3 and MP4 the wetlands appear to be primarily surface water fed with some groundwater contribution during the spring months.

- The continuous surface water level data shows water level elevations have ranged between approximately 219.2 to 219.8 m asl at SW1. In general water levels are highest during the winter and 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 6,633 L/min at SW1. Minor increases in peak flows were observed following large precipitation events, with the most significant peak flows observed during March and April 2025.
- Water budgets were completed for the existing, extraction and rehabilitation conditions. The water budget results predict infiltration will increase, and consequently surface runoff will decrease from existing to proposed conditions as the precipitation falling within the extraction footprint will be contained in the extraction area and infiltrate through the pit floor. The decrease in runoff to the on-site wetlands will result in a minor reduction in the overall wetland storage volume. However, the wetlands will continue to fill with water seasonally and the hydroperiod will be maintained as each 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 Extension.



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, MP1, MP2, MP3 and MP4.
- 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 surface water monitor SW1.
- 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 (provided water is present): BH/MW24-1, BH/MW24-2, BH/MW24-3, BH/MW24-4, and BH/MW24-5.
- 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

- Armstrong, D.K. and Dodge, J.E.P. Paleozoic Geology Map of Southern Ontario; Ontario Geological Survey, Miscellaneous Release – Data 219.
- Blackport Hydrogeology Inc., and Golder Associates. November, 2006. Applied Research on Source Water Protection Issues in the Aggregate Industry, Phase I Findings.
- Chapman, L.J. and Putnam, D.F. 2007. The Physiography of Southern Ontario; Ontario Geological Survey, Miscellaneous Release – Data 228.
- Ontario Geological Survey, 2010. Surficial Geology of Southern Ontario.
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- Ontario Geological Survey 2000. Quaternary geology, seamless coverage of the Province of Ontario; Ontario Geological Survey, Data Set 14---Revised.
- Ministry of Environment, Conservation and Parks, 2025. Source Protection Information Atlas.
- Ministry of Environment, Conservation and Parks, 2025. Well Records - Dataset – Ontario Data Catalogue.
- Otonabee Conservation, 2025. Otonabee-Peterborough Source Protection Area.
- Trent Conservation Coalition Source Protection Region, Drinking Water Source Protection, Approved Trent Assessment report, updated June 13, 2025, vol 1 of 3.

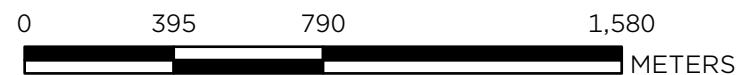
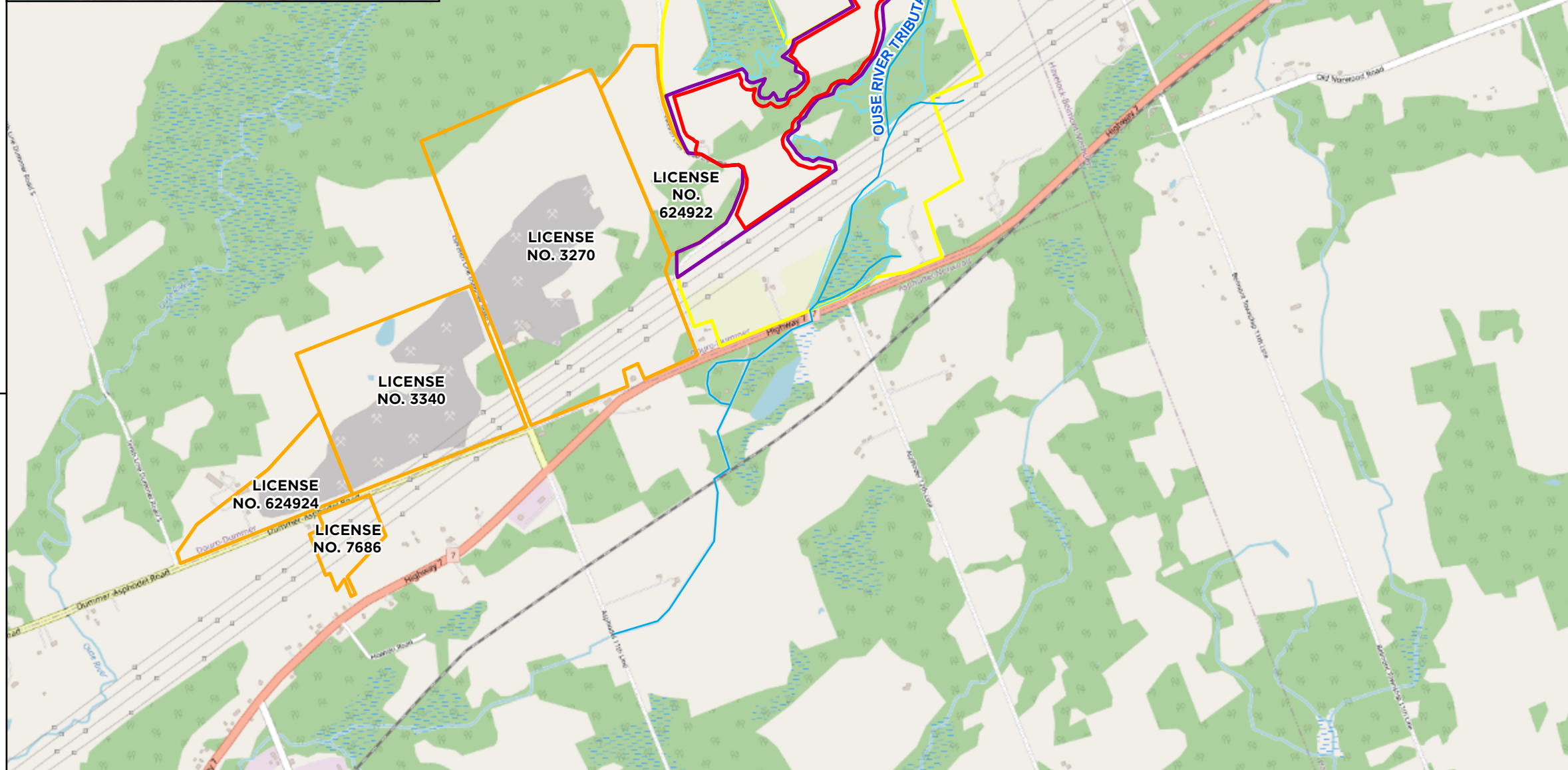
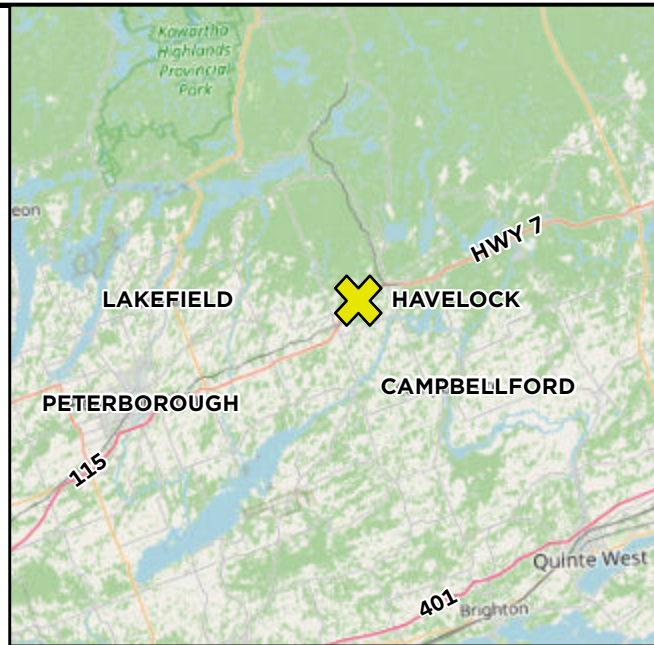




NOTES:
1. COORDINATE SYSTEM: NAD 1983 UTM
ZONE 17N
2. CONTAINS INFORMATION LICENSED
UNDER THE OPEN GOVERNMENT LICENSE -
ONTARIO.

LEGEND

-  OTHER LANDS OWNED BY DRAIN BROS
-  EXISTING LICENSED AREAS
-  PROPOSED LIMIT OF EXTRACTION
-  LICENSE BOUNDARY
-  WATERCOURSE
-  WETLAND



**NORWOOD PIT
LEVEL 1 AND 2 HYDROGEOLOGICAL ASSESSMENT
SITE LOCATION PLAN**

DWG. No.
FIG-1

SCALE: 1:20,000

DRAWN: AO

DATE: JUN. 2026

JOB NO. 424400

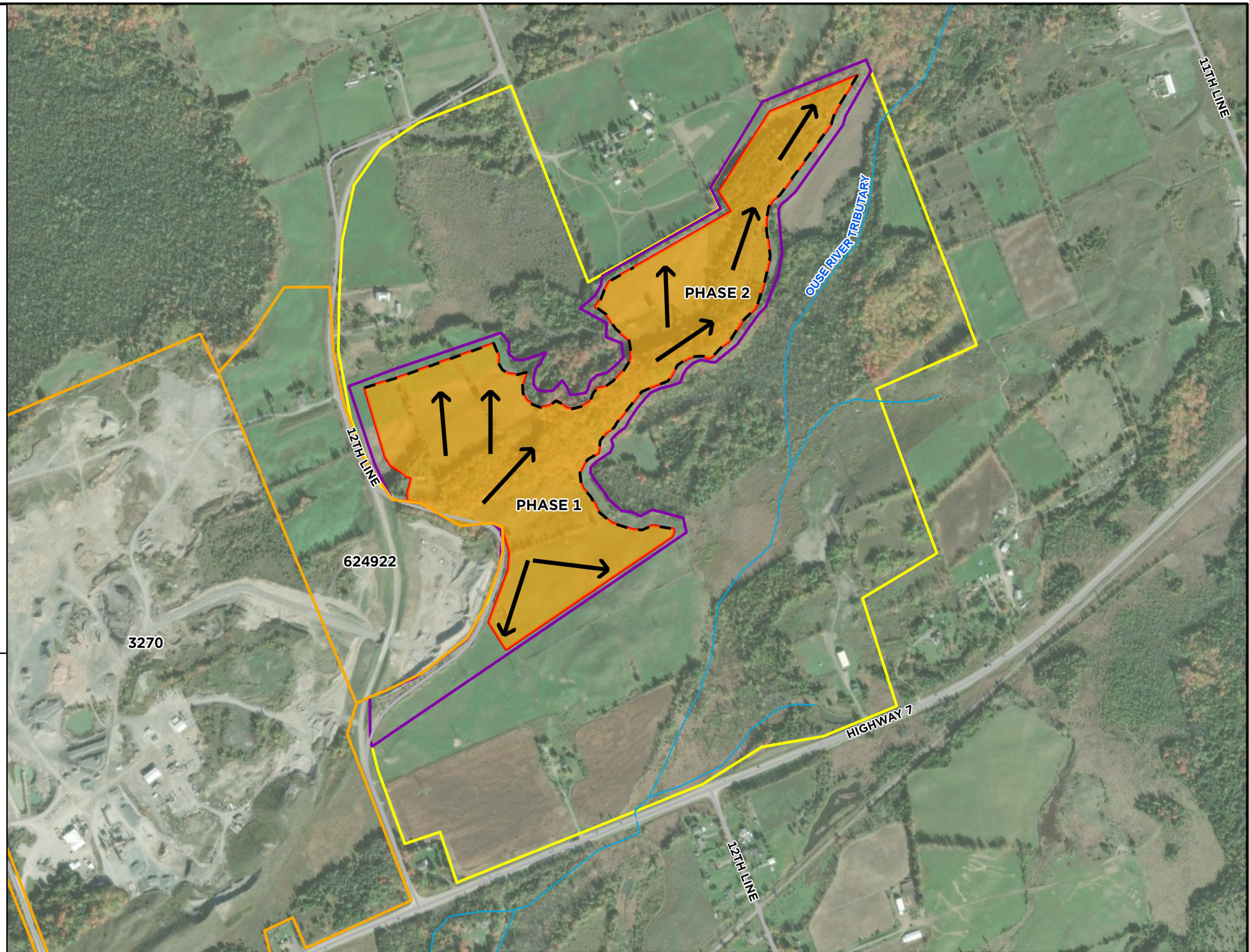


NOTES:

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

LEGEND

- OTHER LANDS OWNED BY DRAIN BROS
- PROPOSED LIMIT OF EXTRACTION
- LICENSE BOUNDARY
- EXISTING LICENSED AREAS
- PROPOSED PHASES OF EXTRACTION
- PROPOSED DIRECTION OF EXTRACTION
- ROADS
- WATERCOURSE
- SILT FENCING



0 155 310 620
METERS

TATHAM
ENGINEERING

**NORWOOD PIT
LEVEL 1 AND 2 HYDROGEOLOGICAL ASSESSMENT
MINING PHASING PLAN**

SCALE: 1:8,000

DRAWN: AO

DATE: JUN. 2026

DWG. No.

FIG-2

JOB NO. 424400

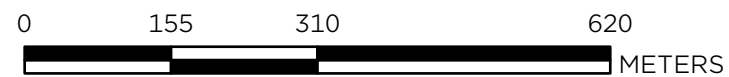
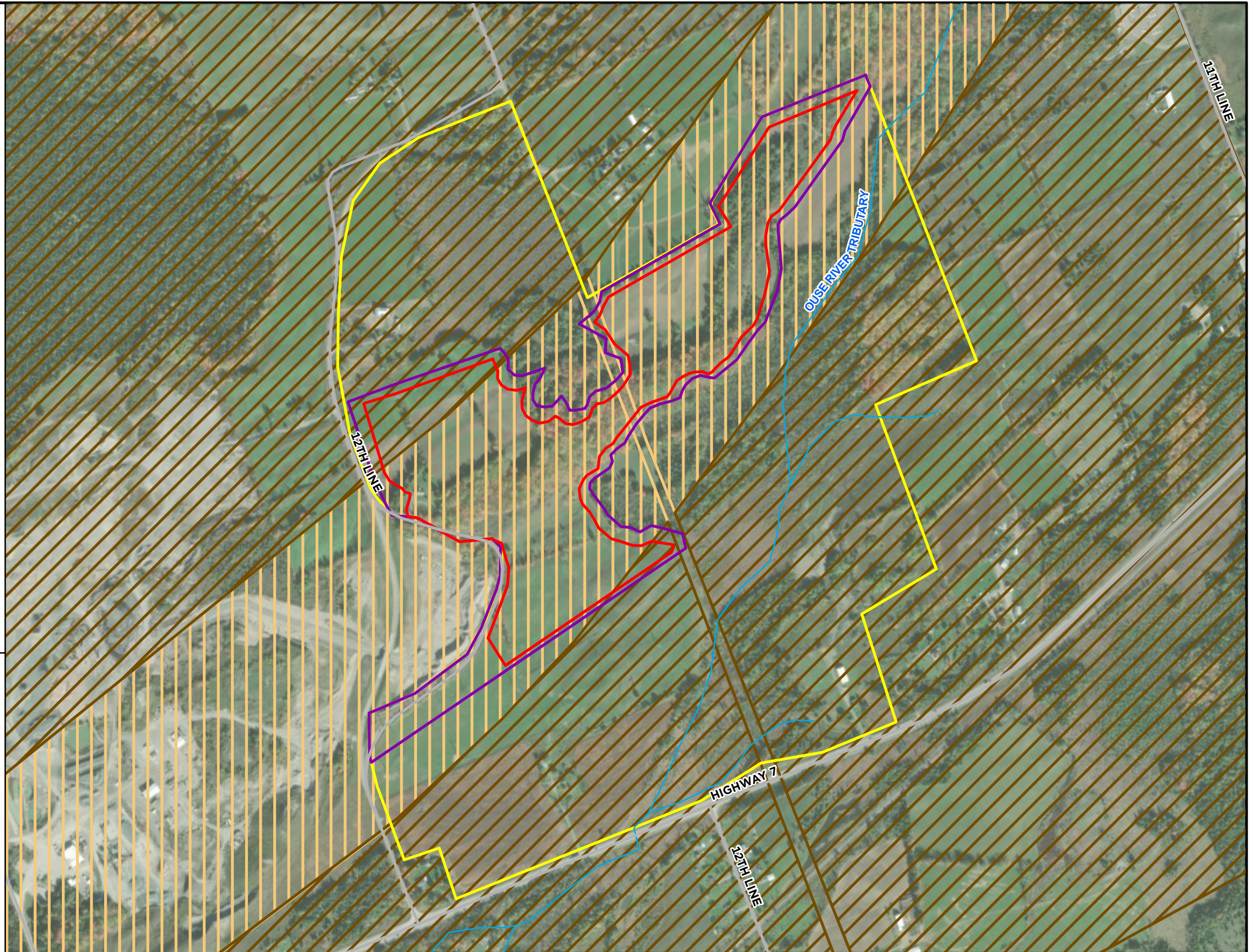


NOTES:

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

-  OTHER LANDS OWNED BY DRAIN BROS
-  PROPOSED LIMIT OF EXTRACTION
-  LICENSE BOUNDARY
-  ROADS
-  WATERCOURSE
- PHYSIOGRAPHY
 -  ESKERS
 -  TILL MORAINES



NORWOOD PIT
LEVEL 1 AND 2 HYDROGEOLOGICAL ASSESSMENT
PHYSIOGRAPHY MAPPING

SCALE: 1:8,000

DRAWN: AO

DATE: JUN. 2026

DWG. No.

FIG-3

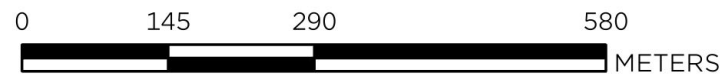
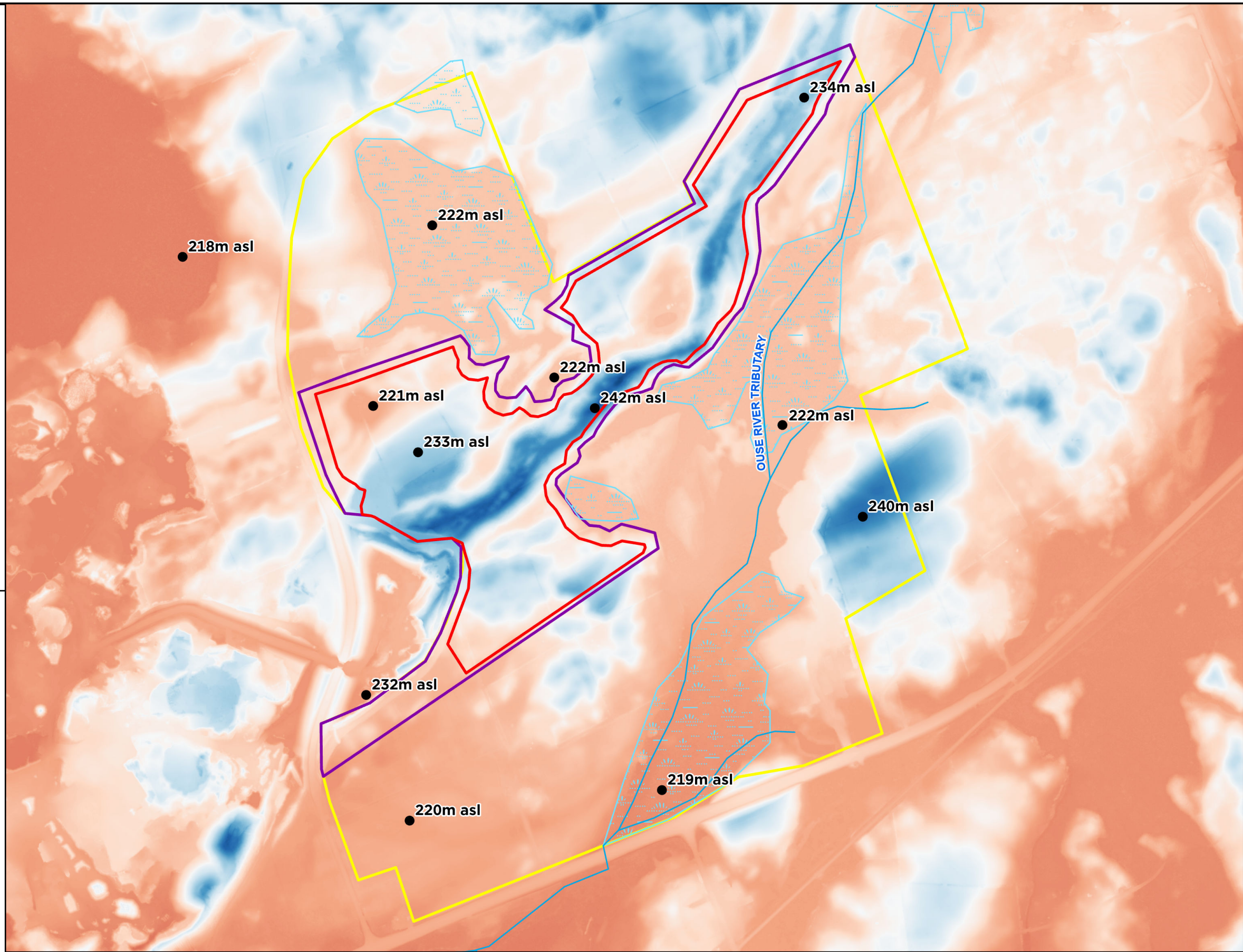
JOB NO. 424400



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

LEGEND

- OTHER LANDS OWNED BY DRAIN BROS
- PROPOSED LIMIT OF EXTRACTION
- LICENSE BOUNDARY
- WATERCOURSE
- WETLAND
- 245
- 237
- 230
- 220
- 210
- SPOT ELEVATIONS



**NORWOOD PIT
LEVEL 1 AND 2 HYDROGEOLOGICAL ASSESSMENT
TOPOGRAPHY AND DRAINAGE**

DWG. No.
FIG-4

SCALE: 1:7,500 | DRAWN: AO | DATE: JUN. 2026 | JOB NO. 424400



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

LEGEND

- PROPOSED LIMIT OF EXTRACTION
- ROADS
- WATERCOURSE
- CONTOUR
- CATCHMENT 101 (MP1/WETLAND 1)
- CATCHMENT 102 (MP2/WETLAND 2)
- CATCHMENT 103 (MP3/WETLAND 3)
- CATCHMENT 104 (MP4/WETLAND 4)
- WETLAND
- OVERLAND FLOW DIRECTION
- WATERCOURSE FLOW DIRECTION

101

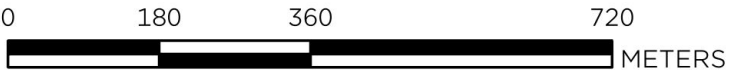
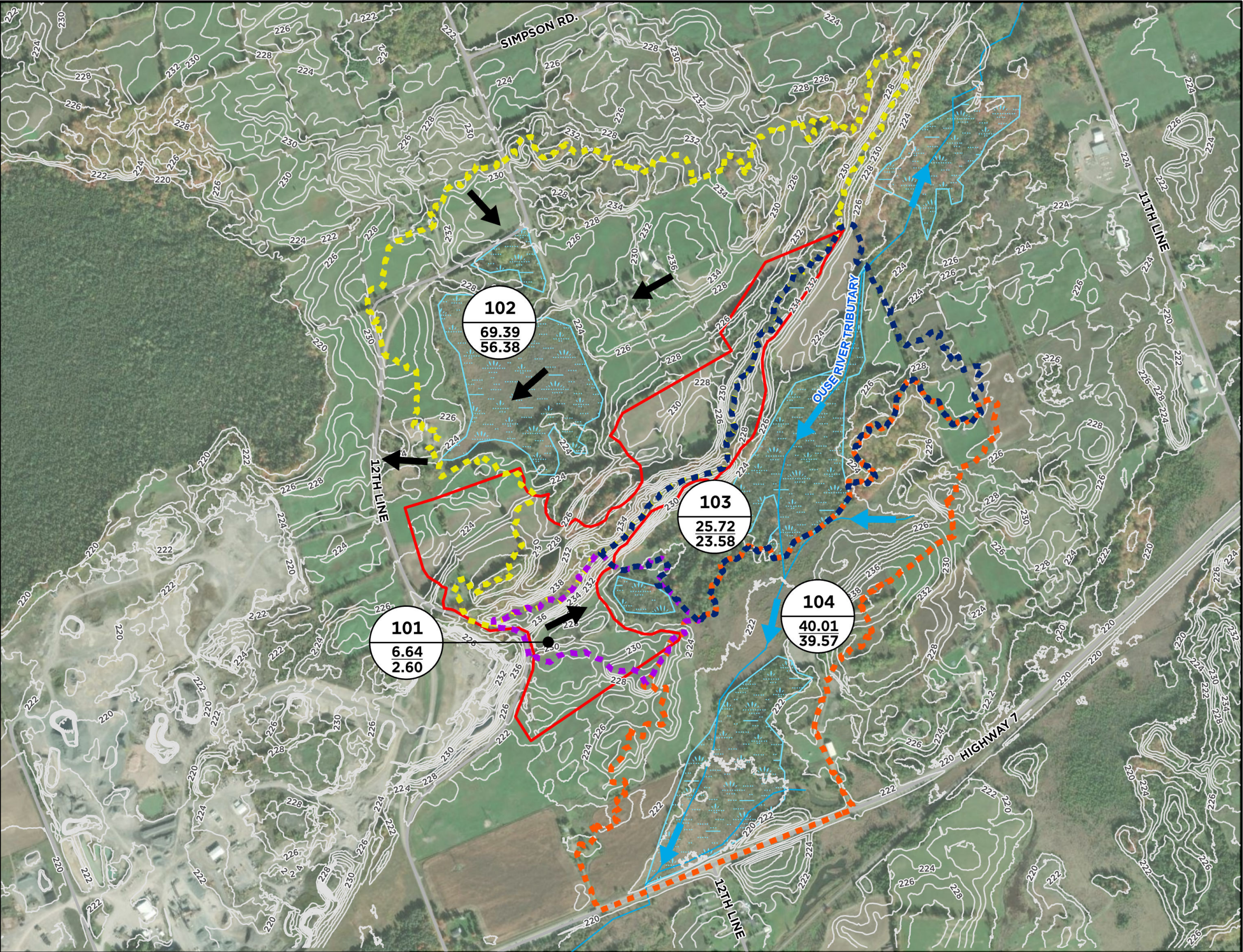
6.64

2.60

CATCHMENT ID

EXISTING AREA (ha)

PROPOSED AREA (ha)



**NORWOOD PIT
LEVEL 1 AND 2 HYDROGEOLOGICAL ASSESSMENT
WETLAND CATCHMENT PLAN**

SCALE: 1:9,000 DRAWN: AO DATE: JUN. 2026 JOB NO. 424400

DWG. No.
FIG-5

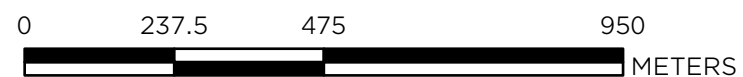
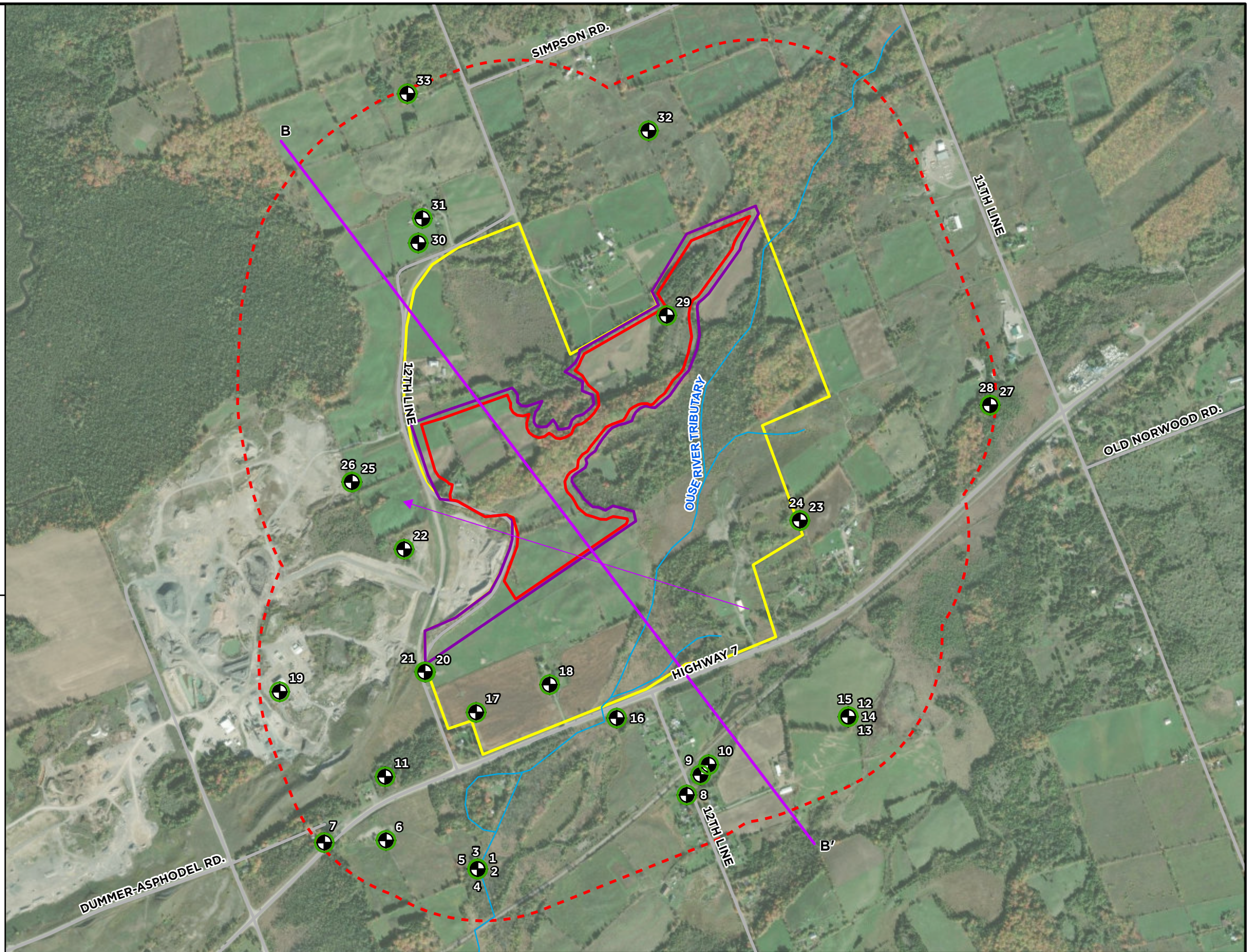


NOTES:

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

LEGEND

- OTHER LANDS OWNED BY DRAIN BROS
- PROPOSED LIMIT OF EXTRACTION
- LICENSE BOUNDARY
- STUDY AREA (500 M)
- WATERCOURSE
- ROADS
- CROSS SECTION
- MECP WATER WELL ID LABEL (SEE APPENDIX A)
- BEDROCK
- GENERAL REGIONAL GROUNDWATER FLOW DIRECTION



NORWOOD PIT
LEVEL 1 AND 2 HYDROGEOLOGICAL ASSESSMENT
MECP WATER WELL RECORDS

SCALE: 1:12,000

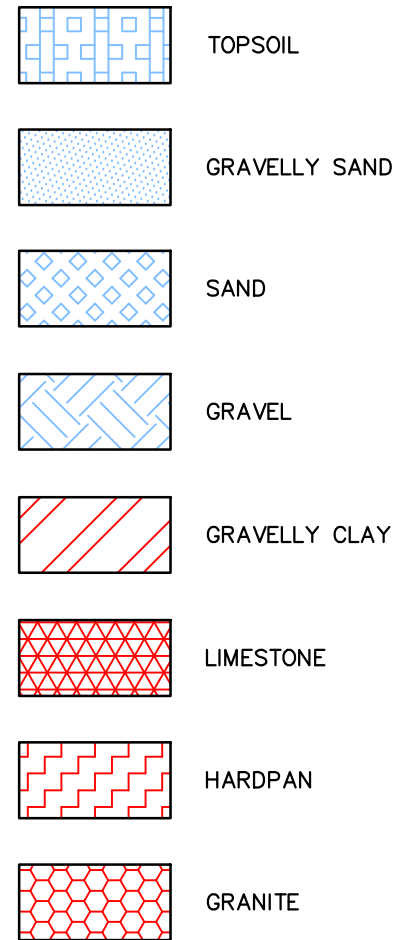
DRAWN: AO

DATE: JUN. 2026

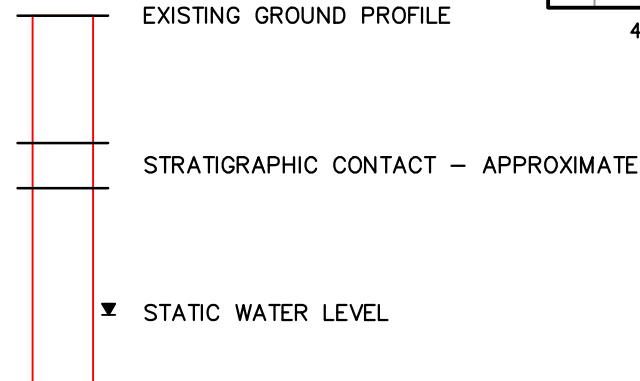
DWG. No.

FIG-6

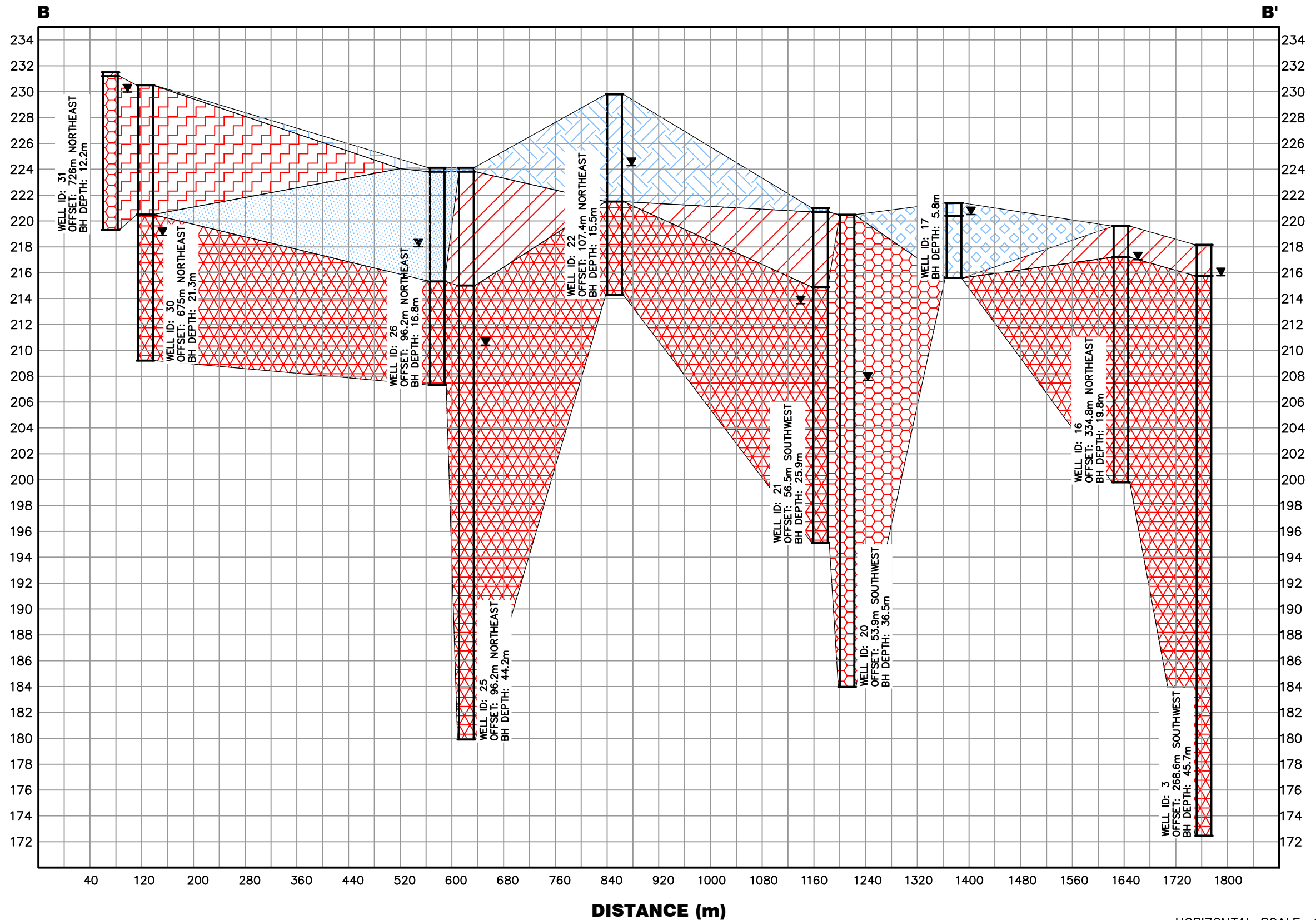
JOB NO. 424400



LEGEND



ELEVATION (m asl)



HORIZONTAL SCALE: 1:6500
VERTICAL SCALE: 1:325
VERTICAL EXAGGERATION: 20X



NORWOOD PIT
LEVEL 1 AND 2 HYDROGEOLOGICAL ASSESSMENT
REGIONAL CROSS-SECTION B-B'

SCALE: AS NOTED | DRAWN: HDY | DATE: SEPT 2025 | JOB NO. 424400

No. **FIG-7**

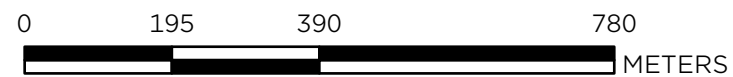
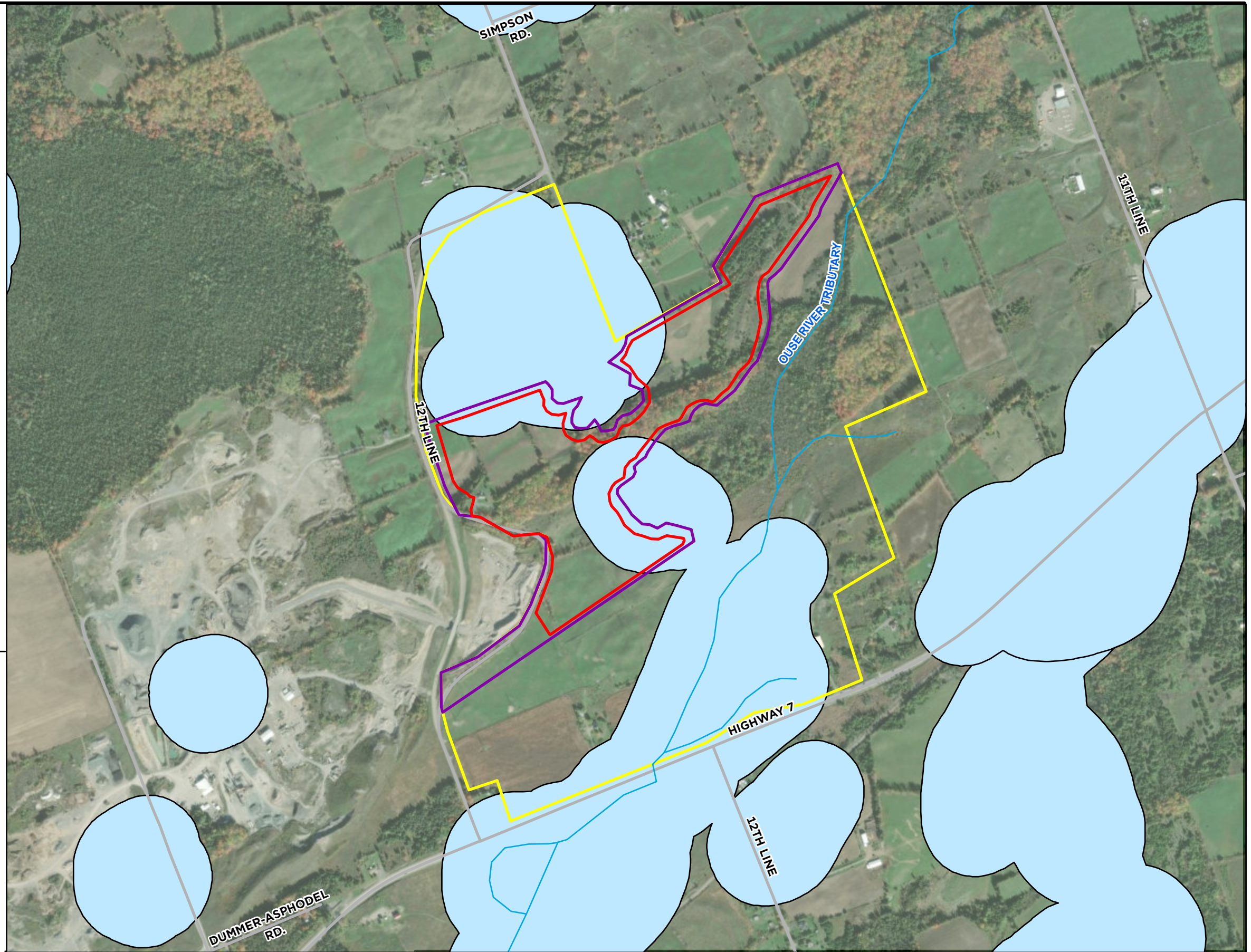


NOTES:

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

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



NORWOOD 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. 424400



NOTES:

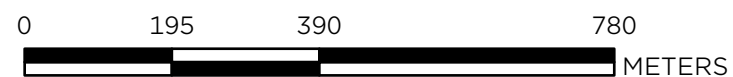
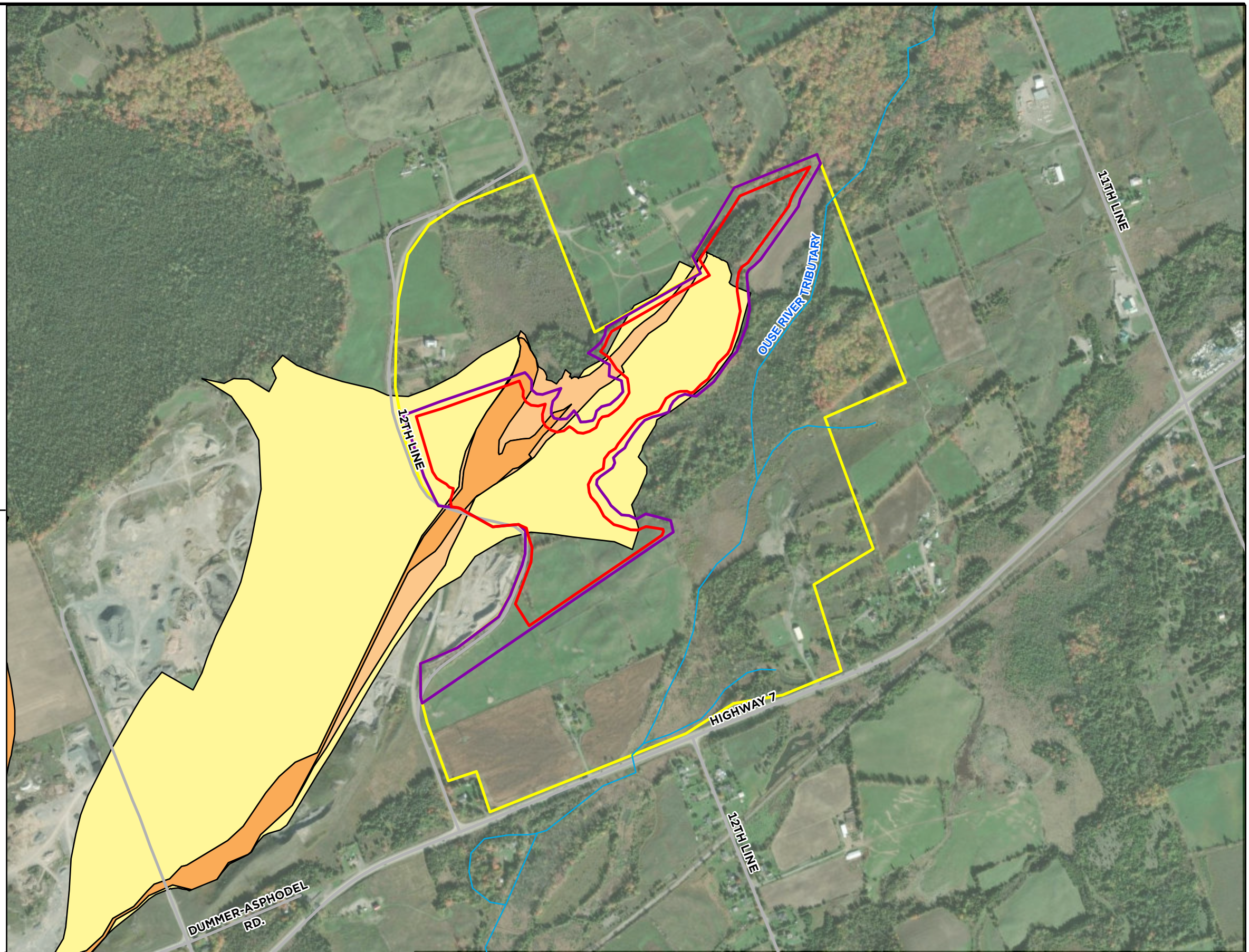
1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N
2. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENSE - ONTARIO.
3. CONTAINS INFORMATION FROM THE OTONABEE-PETERBOROUGH SOURCE WATER PROTECTION PLAN.

LEGEND

-  OTHER LANDS OWNED BY DRAIN BROS
-  PROPOSED LIMIT OF EXTRACTION
-  LICENSE BOUNDARY
-  WATERCOURSE
-  ROADS

WELLHEAD PROTECTION AREA

-  B
-  C
-  D



NORWOOD PIT LEVEL 1 AND 2 HYDROGEOLOGICAL ASSESSMENT WELL HEAD PROTECTION AREA			DWG. No. FIG-9
SCALE: 1:10,000	DRAWN: AO	DATE: JUN. 2026	JOB NO. 424400

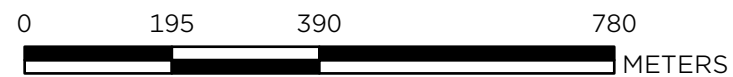
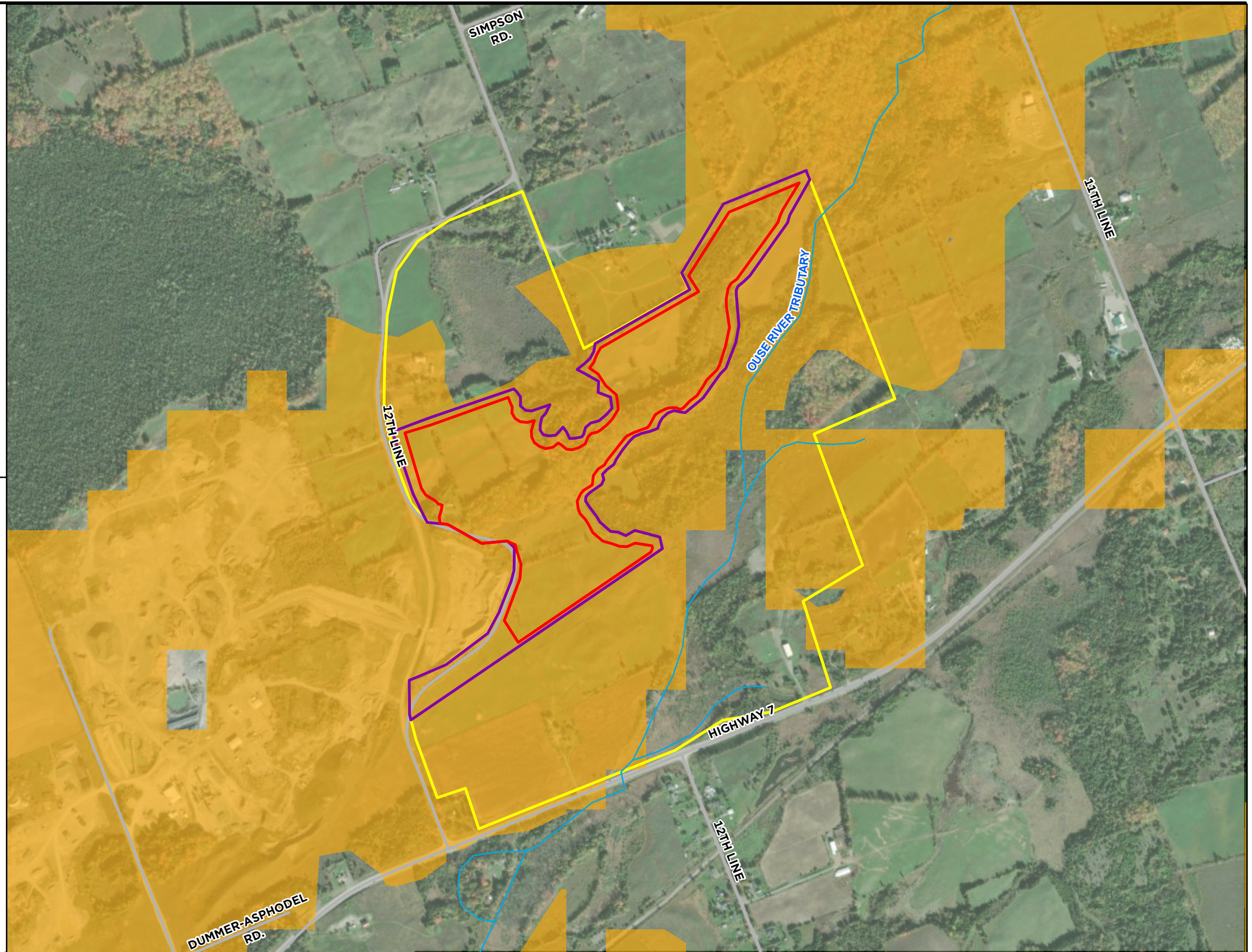


NOTES:

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

- OTHER LANDS OWNED BY DRAIN BROS
- PROPOSED LIMIT OF EXTRACTION
- LICENSE BOUNDARY
- SIGNIFICANT GROUNDWATER RECHARGE AREA
- WATERCOURSE
- ROADS



**NORWOOD PIT
LEVEL 1 AND 2 HYDROGEOLOGICAL ASSESSMENT
SIGNIFICANT GROUNDWATER RECHARGE AREA**

SCALE: 1:10,000

DRAWN: AO

DATE: JUN. 2026

DWG. No.

FIG-10

JOB NO. 424400

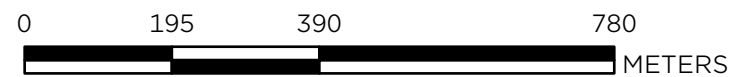
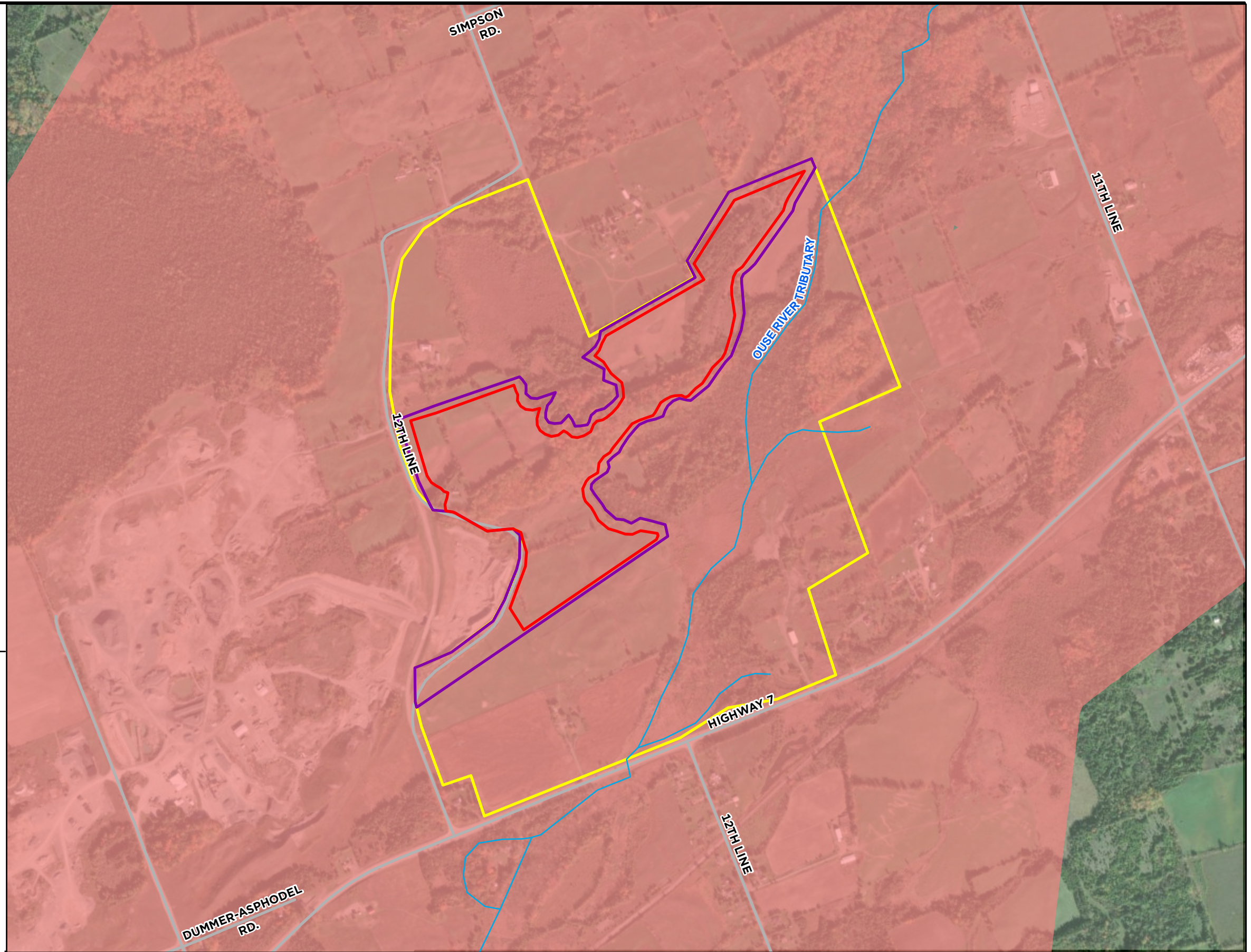


NOTES:

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

-  OTHER LANDS OWNED BY DRAIN BROS
-  PROPOSED LIMIT OF EXTRACTION
-  LICENSE BOUNDARY
-  HIGHLY VULNERABLE AQUIFERS
-  WATERCOURSE
-  ROADS



**NORWOOD PIT
LEVEL 1 AND 2 HYDROGEOLOGICAL ASSESSMENT
HIGHLY VULNERABLE AQUIFER**

DWG. No.

FIG-11

SCALE: 1:10,000

DRAWN: AO

DATE: JUN. 2026

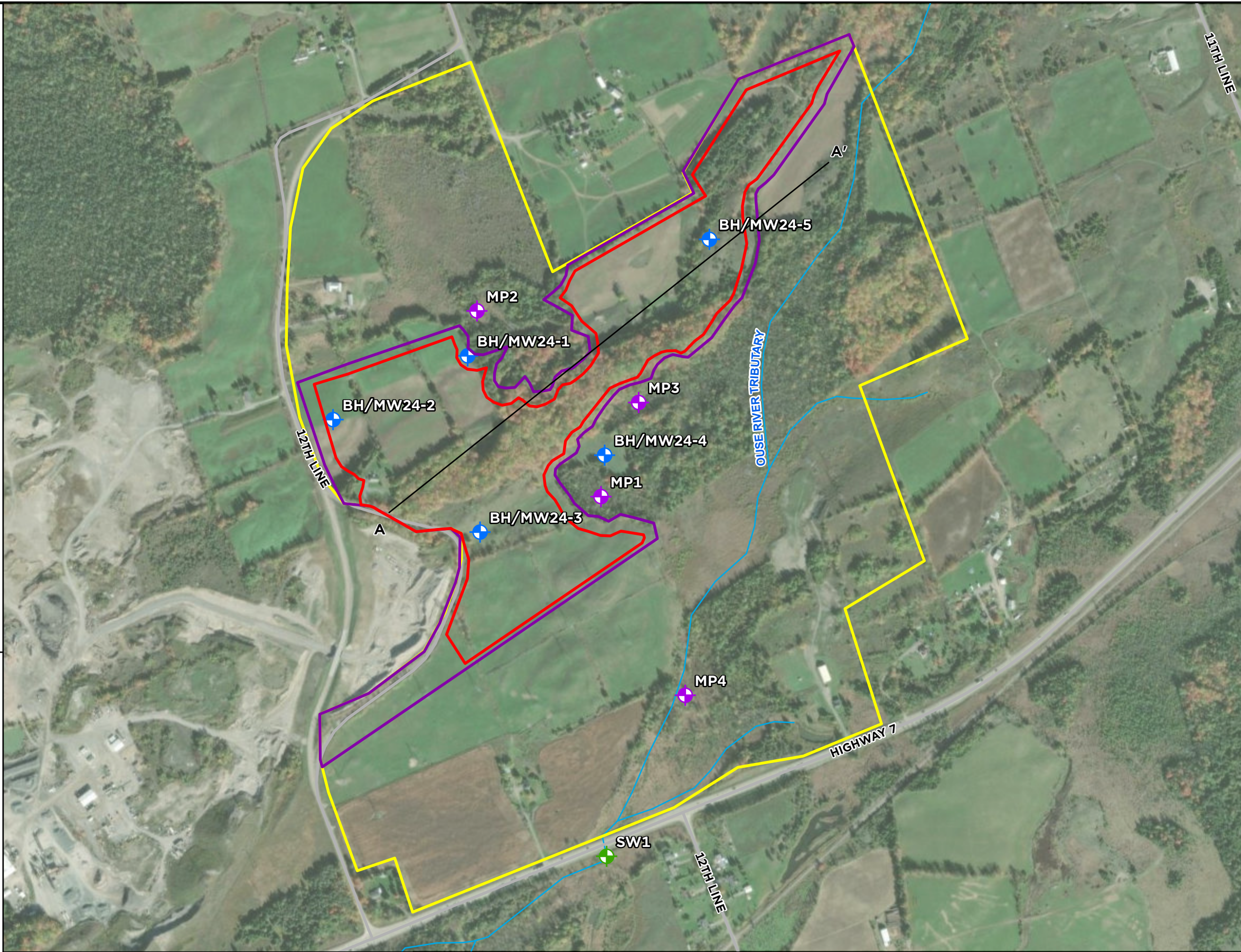
JOB NO. 424400



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

LEGEND

- OTHER LANDS OWNED BY DRAIN BROS
- PROPOSED LIMIT OF EXTRACTION
- LICENSE BOUNDARY
- MONITORING WELL LOCATIONS
- MONITORING POINT LOCATIONS
- SURFACE WATER LOCATIONS
- ROADS
- WATERCOURSE
- CROSS-SECTION



NORWOOD PIT
LEVEL 1 AND 2 HYDROGEOLOGICAL ASSESSMENT
SITE MONITORING LOCATION PLAN

DWG. No.

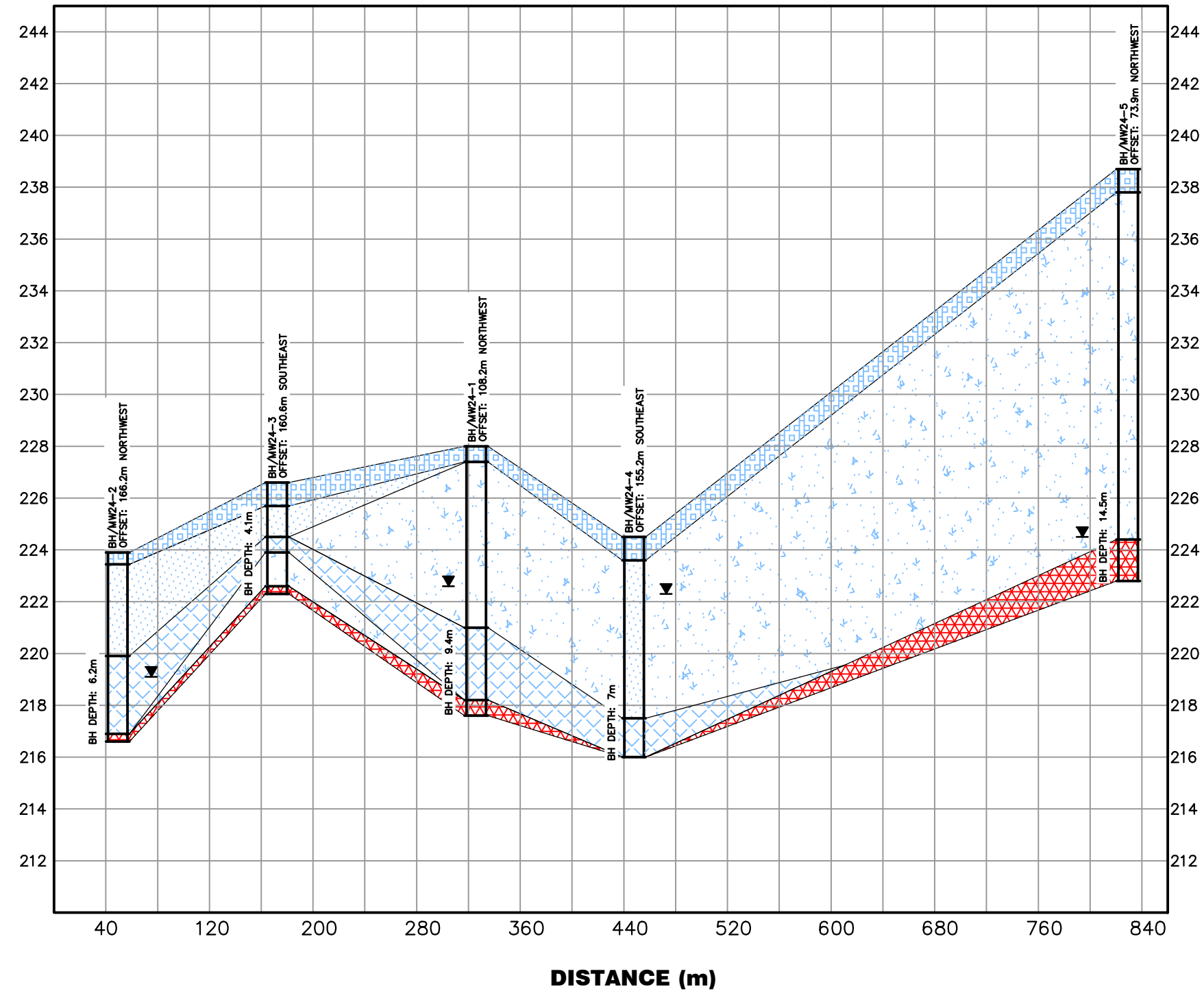
FIG-12

SCALE: 1:7,500	DRAWN: AO	DATE: JUN. 2026	JOB NO. 424400
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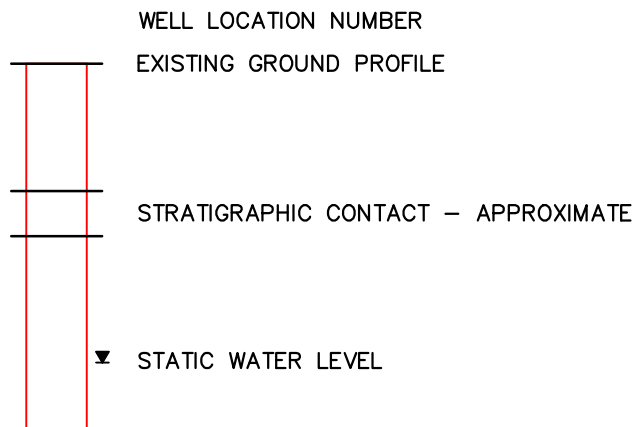
A

ELEVATION (m asl)



A'

LEGEND



HORIZONTAL SCALE: 1:4000
 VERTICAL SCALE: 1:200
 VERTICAL EXAGGERATION: 20X



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

No.
FIG-13

SCALE: AS NOTED | DRAWN: HDY | DATE: SEPT 2025 | JOB NO. 424400



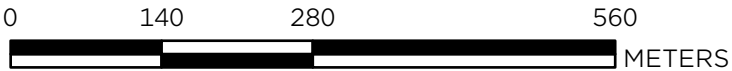
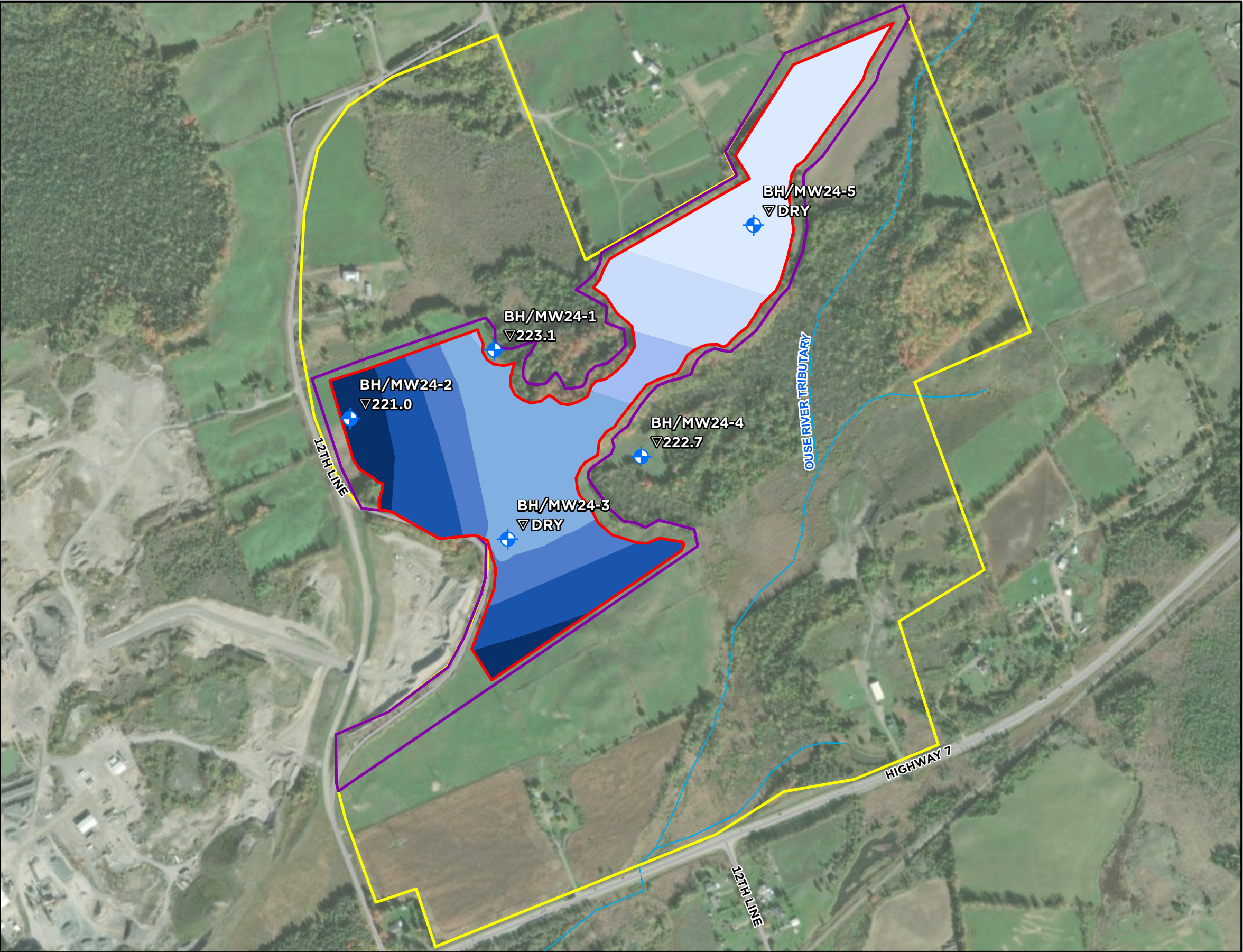
NOTES:
1. COORDINATE SYSTEM: NAD 1983 UTM
ZONE 17N
2. CONTAINS INFORMATION LICENSED
UNDER THE OPEN GOVERNMENT LICENSE -
ONTARIO.

LEGEND

- PROPOSED LIMIT OF EXTRACTION
- LICENSE BOUNDARY
- OTHER LANDS OWNED BY DRAIN BROS
- ROADS
- MONITORING WELL LOCATIONS
- WATERCOURSE

GROUNDWATER ELEVATION (m asl)

- < 221.5
- 221.5-222
- 222-222.5
- 222.5-223
- 223-223.5
- 223.5-224
- > 224



**NORWOOD PIT
LEVEL 1 AND 2 HYDROGEOLOGICAL ASSESSMENT
MAXIMUM GROUNDWATER CONTOURS**

SCALE: 1:7,000

DRAWN: AO

DATE: JUN. 2026

DWG. No.

FIG-14

JOB NO. 424400

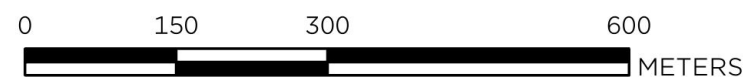
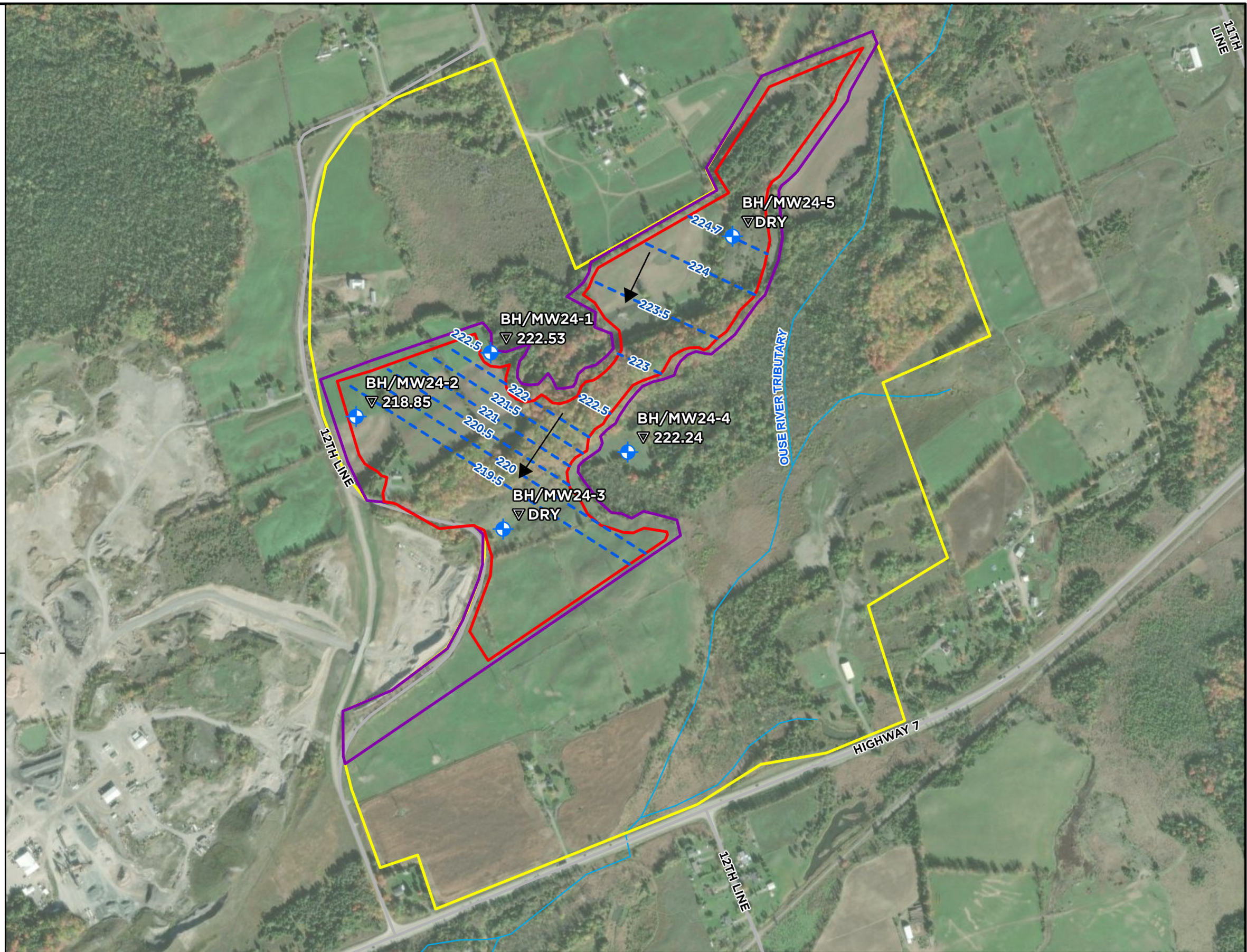


NOTES:

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

LEGEND

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



TATHAM
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NORWOOD PIT
LEVEL 1 AND 2 HYDROGEOLOGICAL ASSESSMENT
GROUNDWATER CONTOUR - JULY 2024

SCALE: 1:7,500

DRAWN: AO

DATE: JUN. 2026

DWG. No.

FIG-15

JOB NO. 424400

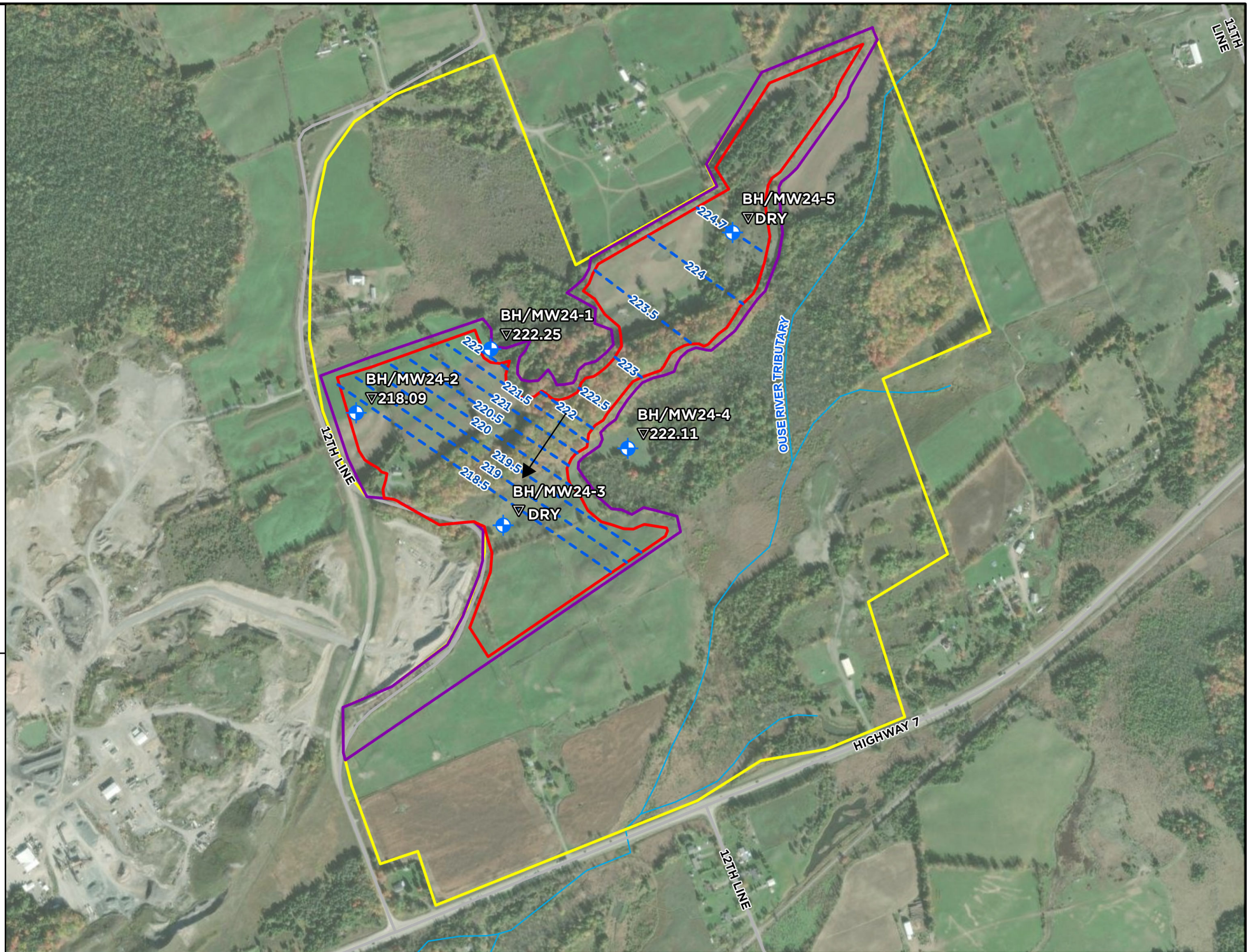


NOTES:

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

LEGEND

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



0 150 300 600
METERS

TATHAM
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NORWOOD PIT
LEVEL 1 AND 2 HYDROGEOLOGICAL ASSESSMENT
GROUNDWATER CONTOUR - OCTOBER 2024

SCALE: 1:7,500

DRAWN: AO

DATE: JUN. 2026

DWG. No.

FIG-16

JOB NO. 424400

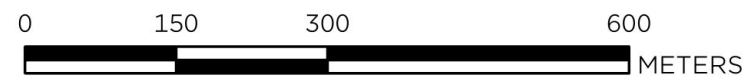
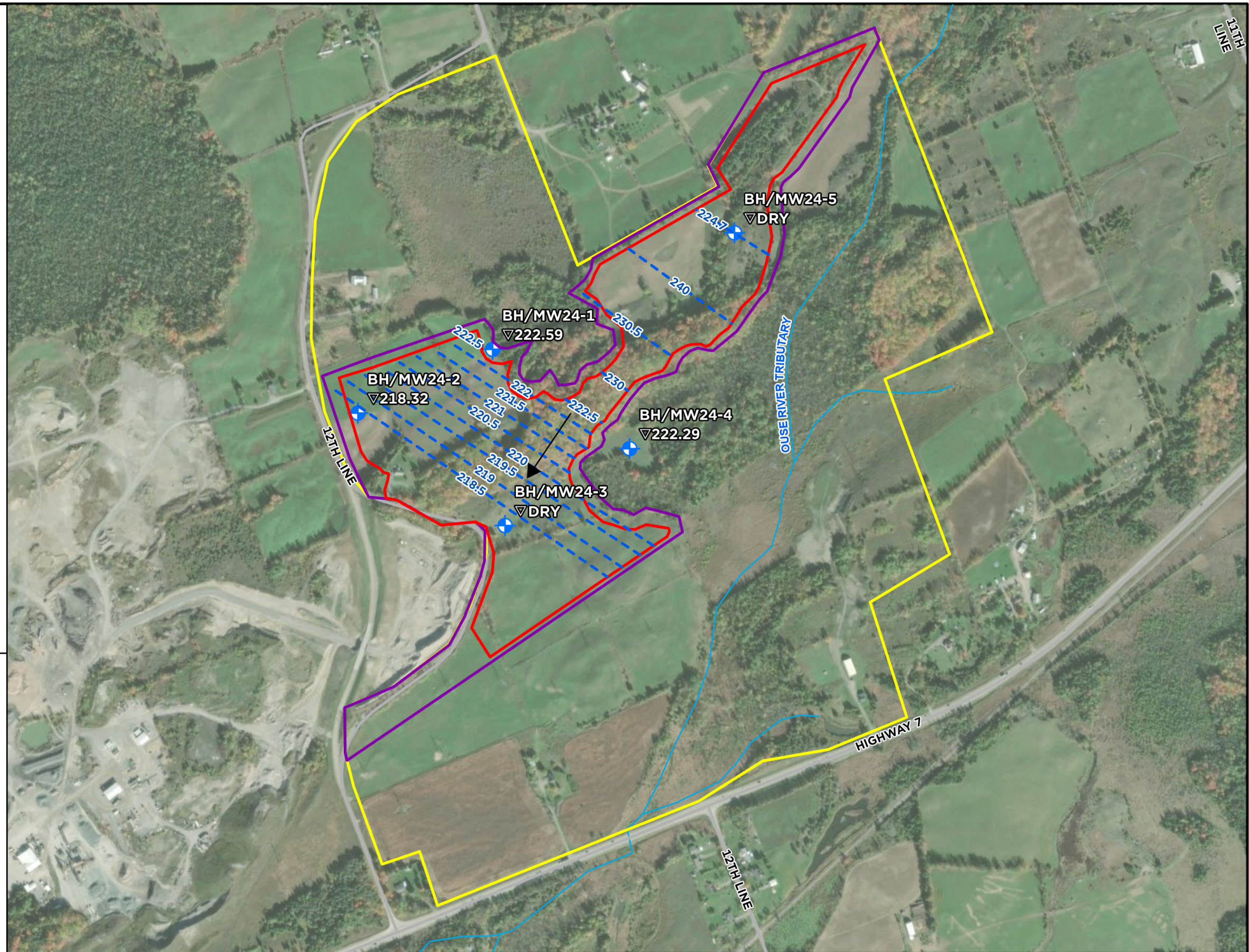


NOTES:

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

LEGEND

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



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

SCALE: 1:7,500

DRAWN: AO

DATE: JUN. 2026

DWG. No.

FIG-17

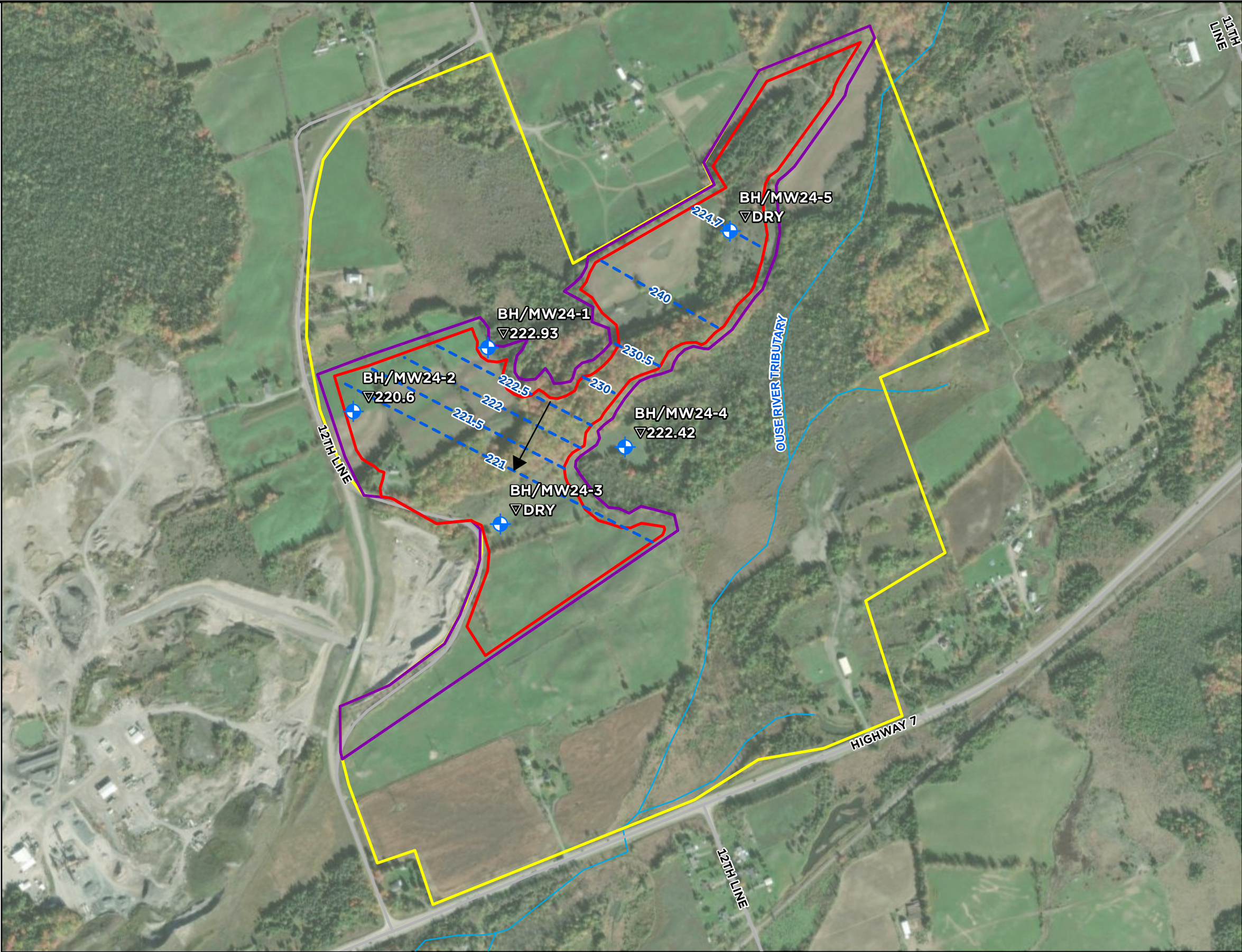
JOB NO. 424400



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

LEGEND

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



		NORWOOD 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. 424400	

Appendix A: MECP Water Well Records

Map ID	Township Con Lot	UTM	Date Centr	Casing Dia	Water	Pump Test	Well Use	Screen Depth	Well	Formation
1	ASPHODEL TOWNSHIP CON 11 020	18 265520 4921332 L	1989/04 2104	6	FR 0033	5/35/6/1:20	ST		5113748 (56899)	BRWN FILL 0008 GREY LMSN 0044
2	ASPHODEL TOWNSHIP CON 11 020	18 265520 4921332 L	1989/01 1673	6	FR 0021	13/20/14/1:15	DO		5114350 (74776)	BRWN STNS CLAY GRVL 0014 GREY LMSN 0034
3	ASPHODEL TOWNSHIP CON 11 020	18 265520 4921332 L	1990/04 6003	6	FR 0021 FR 0148	8/142/4/1:0	DO		5114824 (66686)	GREY CLAY GRVL SAND 0008 GREY LMSN ROCK 0150
4	ASPHODEL TOWNSHIP CON 11 020	18 265520 4921332 L	1991/12 6016	6	FR 0315	17/320/4/2:0	DO		5115686 (105191)	BRWN CLAY 0002 GREY GRVL 0008 GREY LMSN 0140 UNKN 0320
5	ASPHODEL TOWNSHIP CON 11 020	18 265520 4921332 L	1992/11 3651	6 6	FR	14/325/3/2:0	DO		5116098 (120997)	RED HPAN 0010 GREY LMSN 0190 RED GRNT 0325
6	ASPHODEL TOWNSHIP CON 11 020	18 265251 4921438 W	2018/01 7560	6.25	SU 0084	14/22/4/2:	DO		7321875 (Z243106) A218253	BLCK LOAM SOFT 0001 GREY CLAY STNS PCKD 0005 GREY LMSN HARD 0084
7	ASPHODEL TOWNSHIP CON 11 020	18 265066 4921445 W	1964/05 4518	6 6	FR 0017 FR 0024	3/25/15/0:10	DO		5100172 ()	LOAM MSND 0011 GRVL 0015 LMSN 0029
8	ASPHODEL TOWNSHIP CON 11 020	18 266163 4921508 W	2017/11 1455	6.25			DO		7304048 (Z266036) A239735	BRWN SAND FILL 0009 GREY LMSN ROCK 0160 RED GRNT ROCK 0240 BLCK ---- 0300 WHIT GRNT ROCK 0302 RED GRNT 0340 BLCK GRNT 0360
9	ASPHODEL TOWNSHIP CON 12 020	18 266209 4921565 W	1967/08 4811	6					5100175 () A	LOAM 0003 HPAN 0007 LMSN 0040
10	ASPHODEL TOWNSHIP CON 12 020	18 266236 4921594 W	1967/08 4811	6					5100176 () A	LOAM 0003 HPAN 0007 LMSN 0078
11	DUMMER TOWNSHIP CON 11 001	18 265262 4921629 W	1963/06 2203	6 6	SU 0053	10/25/5/1:0	DO		5101212 ()	LMSN 0060
12	ASPHODEL TOWNSHIP CON 12 020	18 266665 4921707 L	1990/10 4923	6	FR 0295	18/250/5/20:3 0	DO		5114932 (89127)	GREY CLAY SNDY 0010 GREY LMSN SHLE 0135 BLCK SHLE 0145 GREY LMSN 0190 RED GRNT 0225 BLCK GRNT 0238 RED GRNT 0270 BLCK GRNT 0275 RED GRNT 0295

Map ID	Township Con Lot	UTM	Date Centr	Casing Dia	Water	Pump Test	Well Use	Screen Depth	Well	Formation
13	ASPHODEL TOWNSHIP CON 12 020	18 266665 4921707 L	1990/10 4923	6	FR 0290	//4/2:30	DO		5114999 (89122)	GREY CLAY SNDY 0010 GREY LMSN SHLE 0135 BLCK SHLE 0145 GREY LMSN 0190 RED GRNT 0225 BLCK GRNT 0238 RED GRNT 0270 BLCK GRNT 0275 RED GRNT 0295 GREY GRNT 0340
14	ASPHODEL TOWNSHIP CON 12 020	18 266665 4921707 L	1990/08 6003		FR 0198	160/200/0/:	NU		5115144 (64304) A	GREY CLAY GRVL PCKD 0008 GREY LMSN SHLE LYRD 0012 GREY LMSN MGRD HARD 0192 RED LMSN SHLE SOFT 0198 RED GRNT HARD CSND 0210
15	ASPHODEL TOWNSHIP CON 12 020	18 266665 4921707 L	1991/11 6564	6	SU 0055	13/62/2/1:30	DO		5115614 (110204)	GREY CLAY STNS LOOS 0003 GREY SHLE 0005 GREY LMSN HARD 0055 BRWN GRNT HARD 0075
16	ASPHODEL TOWNSHIP CON 12 020	18 265970 4921754 W	2005/05 6564	6.4	FR 0026 SU 0059	9/59/2/1:0	DO		5120427 (Z27582) A026423	GREY CLAY STNS 0008 GREY LMSN 0065
17	DUMMER TOWNSHIP CON 11 001	18 265550 4921802 W	1969/07 4811	6	FR 0018	3/10/5/0:30	DO		5106083 ()	LOAM 0003 BRWN MSND 0019
18	ASPHODEL TOWNSHIP	18 265776 4921869 W	2007/10 1455	6.26	FR 0023	18/43/4/1:0	DO		7103840 (Z72842) A058738	BRWN LOAM 0001 GRVL CLAY HARD 0016 DRY GREY SHLE GRVL LYRD 0018 ROCK GREY LMSN 0055
19	DUMMER TOWNSHIP	18 264965 4921907 W	2021/11 7241						7406894 (Z374593) A320379 P	
20	DUMMER TOWNSHIP CON 11 001	18 265407 4921934 L	1995/06 6578	7 6	FR 0042	42/115/2/6:0	DO		5116991 (140879)	GREY GRNT HARD 0042 RED GRNT HARD 0046 GREY GRNT HARD 0120
21	DUMMER TOWNSHIP CON 11 001	17 743107 4922247 L	2000/12 1455	6	FR 0037 FR 0085	26/77/5/2:	DO		5118663 (221596)	BRWN LOAM 0001 BRWN CLAY STNS GRVL 0011 GREY CLAY STNS SHLE 0020 GREY LMSN ROCK 0085
22	DUMMER TOWNSHIP CON 11 002	18 265370 4922307 W	1973/08 1805	6 6	FR 0042	18/30/10/0:30	DO		5106494 ()	GREY GRVL BLDR 0027 GREY LMSN 0042 YLLW LMSN 0051
23	DUMMER TOWNSHIP CON 12 001	18 266563 4922306 L	1990/08 6398	6	FR 0064	25/65/10/3:0	DO		5114836 (85167)	BRWN GRVL SAND CMTD 0057 GREY LMSN 0065
24	DUMMER TOWNSHIP CON 12 001	18 266563 4922306 L	1991/08 6564	6	FR 0024 FR 0030	18/20//:	DO		5115537 (110188)	YLLW SAND BLDR 0006 GREY LMSN 0030

Map ID	Township Con Lot	UTM	Date Centr	Casing Dia	Water	Pump Test	Well Use	Screen Depth	Well	Formation
25	DUMMER TOWNSHIP CON 11 002	18 265228 4922520 L	1986/09 4923	6	FR 0050	45/140/1/2:30	DO		5111933 (NA)	BLCK LOAM 0001 GREY GRVL CLAY STNS 0030 GREY LMSN SHLE 0035 GREY LMSN LYRD 0145
26	DUMMER TOWNSHIP CON 11 002	18 265228 4922520 L	1992/10 3367	6 6	FR 0055	20/25/20/1:30	DO		5116064 (118596)	BRWN LOAM SOFT 0001 RED SAND STNS LOOS 0009 RED BLDR HARD 0013 RED SAND STNS LOOS 0016 GREY STNS SAND PCKD 0029 GREY SHLE LMSN LYRD 0033 GREY LMSN HARD 0055
27	BELMONT & METHUEN TO CON 12 006	18 267159 4922610 L	1990/05 6398	6	FR 0095	18/100/5/2:30	DO		5114639 (77406)	BRWN SAND STNS LOOS 0015 GREY LMSN 0092 BRWN LMSN 0100
28	BELMONT & METHUEN TO CON 12 006	18 267159 4922610 L	1996/01 6564	6 6	UK 0020 UK 0060	5/18//2:0	DO		5117227 (153537)	BRWN CLAY STNS 0009 GREY LMSN 0075
29	DUMMER TOWNSHIP CON 12 003	18 266209 4922950 W	1951/06 3121	5 5	FR 0032	26/26/4/1:30	DO		5101220 ()	CLAY GRVL 0020 LMSN 0037
30	DUMMER TOWNSHIP CON 11 003	18 265480 4923222 W	1980/08 4008	6	FR 0058 FR 0067	38/44/20/1:0	DO		5109984 ()	BRWN HPAN BLDR OBDN 0033 GREY STNS LMSN 0070
31	BELMONT & METHUEN TO 06	18 265497 4923295 W	2008/05 6564	6.11	UK 0032	5/12/6/1:0			7111412 (Z77740) A070112	BRWN CLAY STNS 0001 BLCK GRNT 0040
32	DUMMER TOWNSHIP CON 12 003	18 266195 4923508 L	1991/10 6564	6	FR 0045	31/37/15/1:0	DO ST		5115618 (110202)	BRWN LOAM LOOS 0002 BRWN SAND BLDR 0008 BRWN HPAN SHLE LYRD 0025 BRWN LMSN 0040 BRWN SHLE GRVL 0050
33	DUMMER TOWNSHIP CON 11 004	18 265480 4923672 W	1976/11 2104	6	FR 0020	5/8/15/2:0	DO		5108262 ()	BRWN LOAM SOFT 0001 BRWN GRVL CLAY STNS 0008 GREY LMSN HARD 0020



Ministry of the Environment, Conservation and Parks
Water Well Records

Map ID
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

8

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
	18 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	GYPG 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

PAGE 1 OF 1

CLIENT Drain Bros Excavating Ltd.

PROJECT NAME Norwood Pit Expansion, Duoro-Dummer

PROJECT NUMBER 424400

LOCATION 145 Dummer 12th Line Rd, 4818 Hwy 7 & 4862 Hwy 7

DATE STARTED 5/27/24 COMPLETED 5/27/24

GROUND ELEVATION 228 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 5.32 m / Elev 222.68 m

DEPTH (m)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
				Stick Up Casing
	1		0.60 TOPSOIL: Brown, sand, trace to some gravel, trace organics, moist 227.40	
2	2		SAND AND GRAVEL: Brown, sand and gravel, cobbles and boulders, moist	
	3			
4	4			
	5		First water strike at 5.5 m	
6	6		7.00 SILTY SAND TILL: Red to grey, silty sand, trace to some gravel, cobbles and boulders, sand and gravel layers throughout 221.00	
8	7			
	8		9.80 LIMESTONE 218.20	
10			10.40 Borehole terminated at 10.4 m bgs 217.60	

Bentonite
holeplug seal

Filter sand
and 50 mm
diameter
slotted screen

Upon completion of drilling:
No cave
Water at 5.3 m



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

WELL NUMBER BH/MW24-2

PAGE 1 OF 1

CLIENT Drain Bros Excavating Ltd.
PROJECT NUMBER 424400
DATE STARTED 5/24/24 **COMPLETED** 5/24/24
DRILLING CONTRACTOR Choice Sonic Drilling Ltd.
DRILLING METHOD Sonic Drilling
LOGGED BY NT **CHECKED BY** KG
NOTES _____

PROJECT NAME Norwood Pit Expansion, Duoro-Dummer
LOCATION 145 Dummer 12th Line Rd, 4818 Hwy 7 & 4862 Hwy 7
GROUND ELEVATION 223.4 m **HOLE SIZE** 4.75"
GROUND WATER LEVELS:
AT TIME OF DRILLING ---
AT END OF DRILLING ---
▼ AFTER DRILLING 3.93 m / Elev 219.97 m

DEPTH (m)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
				Stick Up Casing
	1		TOPSOIL: Dark brown, sand, trace silt, trace organics, moist 0.46 223.44	
2	2		SAND: Brown, sand, trace gravel, moist to wet	
	3		First water strike at 2.4 m	
4	4		SILTY SAND TILL: Brown, silty sand, trace to some gravel, cobbles and boulders, moist to wet 4.00 219.90	
6	5		LIMESTONE	
	6		LIMESTONE 7.00 216.90 7.30 216.60	

Borehole terminated at 7.3 m bgs

Upon completion of drilling:
No cave
Water at 3.9 m



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

WELL NUMBER BH/MW24-3

PAGE 1 OF 1

CLIENT Drain Bros Excavating Ltd.

PROJECT NAME Norwood Pit Expansion, Duoro-Dummer

PROJECT NUMBER 424400

LOCATION 145 Dummer 12th Line Rd, 4818 Hwy 7 & 4862 Hwy 7

DATE STARTED 5/24/24 COMPLETED 5/24/24

GROUND ELEVATION 225.4 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 ---

DEPTH (m)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
				Stick Up Casing
	1		TOPSOIL: Dark brown and black, sand, trace to some silt, moist 0.90 225.70	 Bentonite holeplug seal Filter sand and 50 mm diameter slotted screen
2	2		SAND: Brown, sand, moist 2.10 224.50	
			SILTY SAND TILL: Brown, silty sand, trace to some gravel, cobbles and boulders, moist to wet 2.70 223.90	
	3		SAND AND GRAVEL: Brown and grey, sand and gravel, trace clay, very moist to wet First water strike at 3.0 m	
4			LIMESTONE 4.00 222.60	
	4		LIMESTONE 4.30 222.30	
			Borehole terminated at 4.3 m bgs	Upon completion of drilling: No cave No water



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L4N 9H8
Telephone: 7057339037

WELL NUMBER BH/MW24-4

PAGE 1 OF 1

CLIENT Drain Bros Excavating Ltd.

PROJECT NAME Norwood Pit Expansion, Duoro-Dummer

PROJECT NUMBER 424400

LOCATION 145 Dummer 12th Line Rd, 4818 Hwy 7 & 4862 Hwy 7

DATE STARTED 5/24/24 COMPLETED 5/24/24

GROUND ELEVATION 224.5 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 2.14 m / Elev 222.36 m

DEPTH (m)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
				Stick Up Casing
	1		TOPSOIL: Dark brown, sand, trace silt, trace gravel, moist	
			0.90	223.60
	2		SAND: Brown, sand, trace to some gravel, moist to wet	
2				Bentonite holeplug seal
	3		First water strike at 2.4 m	
4				
	4			
6				
	5			
			7.00	217.50
	6		SILTY SAND TILL: Brown to grey, silty sand, trace to some gravel, cobbles and boulders, moist to wet	
8				
			8.50	216.00
			Grey silty sand layer from 8.2 to 8.5 m	
			Borehole terminated at 8.5 m bgs	Upon completion of drilling: No cave Water at 2.1 m

GENERAL BH / TP / WELL 424400 - NORWOOD PIT BH LOGS.GPJ GINT STD CANADA LAB.GDT 6/26/25



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

WELL NUMBER BH/MW24-5

PAGE 1 OF 1

CLIENT Drain Bros Excavating Ltd.

PROJECT NAME Norwood Pit Expansion, Duoro-Dummer

PROJECT NUMBER 424400

LOCATION 145 Dummer 12th Line Rd, 4818 Hwy 7 & 4862 Hwy 7

DATE STARTED 5/27/24 COMPLETED 5/27/24

GROUND ELEVATION 238.7 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 14.26 m / Elev 224.44 m

DEPTH (m)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
				Stick Up Casing
	1		TOPSOIL: Dark brown, sand, trace silt, trace to some gravel, trace organics, moist 0.90 237.80	
	2		SAND AND GRAVEL: Brown, sand and gravel, trace to some silt, cobbles and boulders, moist	
	3			
5	4			
	5			
	6			
	7			
10	8			
	9			
	10			
			14.30 224.40	
15	11		LIMESTONE	
			15.90 222.80	

Bentonite
holeplug seal

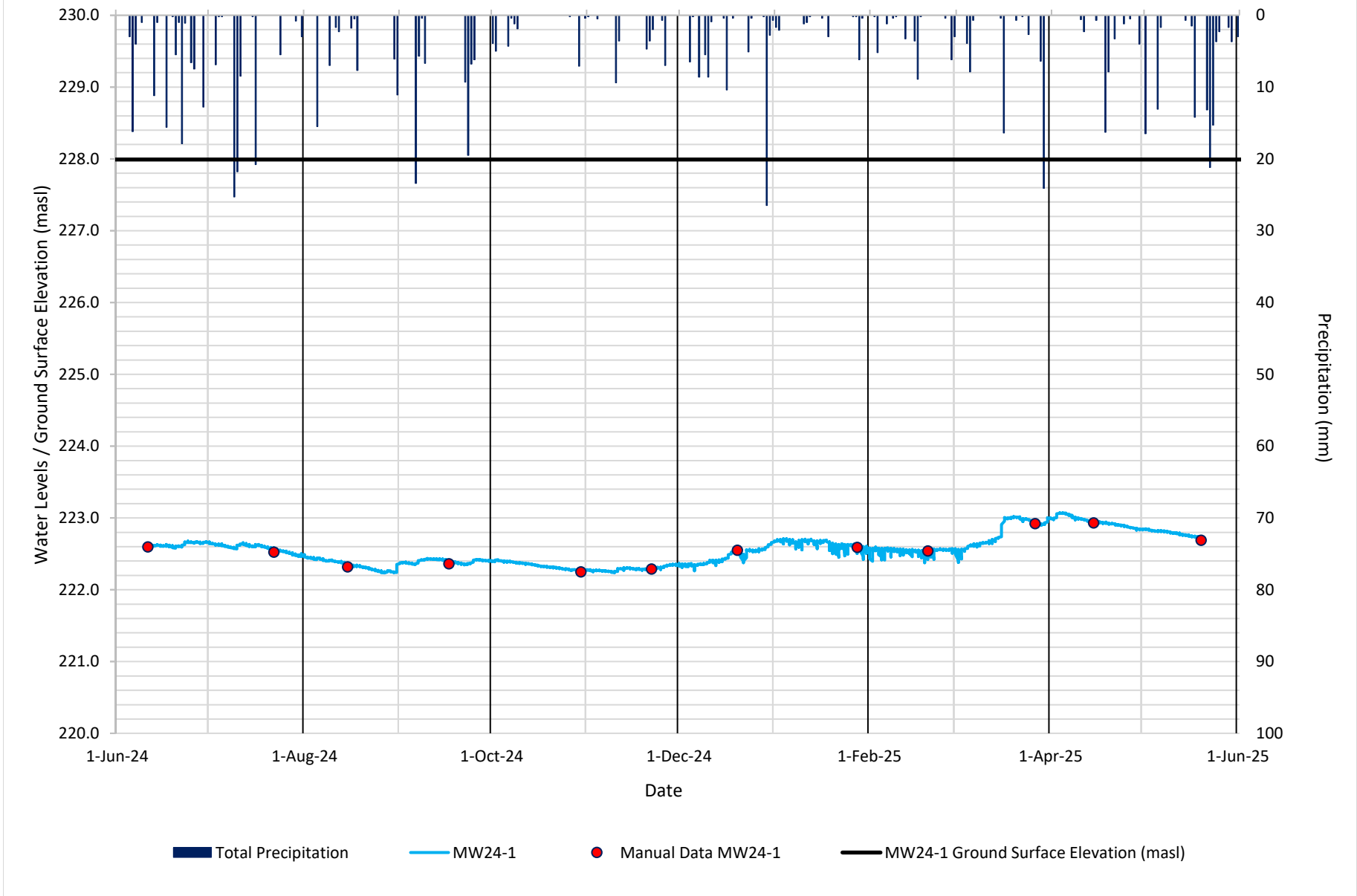
Filter sand
and 50 mm
diameter
slotted screen

Borehole terminated at 15.9 m bgs

Upon completion of drilling:
No cave
Water at 14.3 m

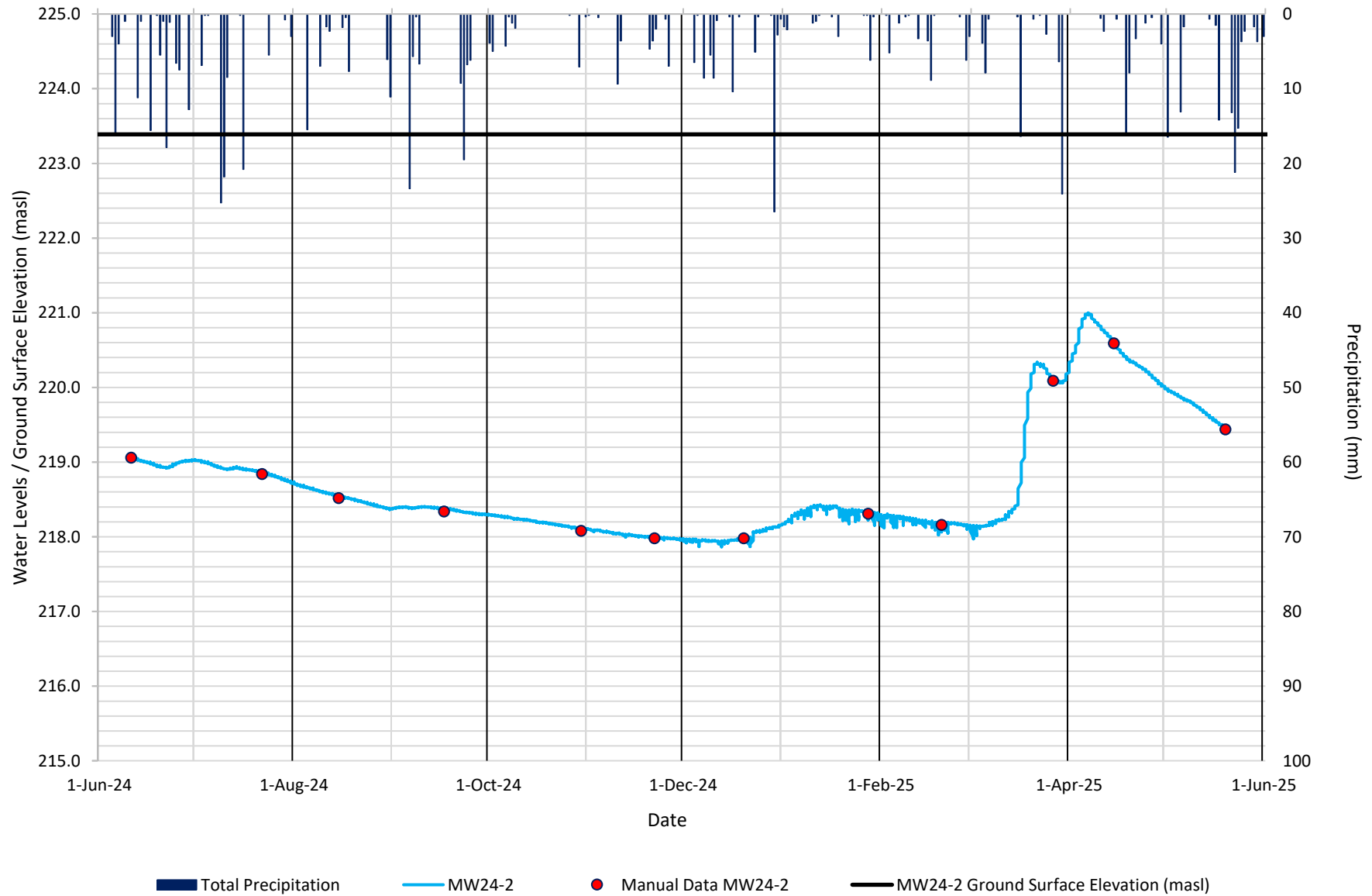
Appendix C: On-Site Monitoring Well Hydrographs

Norwood Pit Monitoring Well (MW24-1)
Water Levels June 2024 - May 2025



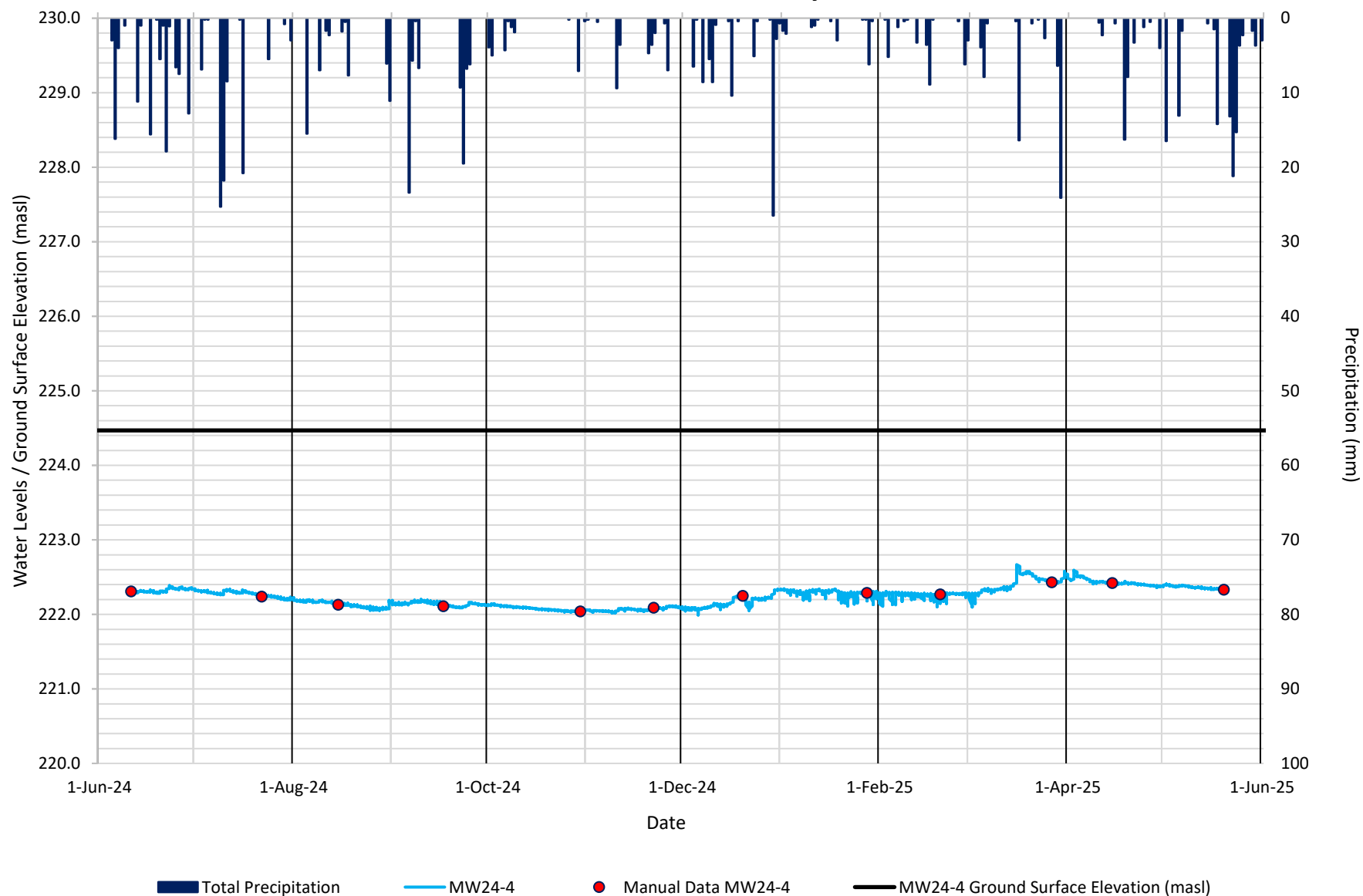
Norwood Pit Monitoring Well (MW24-2)

Water Levels June 2024 - May 2025



Norwood Pit Monitoring Well (MW24-4)

Water Levels June 2024 - May 2025



Appendix D: Groundwater Quality Results

C.O.C.: -

REPORT No: 24-017546 - Rev. 0

Report To:

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

CADUCEON Environmental Laboratories

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

Attention: Kimberly Gardner

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

CUSTOMER PROJECT: 424400 - Norwood Pit
P.O. NUMBER:

Analyses	Qty	Site Analyzed	Authorized	Date Analyzed	Lab Method	Reference Method
Anions (Liquid)	3	OTTAWA	PCURIEL	2024-Jun-14	A-IC-01	SM 4110B
Cond/pH/Alk Auto (Liquid)	3	OTTAWA	SLOZO	2024-Jun-17	COND-02/PH-02/A LK-02	SM 2510B/4500H/ 2320B
ICP/MS (Liquid)	3	OTTAWA	AOZKAYMAK	2024-Jun-17	D-ICPMS-01	EPA 200.8
ICP/OES (Liquid)	3	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

CADUCEON Environmental Laboratories Certificate of Analysis

Final Report

REPORT No: 24-017546 - Rev. 0

Parameter	Units	R.L.	Limits	Client I.D.	MW 24-1	MW 24-2	MW 24-4
				Sample I.D.	24-017546-1	24-017546-2	24-017546-3
				Date Collected	2024-Jun-12	2024-Jun-12	2024-Jun-12
				DWG	-	-	-
Alkalinity(CaCO3) to pH4.5	mg/L	5	500	OG	259	237	232
Bicarbonate (as CaCO3)	mg/L	5			259	237	232
Conductivity @25°C	uS/cm	1			501	737	445
pH @25°C	pH units	-	8.5	OG	7.49	7.62	7.69
Chloride	mg/L	0.5	250	AO	1.9	22.3	1.5
Nitrate (N)	mg/L	0.05	10.0	MAC	0.06	25.3	0.13
Nitrite (N)	mg/L	0.05	1.0	MAC	<0.05	0.21	<0.05
Sulphate	mg/L	1	500	AO	2	7	6
Hardness (as CaCO3)	mg/L as CaCO3	0.02	100	OG	264	360	239
Aluminum	mg/L	0.01	0.1	OG	0.04	0.04	0.03
Barium	mg/L	0.001	1	MAC	0.080	0.074	0.129
Bismuth	mg/L	0.02			<0.02	<0.02	<0.02
Boron	mg/L	0.005	5	MAC	0.007	0.006	0.006
Calcium	mg/L	0.02			94.5	126	79.4
Iron	mg/L	0.005	0.3	AO	2.44	<0.005	<0.005
Lithium	mg/L	0.005			<0.005	<0.005	<0.005
Magnesium	mg/L	0.02			6.64	11.0	9.91
Manganese	mg/L	0.001	0.05	AO	0.274	0.016	0.019
Phosphorus	mg/L	0.1			<0.1	<0.1	<0.1
Potassium	mg/L	0.1			1.0	1.2	1.7
Silicon	mg/L	0.01			4.13	3.02	3.51



Michelle Dubien
Data Specialist

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REPORT No: 24-017546 - Rev. 0

Parameter	Units	R.L.	Limits	Client I.D.	Sample I.D.	Date Collected	DWG	MW 24-1	MW 24-2	MW 24-4
								24-017546-1	24-017546-2	24-017546-3
								2024-Jun-12	2024-Jun-12	2024-Jun-12
								-	-	-
Silica	mg/L	0.02						8.83	6.47	7.52
Sodium	mg/L	0.2	200, 20, 20	AO, WL, MAC				1.7	2.3	1.7
Strontium	mg/L	0.001						0.167	0.218	0.308
Tin	mg/L	0.05						<0.05	<0.05	<0.05
Titanium	mg/L	0.005						<0.005	<0.005	<0.005
Tungsten	mg/L	0.01						<0.01	0.01	<0.01
Yttrium	mg/L	0.005						<0.005	<0.005	<0.005
Zinc	mg/L	0.005	5	AO				<0.005	<0.005	<0.005
Zirconium	mg/L	0.003						<0.003	<0.003	<0.003
Antimony	mg/L	0.0001	0.006	MAC				<0.0001	<0.0001	<0.0001
Arsenic	mg/L	0.0001	0.01	MAC				0.0016	0.0001	0.0001
Beryllium	mg/L	0.0001						<0.0001	<0.0001	<0.0001
Cadmium	mg/L	0.000015	0.005	MAC				<0.000015	<0.000015	<0.000015
Chromium	mg/L	0.001	0.05	MAC				<0.001	<0.001	<0.001
Cobalt	mg/L	0.0001						0.0006	0.0003	0.0006
Copper	mg/L	0.0001	1	AO				0.0049	0.0049	0.0021
Lead	mg/L	0.00002	0.010	MAC				0.00006	0.00005	<0.00002
Molybdenum	mg/L	0.0001						0.0002	0.0004	0.0004
Nickel	mg/L	0.0002						0.0010	0.0010	0.0007
Selenium	mg/L	0.001	0.05	MAC				<0.001	<0.001	<0.001
Silver	mg/L	0.0001						<0.0001	<0.0001	<0.0001



Michelle Dubien
Data Specialist

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					Client I.D.	MW 24-1	MW 24-2	MW 24-4
					Sample I.D.	24-017546-1	24-017546-2	24-017546-3
					Date Collected	2024-Jun-12	2024-Jun-12	2024-Jun-12
Parameter	Units	R.L.	Limits	DWG		-	-	-
Thallium	mg/L	0.00005				<0.00005	<0.00005	<0.00005
Uranium	mg/L	0.00005	0.02	MAC		0.00008	0.00025	0.00026
Vanadium	mg/L	0.0001				0.0022	0.0001	0.0002

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
Iron	2.44	0.3
Manganese	0.274	0.05
Maximum Acceptable Concentration		
MW 24-2	Found Value	Limit
Nitrate (N)	25.3	10.0
Operational Guidelines		
MW 24-1	Found Value	Limit
Hardness (as CaCO ₃)	264	100
MW 24-2	Found Value	Limit
Hardness (as CaCO ₃)	360	100
MW 24-4	Found Value	Limit
Hardness (as CaCO ₃)	239	100



Michelle Dubien

Data Specialist

C.O.C.: -

REPORT No: 24-034138 - Rev. 0

Report To:

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

CADUCEON Environmental Laboratories

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

Attention: Kimberly Gardner

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

CUSTOMER PROJECT: 424400 - Norwood Pit
P.O. NUMBER: Norwood Pit

Analyses	Qty	Site Analyzed	Authorized	Date Analyzed	Lab Method	Reference Method
Anions (Liquid)	3	OTTAWA	PCURIEL	2024-Nov-01	A-IC-01	SM 4110B
Cond/pH/Alk Auto (Liquid)	3	OTTAWA	SBOUDREAU	2024-Nov-01	COND-02/PH-02/A LK-02	SM 2510B/4500H/ 2320B
ICP/MS (Liquid)	3	OTTAWA	AOZKAYMAK	2024-Nov-04	D-ICPMS-01	EPA 200.8
ICP/OES (Liquid)	3	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: 24-034138 - Rev. 0

Parameter	Units	R.L.	Limits	Client I.D.	BH/MW 24-1	BH/MW 24-2	BH/MW 24-4
				Sample I.D.	24-034138-1	24-034138-2	24-034138-3
				Date Collected	2024-Oct-30	2024-Oct-30	2024-Oct-30
				DWG	-	-	-
Alkalinity(CaCO3) to pH4.5	mg/L	5	500	OG	285	273	235
Bicarbonate (as CaCO3)	mg/L	5			285	273	235
Conductivity @25°C	uS/cm	1			513	649	436
pH @25°C	pH units	-	8.5	OG	7.94	7.89	7.97
Chloride	mg/L	0.5	250	AO	2.0	14.6	1.3
Nitrate (N)	mg/L	0.05	10.0	MAC	0.08	12.6	0.09
Nitrite (N)	mg/L	0.05	1.0	MAC	<0.05	<0.05	<0.05
Sulphate	mg/L	1	500	AO	<1	5	6
Hardness (as CaCO3)	mg/L as CaCO3	0.02	100	OG	286	347	244
Aluminum	mg/L	0.01	0.1	OG	0.03	0.06	0.02
Barium	mg/L	0.001	1	MAC	0.078	0.062	0.124
Bismuth	mg/L	0.02			<0.02	<0.02	<0.02
Boron	mg/L	0.005	5	MAC	0.011	0.011	0.007
Calcium	mg/L	0.02			102	122	81.2
Iron	mg/L	0.005	0.3	AO	3.37	0.138	<0.005
Lithium	mg/L	0.005			<0.005	<0.005	<0.005
Magnesium	mg/L	0.02			7.24	10.3	10.0
Manganese	mg/L	0.001	0.05	AO	0.236	0.440	0.002
Phosphorus	mg/L	0.1			<0.1	<0.1	<0.1
Potassium	mg/L	0.1			1.2	1.1	1.6
Silicon	mg/L	0.01			4.14	3.38	3.46



Michelle Dubien
Data Specialist

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Final Report

REPORT No: 24-034138 - Rev. 0

Parameter	Units	R.L.	Limits	DWG	Client I.D.	BH/MW 24-1	BH/MW 24-2	BH/MW 24-4
					Sample I.D.	24-034138-1	24-034138-2	24-034138-3
					Date Collected	2024-Oct-30	2024-Oct-30	2024-Oct-30
						-	-	-
Silica	mg/L	0.02				8.87	7.24	7.41
Sodium	mg/L	0.2	200, 20, 20	AO, WL, MAC		2.0	2.1	1.7
Strontium	mg/L	0.001				0.182	0.231	0.308
Tin	mg/L	0.05				<0.05	<0.05	<0.05
Titanium	mg/L	0.005				<0.005	<0.005	<0.005
Tungsten	mg/L	0.01				<0.01	<0.01	<0.01
Yttrium	mg/L	0.005				<0.005	<0.005	<0.005
Zinc	mg/L	0.005	5	AO		<0.005	<0.005	<0.005
Zirconium	mg/L	0.003				<0.003	<0.003	<0.003
Antimony	mg/L	0.0001	0.006	MAC		<0.0001	<0.0001	<0.0001
Arsenic	mg/L	0.0001	0.01	MAC		0.0020	0.0026	0.0001
Beryllium	mg/L	0.0001				<0.0001	<0.0001	<0.0001
Cadmium	mg/L	0.000015	0.005	MAC		<0.000015	<0.000015	<0.000015
Chromium	mg/L	0.001	0.05	MAC		<0.001	<0.001	<0.001
Cobalt	mg/L	0.0001				0.0005	0.0023	0.0002
Copper	mg/L	0.0001	1	AO		<0.0001	0.0005	0.0003
Lead	mg/L	0.00002	0.010	MAC		<0.00002	0.00004	<0.00002
Molybdenum	mg/L	0.0001				0.0001	0.0010	0.0002
Nickel	mg/L	0.0002				0.0010	0.0019	0.0006
Selenium	mg/L	0.001	0.05	MAC		<0.001	<0.001	<0.001
Silver	mg/L	0.0001				<0.0001	<0.0001	<0.0001



Michelle Dubien
Data Specialist

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Final Report

REPORT No: 24-034138 - Rev. 0

					Client I.D.	BH/MW 24-1	BH/MW 24-2	BH/MW 24-4
					Sample I.D.	24-034138-1	24-034138-2	24-034138-3
					Date Collected	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
Uranium	mg/L	0.00005	0.02	MAC		<0.00005	0.00026	0.00016
Vanadium	mg/L	0.0001				0.0028	0.0017	0.0002

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		
BH/MW 24-1	Found Value	Limit
Iron	3.37	0.3
Manganese	0.236	0.05
BH/MW 24-2	Found Value	Limit
Manganese	0.440	0.05
Maximum Acceptable Concentration		
BH/MW 24-2	Found Value	Limit
Nitrate (N)	12.6	10.0
Operational Guidelines		
BH/MW 24-1	Found Value	Limit
Hardness (as CaCO ₃)	286	100
BH/MW 24-2	Found Value	Limit
Hardness (as CaCO ₃)	347	100
BH/MW 24-4	Found Value	Limit
Hardness (as CaCO ₃)	244	100



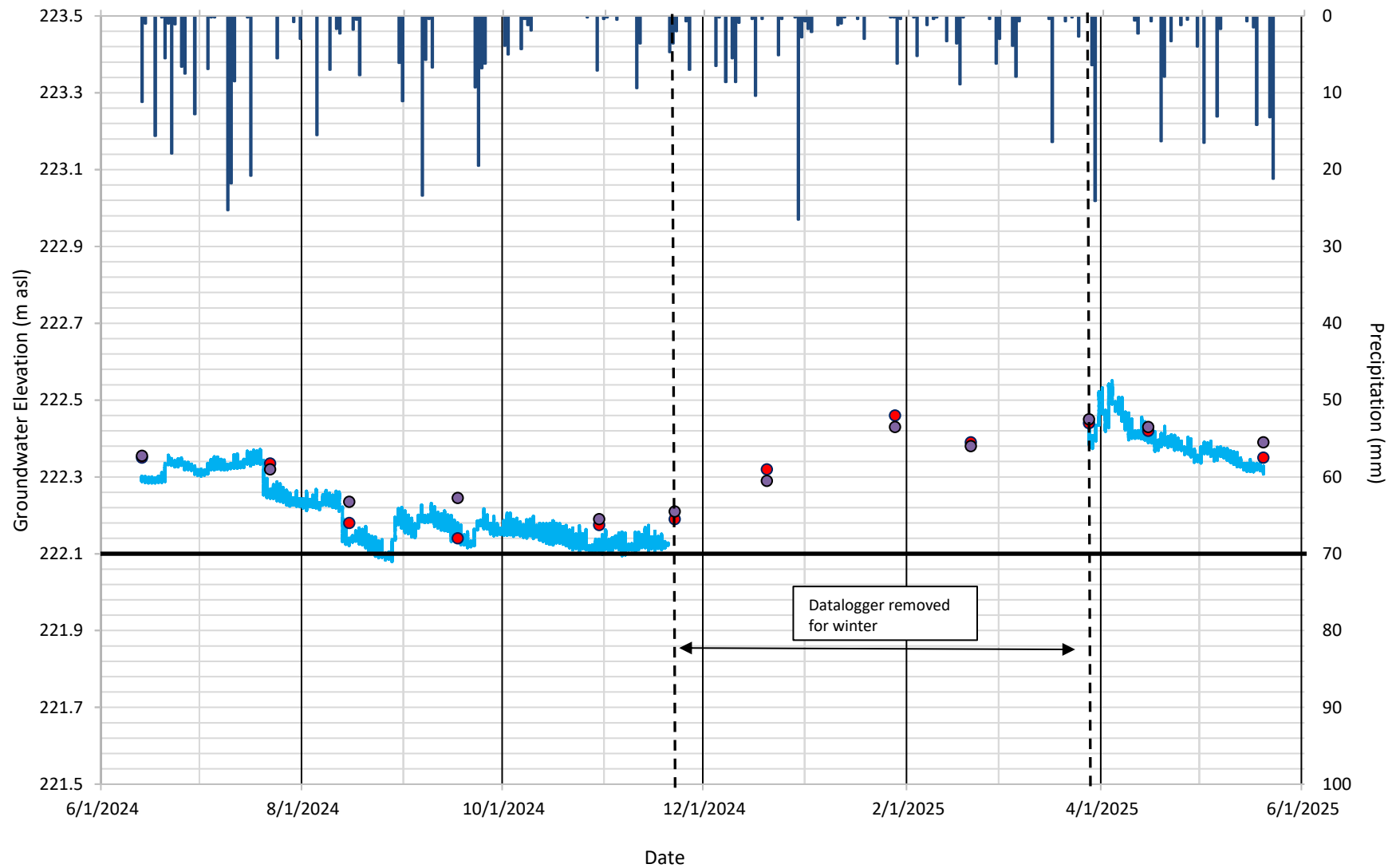
Michelle Dubien

Data Specialist

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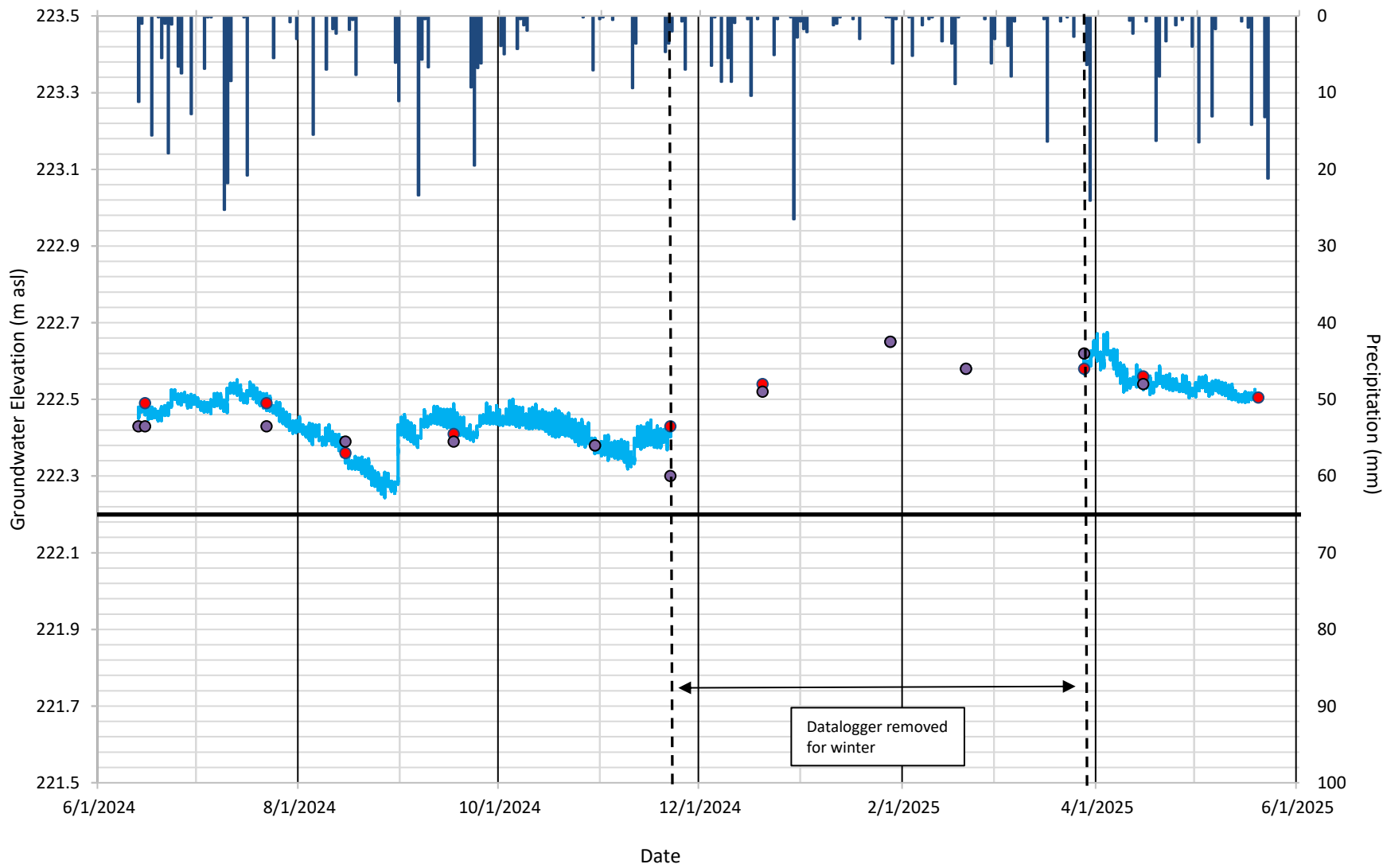
Appendix E: Wetland and Surface Water Hydrographs and Ratings Curve

Monitoring Point (MP1)



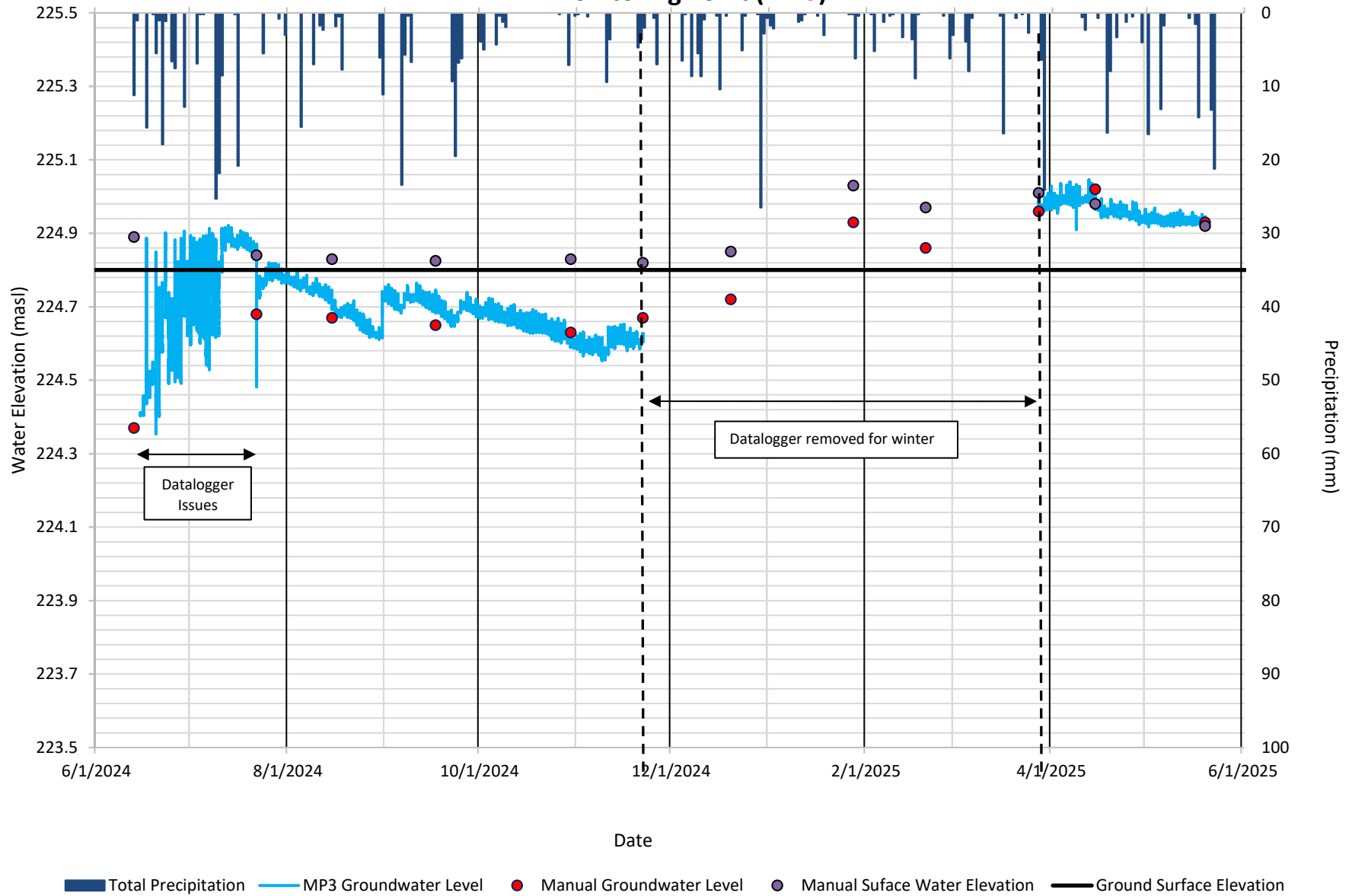
■ Total Precipitation — MP1 Groundwater Level ● Manual Groundwater Level ● Manual Surface Water Elevation — Ground Surface Elevation

Monitoring Point (MP2)

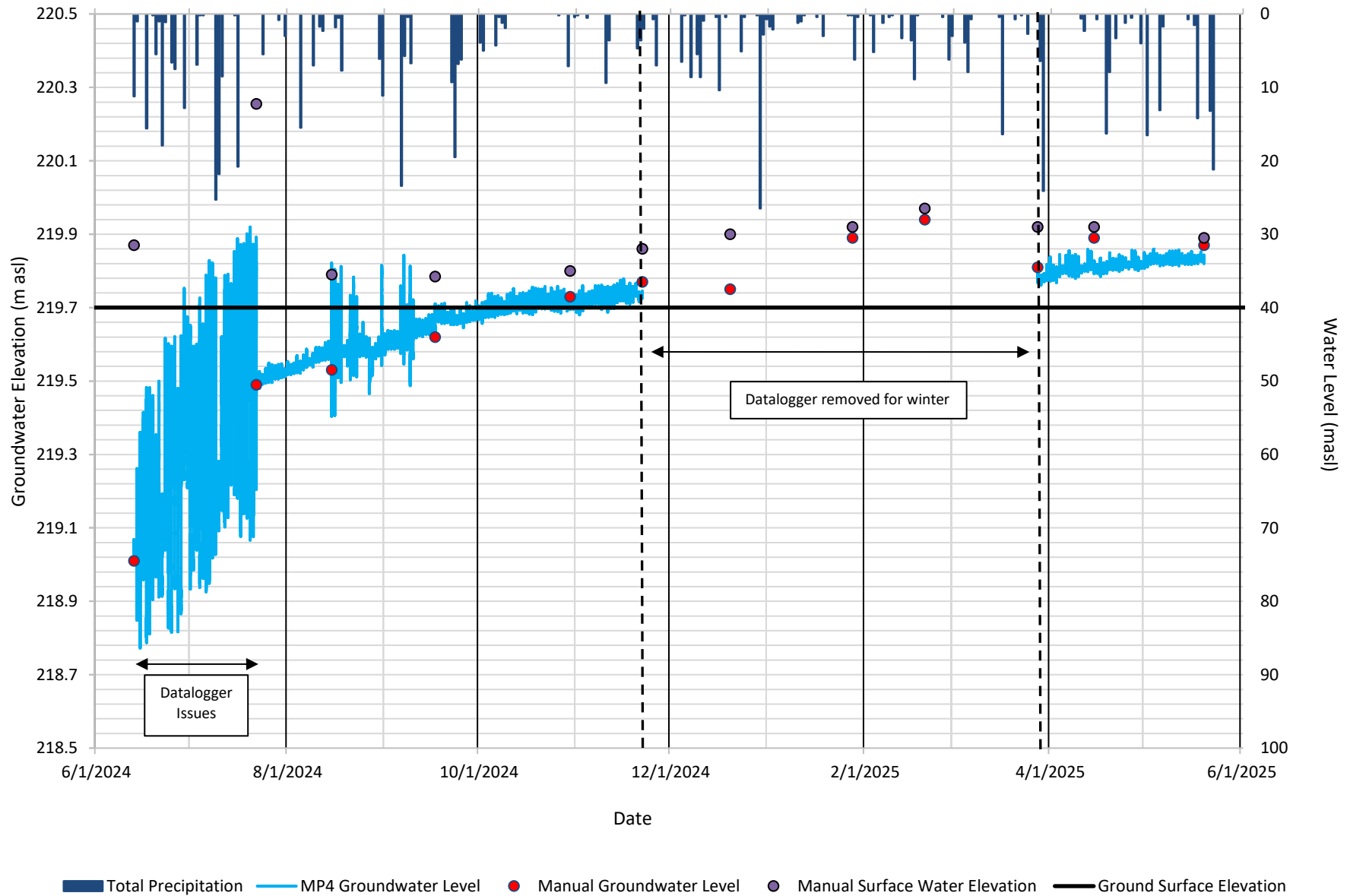


■ Total Precipitation — MP2 Groundwater Level ● Manual Groundwater Level ● Manual Surface Water Elevation — Ground Surface

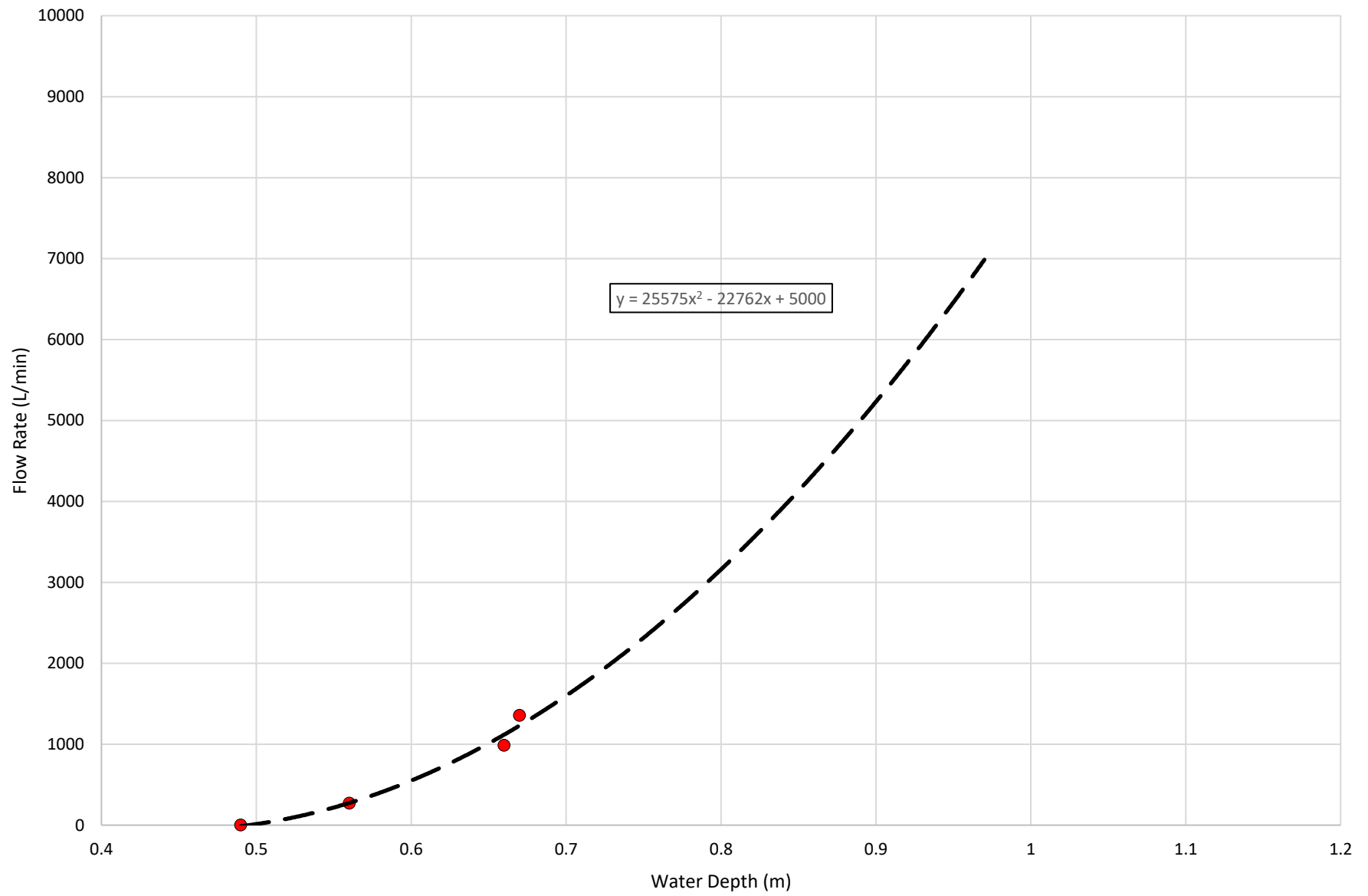
Monitoring Point (MP3)



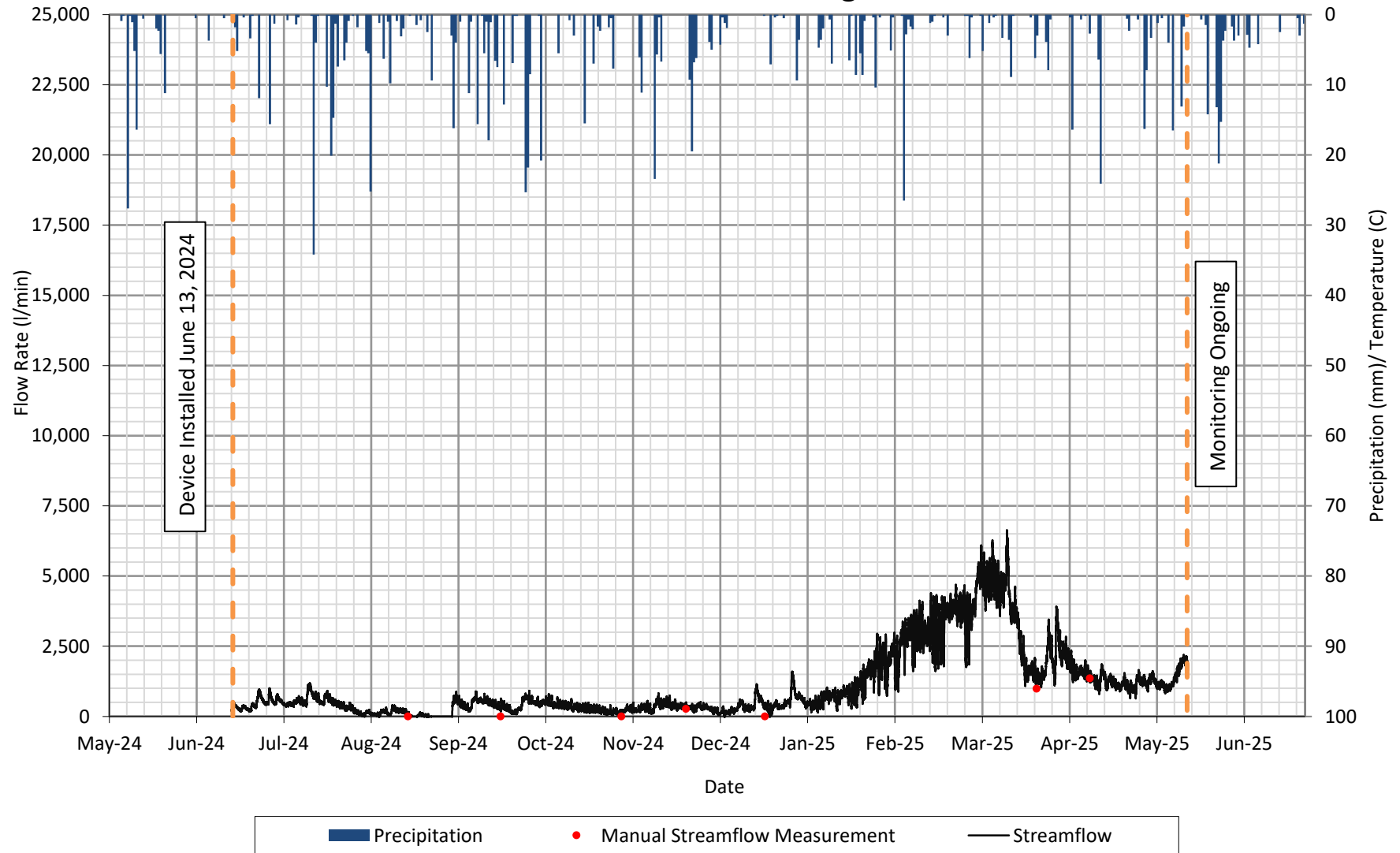
Monitoring Point (MP4)



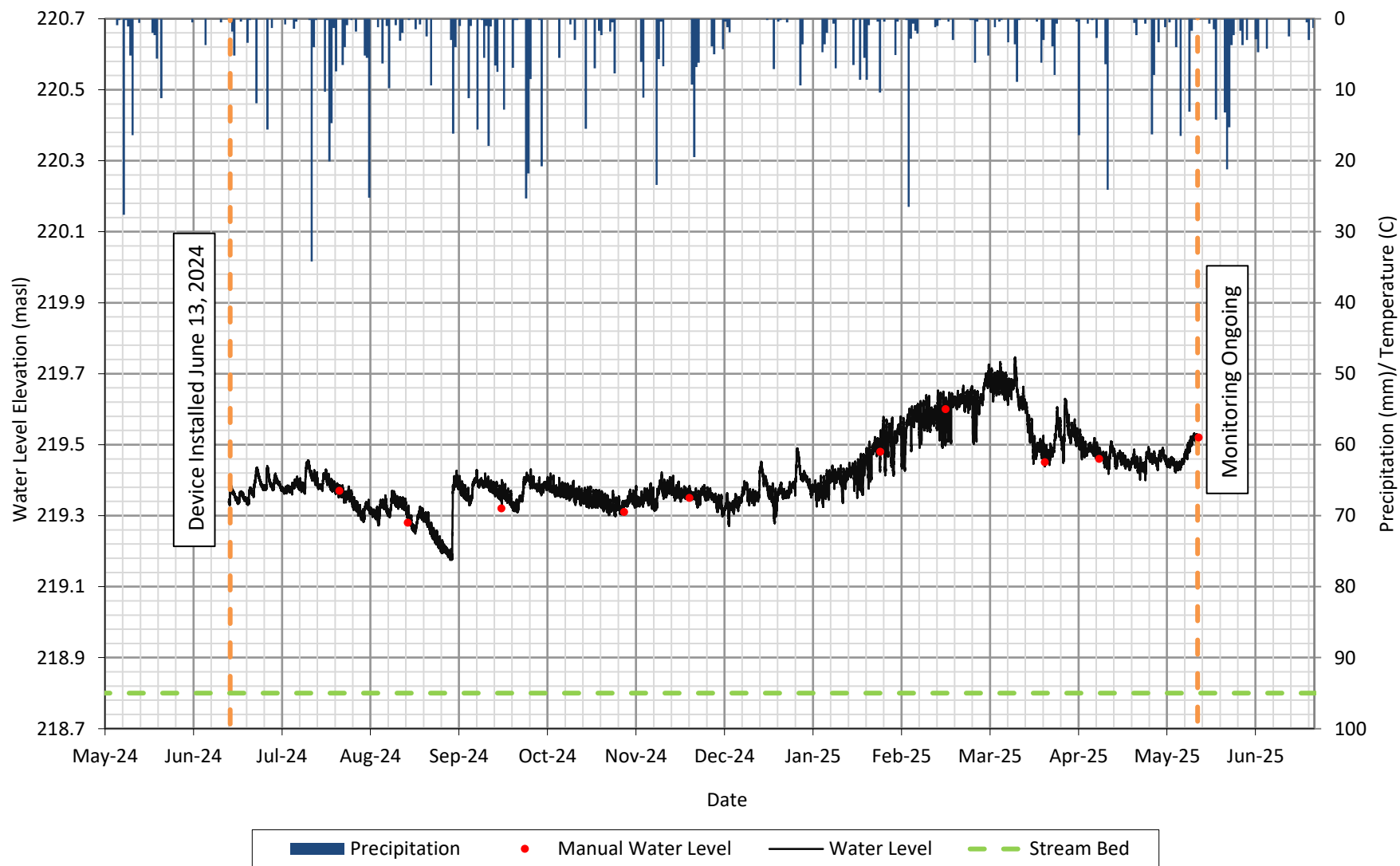
NORWOOD PIT MONITORING SW1 STREAMFLOW RATING CURVE



Surface Water Monitoring (SW1) Streamflow Monitoring



Surface Water Monitoring (SW1) Water Levels



Appendix F: Water Balance

Catchment 101 Water Budget

Pre to Post Extraction Comparison

Project Details

Norwood Pit, Douro-Dummer	424400
---------------------------	--------

Existing Conditions

Catchment ID	101
Total Area (ha)	6.64
Pervious (ha)	6.64
Impervious (ha)	0.00

Infiltration Factor

Catchment ID	101	
Infiltration Factor	Pervious	Impervious
Topography	0.10	0.0
Soil	0.40	0.0
Land Cover	0.15	0.0
Infiltration Factor	0.65	0.0

Water Budget

Catchment ID	101		Total
Water Budget	Pervious	Impervious	
Water Surplus (mm)	17,311	0	17,311
Infiltration (m³)	11,252	0	11,252
Runoff (m³)	6,059	0	6,059

Summary

	Runoff	Infiltration
Existing Conditions (m³)	6,059	11,252
Extraction/Rehab. Conditions (m³)	2,372	14,938
Proposed Change (m³)	-3,686	3,686
Proposed Change (%)	-61%	33%

Additional Notes

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

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

Prepared By Reviewed By

Jonathan Paul	John Gore	2026-06-23
---------------	-----------	------------

Extraction / Rehabilitation Conditions

Catchment 101 Land Use	Undisturbed Area	Extraction Area	Total Area
Total Area (ha)	2.60	4.04	6.64
Pervious (ha)	2.60	4.04	6.64
Impervious (ha)	0.00	0.00	0.00

Undisturbed Area		Extraction Area	
Pervious	Impervious	Pervious	Impervious
0.10	0.0	-	0.0
0.40	0.0	-	0.0
0.15	0.0	-	0.0
0.65	0.0	1.00	0.0

Undisturbed Area		Extraction Area		Total
Pervious	Impervious	Pervious	Impervious	
6,778	0	10,532	0	17,311
4,406	0	10,532	0	14,938
2,372	0	0	0	2,372

Infiltration Factors (SWMP&DM, MOE, 2023)

<u>Topography</u>	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
<u>Soils</u>	Tight impervious clay	0.1
	Medium combinations of clay and loam	0.2
	Open Sandy loam	0.4
<u>Cover</u>	Cultivated Land	0.1
	Woodland	0.2

Monthly Feature-Based Water Budget

Wetland 1: Existing Conditions

Project Details

Norwood Pit, Douro-Dummer	424400
---------------------------	--------

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 (m³)	Wetland Depth (m)	Wetland Surface Area (m²)
Jan.	-7.6	66.5	0.0	0.0	0.81	31	9.367	0.0	66.5	0.0	2.7	1,976	0.33	10,491
Feb.	-7.3	42.3	0.0	0.0	0.82	28	10.507	0.0	42.3	0.0	2.4	1,976	0.33	10,491
Mar.	-1.5	53.6	0.0	0.0	1.03	31	11.946	0.0	53.6	0.0	2.7	1,976	0.33	10,491
Apr.	5.7	72.7	1.2	27.2	1.12	30	13.449	30.4	42.3	0.0	2.6	1,976	0.33	10,491
May	12.5	79.4	4.0	61.7	1.27	31	14.730	78.2	1.2	0.0	2.7	1,155	0.19	6,133
Jun.	17.4	87.8	6.6	87.1	1.28	30	15.385	111.7	0.0	-23.9	2.6	454	0.08	2,413
Jul.	19.7	69.1	8.0	99.2	1.30	31	15.060	128.6	0.0	-59.5	2.7	138	0.02	731
Aug.	18.6	77.6	7.3	93.4	1.20	31	13.938	112.1	0.0	-34.5	2.7	54	0.01	286
Sep.	14.4	75.7	5.0	71.5	1.04	30	12.502	74.5	1.2	0.0	2.6	60	0.01	321
Oct.	8	74.7	2.0	38.7	0.95	31	11.010	36.7	38.0	0.0	2.7	931	0.16	4,944
Nov.	1.9	76.3	0.2	8.6	0.81	30	9.688	7.0	69.3	0.0	2.6	1,976	0.33	10,491
Dec.	-3.9	64.1	0.0	0.0	0.77	31	8.994	0.0	64.1	0.0	2.7	1,976	0.33	10,491
Total	-	840	34.3	487.3	-	365	-	579.1	378.5	-117.8	31.4	-	-	-

Equations

$PET = 16 \left(\frac{L}{12} \right) \left(\frac{N}{30} \right) \left(\frac{10T_d}{T} \right)^{-0.5}$ 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	66,400 m ²	Existing catchment area including wetland =6.64 ha
Wetland Depth =	0.33 m	Based on LIDAR calculations and field monitoring data
Wetland Area =	10,491 m ²	Area of the wetland within the catchment at a depth of 0.33 m of water (1.04 ha)
Wetland Volume =	1,976 m ³	Based on LIDAR calculations
Infiltration Factor =	0.65	MOE Infiltration factor of wetland 1

Monthly Feature-Based Water Budget

Wetland 1: Extraction and Rehabilitation Scenario

Project Details

Norwood Pit, Douro-Dummer	424400
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Prepared By

Jonathan Paul	John Gore	2026-06-23
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Reviewed By

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 (m³)	Wetland Depth (m)	Wetland Surface Area (m²)
Jan.	-7.6	66.5	0.0	0.0	0.81	31	9.367	0.0	66.5	0.0	2.8	1,976	0.33	10,491
Feb.	-7.3	42.3	0.0	0.0	0.82	28	10.507	0.0	42.3	0.0	2.5	1,976	0.33	10,491
Mar.	-1.5	53.6	0.0	0.0	1.03	31	11.946	0.0	53.6	0.0	2.8	1,976	0.33	10,491
Apr.	5.7	72.7	1.2	27.2	1.12	30	13.449	30.4	42.3	0.0	2.7	1,976	0.33	10,491
May	12.5	79.4	4.0	61.7	1.27	31	14.730	78.2	1.2	0.0	2.8	1,137	0.19	6,037
Jun.	17.4	87.8	6.6	87.1	1.28	30	15.385	111.7	0.0	-23.9	2.7	447	0.07	2,371
Jul.	19.7	69.1	8.0	99.2	1.30	31	15.060	128.6	0.0	-59.5	2.8	135	0.02	717
Aug.	18.6	77.6	7.3	93.4	1.20	31	13.938	112.1	0.0	-34.5	2.8	53	0.01	280
Sep.	14.4	75.7	5.0	71.5	1.04	30	12.502	74.5	1.2	0.0	2.7	42	0.01	225
Oct.	8	74.7	2.0	38.7	0.95	31	11.010	36.7	38.0	0.0	2.8	379	0.06	2,014
Nov.	1.9	76.3	0.2	8.6	0.81	30	9.688	7.0	69.3	0.0	2.7	991	0.17	5,261
Dec.	-3.9	64.1	0.0	0.0	0.77	31	8.994	0.0	64.1	0.0	2.8	1,560	0.26	8,280
Total	-	840	34.3	487.3	-	365	-	579.1	378.5	-117.8	32.9	-	-	-

Equations

$PET = 16 \left(\frac{L}{12} \right) \left(\frac{N}{30} \right) \left(\frac{10T_d}{T} \right)^{-0.5}$ 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
 $\alpha = (6.75 \times 10^{-7})I^3 - (7.71 \times 10^{-5})I^2 + (1.792 \times 10^{-2})I + 0.49239$
 $I = \sum_{i=1}^{12} \left(\frac{T_{mi}}{5} \right)^{1.514}$ is a heat index which depends on the 12 monthly mean temperatures T_{mi} ⁽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=	26,000 m ²	Post development catchment area including wetland = 2.60 ha
Wetland Depth =	0.33 m	Based on LIDAR calculations and field monitoring data
Wetland Area =	10,491 m ²	Area of the wetland within the catchment at a depth of 0.33 m of water (1.04 ha)
Wetland Volume =	1,976 m ³	Based on LIDAR calculations
Infiltration Factor =	0.65	MOE Infiltration factor of wetland 1

Monthly Feature-Based Water Budget

Wetland 1: Pre to Post Extraction Comparison

Project Details

Norwood Pit, Douro-Dummer	424400
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Prepared By Reviewed By

Jonathan Paul	John Gore	2026-06-23
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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.	1,976	1,976	0	0.33	0.33	0.00	10,491	10,491	0	0%
Feb.	1,976	1,976	0	0.33	0.33	0.00	10,491	10,491	0	0%
Mar.	1,976	1,976	0	0.33	0.33	0.00	10,491	10,491	0	0%
Apr.	1,976	1,976	0	0.33	0.33	0.00	10,491	10,491	0	0%
May	1,155	1,137	-18	0.19	0.19	0.00	6,133	6,037	-96	-2%
Jun.	454	447	-8	0.08	0.07	0.00	2,413	2,371	-42	-2%
Jul.	138	135	-3	0.02	0.02	0.00	731	717	-14	-2%
Aug.	54	53	-1	0.01	0.01	0.00	286	280	-6	-2%
Sep.	60	42	-18	0.01	0.01	0.00	321	225	-96	-30%
Oct.	931	379	-552	0.16	0.06	-0.09	4,944	2,014	-2930	-59%
Nov.	1,976	991	-985	0.33	0.17	-0.16	10,491	5,261	-5230	-50%
Dec.	1,976	1,560	-416	0.33	0.26	-0.07	10,491	8,280	-2211	-21%
									Average	-14%

Summary

Pre-to-post extraction change in catchment runoff to feature	-61%
Pre-to-post change in catchment infiltration	33%
Pre-to-post extraction change in wetland storage (average)	-14%

Catchment 102 Water Budget

Pre to Post Extraction Comparison

Project Details

Norwood Pit, Douro-Dummer	424400
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Existing Conditions

Catchment ID	102
Total Area (ha)	69.39
Pervious (ha)	68.58
Impervious (ha)	0.81

Infiltration Factor

Catchment ID	102	
Infiltration Factor	Pervious	Impervious
Topography	0.10	0.0
Soil	0.30	0.0
Land Cover	0.15	0.0
Infiltration Factor	0.55	0.0

Water Budget

Catchment ID	102		Total
Water Budget	Pervious	Impervious	
Water Surplus (mm)	178,789	5,442	184,231
Infiltration (m ³)	98,334	0	98,334
Runoff (m ³)	80,455	5,442	85,897

Summary

	Runoff	Infiltration
Existing Conditions (m ³)	85,897	98,334
Extraction/Rehab. Conditions (m ³)	70,634	113,597
Proposed Change (m ³)	-15,263	15,263
Proposed Change (%)	-18%	16%

Additional Notes

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

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

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Extraction / Rehabilitation Conditions

Catchment 102 Land Use	Undisturbed Area	Extraction Area	Total Area
Total Area (ha)	56.38	13.01	69.39
Pervious (ha)	55.57	13.01	68.58
Impervious (ha)	0.81	0.00	0.81

Undisturbed Area		Extraction Area	
Pervious	Impervious	Pervious	Impervious
0.10	0.0	-	0.0
0.30	0.0	-	0.0
0.15	0.0	-	0.0
0.55	0.0	1.00	0.0

Undisturbed Area		Extraction Area		Total
Pervious	Impervious	Pervious	Impervious	
144,872	5,442	33,917	0	184,231
79,679	0	33,917	0	113,597
65,192	5,442	0	0	70,634

Infiltration Factors (SWMP&DM, MOE, 2023)

<u>Topography</u>	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
<u>Soils</u>	Tight impervious clay	0.1
	Medium combinations of clay and loam	0.2
	Open Sandy loam	0.4
<u>Cover</u>	Cultivated Land	0.1
	Woodland	0.2

Monthly Feature-Based Water Budget

Wetland 2: Existing Conditions

Project Details

Norwood Pit, Douro-Dummer	424400
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Prepared By

Reviewed By

Jonathan Paul	John Gore	2026-06-23
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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 (m³)	Wetland Depth (m)	Wetland Surface Area (m²)
Jan.	-7.6	66.5	0.0	0.0	0.81	31	9.367	0.0	66.5	0.0	2.7	17,842	0.30	99,575
Feb.	-7.3	42.3	0.0	0.0	0.82	28	10.507	0.0	42.3	0.0	2.4	17,842	0.30	99,575
Mar.	-1.5	53.6	0.0	0.0	1.03	31	11.946	0.0	53.6	0.0	2.7	17,842	0.30	99,575
Apr.	5.7	72.7	1.2	27.2	1.12	30	13.449	30.4	42.3	0.0	2.6	17,842	0.30	99,575
May	12.5	79.4	4.0	61.7	1.27	31	14.730	78.2	1.2	0.0	2.7	10,159	0.17	56,699
Jun.	17.4	87.8	6.6	87.1	1.28	30	15.385	111.7	0.0	-23.9	2.6	3,682	0.06	20,548
Jul.	19.7	69.1	8.0	99.2	1.30	31	15.060	128.6	0.0	-59.5	2.7	985	0.02	5,496
Aug.	18.6	77.6	7.3	93.4	1.20	31	13.938	112.1	0.0	-34.5	2.7	354	0.01	1,977
Sep.	14.4	75.7	5.0	71.5	1.04	30	12.502	74.5	1.2	0.0	2.6	586	0.01	3,271
Oct.	8	74.7	2.0	38.7	0.95	31	11.010	36.7	38.0	0.0	2.7	12,328	0.20	68,802
Nov.	1.9	76.3	0.2	8.6	0.81	30	9.688	7.0	69.3	0.0	2.6	17,842	0.30	99,575
Dec.	-3.9	64.1	0.0	0.0	0.77	31	8.994	0.0	64.1	0.0	2.7	17,842	0.30	99,575
Total	-	840	34.3	487.3	-	365	-	579.1	378.5	-117.8	31.4	-	-	-

Equations

$PET = 16 \left(\frac{L}{12} \right) \left(\frac{N}{30} \right) \left(\frac{10T_d}{T} \right)^{\alpha}$ 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
 $\alpha = (6.75 \times 10^{-7})T^3 - (7.71 \times 10^{-5})T^2 + (1.792 \times 10^{-2})T + 0.49239$
 $I = \sum_{i=1}^{12} \left(\frac{T_{m_i}}{5} \right)^{1.514}$ 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	693,900 m ²	Existing catchment area including wetland =63.39 ha
Wetland Depth =	0.30 m	Based on LIDAR calculations and field monitoring data
Wetland Area =	99,575 m ²	Area of the wetland within the catchment at a depth of 0.30 m of water (9.96 ha)
Wetland Volume =	17,842 m ³	Based on LIDAR calculations
Infiltration Factor =	0.55	MOE Infiltration factor of wetland 2

Monthly Feature-Based Water Budget

Wetland 2: Extraction and Rehabilitation Scenario

Project Details

Norwood Pit, Douro-Dummer	424400
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Prepared By

Jonathan Paul	John Gore	2026-06-23
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Reviewed By

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 (m³)	Wetland Depth (m)	Wetland Surface Area (m²)
Jan.	-7.6	66.5	0.0	0.0	0.81	31	9.367	0.0	66.5	0.0	2.8	17,842	0.30	99,575
Feb.	-7.3	42.3	0.0	0.0	0.82	28	10.507	0.0	42.3	0.0	2.5	17,842	0.30	99,575
Mar.	-1.5	53.6	0.0	0.0	1.03	31	11.946	0.0	53.6	0.0	2.8	17,842	0.30	99,575
Apr.	5.7	72.7	1.2	27.2	1.12	30	13.449	30.4	42.3	0.0	2.7	17,842	0.30	99,575
May	12.5	79.4	4.0	61.7	1.27	31	14.730	78.2	1.2	0.0	2.8	10,078	0.17	56,242
Jun.	17.4	87.8	6.6	87.1	1.28	30	15.385	111.7	0.0	-23.9	2.7	3,645	0.06	20,344
Jul.	19.7	69.1	8.0	99.2	1.30	31	15.060	128.6	0.0	-59.5	2.8	973	0.02	5,428
Aug.	18.6	77.6	7.3	93.4	1.20	31	13.938	112.1	0.0	-34.5	2.8	349	0.01	1,948
Sep.	14.4	75.7	5.0	71.5	1.04	30	12.502	74.5	1.2	0.0	2.7	511	0.01	2,852
Oct.	8	74.7	2.0	38.7	0.95	31	11.010	36.7	38.0	0.0	2.8	10,043	0.17	56,051
Nov.	1.9	76.3	0.2	8.6	0.81	30	9.688	7.0	69.3	0.0	2.7	17,842	0.30	99,575
Dec.	-3.9	64.1	0.0	0.0	0.77	31	8.994	0.0	64.1	0.0	2.8	17,842	0.30	99,575
Total	-	840	34.3	487.3	-	365	-	579.1	378.5	-117.8	32.9	-	-	-

Equations

$PET = 16 \left(\frac{L}{12} \right) \left(\frac{N}{30} \right) \left(\frac{10T_d}{T} \right)^{0.5}$ 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=	563,800 m ²	Post development catchment area including wetland = 56.38 ha
Wetland Depth =	0.30 m	Based on LIDAR calculations and field monitoring data
Wetland Area =	99,575 m ²	Area of the wetland within the catchment at a depth of 0.30 m of water (9.96 ha)
Wetland Volume =	17,842 m ³	Based on LIDAR calculations
Infiltration Factor =	0.55	MOE Infiltration factor of wetland 2

Monthly Feature-Based Water Budget

Wetland 2: Pre to Post Extraction Comparison

Project Details

Norwood Pit, Douro-Dummer	424400
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Prepared By Reviewed By

Jonathan Paul	John Gore	2026-06-23
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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.	17,842	17,842	0	0.30	0.30	0.00	99,575	99,575	0	0%
Feb.	17,842	17,842	0	0.30	0.30	0.00	99,575	99,575	0	0%
Mar.	17,842	17,842	0	0.30	0.30	0.00	99,575	99,575	0	0%
Apr.	17,842	17,842	0	0.30	0.30	0.00	99,575	99,575	0	0%
May	10,159	10,078	-82	0.17	0.17	0.00	56,699	56,242	-457	-1%
Jun.	3,682	3,645	-36	0.06	0.06	0.00	20,548	20,344	-203	-1%
Jul.	985	973	-12	0.02	0.02	0.00	5,496	5,428	-68	-1%
Aug.	354	349	-5	0.01	0.01	0.00	1,977	1,948	-28	-1%
Sep.	586	511	-75	0.01	0.01	0.00	3,271	2,852	-420	-13%
Oct.	12,328	10,043	-2,285	0.20	0.17	-0.04	68,802	56,051	-12,750	-19%
Nov.	17,842	17,842	0	0.30	0.30	0.00	99,575	99,575	0	0%
Dec.	17,842	17,842	0	0.30	0.30	0.00	99,575	99,575	0	0%
Average									-3%	

Summary

Pre-to-post extraction change in catchment runoff to feature	-18%
Pre-to-post change in catchment infiltration	16%
Pre-to-post extraction change in wetland storage (average)	-3%

Catchment 103 Water Budget

Pre to Post Extraction Comparison

Project Details

Norwood Pit, Douro-Dummer	424400
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Existing Conditions

Catchment ID	103
Total Area (ha)	25.72
Pervious (ha)	25.72
Impervious (ha)	0.00

Infiltration Factor

Catchment ID	103	
Infiltration Factor	Pervious	Impervious
Topography	0.10	0.0
Soil	0.40	0.0
Land Cover	0.15	0.0
Infiltration Factor	0.65	0.0

Water Budget

Catchment ID	103		Total
Water Budget	Pervious	Impervious	
Water Surplus (mm)	67,052	0	67,052
Infiltration (m ³)	43,584	0	43,584
Runoff (m ³)	23,468	0	23,468

Summary

	Runoff	Infiltration
Existing Conditions (m ³)	23,468	43,584
Extraction/Rehab. Conditions (m ³)	21,516	45,537
Proposed Change (m ³)	-1,953	1,953
Proposed Change (%)	-8%	4%

Additional Notes

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

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

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Extraction / Rehabilitation Conditions

Catchment 103 Land Use	Undisturbed Area	Extraction Area	Total Area
Total Area (ha)	23.58	2.14	25.72
Pervious (ha)	23.58	2.14	25.72
Impervious (ha)	0.00	0.00	0.00

Undisturbed Area		Extraction Area	
Pervious	Impervious	Pervious	Impervious
0.10	0.0	-	0.0
0.40	0.0	-	0.0
0.15	0.0	-	0.0
0.65	0.0	1.00	0.0

Undisturbed Area		Extraction Area		Total
Pervious	Impervious	Pervious	Impervious	
61,473	0	5,579	0	67,052
39,958	0	5,579	0	45,537
21,516	0	0	0	21,516

Infiltration Factors (SWMP&DM, MOE, 2023)

<u>Topography</u>	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
<u>Soils</u>	Tight impervious clay	0.1
	Medium combinations of clay and loam	0.2
	Open Sandy loam	0.4
<u>Cover</u>	Cultivated Land	0.1
	Woodland	0.2

Monthly Feature-Based Water Budget

Wetland 3: Existing Conditions

Project Details

Norwood Pit, Douro-Dummer	424400
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Prepared By Reviewed By

Jonathan Paul	John Gore	2026-06-23
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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 (m³)	Wetland Depth (m)	Wetland Surface Area (m²)
Jan.	-7.6	66.5	0.0	0.0	0.81	31	9.367	0.0	66.5	0.0	2.7	23,024	0.59	93,624
Feb.	-7.3	42.3	0.0	0.0	0.82	28	10.507	0.0	42.3	0.0	2.4	23,024	0.59	93,624
Mar.	-1.5	53.6	0.0	0.0	1.03	31	11.946	0.0	53.6	0.0	2.7	23,024	0.59	93,624
Apr.	5.7	72.7	1.2	27.2	1.12	30	13.449	30.4	42.3	0.0	2.6	23,024	0.59	93,624
May	12.5	79.4	4.0	61.7	1.27	31	14.730	78.2	1.2	0.0	2.7	15,559	0.51	86,792
Jun.	17.4	87.8	6.6	87.1	1.28	30	15.385	111.7	0.0	-23.9	2.6	5,643	0.21	38,313
Jul.	19.7	69.1	8.0	99.2	1.30	31	15.060	128.6	0.0	-59.5	2.7	614	0.02	4,171
Aug.	18.6	77.6	7.3	93.4	1.20	31	13.938	112.1	0.0	-34.5	2.7	136	0.01	922
Sep.	14.4	75.7	5.0	71.5	1.04	30	12.502	74.5	1.2	0.0	2.6	176	0.01	1,192
Oct.	8	74.7	2.0	38.7	0.95	31	11.010	36.7	38.0	0.0	2.7	3,551	0.14	24,108
Nov.	1.9	76.3	0.2	8.6	0.81	30	9.688	7.0	69.3	0.0	2.6	9,562	0.36	64,924
Dec.	-3.9	64.1	0.0	0.0	0.77	31	8.994	0.0	64.1	0.0	2.7	15,160	0.50	86,427
Total	-	840	34.3	487.3	-	365	-	579.1	378.5	-117.8	31.4	-	-	-

Equations

$PET = 16 \left(\frac{L}{12} \right) \left(\frac{N}{30} \right) \left(\frac{10T_d}{T} \right)^{0.5}$ 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	257,200 m ²	Existing catchment area including wetland =25.72 ha
Wetland Depth =	0.59 m	Based on LIDAR calculations and field monitoring data
Wetland Area =	93,624 m ²	Area of the wetland within the catchment at a depth of 0.59 m of water (9.36 ha)
Wetland Volume =	23,024 m ³	Based on LIDAR calculations
Infiltration Factor =	0.65	MOE Infiltration factor of wetland 3

Monthly Feature-Based Water Budget

Wetland 3: Extraction and Rehabilitation Scenario

Project Details

Norwood Pit, Douro-Dummer	424400
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Prepared By

Jonathan Paul	John Gore	2026-06-23
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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 (m³)	Wetland Depth (m)	Wetland Surface Area (m²)
Jan.	-7.6	66.5	0.0	0.0	0.81	31	9.367	0.0	66.5	0.0	2.8	23,024	0.59	93,624
Feb.	-7.3	42.3	0.0	0.0	0.82	28	10.507	0.0	42.3	0.0	2.5	23,024	0.59	93,624
Mar.	-1.5	53.6	0.0	0.0	1.03	31	11.946	0.0	53.6	0.0	2.8	23,024	0.59	93,624
Apr.	5.7	72.7	1.2	27.2	1.12	30	13.449	30.4	42.3	0.0	2.7	23,024	0.59	93,624
May	12.5	79.4	4.0	61.7	1.27	31	14.730	78.2	1.2	0.0	2.8	15,538	0.51	86,773
Jun.	17.4	87.8	6.6	87.1	1.28	30	15.385	111.7	0.0	-23.9	2.7	5,614	0.21	38,118
Jul.	19.7	69.1	8.0	99.2	1.30	31	15.060	128.6	0.0	-59.5	2.8	607	0.02	4,118
Aug.	18.6	77.6	7.3	93.4	1.20	31	13.938	112.1	0.0	-34.5	2.8	134	0.01	906
Sep.	14.4	75.7	5.0	71.5	1.04	30	12.502	74.5	1.2	0.0	2.7	165	0.01	1,121
Oct.	8	74.7	2.0	38.7	0.95	31	11.010	36.7	38.0	0.0	2.8	3,258	0.12	22,122
Nov.	1.9	76.3	0.2	8.6	0.81	30	9.688	7.0	69.3	0.0	2.7	8,767	0.33	59,522
Dec.	-3.9	64.1	0.0	0.0	0.77	31	8.994	0.0	64.1	0.0	2.8	13,891	0.49	85,265
Total	-	840	34.3	487.3	-	365	-	579.1	378.5	-117.8	32.9	-	-	-

Equations

$PET = 16 \left(\frac{L}{12} \right) \left(\frac{N}{30} \right) \left(\frac{10T_d}{T} \right)^{-0.5}$ 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=	235,800 m ²	Post development catchment area including wetland = 23.58 ha
Wetland Depth =	0.59 m	Based on LIDAR calculations and field monitoring data
Wetland Area =	93,624 m ²	Area of the wetland within the catchment at a depth of 0.59 m of water (9.36 ha)
Wetland Volume =	23,024 m ³	Based on LIDAR calculations
Infiltration Factor =	0.65	MOE Infiltration factor of wetland 3

Monthly Feature-Based Water Budget

Wetland 3: Pre to Post Extraction Comparison

Project Details

Norwood Pit, Douro-Dummer	424400
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Prepared By Reviewed By

Jonathan Paul	John Gore	2026-06-23
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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.	23,024	23,024	0	0.59	0.59	0.00	93,624	93,624	0	0%
Feb.	23,024	23,024	0	0.59	0.59	0.00	93,624	93,624	0	0%
Mar.	23,024	23,024	0	0.59	0.59	0.00	93,624	93,624	0	0%
Apr.	23,024	23,024	0	0.59	0.59	0.00	93,624	93,624	0	0%
May	15,559	15,538	-21	0.51	0.51	0.00	86,792	86,773	-19	0%
Jun.	5,643	5,614	-29	0.21	0.21	0.00	38,313	38,118	-195	-1%
Jul.	614	607	-8	0.02	0.02	0.00	4,171	4,118	-53	-1%
Aug.	136	134	-2	0.01	0.01	0.00	922	906	-15	-2%
Sep.	176	165	-10	0.01	0.01	0.00	1,192	1,121	-71	-6%
Oct.	3,551	3,258	-292	0.14	0.12	-0.01	24,108	22,122	-1986	-8%
Nov.	9,562	8,767	-796	0.36	0.33	-0.03	64,924	59,522	-5401	-8%
Dec.	15,160	13,891	-1,269	0.50	0.49	-0.01	86,427	85,265	-1161	-1%
									Average	-2%

Summary

Pre-to-post extraction change in catchment runoff to feature	-8%
Pre-to-post change in catchment infiltration	4%
Pre-to-post extraction change in wetland storage (average)	-2%

Catchment 104 Water Budget

Pre to Post Extraction Comparison

Project Details

Norwood Pit, Douro-Dummer	424400
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Existing Conditions

Catchment ID	104
Total Area (ha)	40.01
Pervious (ha)	40.01
Impervious (ha)	0.00

Infiltration Factor

Catchment ID	104	
Infiltration Factor	Pervious	Impervious
Topography	0.15	0.0
Soil	0.30	0.0
Land Cover	0.15	0.0
Infiltration Factor	0.60	0.0

Water Budget

Catchment ID	104		Total
Water Budget	Pervious	Impervious	
Water Surplus (m³)	104,306	0	104,306
Infiltration (m³)	62,584	0	62,584
Runoff (m³)	41,723	0	41,723

Summary

	Runoff	Infiltration
Existing Conditions (m³)	41,723	62,584
Extraction/Rehab. Conditions (m³)	41,264	63,043
Proposed Change (m³)	-459	459
Proposed Change (%)	-1%	1%

Additional Notes

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

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

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Extraction / Rehabilitation Conditions

Catchment 104 Land Use	Undisturbed Area	Extraction Area	Total Area
Total Area (ha)	39.57	0.44	40.01
Pervious (ha)	39.57	0.44	40.01
Impervious (ha)	0.00	0.00	0.00

Undisturbed Area		Extraction Area	
Pervious	Impervious	Pervious	Impervious
0.15	0.0	-	0.0
0.30	0.0	-	0.0
0.15	0.0	-	0.0
0.60	0.0	1.00	0.0

Undisturbed Area		Extraction Area		Total
Pervious	Impervious	Pervious	Impervious	
103,159	0	1,147	0	104,306
61,896	0	1,147	0	63,043
41,264	0	0	0	41,264

Infiltration Factors (SWMP&DM, MOE, 2023)

<u>Topography</u>	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
<u>Soils</u>	Tight impervious clay	0.1
	Medium combinations of clay and loam	0.2
	Open Sandy loam	0.4
<u>Cover</u>	Cultivated Land	0.1
	Woodland	0.2

Monthly Feature-Based Water Budget

Wetland 4: Existing Conditions

Project Details

Norwood Pit, Douro-Dummer	424400
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Prepared By

Reviewed By

Jonathan Paul	John Gore	2026-06-23
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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 (m³)	Wetland Depth (m)	Wetland Surface Area (m²)
Jan.	-7.6	66.5	0.0	0.0	0.81	31	9.367	0.0	66.5	0.0	2.7	16,379	0.60	54,237
Feb.	-7.3	42.3	0.0	0.0	0.82	28	10.507	0.0	42.3	0.0	2.4	16,379	0.60	54,237
Mar.	-1.5	53.6	0.0	0.0	1.03	31	11.946	0.0	53.6	0.0	2.7	16,379	0.60	54,237
Apr.	5.7	72.7	1.2	27.2	1.12	30	13.449	30.4	42.3	0.0	2.6	16,379	0.60	54,237
May	12.5	79.4	4.0	61.7	1.27	31	14.730	78.2	1.2	0.0	2.7	12,183	0.51	48,537
Jun.	17.4	87.8	6.6	87.1	1.28	30	15.385	111.7	0.0	-23.9	2.6	6,637	0.39	39,069
Jul.	19.7	69.1	8.0	99.2	1.30	31	15.060	128.6	0.0	-59.5	2.7	1,509	0.09	8,884
Aug.	18.6	77.6	7.3	93.4	1.20	31	13.938	112.1	0.0	-34.5	2.7	490	0.03	2,884
Sep.	14.4	75.7	5.0	71.5	1.04	30	12.502	74.5	1.2	0.0	2.6	465	0.03	2,735
Oct.	8	74.7	2.0	38.7	0.95	31	11.010	36.7	38.0	0.0	2.7	6,441	0.37	37,914
Nov.	1.9	76.3	0.2	8.6	0.81	30	9.688	7.0	69.3	0.0	2.6	16,379	0.60	54,237
Dec.	-3.9	64.1	0.0	0.0	0.77	31	8.994	0.0	64.1	0.0	2.7	16,379	0.60	54,237
Total	-	840	34.3	487.3	-	365	-	579.1	378.5	-117.8	31.4	-	-	-

Equations

$PET = 16 \left(\frac{L}{12} \right) \left(\frac{N}{30} \right) \left(\frac{10T_d}{T} \right)^{\alpha}$ 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
 $\alpha = (6.75 \times 10^{-7})T^3 - (7.71 \times 10^{-5})T^2 + (1.792 \times 10^{-2})T + 0.49239$
 $T = \sum_{i=1}^{12} \left(\frac{T_{m_i}}{5} \right)^{1.514}$ 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	400,100 m ²	Existing catchment area including wetland =40.01 ha
Wetland Depth =	0.60 m	Based on LIDAR calculations and field monitoring data
Wetland Area =	54,237 m ²	Area of the wetland within the catchment at a depth of 0.59 m of water (9.36 ha)
Wetland Volume =	16,379 m ³	Based on LIDAR calculations
Infiltration Factor =	0.60	MOE Infiltration factor of wetland 4

Monthly Feature-Based Water Budget

Wetland 4: Extraction and Rehabilitation Scenario

Project Details

Norwood Pit, Douro-Dummer	424400
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Prepared By

Jonathan Paul	John Gore	2026-06-23
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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 (m³)	Wetland Depth (m)	Wetland Surface Area (m²)
Jan.	-7.6	66.5	0.0	0.0	0.81	31	9.367	0.0	66.5	0.0	2.8	16,379	0.60	54,237
Feb.	-7.3	42.3	0.0	0.0	0.82	28	10.507	0.0	42.3	0.0	2.5	16,379	0.60	54,237
Mar.	-1.5	53.6	0.0	0.0	1.03	31	11.946	0.0	53.6	0.0	2.8	16,379	0.60	54,237
Apr.	5.7	72.7	1.2	27.2	1.12	30	13.449	30.4	42.3	0.0	2.7	16,379	0.60	54,237
May	12.5	79.4	4.0	61.7	1.27	31	14.730	78.2	1.2	0.0	2.8	12,174	0.51	48,525
Jun.	17.4	87.8	6.6	87.1	1.28	30	15.385	111.7	0.0	-23.9	2.7	6,624	0.38	38,991
Jul.	19.7	69.1	8.0	99.2	1.30	31	15.060	128.6	0.0	-59.5	2.8	1,501	0.09	8,838
Aug.	18.6	77.6	7.3	93.4	1.20	31	13.938	112.1	0.0	-34.5	2.8	486	0.03	2,862
Sep.	14.4	75.7	5.0	71.5	1.04	30	12.502	74.5	1.2	0.0	2.7	460	0.03	2,709
Oct.	8	74.7	2.0	38.7	0.95	31	11.010	36.7	38.0	0.0	2.8	6,370	0.37	37,498
Nov.	1.9	76.3	0.2	8.6	0.81	30	9.688	7.0	69.3	0.0	2.7	16,379	0.60	54,237
Dec.	-3.9	64.1	0.0	0.0	0.77	31	8.994	0.0	64.1	0.0	2.8	16,379	0.60	54,237
Total	-	840	34.3	487.3	-	365	-	579.1	378.5	-117.8	32.9	-	-	-

Equations

$PET = 16 \left(\frac{L}{12} \right) \left(\frac{N}{30} \right) \left(\frac{10T_d}{T} \right)^{-0.5}$ 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=	395,700 m ²	Post development catchment area including wetland = 39.57 ha
Wetland Depth =	0.60 m	Based on LIDAR calculations and field monitoring data
Wetland Area =	54,237 m ²	Area of the wetland within the catchment at a depth of 0.59 m of water (9.36 ha)
Wetland Volume =	16,379 m ³	Based on LIDAR calculations
Infiltration Factor =	0.60	MOE Infiltration factor of wetland 4

Monthly Feature-Based Water Budget

Wetland 4: Pre to Post Extraction Comparison

Project Details

Norwood Pit, Douro-Dummer	424400
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Prepared By Reviewed By

Jonathan Paul	John Gore	2026-06-23
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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.	16,379	16,379	0	0.60	0.60	0.00	54,237	54,237	0	0%
Feb.	16,379	16,379	0	0.60	0.60	0.00	54,237	54,237	0	0%
Mar.	16,379	16,379	0	0.60	0.60	0.00	54,237	54,237	0	0%
Apr.	16,379	16,379	0	0.60	0.60	0.00	54,237	54,237	0	0%
May	12,183	12,174	-9	0.51	0.51	0.00	48,537	48,525	-12	0%
Jun.	6,637	6,624	-13	0.39	0.38	0.00	39,069	38,991	-78	0%
Jul.	1,509	1,501	-8	0.09	0.09	0.00	8,884	8,838	-46	-1%
Aug.	490	486	-4	0.03	0.03	0.00	2,884	2,862	-21	-1%
Sep.	465	460	-5	0.03	0.03	0.00	2,735	2,709	-26	-1%
Oct.	6,441	6,370	-71	0.37	0.37	0.00	37,914	37,498	-416	-1%
Nov.	16,379	16,379	0	0.60	0.60	0.00	54,237	54,237	0	0%
Dec.	16,379	16,379	0	0.60	0.60	0.00	54,237	54,237	0	0%
Average									0%	

Summary

Pre-to-post extraction change in catchment runoff to feature	-1%
Pre-to-post change in catchment infiltration	1%
Pre-to-post extraction change in wetland storage (average)	0%