Combined Level 1 and Level 2 Hydrogeological Assessment

Duivenvoorden Pit Expansion

Melancthon, Ontario

Prepared for:
Duivenvoorden Haulage Ltd.

Prepared by:
Azimuth Environmental
Consulting, Inc.

September 2020

AEC 17-178a

AZIMUTH ENVIRONMENTAL CONSULTING, INC.

Environmental Assessments & Approvals

December 1, 2020 AEC 17-178a

Duivenvoorden Haulage Ltd.
3425 9th Line
Innisfil, Ontario
L9S 3Z6

Attention: John Duivenvoorden

Re: **Combined Level 1 and Level 2 Hydrogeological Assessment**
Duivenvoorden Pit Expansion
Melancthon, ON

Dear Mr. Duivenvoorden:

Azimuth Environmental Consulting, Inc. (Azimuth) is pleased to present this report consisting of a Level 1 and 2 Hydrogeological Assessment for the proposed expansion of the existing Duivenvoorden Pit, located in Melancthon, Ontario. The proponent (Duivenvooden Haulage Ltd.) is filing an application with the Ministry of Natural Resources and Forestry (MNRF) for an Aggregate Resources Act (ARA) Category 3, Class A Pit Above Water license for expansion of their existing Duivenvoorden Pit.

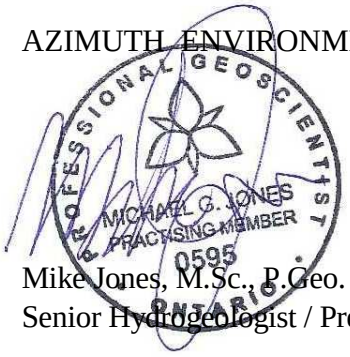
Azimuth has completed a Level 2 Hydrogeological Assessment to enable expansion of the existing Duivenvoorden Pit. This assessment is based on a comprehensive field monitoring program which provides the basis to the conceptual understanding of the regional and local hydrogeological conditions.

The results of the hydrogeological assessment indicate that the potential impacts associated with the extraction of aggregate on the existing ground water and surface water regimes will be negligible. The proposed above water table extraction significantly decreases the potential for impacts to the underlying ground water table, as well as the deeper bedrock aquifer system. As a result, there will be no influence from the operations on local domestic water wells in the vicinity of the proposed operations. This conclusion is supported by the long-term operation of the existing Duivenvoorden Pit with no complaints of well interference from local users.

We assume that this information is sufficient for the MNRF and other relevant reviewing agencies to approve expansion of the Duivenvoorden Pit. If you have any questions or comments please contact the undersigned.

Yours truly,

AZIMUTH ENVIRONMENTAL CONSULTING, INC.



Mike Jones, M.Sc., P.Geo.
Senior Hydrogeologist / President

Table of Contents

List of In-Text Tables

List of Figures

LIST OF APPENDICES

1.0 INTRODUCTION

Duivenvoorden Haulage Ltd. (Duivenvoorden) owns an approximate 82.6 ha property, located on Part Lots 13 & 14, Concession 4, Township of Melancthon, Dufferin County (Figure 1 – Appendix A). The property consists of an existing gravel pit (referred to as Duivenvoorden Pit) which is located on Part Lot 13, and Duivenvoorden wishes to expand the gravel pit into Part Lot 14 to the north. The southern parcel (Part Lot 13) containing the existing pit is approximately 40.2 ha and the northern parcel (Part Lot 14) is approximately 42.4 ha.

Duivenvoorden intends to file an application with the Ministry of Natural Resources and Forestry (MNRF) for an Aggregate Resources Act (ARA) Category 3, Class A Pit Above Water license for expansion of the existing Duivenvoorden Pit. The expansion will extend the boundary of the existing pit into the majority of the northern parcel of land. The northern parcel currently consists primarily of active agricultural land, with a small area consisting of forest and wetland (southwest portion of parcel). Adjacent land uses consist primarily of active agricultural land and other active gravel pits.

Duivenvoorden has retained Azimuth to complete a combined Level 1 and Level 2 Hydrogeological Assessment in support of the proposed aggregate expansion and operation. Whitewater Hydrogeology Ltd. (Whitewater) also provided support to Azimuth in providing relevant hydrogeological data and background information in support of this application. Whitewater has completed aggregate license applications for other gravel pit properties in the immediate area.

1.1 Study Approach

Duivenvoorden Pit is currently licensed to extract sand and gravel from above the established water table, which is also proposed for the expansion lands to the north of the existing pit. Similarly, the Strata-owned gravel pits to the east/southeast of the Duivenvoorden lands are also licensed for above water table extraction. Locally, the presence and influence of these pits provides important hydrogeological information to determine the potential for long-term effect(s) of such operations on the ground water and surface water regimes in the local area.

Along with the compilation of existing hydrogeological data from existing aggregate extraction areas, a comprehensive hydrogeological field program was completed by Azimuth for the Duivenvoorden expansion lands (northern parcel). The results of this field program provided the basis for the conceptual understanding of the geology and hydrogeology beneath the proposed expansion area.

To develop a more regional understanding of the hydrogeological conditions, Whitewater provided their combined Level 1 and Level 2 Hydrogeological Assessment Report (2017) for the Prince and Bonnefield Pits (Strata). This report provides a comprehensive description of the regional setting, and excerpts have been provided in Section 2.0. When incorporated with data from the subject site, Whitewater's report also provided valuable ground water level data to understand regional ground water flow patterns.

In order to complete a Level 2 Hydrogeological Assessment for the proposed pit expansion, relevant legislation was referenced and a work plan was developed. Provincial Standards which support the ARA are referenced to define the technical deliverables for aggregate applications. Aggregate applications for Category 3 Pits Above Water (https://files.ontario.ca/environment-and-energy/aggregates/provincial-standards/mnr_e000028.pdf) require a hydrogeological study to "*determine the elevation of the established ground water table within the Site or demonstrate that the final depth of extraction is at least 1.5 m above the water table.*" The Growth Plan for the Greater Golden Horseshoe (2017) states "*an application requiring a new approval under the Aggregate Resources Act to expand an existing mineral aggregate operation may be permitted in the Natural Heritage System, including in key natural heritage features, key hydrologic features and any associated vegetation protection zones, only if the related decision is consistent with the PPS and satisfies the rehabilitation requirements of the policies in this subsection*." (s. 4.2.8.2.c)

The work program completed for this hydrogeological study was designed to comply with these requirements by characterizing the regional and local geological, hydrogeological, and hydrological conditions. To determine potential impacts (if any) of above water aggregate extraction to the natural environment, an impact assessment has also been completed.

2.0 REGIONAL SETTING

2.1 Physiography

The existing Duivenvoorden Pit and proposed expansion reside within the Horseshoe Moraine physiographic region (Chapman and Putnam, 1984). The moraine lies along the slopes of the Niagara Escarpment, from Singhampton to Caledon Village. This moraine is known for its systems of broad gravel and sand terraces. The proposed expansion to the Duivenvoorden Pit will extract the sand and gravels from these spillways, also referred to as the Orangeville Moraine.

The dominant physiographic feature within this region is the glacial re-entrant valley of the Pine River. This valley extends east of Horning Mills, terminating at Terra Nova and

is cut deeply into the bedrock escarpment from the east. The proposed pit expansion is located on the plateau formed by the dolostone cap rock, west of the Niagara Escarpment face (Whitewater Hydrogeology Ltd., 2017). Figure 2 (Appendix A) shows the local topography based on the 5 metre contours, which provides further refinement in the site topography. Elevations within the proposed expansion lands range from approximately 520 masl in the southwest portion of the property and 500 masl in the northeast portion.

2.2 Hydrology

The proposed pit expansion is located within the Boyne River sub-watershed of the Nottawasaga watershed, which covers an area of 24,000 ha. The Boyne River sub-watershed flows easterly from the Shelburne area to Alliston, where it joins the main branch of the Nottawasaga River. The Nottawasaga River flows north to Nottawasaga Bay at Wasaga Beach. The NVCA Boyne River Subwatershed Health Check (2013) describes the western portion of the river corridor as "a rolling agricultural/rural/ aggregate pit landscape".

There are no permanent watercourses on the Duivenvoorden expansion lands, although multiple swales convey surface drainage on a seasonal basis (water only present during spring freshet). These swales direct surface drainage to a low-lying basin area within the northeast portion of the property where it collects and infiltrates/evaporates. There is no outlet to this basin feature, so surface water sits in this area until it dries up in late spring/early summer. Drainage from adjacent properties to the north and west contribute surface water to this feature (see Figure 5). A wetland feature is also present on the expansion lands within the southwest portion of the property. This wetland feature holds surface water typically between April (freshet) and August, although the hydroperiod is presumed to change depending on the amount of precipitation received during each year. During spring freshet it is believed this wetland receives direct surface runoff from surrounding areas, including offsite from the south and west. When the wetland reaches water levels high enough, it outlets to the basin feature on the property via a semi-defined swale. According to water level data collected by Azimuth in 2018, the wetland also receives some degree of seasonal ground water contribution.

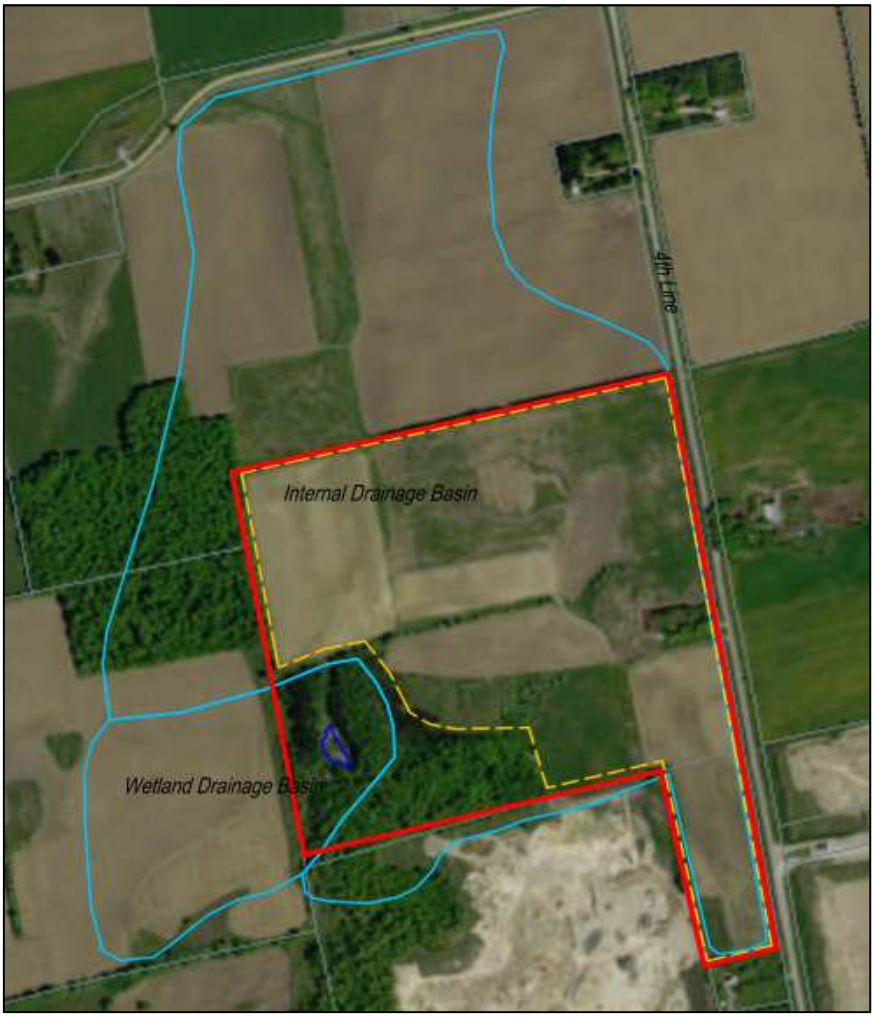


Figure 5: On-site Drainage Features

The swales and low-lying basin are not Key Hydrologic Features due to their limited size, limited habitat function and that they are not connected to other features. Their function is to collect and infiltrate surface runoff and this function will continue in the future.

2.3 Geology

2.3.1 Quaternary Geology

The Quaternary deposits in the study area are presented on Figure 6 (figure from by Whitewater Hydrogeology Ltd., 2017). For reference purposes, other nearby aggregate pits are shown in this figure. The Quaternary soils primarily consist of ice-contact stratified sand and gravel that are incised into the underlying fine-grained till.

The unconsolidated sand and gravel resource is underlain by a clay till deposit that is part of the regionally extensive Tavistock Till. Tavistock Till is a calcareous silty clay to silt till largely derived from glaciolacustrine sediments. This till sheet overlies the Paleozoic bedrock (Whitewater Hydrogeology Ltd., 2017). The Tavistock Till was encountered on-site at MW-1, MW-2 and MW-3. All other locations have the ice-contact sand and gravel unconformably overlying the Amabel bedrock.

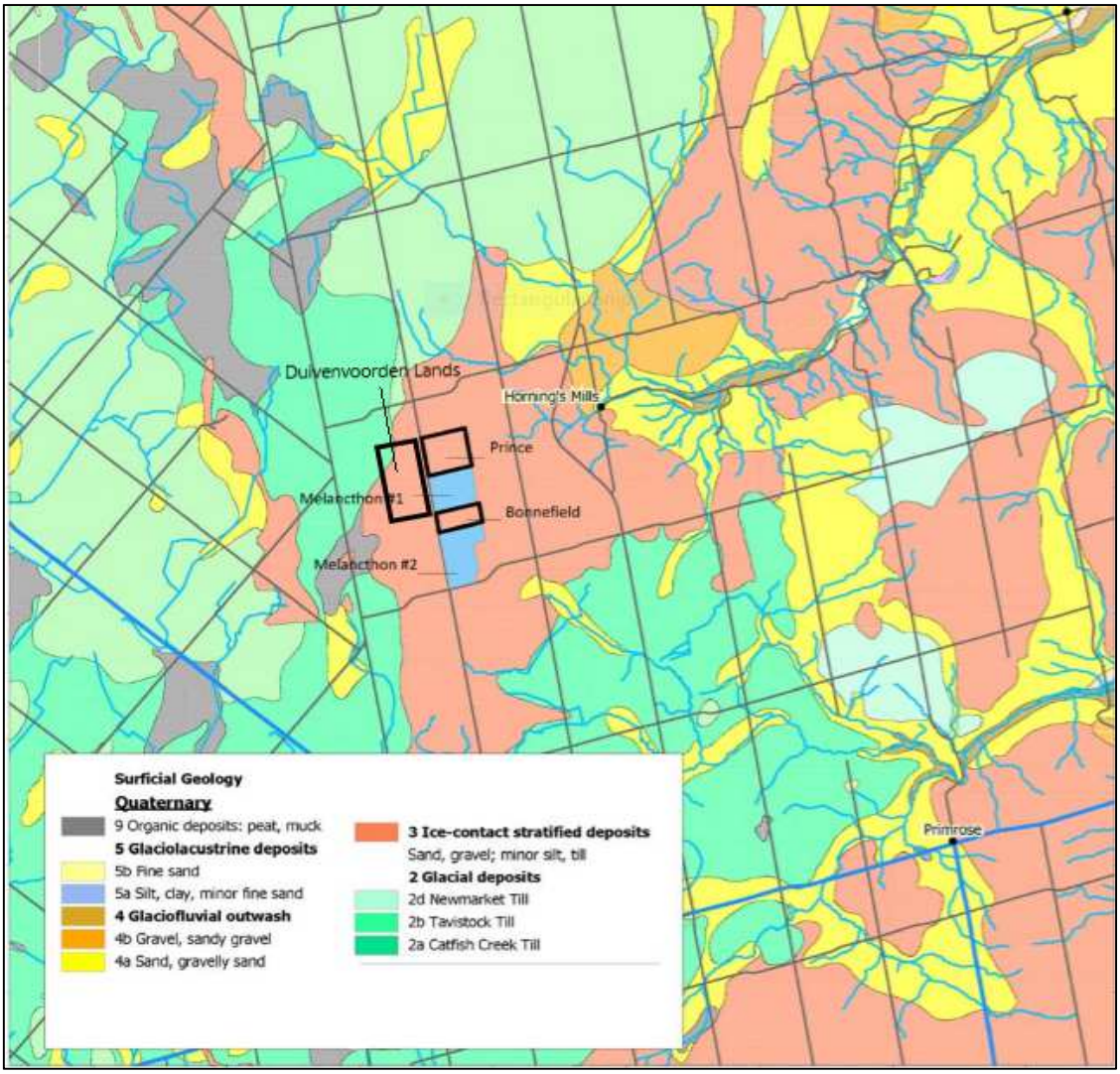


Figure 6: Regional Quaternary Geology (Whitewater, 2017)

2.3.2 Paleozoic Geology

The Paleozoic bedrock geology of the study area is presented in Figure 7 (figure from by Whitewater Hydrogeology Ltd., 2017). For reference purposes, other nearby aggregate pits are shown in this figure. The extraction plans do not include extraction of the

bedrock, and the bedrock is at a depth of more than 2.5 m below the seasonally high water table.

The Paleozoic bedrock beneath the subject property is comprised of a sedimentary rock sequence consisting primarily of layered dolostone, shale and sandstone. Located at the top of the bedrock column is the Amabel Formation, the only formation exposed above the escarpment, followed by the underlying Fossil Hill Formation and Cabot Head Formation of the Cataract Group (Whitewater Hydrogeology Ltd., 2017).

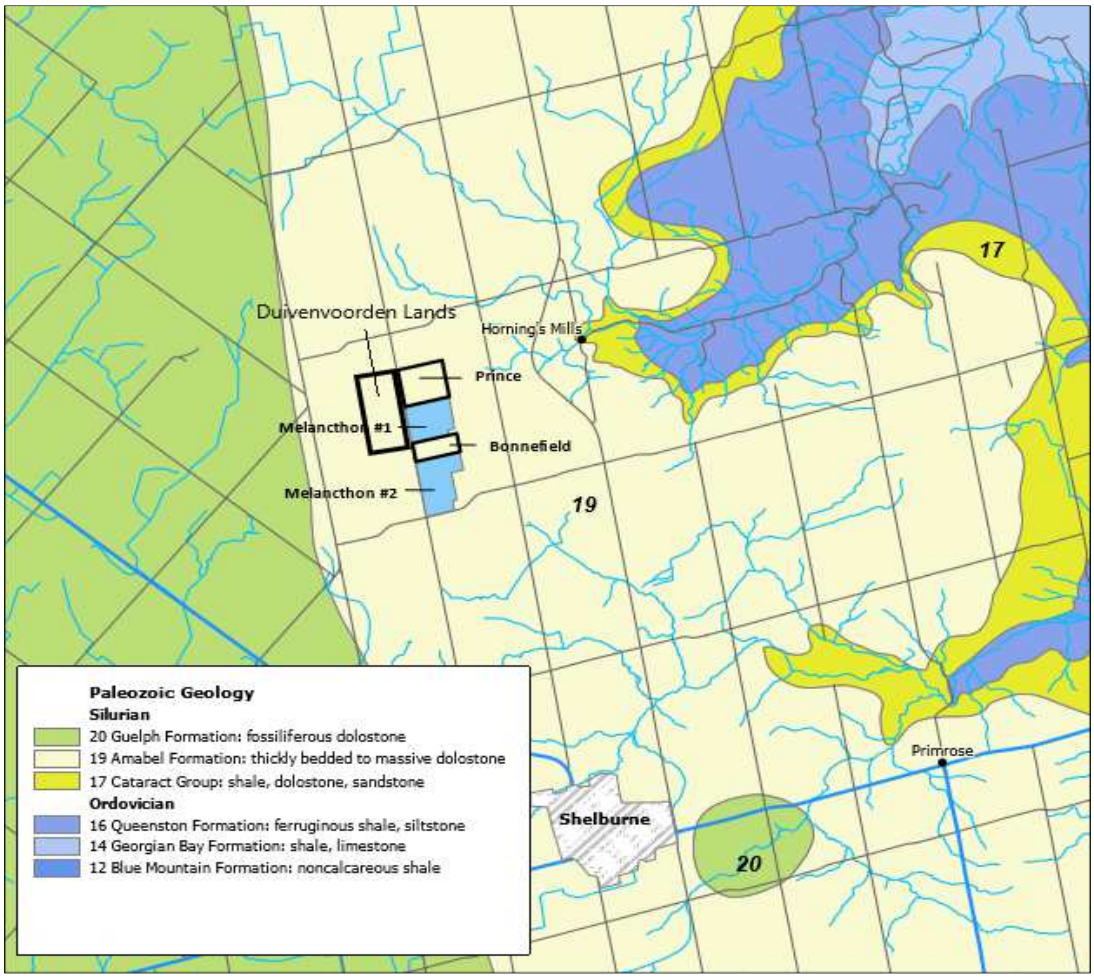


Figure 7: Regional Paleozoic Geology (Whitewater, 2017)

The top of the bedrock ranges between approximately 500.2 masl and 489.6 masl beneath the Duivenvoorden expansion lands. The bedrock surface slopes down toward the east, similar to overburden ground water flow direction. In the vicinity of the subject property, the Amabel Formation combined with the lower limestone units are reported to be

approximately 80 m in thickness, and does not affect the hydrogeological regime of the overburden granular units.

2.4 Overburden Hydrogeology

Across most of the site, the sand and gravel surficial unit is in direct contact with the bedrock and the flow characteristics of the ground water regime are controlled by the bedrock elevation (as a bounding unit of lower conductivity) and the permeability and gradients within the overburden. The permeability is moderate (estimated between $1x10^{-4}$ to 10^{-5} m/s) and the lateral gradients are approximately 0.02. Ground water velocities are approximately 0.2 to 2m per day and flow is along the east-west axis of the Boyne River sub-watershed. The bedrock being of much lower permeability, acts as the lower boundary for the active flow zone in the overburden.

2.5 Ground Water Use

Two principal aquifers were identified in the Town of Shelburne Ground Water Management Study (Burnside, 2001) being the overburden aquifer and the contact zone aquifer. The contact zone includes the upper fractured bedrock. Production wells in the Town of Shelburne utilize the contact zone aquifer (*i.e.* bedrock aquifer). The following sections provide a description of the ground water use (both municipal and private). The locations of the Town of Shelburne's municipal wells and wellhead protection zones, as well as domestic water wells which are on record with the Ministry of the Environment, Conservation and Park (MECP).

2.5.1 Town of Shelburne – Municipal Ground Water Wells

The Town of Shelburne is currently serviced by six production wells all of which are constructed in the bedrock of the Amabel Formation. Four wells (PW1, PW3, PW5 and PW6) are located within the Nottawasaga Valley Source Protection Area. The fifth and sixth production wells (PW7 and PW8) were installed in 2010 and 2014 respectively, and are within the Grand River Source Protection Area. NVCA (2018) reported that the regional ground water flow in the vicinity of the Town of Shelburne generally flows from southwest to northeast following the general patterns of the surface watercourses.

The wellhead protection areas for the Town of Shelburne provide an indication of the area that supplies water to the municipal wells (NVCA, 2018). The capture zones extend up to 6 km from the wellhead areas in a southwesterly and westerly direction (see Figure 8 taken from NVCA (2018)). These capture zones are located in excess of 6 km from the proposed Duivenvoorden expansion lands.

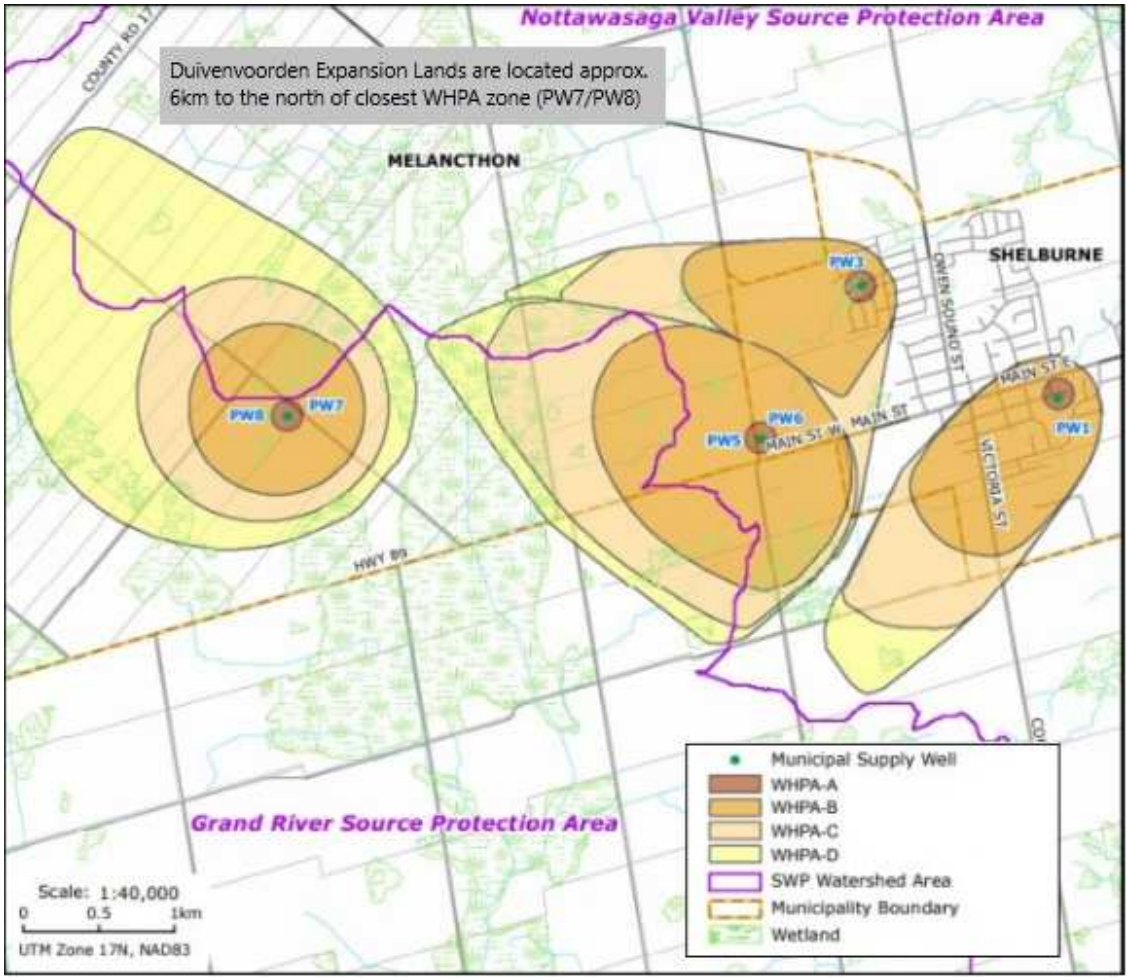


Figure 8: Town of Shelburne Wellhead Protection Zones

2.5.2 Township of Melancthon – Domestic Water Wells

A desktop well survey was undertaken to evaluate the well supply characteristics within the local area. A search of the online MECP database was completed for a radius of 750m from the Duivenvoorden expansion site boundary. These well records were used to assess the number of domestic wells within this area, and identify the target aquifer for each well. As ground water is the primary water supply for the local area, it can be assumed that homes not listed in the MECP database will actually be serviced by a private well. Under this assumption, there are 9 domestic wells within a 750m radius of the proposed Duivenvoorden expansion lands. Of these 9 wells, only six are shown in the MECP water well database. The other four wells were added to Figure 9 below for visual purposes.

Figure 9: MECP Database Well Locations

The majority of domestic wells (where information is available) within the 750m study area obtain water from the Amabel Formation (bedrock aquifer), with the exceptions of Well No. 1701316 which is a shallow overburden well (presumably close to bedrock contact). It should be noted that Well No. 1701316 has been decommissioned as the house was torn down on this property. Also, Well No. 1705240 is not located within the area shown in Figure 9. It is assumed that the waypoint location used for this well in the MECP database is for a lot centroid, not the actual well location.

Table 1 (below) summarizes the well records available for domestic wells within the study area. Well records for these wells are also presented in Appendix B.

Table 1: MECP Domestic Well Details

Tag/MECP No.	Well Depth	Target Aquifer	Observations
A084702	37.2	Bedrock	Drilled Well
A061262	13.7	Bedrock	Drilled Well
1705240	30.5	Bedrock	Drilled Well, Location Not Accurate
1700345	36.6	Bedrock	Drilled Well
1702233	17.1	Bedrock	Drilled Well
1701316	15.8	Overburden	Drilled Well (Well now decommissioned)

If wells are dug or drilled prior to 1950's they were likely not registered with the MECP and therefore are not present within the provincial database. This is likely the case for the wells shown in orange on Figure 9. The wells shown in green within the study area are mostly monitoring wells associated with the Duivenvoorden and nearby aggregrate pits.

The domestic wells listed in Table 1 are at a very low risk of being impacted by the proposed Duivenvoorden expansion operations, as the majority target the bedrock aquifer. There have been no known well complaints from this owner as all local operations are performed above the water table.

3.0 SOURCE WATER PROTECTION

The Clean Water Act (CA S.O. 2006, Chapter 22) primarily focuses on sources of water that have been designated by a municipality as being a current or future source of residential municipal drinking water for the community. The general goal of Source Water Protection is protecting source water from overuse and contamination to ensure safe municipal drinking water supplies.

When assessing the Duivenvoorden expansion lands from a Source Water Protection perspective, potential impacts to local municipal and private water supplies from the extraction of aggregate must be considered. In Section 2.4 the closest municipal water supply (Town of Shelburne) was determined and the Duivenvoorden expansion lands fall at minimum 6 km from the delineated Town of Shelburne's WHPAs.

Although the proposed Duivenvoorden expansion lands are located well outside of a municipal WHPA, this assessment has included a review of the aquifer vulnerability in the local area. This review has also been applied to the domestic water wells, which are the primary source of potable water for local residents. Specifically, an assessment of the Significant Ground Water Recharge Areas (SGRAs) and Highly Vulnerable Aquifers (HVAs) has been completed.

3.1 Significant Ground Water Recharge Areas / Highly Vulnerable Aquifers

In the Nottawasaga Valley watershed, SGRAs are defined as an area that has an average annual recharge rate than is 15% greater than the average annual recharge rate for the watershed; and an area that has a hydrological connection to a surface water body or aquifer that is a source of drinking water for a drinking water system. The vulnerability of SGRAs is categorized as high, medium or low based on their mapped intrinsic susceptibility. The susceptibility of the overburden soil layers are classified based on how readily each transmits water, and the thickness of each is considered. Based on the local surficial geology and physiography, a portion of the Township of Melancthon is covered by permeable sand and gravel deposits. As shown in Figure 10, the Duivenvoorden expansion lands fall within a SGRA, as delineated in the Nottawasaga Valley Source Water Protection Assessment Report (2018).

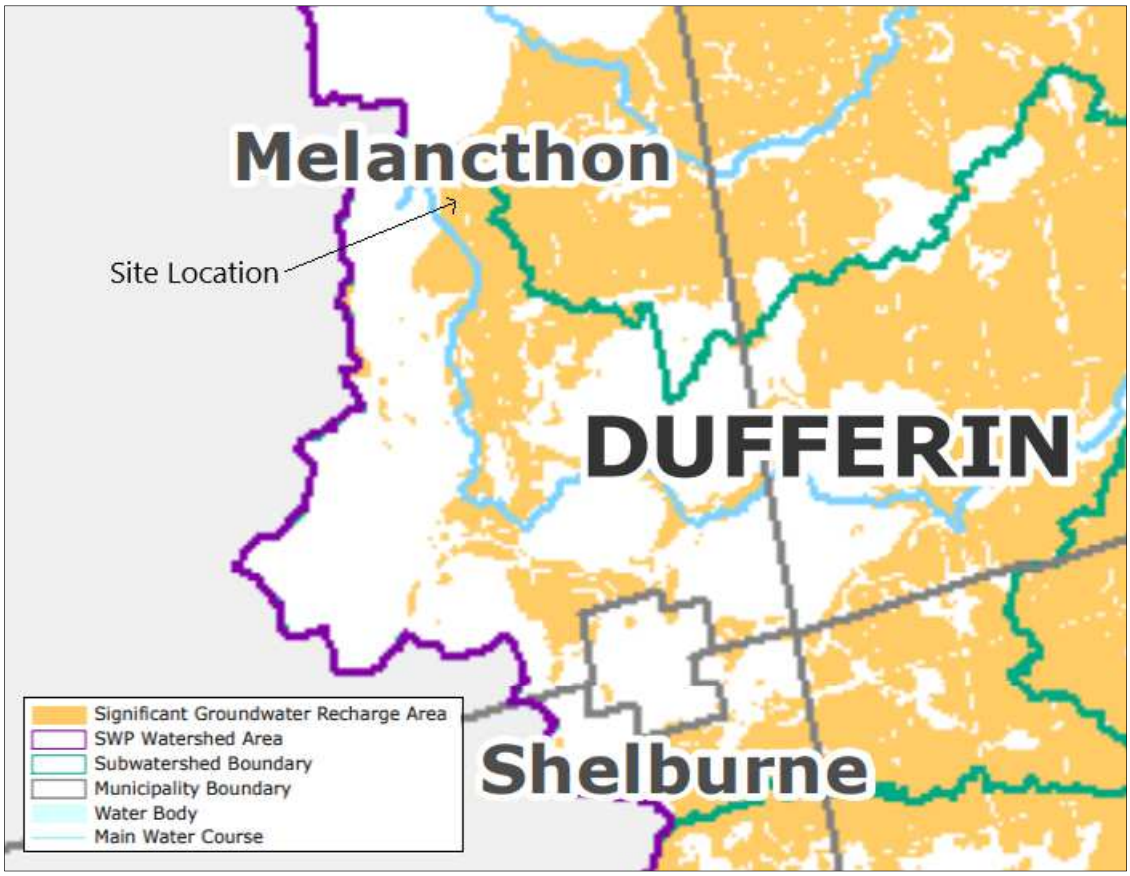


Figure 10: Significant Ground Water Recharge Areas Mapping

As shown in Figure 11 below, ground water vulnerability is considered "low" at the Duivenvoorden expansion lands, as delineated in the Nottawasaga Valley Source Water Protection Assessment Report (2015). The proposed change in land-use from agriculture

to aggregate extraction may increase the vulnerability rating; therefore it is important to assess the potential for changes associated with an aggregate operation (see Section 3.2).

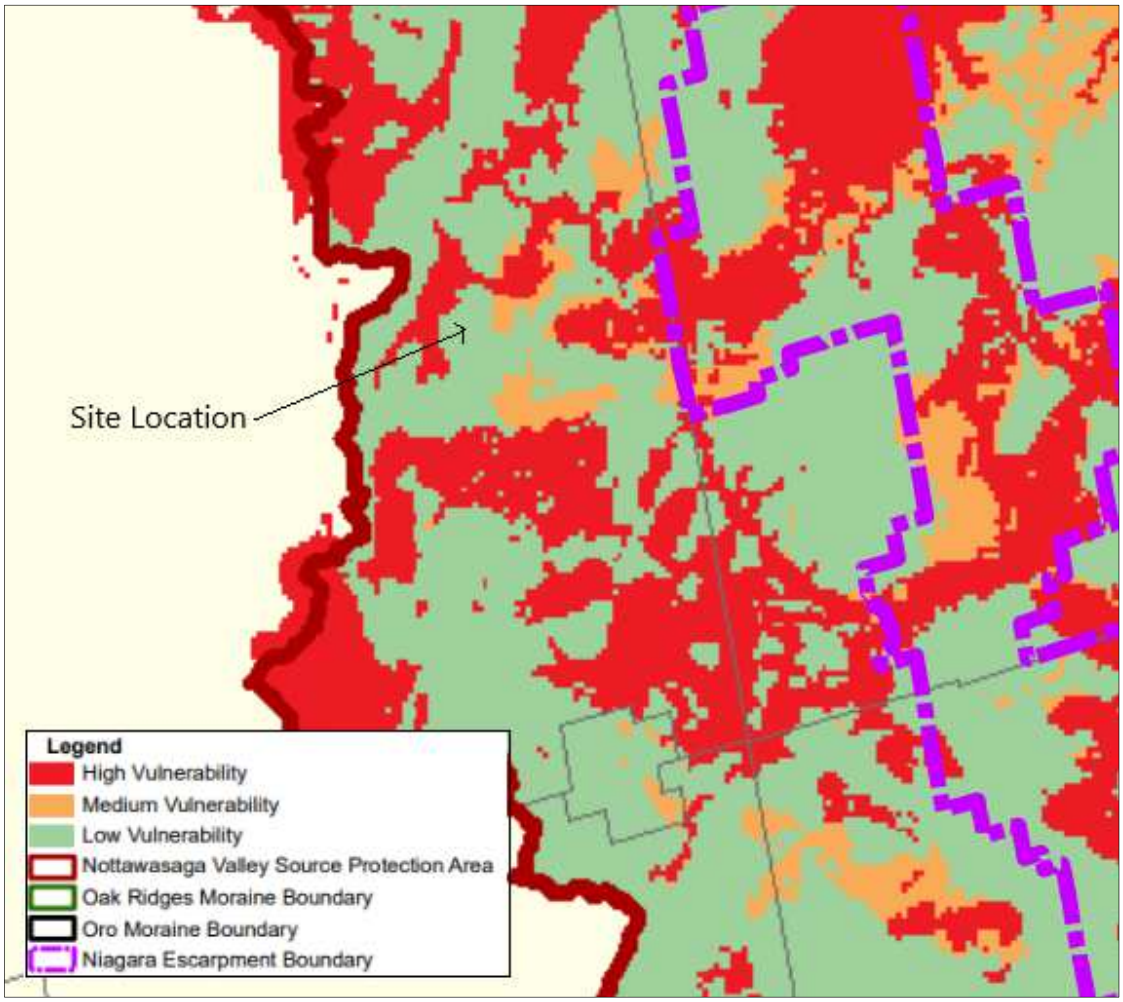


Figure 11: Highly Vulnerable Aquifer Mapping

3.2 Source Water Protection and the Aggregate Industry

The Ontario Stone, Sand and Gravel Association (OSSGA) supported a literature review study by the MNRF to assess the role of the aggregate industry and associated lands in the context of source water programs. The MNRF study (Applied Research on Source Water Protection Issues in the Aggregate Industry; Blackport and Golder, 2006) did not link the extraction and processing of stone, sand and gravel as a threat to drinking water sources.

The province of Ontario has identified 21 prescribed drinking water threats under the CWA. Nineteen of these relate to water quality and two to water quantity. The current land use at the proposed Duivenvoorden expansion lands is primarily agriculture, which results in at least five potential prescribed drinking water threats, including:

- Agricultural source material – application to land
- Agricultural source material – storage
- Agricultural source material – management
- Commercial fertilizer – application
- Pesticide – application

The site property is outside of the wellhead protection areas for any communal water supply wells. The proposed changing in land use (from agriculture to aggregate extraction) will temporarily reduce the number of prescribed drinking water threats. There is no proposed storage of fuel at the Duivenvoorden expansion site which further decreases the potential for threats to drinking water.

4.0 HYDROGEOLOGICAL/HYDROLOGICAL INVESTIGATION

4.1 Subsurface Drilling Program

In September 2017, a drilling program was completed by Orbit Garant Drilling (supervised by Azimuth field staff) for the purpose of installing a series of monitoring wells across the Duivenvoorden expansion lands. A total of seven monitoring wells at five locations (two nested sites) were installed for the purpose of long-term ground water level monitoring for the overburden aquifer underlying the site. The drilling program also provided useful geological logs at each drilling location to assess the extent of potential aggregate material across the property.

Bedrock refusal was encountered at each drilling location and determined well depth in most cases, which ranged between 12.2 and 20.7 mbgs (metres below ground surface). Two shallow wells (at nested sites) were drilled to depths of 6.7 mbgs (MW-2s) and 8.7 mbgs (MW-4s). All wells were screened into the water table, with the exception of MW-2s which was dry for the majority of the monitoring period (see Section 4.2). Figure 2 (Appendix A) shows the locations of all monitoring wells. Borehole logs for each monitoring well are presented in Appendix C. Table 2 provides a summary of construction details for each monitoring well.

Figure 3 (Appendix A) presents geological cross sections for the site showing northwest/southeast and southwest/northeast orientations.

Table 2: Duivenvoorden Monitoring Well Details

Well Name	Top of Casing	Ground Surface	Top of Screen	Bottom of Screen	Location	
	Metres Above Sea Level (masl)				Easting	Northing
MW-1	510.21	509.19	501.60	494.90	560990	4888189
MW-2s	508.11	507.15	501.95	500.45	560655	4888409
MW-2d	508.10	507.15	493.15	491.65	560655	4888409
MW-3	518.86	518.52	502.82	498.82	560483	4888249
MW-4s	513.17	512.25	503.05	500.05	560248	4888619
MW-4d	513.22	512.26	506.56	503.56	560248	4888619
MW-5	511.17	510.34	492.65	489.65	560903	4888686

Azimuth staff also manually installed a ground water piezometer adjacent to the wetland feature within the southwest portion of the site (see Figure 2 – Appendix A) in April 2018 following spring freshet. The piezometer was driven to a total depth of 1.45 mbgs for the purpose of monitoring shallow ground water levels to assess the degree of ground water contribution (if any) to the wetland feature.

4.2 Ground Water Level Monitoring

Following completion of the drilling program/monitoring well installations, Azimuth staff initiated a long-term ground water level monitoring program at the Duivenvoorden expansion lands. In late September 2017, staff installed water level/temperature dataloggers (Solinst Levelogger – M30) in all monitoring wells. The dataloggers recorded hydrostatic pressure measurements at set intervals over time to determine changes in water level elevations. Dataglogger accuracy was field-verified by taking quarterly ground water level measurements using a water level tape (Solinst – Model 101).

The dataloggers were installed in late September 2017 and recorded ground water levels within the monitoring wells until early October 2018. The dataloggers were programmed to collect water level measurements at hourly intervals throughout the monitoring period and data downloading occurred quarterly. A round of manual ground water level measurements were also completed in December 2018 when it was determined that the existing pit contains two monitoring wells (see Figure 4). Azimuth felt it was prudent to measure water levels in all wells (in both existing pit and expansion lands) to accurately determine regional ground water flow direction.

Manual water level measurements were also collected within the shallow piezometer on a monthly basis between April – October 2018 as the pipe diameter was too small to accommodate a datalogger installation.

4.3 Surface Water Level Monitoring

To monitor seasonal surface water levels in the on-site wetland feature, Azimuth staff installed a stilling well/staff gauge equipped with a water level/temperature datalogger. The stilling well was constructed from a "t-bar" fence post which was driven into the bottom of the deepest part of the wetland, and a 2" PVC well screen was affixed to the t-bar. The datalogger was installed in the bottom of the PVC well screen. A meter stick was also affixed to the t-bar to manually measure wetland water levels during monthly site visits. The manual water level measurements were completed to ensure accuracy of the datalogger data. Surface water level monitoring was initiated in April 2018 following spring freshet and concluded in October 2018.

4.4 Monitoring Results

4.4.1 Ground Water Flow

The local (on-site) ground water flow patterns within the overburden are presented in Figure 12 below.

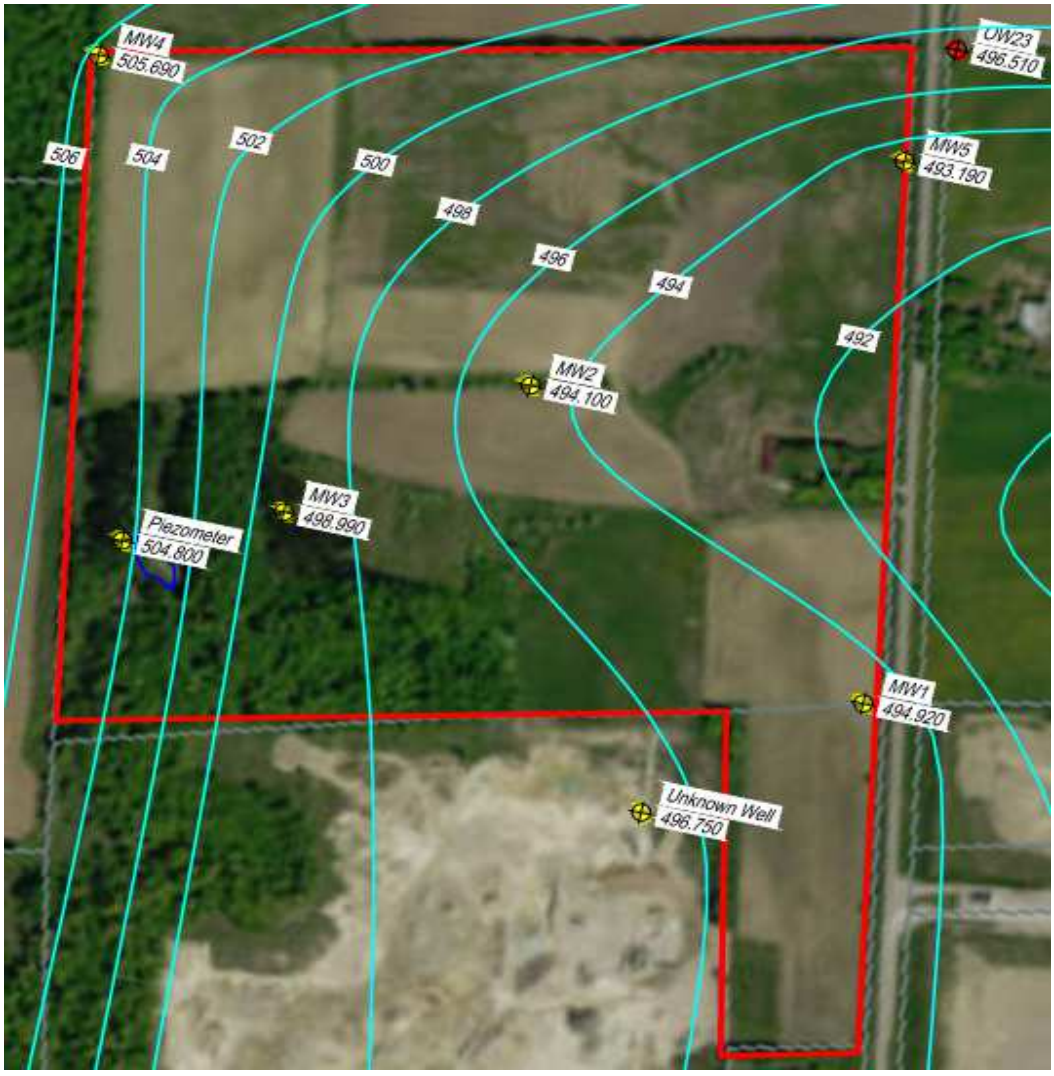


Figure 12: Local Ground Water Contours

The ground water contours shown in Figure 12 are based on manual measurements taken in December 2018, when measurements were taken from wells within both the existing pit and expansion lands. The contours show ground water within the overburden flows in an eastern to southeastern direction. Regional (on-site and off-site) ground water flow patterns within the overburden are presented in Figure 4 (Appendix A) which show both the existing pit and expansion lands.

Figure 13 below presents local bedrock elevation contours which shows that the bedrock forms a buried valley dipping towards the east. The contours of the buried valley follow the same general form as ground water contours, which points to bedrock topography locally influencing ground water flow patterns.

Figure 13: Bedrock Contours

It should be noted that the above bedrock contours are based on the assumption that auger refusal during drilling was due to the bedrock being contacted. No bedrock wells were completed during the subsurface drilling program.

4.4.2 Overburden Ground Water Elevations

Figure 14 and Figure 15 present all ground water level/elevation data collected for the monitoring wells installed across the Duivenvoorden expansion lands. The seasonally high water table is found within the overburden across the site. As the limit of

excavation is based on the high water table, the excavation will also be completely within the overburden.

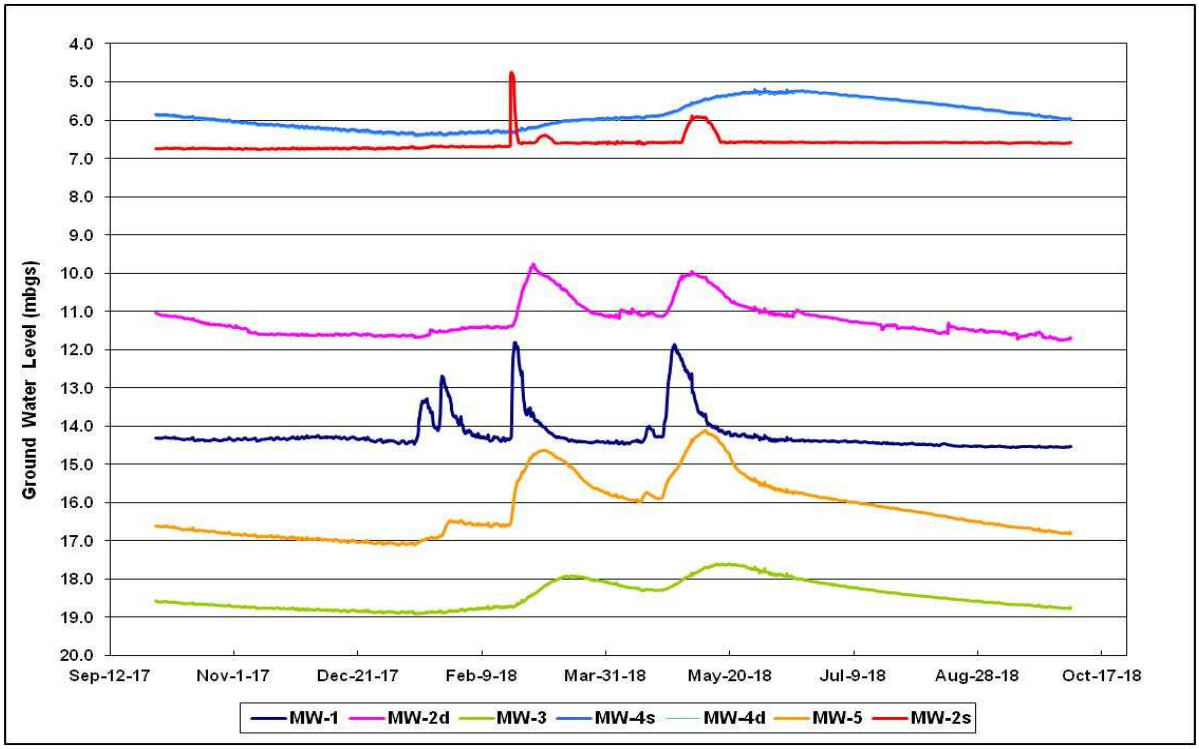


Figure 14: Overburden Ground Water Level (mbgs)

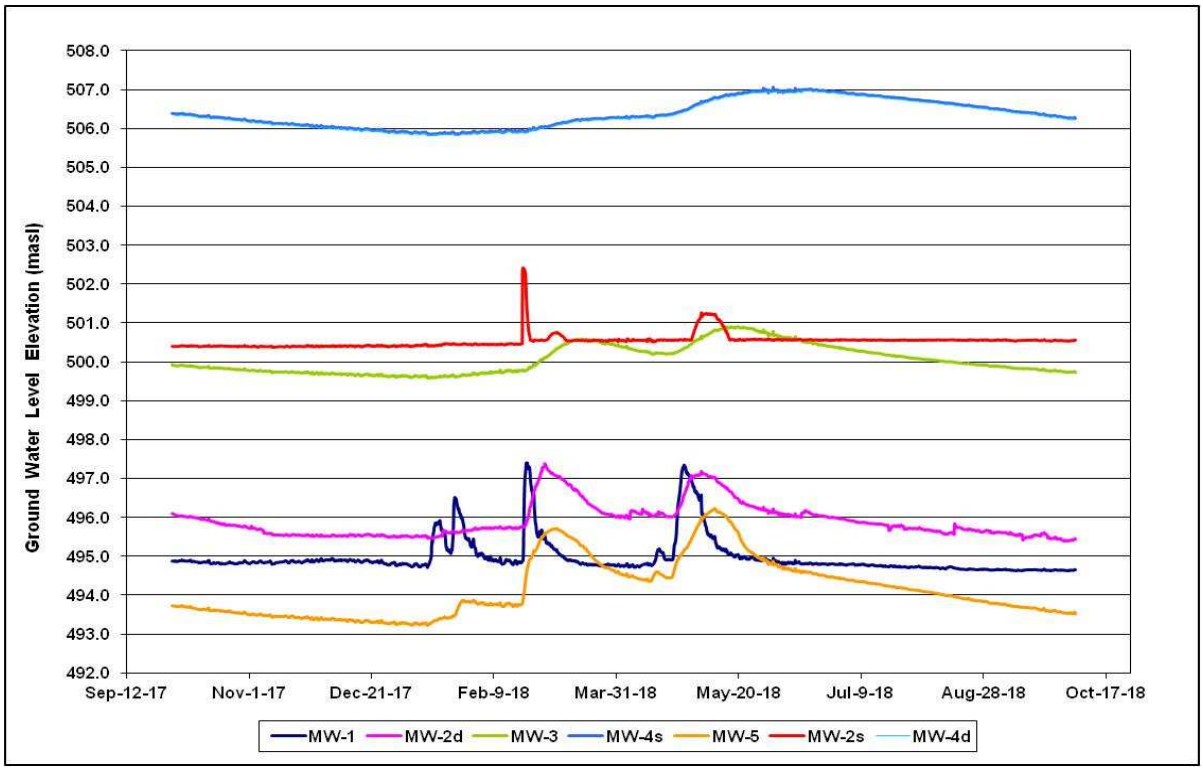


Figure 15: Overburden Ground Water Elevations (masl)

Generally, the water level trends are seasonal, with water levels peaking in the spring and decreasing over the warmer and drier summer/fall months. Some monitoring wells showed abrupt spikes during short warming trends in the winter months which represent times of snow melt. Based on the datalogger data, the water table elevations range between a high of approximately 507 masl and a low of approximately 493 masl across the site. These elevations equate to a high of approximately 5.0 mbgs and a low of approximately 19.0 mbgs.

It should be noted that the shallow well (MW-2s) at nest MW-2 was dry for the majority of the monitoring period, with only a few temporary spikes where water entered the well pipe. These spikes were related to spring freshet and periods of significant snow melt during the winter months. It is believed that MW-2s was screened within a perched sand seam rather than the water table, which explains the lack of water within the well pipe for extended periods of time.

4.4.3 Surface Water Elevations

Figure 16 presents all surface water level data for the on-site wetland feature which was measured by a datalogger between early April and early October 2018.

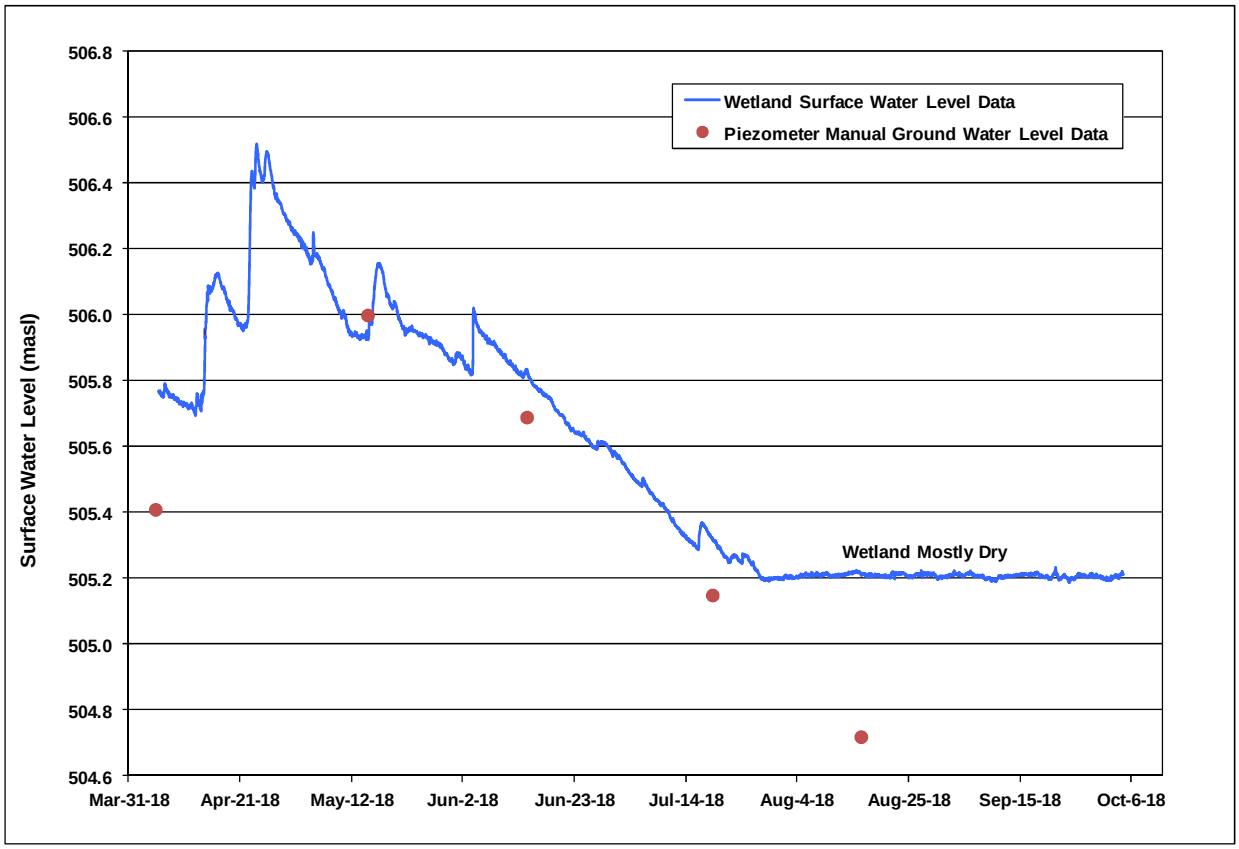


Figure 16: Wetland Water Levels

Figure 16 shows water levels spiked to a high of approximately 1.35 metres within the wetland feature in spring during snow melt/increased rainfall and gradually decreased thereafter with less rainfall and warmer temperatures. The wetland began to dry out in late July and stayed dry for the majority of the remaining monitoring period. Figure 16 below shows decreasing shallow ground water levels adjacent to the wetland feature which also likely contributed to the wetland drying out in mid-summer. The manual measurements at both the wetland stilling well and shallow piezometer show a correlation between surface water and shallow ground water levels in this area of the site. Shallow ground water contribution is most evident in the spring (May measurement), although the degree of contribution from early summer to fall decreases. It should be noted that the final ground water measurement (October 4th) within the piezometer was observed as dry.

4.5 Water Quality

On-site monitoring wells and the wetland feature were sampled in July 2018 for general water quality parameters. The results for the three monitoring wells sampled were generally consistent, and results for the wetland showing a different chemical signature.

As can be seen in Table 3, major ion parameters for the wetland feature exhibited consistently lower levels than MW2d, MW4s and MW5.

Table 3: Major Ion Chemistry Results for Sampling Locations

Location	Bicarbonate (mg/L)	Sulphate (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Sodium (mg/L)
MW-2d	237	8.26	71.8	18.8	3.77
MW-4s	307	3.83	87.1	25.8	1.77
MW-5	232	25.9	84.8	32.0	3.43
Wetland	115	0.20	34.6	9.07	2.01

The relatively low levels in the wetland reflect that of a primary surface water source. Since sampling occurred in July the degree of ground water contribution to the wetland was likely low.

The ground water samples from MW-2d, MW-4s and MW5 were compared to the Ontario Drinking Water Quality Standard (ODWQS), with only aesthetic and operational parameters such as hardness, turbidity and colour exceeding the guideline limits. Full water quality results are presented in Appendix D.

5.0 PIT FLOOR ELEVATIONS

The proposed Duivenvoorden expansion would stay consistent with the existing Pit license, which consists of a Class A Pit Above Water and restricts the extraction of aggregate material within 1.5 metres above the established ground water table. To comply with the requirements of a Class A license, site plans must show floor elevations above the 1.5 metre water table separation mark across the proposed extraction area.

Based on the seasonal high water level elevations presented in Figure 15, the proposed pit floor elevations are presented in Figure 17. Since the monitoring completed by Azimuth captured a full year of water level data, the high water table was captured making the proposed pit floor elevations accurate.

Figure 17 shows the high water table elevations recorded during monitoring at each well, along with elevations 1.5 metres higher (in brackets) than the water table measurements. It should be noted that the future floor elevation for the existing (active) pit to the south will eventually be 500.0 masl. This elevation will match up well with the proposed pit elevations within the expansion lands, which range between approximately 499.0 – 501.00 masl where these parcels will meet.

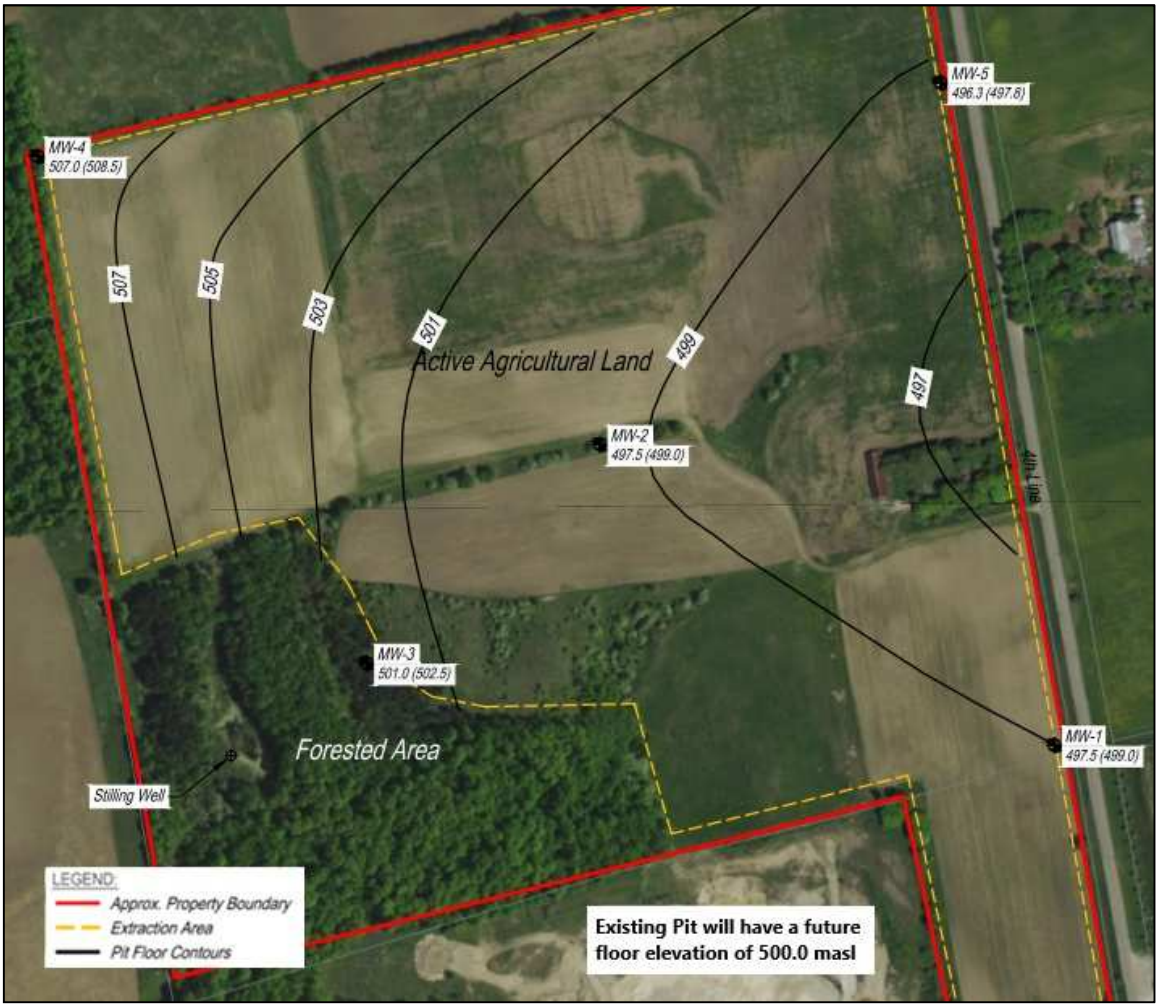


Figure 17: Proposed Pit Floor Elevations

6.0 IMPACT ASSESSMENT

6.1 Water Balance

A water balance has been completed as part of the impact assessment for the proposed extraction of aggregate from the Duivenvoorden expansion lands to ensure that the site operations will not have an adverse impact on the ground water and surface water systems. A water balance focuses on a comparison between pre and post-development conditions, or in this case pre and post-extraction. Specific focus is upon impacts to local ground water recharge and surface water runoff conditions. The purpose of this assessment was to present the limited influence of an above water table pit on the ground water and surface water regimes.

In order to determine the potential changes to the natural ground water recharge and surface water runoff conditions, a pre- and post-extraction water balance assessment has been completed using the Thornthwaite and Mather method (1957). This method evaluates evapotranspiration based on precipitation and temperature. Residual soil saturation is a function of topography and soil type. Monthly data are tabulated from daily average temperature and precipitation, and the water budget is a continuous calculation over the period of record. To clarify, the method and the approach used by many individuals in examining infiltration resets annual conditions (moisture deficit, snow storage, etc) over the winter months because of the general lack of infiltration during the frost period. However, we maintain those records and carry them forward from month to month during the entire period of record.

Values were determined on a monthly basis, compiled from daily Environment Canada meteorological data station located in Orangeville (No. 6155790) for the period between 1969 – 2015. The calculations are based on the average conditions during this period, including outputs for monthly potential and actual evapotranspiration, soil moisture storage, snow storage, surplus and runoff. The results indicate that the average annual precipitation for the regional area is 896 mm, with an average water surplus of 393 mm.

Infiltration factors are used to determine the fraction of water surplus that infiltrates into the ground and the fraction that runs off to nearby drainage features. Infiltration rates were estimated using the method listed in Table 2 of the MOEE Hydrogeological Technical Information Requirements for Land Development Applications (1995). Due to the highly permeable nature of the sand and gravel deposits at surface, the majority of the site being cultivated land and the 'hilly' nature of the local topography, it was determined that approximately 70% of the water surplus will infiltrate into the ground. Using an infiltration value of 0.7, the average infiltration rate for the site would be approximately 275 mm/year.

Recharge within the internally drained basins will be equal to the average water surplus (393 mm/year). The two delineated sub-catchment basins for the Duivenvoorden expansion site are presented in Figure 19. According to topographic mapping, the entire Duivenvooden expansion site is internally drained, which explains the large drainage basin feature which collects surface runoff promoting ground water infiltration.

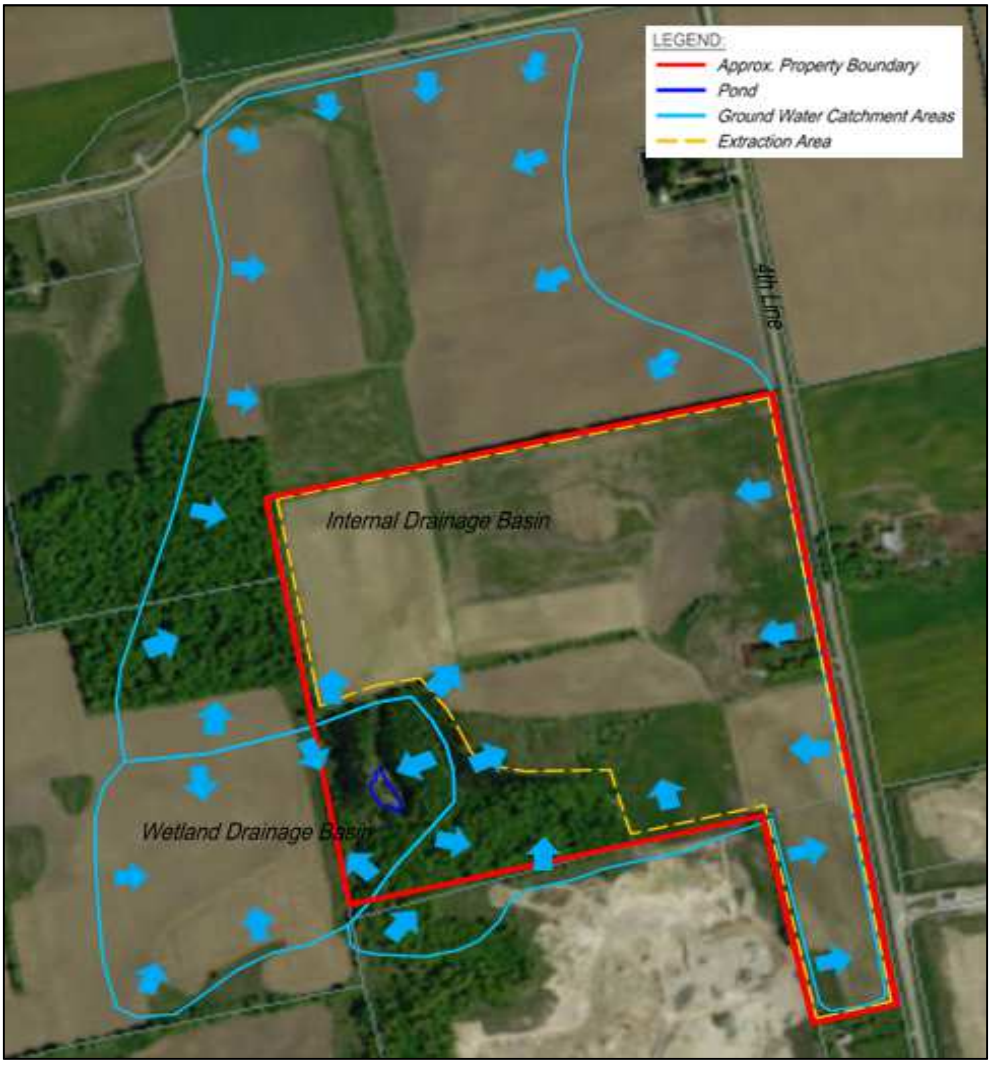


Figure 18: Surface Water Catchment Areas

Figure 18 shows large off-site areas which contribute surface runoff to the on-site drainage and wetland basins, but little to no flow leaving the site. Any drainage off-site would be negligible and limited to the roadside ditch at the eastern property boundary.

The infiltration rate of 393 mm/year (entire water surplus) has been applied to both drainage basins (internal and wetland). The combined area of the two drainage basins is approximately 968,400 m^2, which equals a total annual ground water recharge of approximately 380,580 m^3/year.

As aggregate is extracted, the flattening of the pit floor promotes infiltration as the average land slope lessens and the highly permeable materials are exposed (vegetation

and topsoil removed). Considering the entire site is internally drained (little to no runoff off-site), pre-extraction recharge conditions would not be impacted to a significant degree due to the proposed extraction operations.

The catchment area that provides surface runoff to the wetland feature will also not be impacted, as the majority of this catchment is off-site. The remainder of the catchment is within the forested area that will be preserved within the southwestern corner of the site.

6.2 Potential Interference with Local Ground Water Regime

The proposed extraction of aggregate will occur at an elevation of at least 1.5 metres above the established high water table elevation. As discussed in Section 6.1, the permeable materials on the pit floor will allow for ground water to recharge at an increased rate of an average of 393 mm/year. Therefore, the pit operations will not require a water management plan.

The change in land use will maintain or slightly increase ground water recharge within the extraction area. An increase in recharge from the flattening of slopes and stripping of vegetation/topsoil will likely have no measureable change in water table elevations across the site and therefore will have no impact on off-site domestic water wells.

6.3 Potential Interference with Surface Water Features

On-site surface water features include a wetland within the southwest portion of the site located within the forested area being preserved (not included within extraction area). This wetland has been found to have some degree of ground water contribution (likely only during times of elevated water table) and therefore has a seasonal connection to the local ground water regime. As determined in the water balance assessment for the site, no negative impacts to the existing pre-extraction recharge conditions are anticipated, so impacts to the wetland are also not expected. The wetland catchment area will also be maintained so changes to direct runoff will not occur during post-extraction conditions.

The temporary drainage features (swales and basin) shown in Figure 5 only contain surface water during spring freshet and have no connection to the local ground water regime. These features within the proposed extraction area would be eliminated due to extraction of material and grade changes. These features will not be required to convey/contain runoff post-extraction as perimeter berms will significantly reduce the amount of runoff into this area.

7.0 MITIGATION MEASURES

Although there are no anticipated impacts associated with the proposed extraction of aggregate, which will occur at least 1.5 metres above the established water table, there

are preventative operational practices that are recommended to further protect ground water quality.

- Refueling of machinery should not be conducted in areas of the excavation that are within 1.5 metres of the water table (i.e., on the pit floor).
- Operator training should include understanding and the ability to implement the preventative measures provided above, in addition to the Spill Contingency Plan (as per prescribed conditions on Site Plans).

8.0 RECOMMENDED MONITORING PROGRAM

A monitoring program has been developed for the proposed Duivenvoorden expansion site. The program focuses on monitoring and continuing the characterization of the local overburden ground water regime, both from water level and water quality perspectives.

Considering the proposed aggregate operation will not be extracting from below the water table, there will be no influence on the bedrock aquifer system. Therefore, we do not recommend the installation of wells to monitor the bedrock aquifer. However, to continue the characterization of the water table aquifer within the overburden, continuous ground water elevation monitoring is recommended. It is also recommended that one upgradient and two downgradient monitoring locations be sampled for water quality on a semi-annual basis.

Table 4 provides a summary of the proposed monitoring program for the Duivenvooden expansion site.

Table 4: Proposed Monitoring Program

Monitor	Water Levels (Datalogger/Spring-Summer-Fall Manuals)	Water Quality (Semi-Annual)
MW-1	X	X
MW-2s	X	
MW-2d	X	
MW-3	X	
MW-4s	X	
MW-4d	X	X
MW-5	X	X

The proposed water quality package for the monitoring program consists of a wide range of metals, nutrients and inorganic parameters, including:

pH, electrical conductivity, alkalinity, total phosphorus, ammonia, hardness, TDS, TOC, Colour, chloride, nitrate, nitrite, bromide, sulphate, ortho-phosphate, calcium, magnesium, sodium, potassium, aluminum, boron, copper, iron, lead, manganese, strontium, zinc, Total Petroleum Hydrocarbons (F1 – F4), BTEX and Total Oil and Grease

It is recommended that an annual monitoring report for the Duivenvoorden expansion site be prepared and submitted to the MNRF prior to March 31st of each year and include the monitoring data for the preceding calendar year. The report shall include the following:

- Monitoring data collected as per Table 4;
- Water quality sampling results;
- Data tabulated in graphical and tabular formats;
- Interpretation of all water level and water quality data;
- Recommendations pertaining to continuation of the monitoring program, and/or changes such as monitoring type, monitoring frequency, monitoring locations, etc., and;
- Summary and documentation of any water well complaint(s) and their resolution(s).

9.0 CONCLUSIONS

The proposed Duivenvoorden Pit expansion lands were investigated to determine the suitability of the extraction of aggregate from above the water table. As there will be no water diversion or dewatering to maintain dry pit operating conditions, and the maximum depth of extraction will not be less than 1.5 metres of the seasonal high water table, there be no measureable influence on the underlying water table aquifer. Therefore, there will be no anticipated impact to local domestic water wells. Surface water features (i.e., on-site wetland) will also not be impacted due to the lack of proposed changes to local catchment areas and that the pit excavation will somewhat increase infiltration. Considering all available data compiled during this assessment, the Duivenvoorden Pit expansion lands are suitable for above water table aggregate extraction.

10.0 REFERENCES

Bolton, T.E., 1957.
Silurian stratigraphy and paleontology of the Niagara Escarpment in Ontario; Geological Survey of Canada, Memoir 289, 145p.

Burnside and Waterloo Hydrogeologic, 2001.
Town of Shelburne: Groundwater Management Study.

Chapman, L.J., and Putman, D.F., 1984.
The Physiography of southern Ontario. 3rd Edition. Ontario Geological Survey.

Gwyn, Q.H.J., 1972.
The Quaternary Geology of Dundalk area – Southern Ontario. Ont. Dept. Mines and Northern Affairs, P.727

Liberty, B.A. and Bolton, T.E., 1971.
Paleozoic geology of the Bruce Peninsula area, Ontario; Geological Survey of Canada, Memoir 360, 163p.

Pratt, B.R., and Miall, A.D., 1993.
Anatomy of a bioclastic grainstone megashoal (Middle Silurian, southern Ontario) revealed by ground penetrating radar, Geology, 21, 223-236.

MOEE, 1995.
Hydrogeological Technical Information Requirements for Land Development Applications. MOEE Hydrogeological Technical Info Requirements. Table 2.

Nottawasaga Valley Source Protection Area, 2018.
Approved Assessment Report

Thornthwaite, C.W., and Mather, J.R., 1957
Instructions and tables for computing potential evapotranspiration and the water balance. Climatology, vol. X, #3.

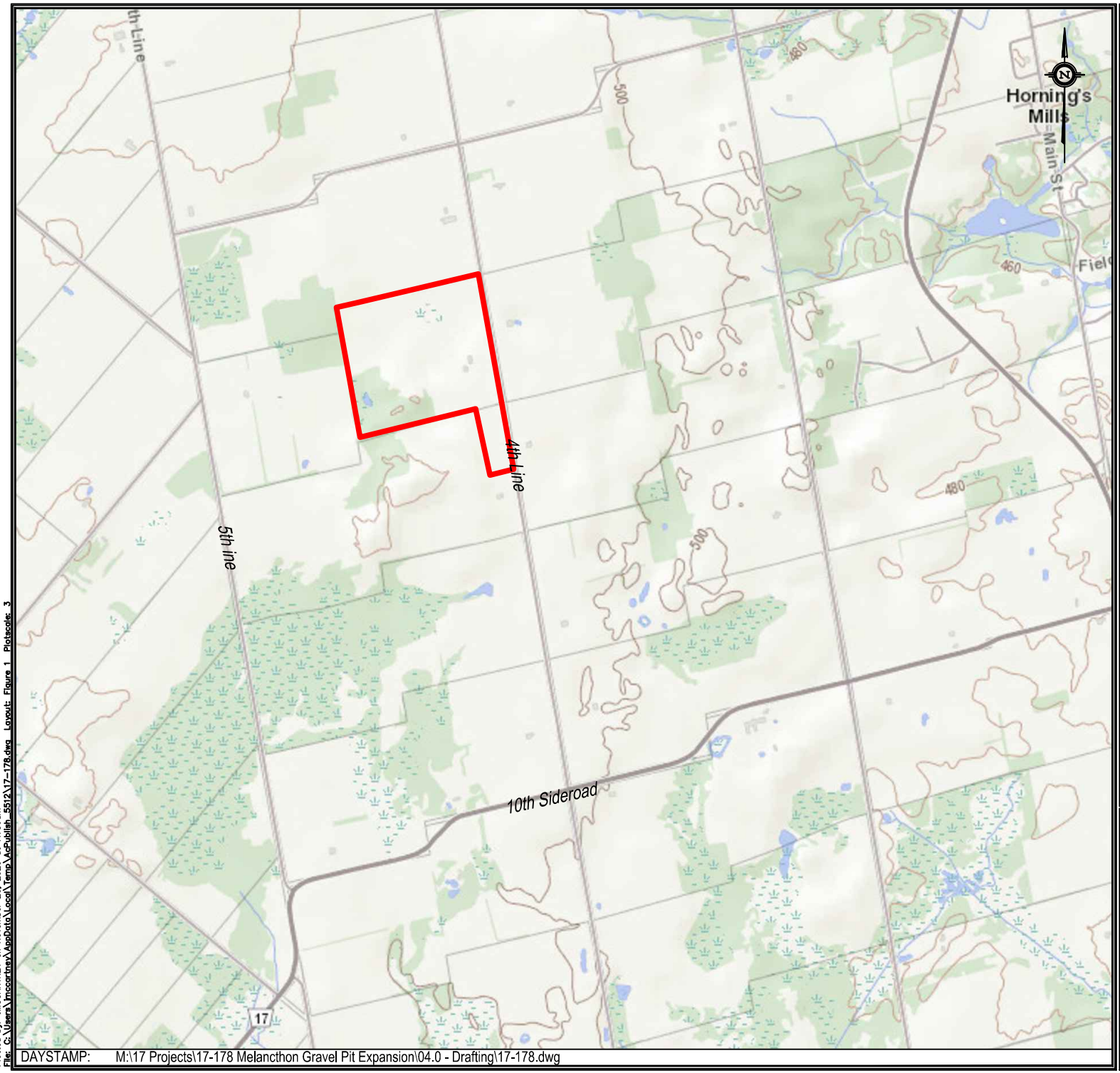
Whitewater Hydrogeology Ltd., 2017
Combined Level 1 and 2 Hydrogeological Assessment Report. Proposed Bonnefield and Prince Pits.

APPENDICES

Appendix A: Figures
Appendix B: MECP Domestic Water Well Records
Appendix C: Borehole Logs
Appendix D: Water Quality Results

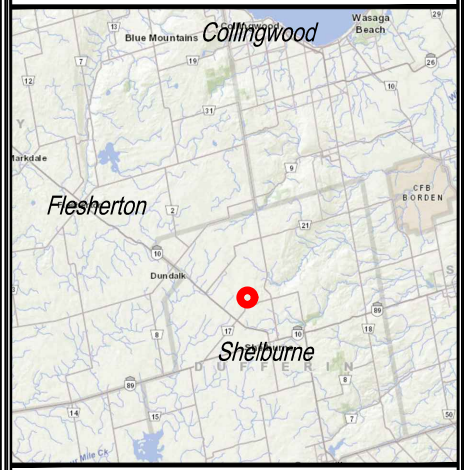
APPENDIX A

Figures



LEGEND:

Approx. Property Boundary



REG MAP

250m 0 750m

HORIZONTAL SCALE 1:25,000

AZIMUTH ENVIRONMENTAL CONSULTING, INC.

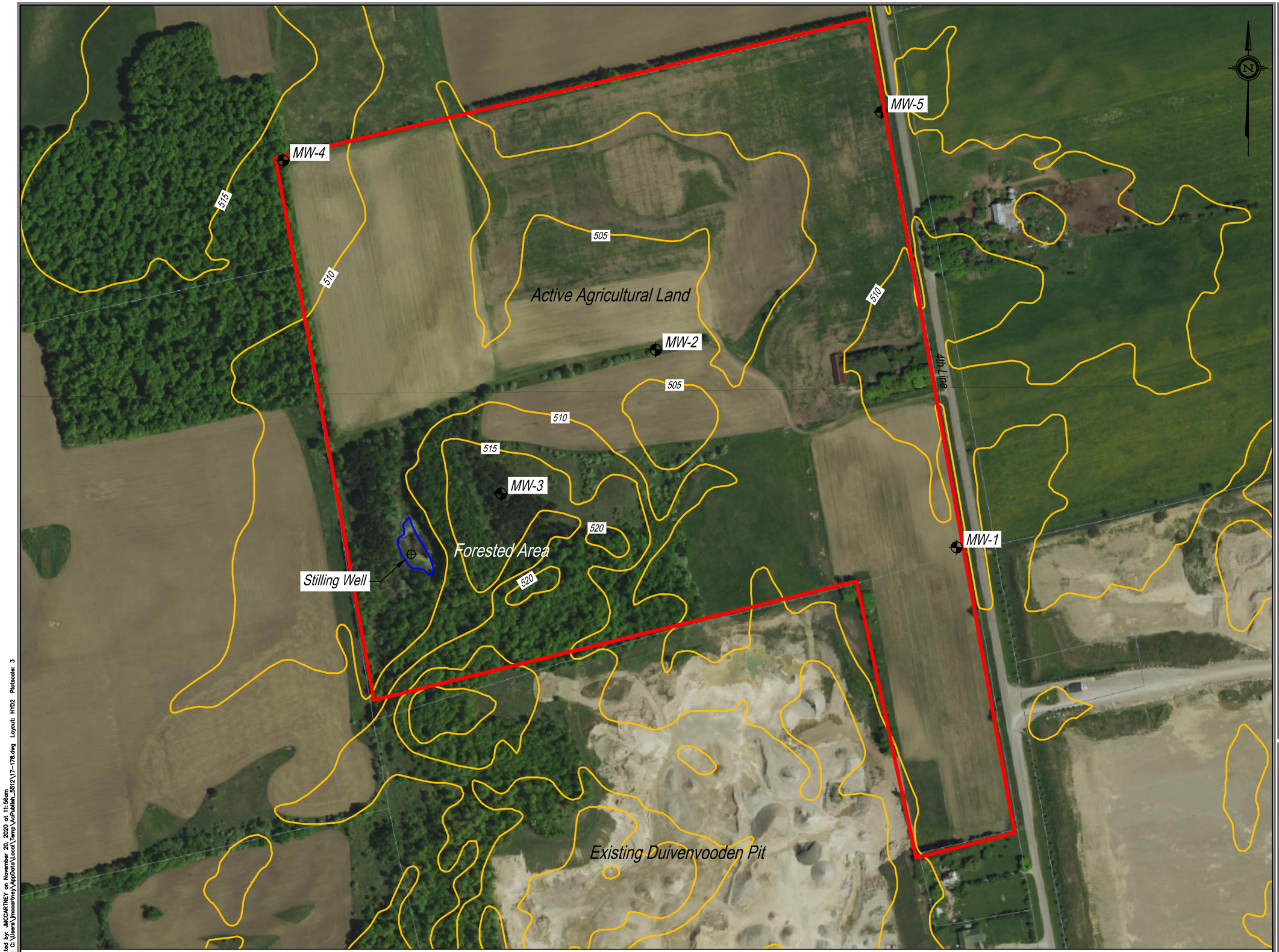
Study Area Location

Melancthon Gravel Pit Expansion,
Melancthon, ON

DATE ISSUED: *November 2020*	Figure No.
CREATED BY: *JLM*	
PROJECT NO.: *17-178*	1
REFERENCE: *MNRF*	

DAYSTAMP: M:\17 Projects\17-178 Melancthon Gravel Pit Expansion\04.0 - Drafting\17-178.dwg

Plotted by: JMCCARTNEY on November 20, 2020 at 11:56am
File: C:\Users\jmccartney\AppData\Local\Temp\AcPublish_5512\17-178.dwg Layout: Figure 1 Plotscale: 3



LEGEND:

- *Approx. Expansion Property Boundary*
- *Pond*
- *Well Locations*
- *5m OBM Contours*

60m 0 120m

HORIZONTAL SCALE 1: 4,000

AZIMUTH ENVIRONMENTAL CONSULTING, INC.

Environmental Features

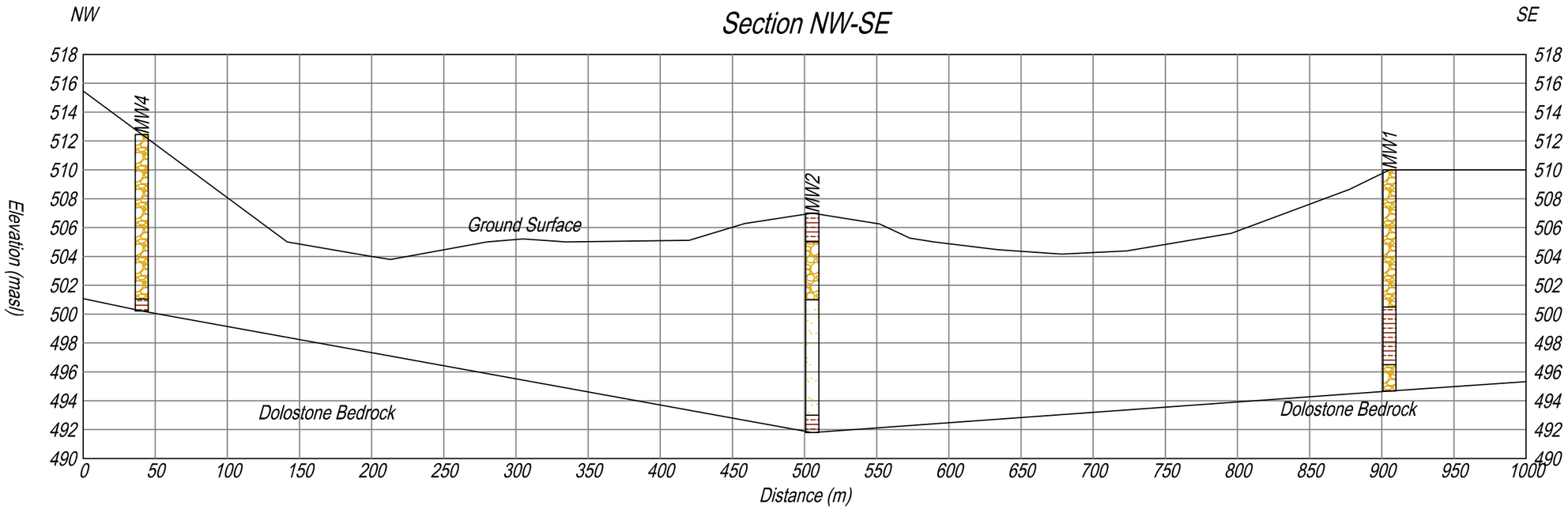
Melancthon Gravel Pit Expansion,
Melancthon, ON

DATE ISSUED:	*November 2020*	Figure No. 2
CREATED BY:	*JLM*	
PROJECT NO.:	*17-178*	
REFERENCE:	*MNRF*	

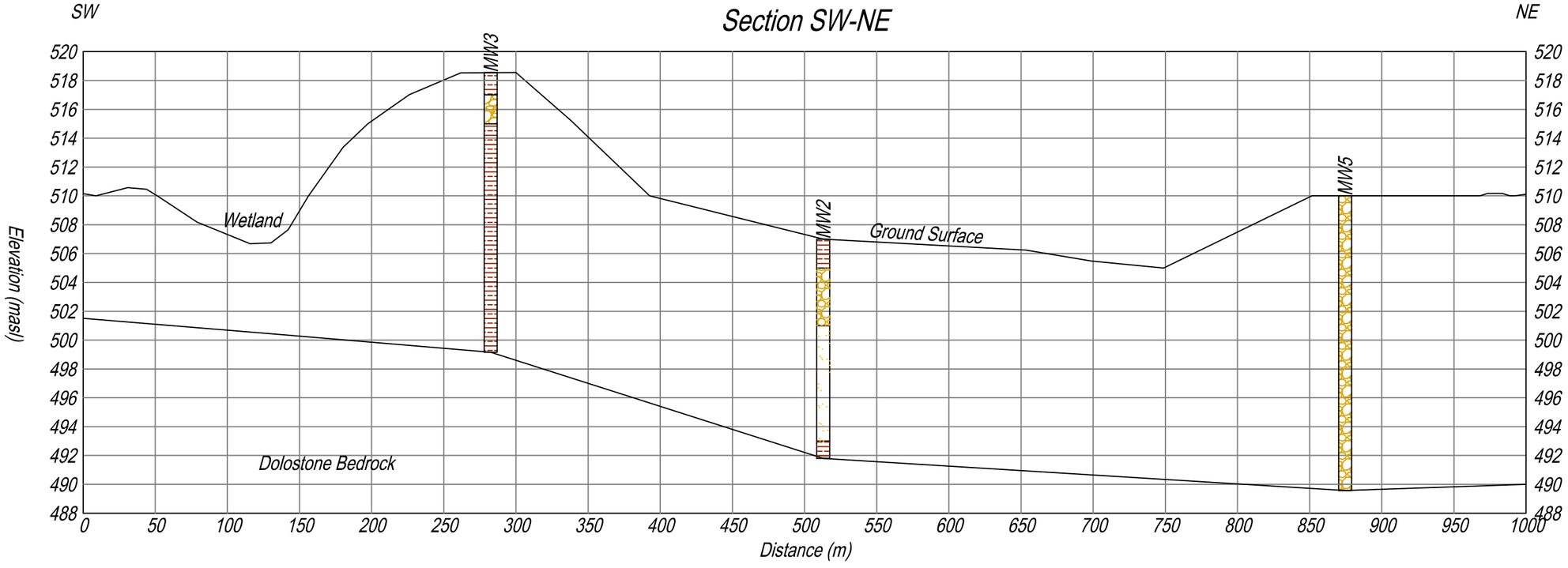
DAYSTAMP: M:\17 Projects\17-178 Melancthon Gravel Pit Expansion\04.0 - Drafting\17-178.dwg

Plotted by: JMCCARTNEY on November 20, 2020 at 11:56am
File: C:\Users\jmccartney\AppData\Local\Temp\AcPublish_5512\17-178.dwg Layout: HYD2 Plotscale: 3

Section NW-SE

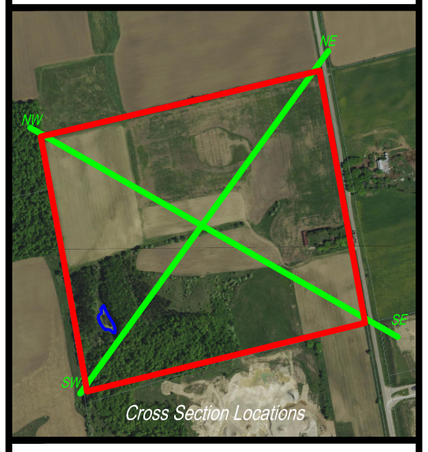


Section SW-NE



LEGEND:

- Approx. Property Boundary
- Pond
- Cross Section Locations
- Sand
- Sand and Gravel
- Till



Not to Scale
10x Vertical Exaggeration

AZIMUTH ENVIRONMENTAL CONSULTING, INC.

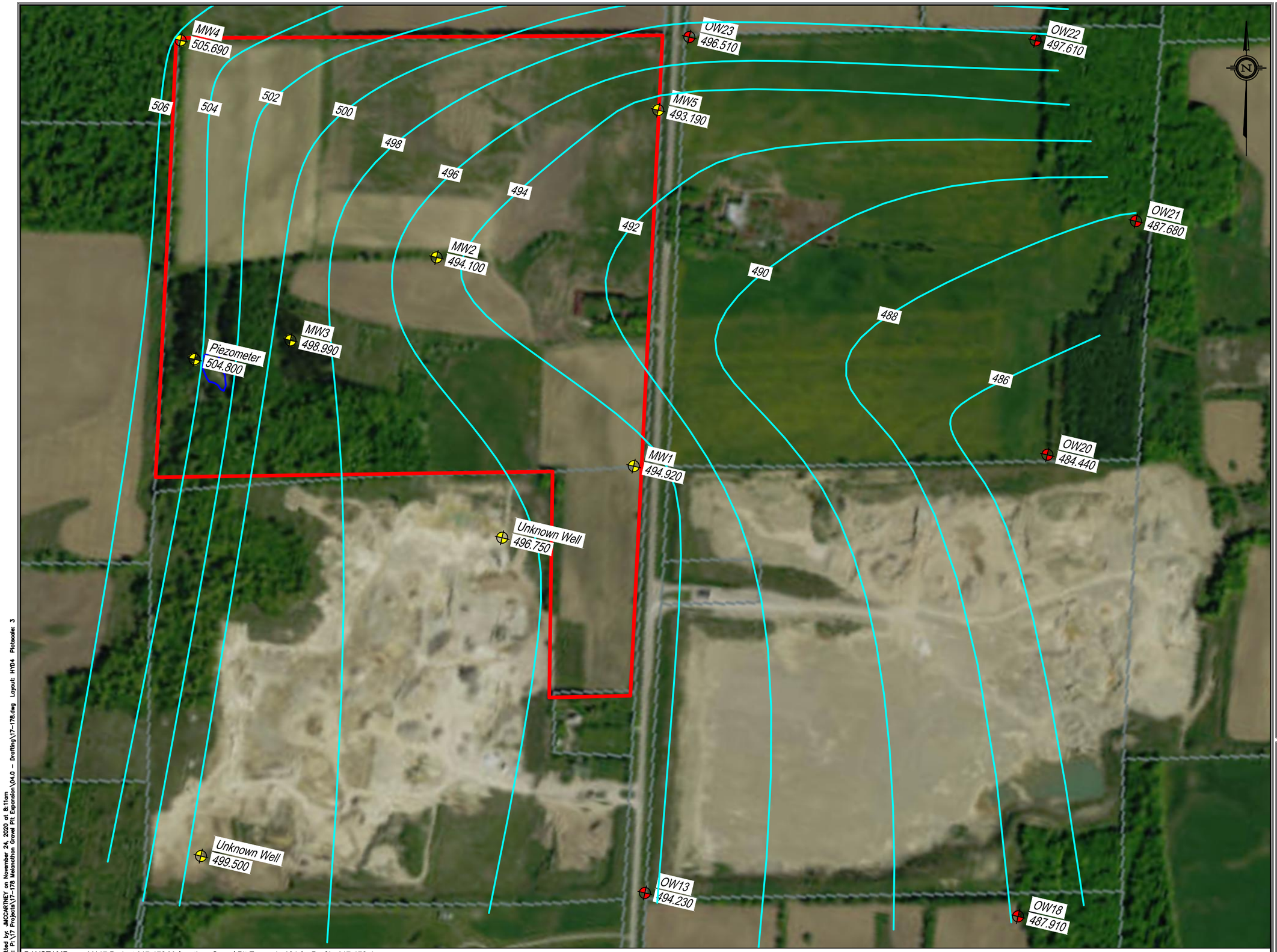
Cross Sections

Melancthon Gravel Pit Expansion,
Melancthon, ON

DATE ISSUED:	February 2019	Figure No.
CREATED BY:	JLM	3
PROJECT NO.:	17-178	
REFERENCE:	MNRF	

DAYSTAMP: M:\17 Projects\17-178 Melancthon Gravel Pit Expansion\04.0 - Drafting\17-178.dwg

Plotted by: JMCCARTNEY on March 15, 2019 at 1:43pm
File: M:\17 Projects\17-178 Melancthon Gravel Pit Expansion\04.0 – Drafting\17-178.dwg Layout: HYD3 Plotscale: 3



LEGEND:

- Approx. Property Boundary
- Pond
- Duivenvoorden Well Locations
- Strada Well Locations
- 2m Ground Water Contours (Dec. 2018)
- 494.78 Ground Water Elevations (Dec. 2018)

150m 0 300m

HORIZONTAL SCALE 1:10,000

AZIMUTH ENVIRONMENTAL CONSULTING, INC.

Regional Ground Water Contours

Melancthon Gravel Pit Expansion, Melancthon, ON

DATE ISSUED:	November 2020	Figure No. 4
CREATED BY:	JLM	
PROJECT NO.:	17-178	
REFERENCE:	MNRF	

DAYSTAMP: M:\17 Projects\17-178 Melancthon Gravel Pit Expansion\04.0 - Drafting\17-178.dwg

Plotted by: JMCCARTNEY on November 24, 2020 at 8:11am
File: P:\17 Projects\17-178 Melancthon Gravel Pit Expansion\04.0 - Drafting\17-178.dwg Layout: HYD4 Plotscale: 3

APPENDIX B

MECP Domestic Water Well Records

68

UTM | | Z | | E

Old 5 Survey R | | N

Con IV Lot 14 Elev. 5 R 4 | 685

Basin 22

The Ontario Water Resources Commission Act

WATER WELL RECORD

17 № 345

County or District Dufferin .... Township, Village, Town or City Melancthon

Con. IV 5. OLD SURVEY Lot 14. .... Date completed 17 (day) Oct. (month) 1963 (year)

Owner [redacted] .... Address R.R. 1 Melancthon

Casing and Screen Record

Inside diameter of casing 4"

Total length of casing 44. ft

Type of screen —

Length of screen —

Depth to top of screen —

Diameter of finished hole 4"

Pumping Test

Static level 21.

Test-pumping rate 12. G.P.M.

Pumping level 48.

Duration of test pumping 3 hrs.

Water clear or cloudy at end of test Clear.

Recommended pumping rate 6 G.P.M.

with pump setting of 60 feet below ground surface

Well Log

Overburden and Bedrock Record	From ft.	To ft.	Depth(s) at which water(s) found	Kind of water (fresh, salty, sulphur)
TopSoil Clay and Gravel.	0	20	70	FRESH
Sand and Clay.	20	35	To	
Soft Brown Shale Rock.	35	44	100.	
Gray Rock.	44.	120		

For what purpose(s) is the water to be used? Domestic and Farm stock

Is well on upland, in valley, or on hillside? up land.

Drilling or Boring Firm Durham Drillers and Enterprises

Address Durham ontario

Licence Number 1000.

Name of Driller or Borer Fred Hotchkiss

Address Mount Forest ont.

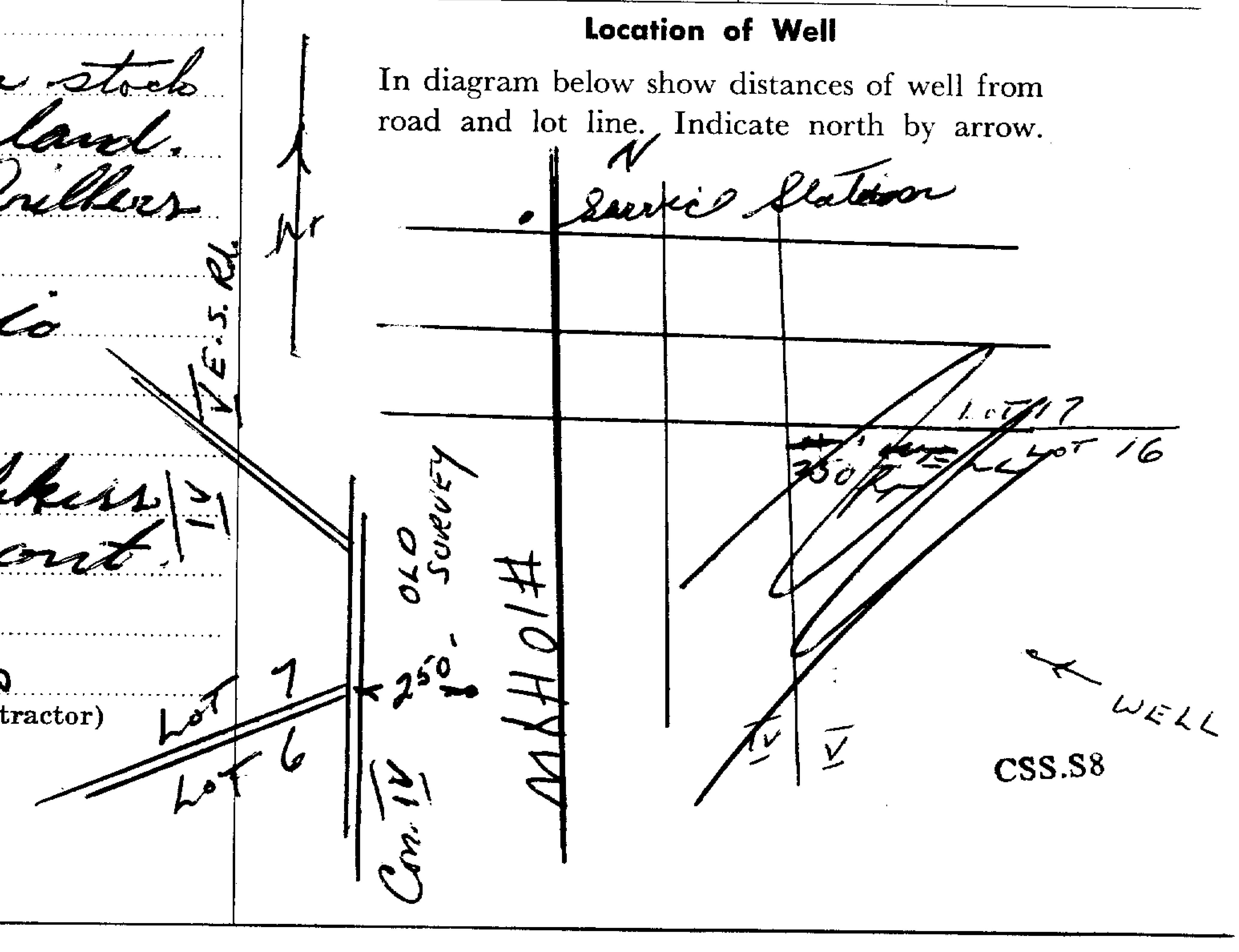
Date oct. 19.

Edward Bryans

(Signature of Licensed Drilling or Boring Contractor)

Location of Well

In diagram below show distances of well from road and lot line. Indicate north by arrow.



CSS.S8

Form 7 10M-62-1152

OWRC COPY

41A/1E

The Ontario Water Resources Commission Act

WATER WELL RECORD

management in Ontario

1. PRINT ONLY IN SPACES PROVIDED
2. CHECK ☒ CORRECT BOX WHERE APPLICABLE

11	1701316	MUNICIP. 17004	CON. CON 03

[redacted]TY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON., BLOCK, TRACT, SURVEY, ETC.	LOT 25-27
[redacted]UFFERIN	MELANCTHON	3. ~~O.S.~~	~~012 W/2~~ 012

[redacted]ER (SURNAME FIRST) 28-47	ADDRESS	DATE COMPLETED 48-53
[redacted]	R.R. 6 SHELBURNE	DAY 28 MO 04 YR 72

21	UTM ZONE	EASTING	NORTHING	RC.	ELEVATION	RC.	BASIN CODE
	17	561250	4887240	4	1660	5	22

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH – FEET FROM	TO
BROWN	GRAVEL	CLAY	SOFT	0	48
GREY	GRAVEL	—	SOFT.	48	52

31	00486 11 05	0052 2 11
32		

41 WATER RECORD

WATER FOUND AT – FEET	KIND OF WATER
0052	1 ☒ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERAL
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERAL
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERAL
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERAL
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERAL

51 CASING & OPEN HOLE RECORD

INSIDE DIAM. INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH – FEET FROM	TO
05	1 ☒ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE	188	0	~~52~~ 0052
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE			
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE			

SCREEN

SIZE(S) OF OPENING (SLOT NO.)	DIAMETER INCHES	LENGTH FEET
—		

MATERIAL AND TYPE	DEPTH TO TOP OF SCREEN FEET
—	

61 PLUGGING & SEALING RECORD

DEPTH SET AT – FEET FROM	TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)
		—

71 PUMPING TEST

PUMPING TEST METHOD	PUMPING RATE	DURATION OF PUMPING
1 ☐ PUMP 2 ☒ BAILER	0015 GPM.	01 HOURS 30 MINS.

STATIC LEVEL	WATER LEVEL END OF PUMPING	WATER LEVELS DURING (1 ☐ PUMPING 2 ☒ RECOVERY) 15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
025 FEET	030 FEET	025 FEET	025 FEET	025 FEET	025 FEET

IF FLOWING, GIVE RATE	PUMP INTAKE SET AT	WATER AT END OF TEST
— GPM.	— FEET	1 ☐ CLEAR 2 ☒ CLOUDY

RECOMMENDED PUMP TYPE	RECOMMENDED PUMP SETTING	RECOMMENDED PUMPING RATE
☐ SHALLOW ☒ DEEP	035 FEET	0010. GPM.

50-53 003.0 GPM./FT. SPECIFIC CAPACITY

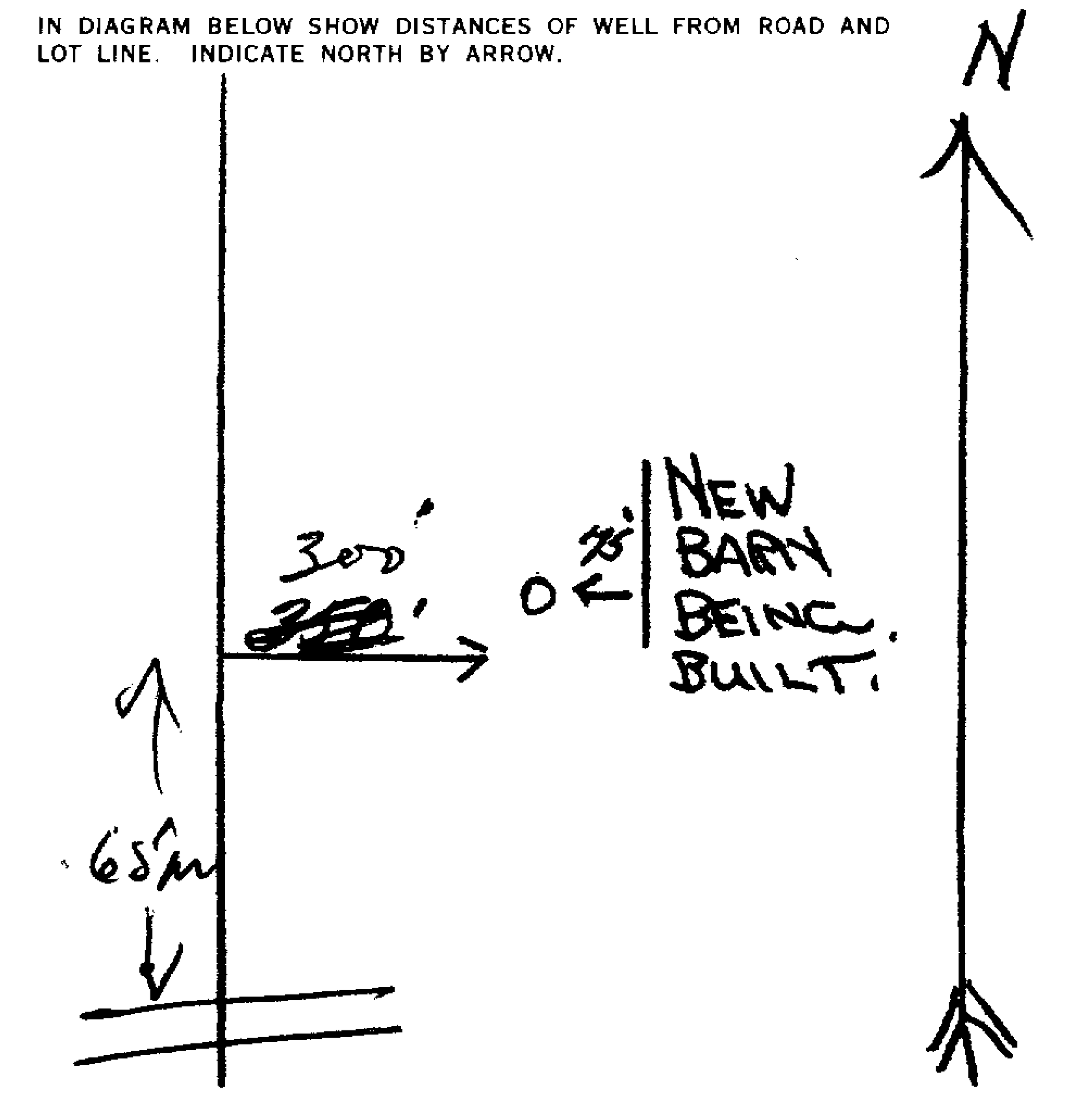
FINAL STATUS OF WELL: 1 ☒ WATER SUPPLY; 2 ☐ OBSERVATION WELL; 3 ☐ TEST HOLE; 4 ☐ RECHARGE WELL; 5 ☐ ABANDONED, INSUFFICIENT SUPPLY; 6 ☐ ABANDONED, POOR QUALITY; 7 ☐ UNFINISHED

WATER USE 01: 1 ☒ DOMESTIC; 2 ☐ STOCK; 3 ☐ IRRIGATION; 4 ☐ INDUSTRIAL; ☐ OTHER; 5 ☐ COMMERCIAL; 6 ☐ MUNICIPAL; 7 ☐ PUBLIC SUPPLY; 8 ☐ COOLING OR AIR CONDITIONING; 9 ☐ NOT USED

METHOD OF DRILLING: 1 ☐ CABLE TOOL; 2 ☒ ROTARY (CONVENTIONAL); 3 ☐ ROTARY (REVERSE); 4 ☐ ROTARY (AIR); 5 ☐ AIR PERCUSSION; 6 ☐ BORING; 7 ☐ DIAMOND; 8 ☐ JETTING; 9 ☐ DRIVING

LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.



DRILLERS REMARKS:

CONTRACTOR

NAME OF WELL CONTRACTOR	LICENCE NUMBER
LUNNEY WELL DRILLING	3406

ADDRESS: 36 BUENA VISTA DR ORANGEVILLE

NAME OF DRILLER OR BORER	LICENCE NUMBER
GORDON LUNNEY	3406

SIGNATURE OF CONTRACTOR: Gordon Lunney — SUBMISSION DATE DAY 7 MO. 6 YR. 72

OFFICE USE ONLY

DATA SOURCE	CONTRACTOR	DATE RECEIVED
1	3406	090672

DATE OF INSPECTION | INSPECTOR

REMARKS: CSS.S8

P | WI

OWRC COPY

MINISTRY OF THE ENVIRONMENT
The Ontario Water Resources Act

WATER WELL RECORD

41A/1W

Ontario

1. PRINT ONLY IN SPACES PROVIDED
2. CHECK ☒ CORRECT BOX WHERE APPLICABLE

11 | 1702233 | MUNICIP 17.004 | CON. CON 04

COUNTY OR DISTRICT: DUFFERIN
TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE: MELANCTHON
CON., BLOCK, TRACT, SURVEY, ETC.: 4
LOT: 013
OWNER (SURNAME FIRST): [redacted]
ADDRESS: R.R 6 SHELBURNE
DATE COMPLETED: DAY 13 MO 09 YR 76

21 | UTM ZONE 17 | EASTING 559800 | NORTHING 4887350 | RC 5 | ELEVATION 1690 | RC 5 | BASIN CODE 22

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	DEPTH - FEET TO
BROWN	CLAY	SAND		0	45
GREY	LIMESTONE			45	56

31 | 0045605 28 | 0056215

32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
005-6	1 ☒ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL

51 CASING & OPEN HOLE RECORD

INSIDE DIAM. INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	DEPTH - FEET TO
05	1 ☒ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE	188	0	0048
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE			
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE			

SCREEN

SIZE(S) OF OPENING (SLOT NO.)	DIAMETER INCHES	LENGTH FEET
MATERIAL AND TYPE	DEPTH TO TOP OF SCREEN FEET	

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	DEPTH SET AT - FEET TO	MATERIAL AND TYPE (CEMENT GROUT LEAD PACKER, ETC.)
10-13	14-17	
18-21	22-25	
26-29	30-33	

71 PUMPING TEST

PUMPING TEST METHOD: 1 ☒ PUMP 2 ☐ BAILER
PUMPING RATE: 0050 GPM
DURATION OF PUMPING: 01 HOURS 00 MINS

STATIC LEVEL	WATER LEVEL END OF PUMPING
013 FEET	023 ~~013~~ FEET

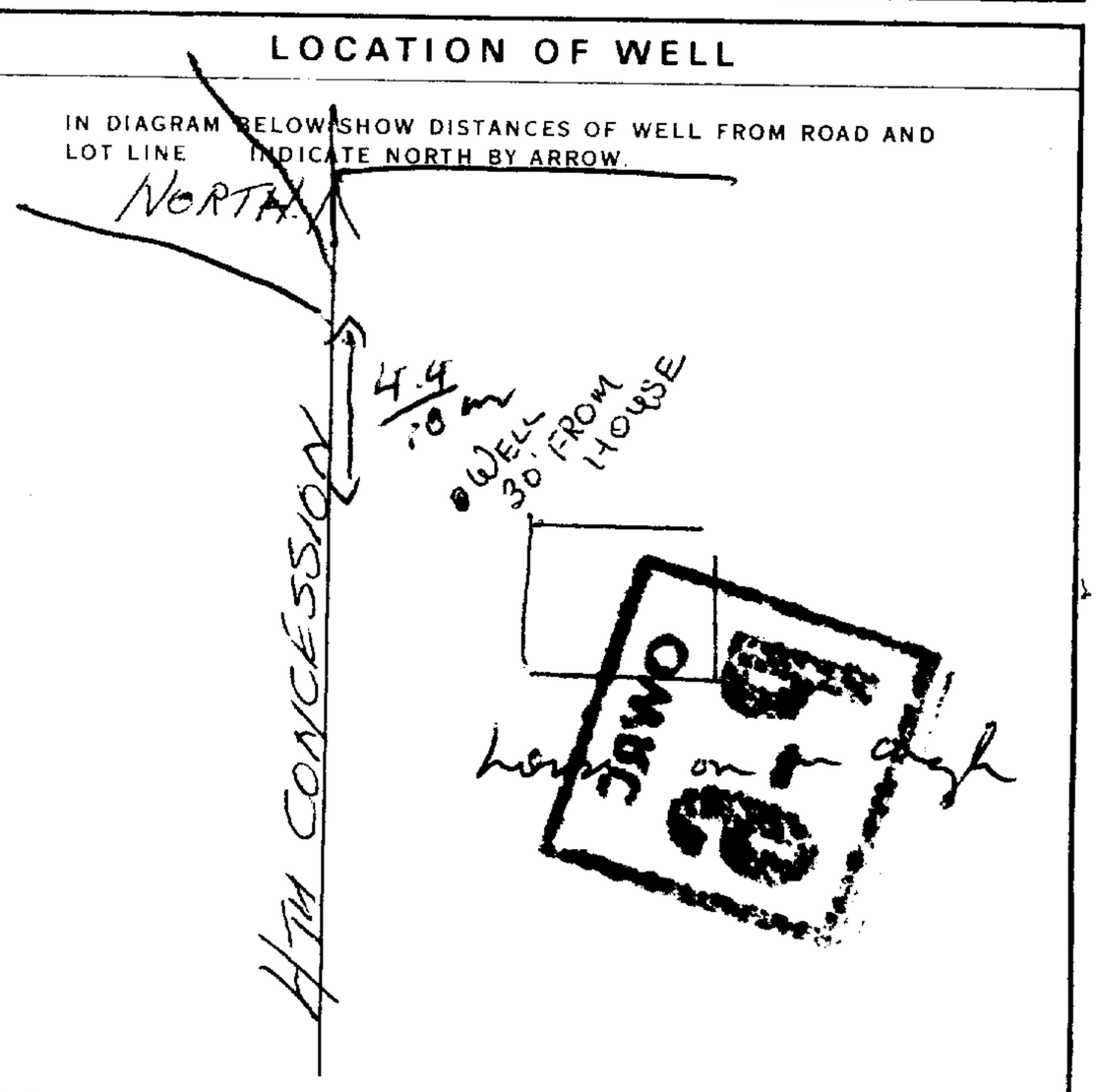
WATER LEVELS DURING: 1 ☐ PUMPING 2 ☒ RECOVERY

15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
013 FEET	013 FEET	013 FEET	013 FEET

IF FLOWING, GIVE RATE: GPM
PUMP INTAKE SET AT: 95 FEET
WATER AT END OF TEST: 1 ☐ CLEAR 2 ☒ CLOUDY
RECOMMENDED PUMP TYPE: ☒ SHALLOW ☐ DEEP
RECOMMENDED PUMP SETTING: 025 FEET
RECOMMENDED PUMPING RATE: 0010 GPM
— — — • — GPM./FT. SPECIFIC CAPACITY

LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.



DRILLERS REMARKS:

FINAL STATUS OF WELL: 1

1 ☒ WATER SUPPLY 2 ☐ OBSERVATION WELL 3 ☐ TEST HOLE 4 ☐ RECHARGE WELL 5 ☐ ABANDONED, INSUFFICIENT SUPPLY 6 ☐ ABANDONED, POOR QUALITY 7 ☐ UNFINISHED

WATER USE: 01

1 ☒ DOMESTIC 2 ☐ STOCK 3 ☐ IRRIGATION 4 ☐ INDUSTRIAL ☐ OTHER 5 ☐ COMMERCIAL 6 ☐ MUNICIPAL 7 ☐ PUBLIC SUPPLY 8 ☐ COOLING OR AIR CONDITIONING 9 ☐ NOT USED

METHOD OF DRILLING: 2

1 ☐ CABLE TOOL 2 ☒ ROTARY (CONVENTIONAL) 3 ☐ ROTARY (REVERSE) 4 ☐ ROTARY (AIR) 5 ☐ AIR PERCUSSION 6 ☐ BORING 7 ☐ DIAMOND 8 ☐ JETTING 9 ☐ DRIVING

CONTRACTOR

NAME OF WELL CONTRACTOR: LUNNEY WELL DRILLING LTD — LICENCE NUMBER: 3406
ADDRESS: 36 BUENA VISTA DR RANGEVILLE
NAME OF DRILLER OR BORER: GORDON LUNNEY — LICENCE NUMBER: 3406
SIGNATURE OF CONTRACTOR: Gordon Lunney — SUBMISSION DATE: DAY ____ MO. ____ YR. ____

OFFICE USE ONLY

DATA SOURCE: 1
CONTRACTOR: 3406
DATE RECEIVED: 140477
DATE OF INSPECTION: By 16/78
INSPECTOR: TP
REMARKS:
CSS.S8
P
WI

MINISTRY OF THE ENVIRONMENT COPY

FORM 7 MOE 07-091

Ministry of Environment and Energy
Ontario

The Ontario Water Resources Act
WATER WELL RECORD

Print only in spaces provided.
Mark correct box with a checkmark, where applicable.

11

1705240

Municipality: 17004 Con.: CON 04 Easthoff

County or District	Township/Borough/City/Town/Village	Con block tract survey, etc.	Lot
Duff	Melancthon	4th	14

Owner's surname / First name: [redacted]

Address: RR#2 SHELBURNE

Date completed: 19 day 11 month 98 year 98

21 UTM Zone / Easting / Northing / RC / Elevation / RC / Basin Code / ii / iii / iv

LOG OF OVERBURDEN AND BEDROCK MATERIALS (see instructions)

General colour	Most common material	Other materials	General description	Depth – feet From	Depth – feet To
Black	topsoil			0	1
Brown	gravel, stones, clay			1	40
Brown	clay, gravel			40	45
Brown	sand			45	50
Brown	limestone			50	100

31
32

41 WATER RECORD

Water found at – feet	Kind of water
90	1 ☑ Fresh 2 ☐ Salty 3 ☐ Sulphur 4 ☐ Minerals 6 ☐ Gas
	1 ☐ Fresh 2 ☐ Salty 3 ☐ Sulphur 4 ☐ Minerals 6 ☐ Gas
	1 ☐ Fresh 2 ☐ Salty 3 ☐ Sulphur 4 ☐ Minerals 6 ☐ Gas
	1 ☐ Fresh 2 ☐ Salty 3 ☐ Sulphur 4 ☐ Minerals 6 ☐ Gas
	1 ☐ Fresh 2 ☐ Salty 3 ☐ Sulphur 4 ☐ Minerals 6 ☐ Gas

51 CASING & OPEN HOLE RECORD

Inside diam inches	Material	Wall thickness inches	Depth – feet From	Depth – feet To
6	1 ☑ Steel 2 ☐ Galvanized 3 ☐ Concrete 4 ☐ Open hole 5 ☐ Plastic	188	+2	53
	1 ☐ Steel 2 ☐ Galvanized 3 ☐ Concrete 4 ☐ Open hole 5 ☐ Plastic			
	1 ☐ Steel 2 ☐ Galvanized 3 ☐ Concrete 4 ☐ Open hole 5 ☐ Plastic			

SCREEN

Sizes of opening (Slot No.) — Diameter inches — Length feet
Material and type — Depth at top of screen feet

61 PLUGGING & SEALING RECORD

☐ Annular space ☐ Abandonment

Depth set at – feet From	To	Material and type (Cement grout, bentonite, etc.)

71 PUMPING TEST

Pumping test method: 1 ☐ Pump 2 ☑ Bailer
Pumping rate: 5 GPM
Duration of pumping: 2 Hours .... Mins

Static level	Water level end of pumping	15 minutes	30 minutes	45 minutes	60 minutes
65 feet	90 feet	90 feet	90 feet	90 feet	90 feet

Water levels during: 1 ☑ Pumping 2 ☐ Recovery

If flowing give rate: GPM
Pump intake set at: feet
Water at end of test: ☐ Clear ☑ Cloudy
Recommended pump type: ☐ Shallow ☑ Deep
Recommended pump setting: 98 feet
Recommended pump rate: 3 GPM

FINAL STATUS OF WELL

1 ☑ Water supply
2 ☐ Observation well
3 ☐ Test hole
4 ☐ Recharge well
5 ☐ Abandoned, insufficient supply
6 ☐ Abandoned, poor quality
7 ☐ Abandoned (Other)
8 ☐ Dewatering
9 ☐ Unfinished
10 ☐ Replacement well

WATER USE

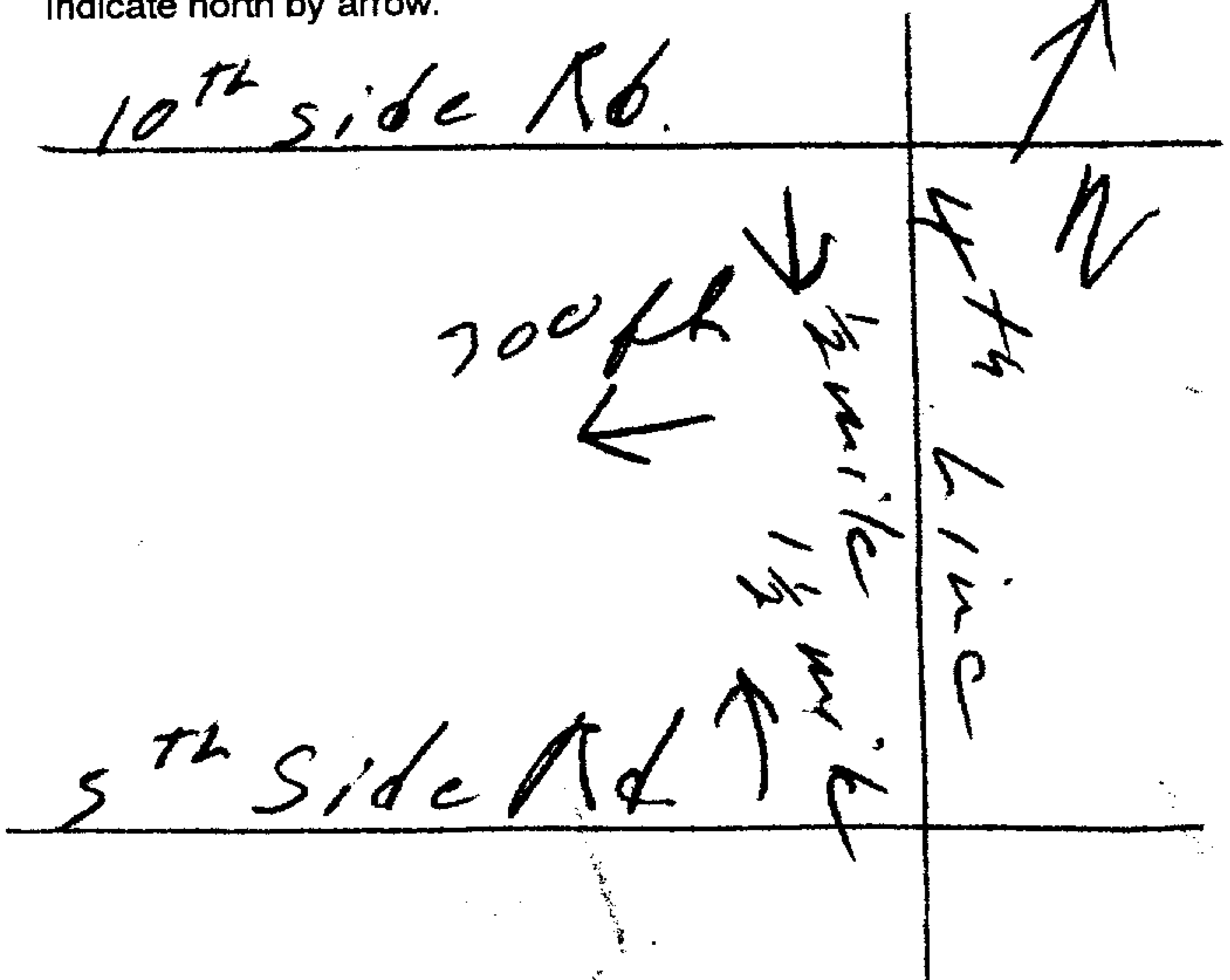
1 ☑ Domestic
2 ☐ Stock
3 ☐ Irrigation
4 ☐ Industrial
5 ☐ Commercial
6 ☐ Municipal
7 ☐ Public supply
8 ☐ Cooling & air conditioning
9 ☐ Not used
10 ☐ Other ....

METHOD OF CONSTRUCTION

1 ☑ Cable tool
2 ☐ Rotary (conventional)
3 ☐ Rotary (reverse)
4 ☐ Rotary (air)
5 ☐ Air percussion
6 ☐ Boring
7 ☐ Diamond
8 ☐ Jetting
9 ☐ Driving
10 ☐ Digging
11 ☐ Other ....

LOCATION OF WELL

In diagram below show distances of well from road and lot line. Indicate north by arrow.



199520

Name of Well Contractor: Same
Well Contractor's Licence No.: 3561
Address: 156 [illegible]
Name of Well Technician: Same
Well Technician's Licence No.: T-0298
Signature of Technician/Contractor:
Submission date: day mo yr

MINISTRY USE ONLY

Data source — Contracctor 3561 — Date received DEC 14 1998
Date of inspection — Inspector
Remarks

CSS. ES9

2 - MINISTER OF ENVIRONMENT & ENERGY COPY

0506 (07/94) Front Form 9

Ontario Ministry of the Environment

Well Tag No. *(Place Sticker and/or Print Below)* A 061262

Well Record

Regulation 903 Ontario Water Resources Act

Page _____ of _____

[redacted]

Address of Well Location (Street Number/Name, RR)	Township	Lot	Concession
RR#6 SHELBURNE	MELANCTHON	16	4

County/District/Municipality	City/Town/Village	Province	Postal Code
DUFFERIN	SHELBURNE	Ontario	L0N1S6

UTM Coordinates NAD 83 | Zone 17 | Easting 593682 | Northing 4890258 | GPS Unit Make Magellan | Model sportrak | Mode of Operation: ☐ Undifferentiated ☒ Averaged ☐ Differentiated, specify

Overburden and Bedrock Materials *(see instructions on the back of this form)*

General Colour	Most Common Material	Other Materials	General Description	Depth (Metres) From	To
Black	top soil			0	1
Brown	Clay			1	21
Brown	lime stone			21	45

All Measurements imperial

Annular Space/Abandonment Sealing Record

Depth Set at (Metres) From	To	Type of Sealant Used (Material and Type)	Volume Placed (Cubic Metres)
0	20	Holeplug	3 bags

Method of Construction

☒ Cable Tool ☐ Rotary (Conventional) ☐ Rotary (Reverse) ☐ Rotary (Air) ☐ Air percussion ☐ Other, specify

☐ Diamond ☐ Jetting ☐ Driving ☐ Digging ☐ Boring

Water Use

☐ Public ☐ Domestic ☐ Livestock ☐ Irrigation ☐ Industrial ☐ Other, specify

☐ Commercial ☐ Municipal ☐ Test Hole ☐ Cooling & Air Conditioning

☐ Not used ☐ Dewatering ☐ Monitoring

Status of Well

☒ Water Supply ☐ Replacement Well ☐ Test Hole ☐ Recharge Well

☐ Dewatering Well ☐ Abandoned, Insufficient Supply ☐ Abandoned, Poor Water Quality ☐ Abandoned, other, specify

☐ Observation and/or Monitoring Hole ☐ Alteration (Construction) ☐ Other, specify

Location of Well

Please provide a map below showing:
- all property boundaries, and measurements sufficient to locate the well in relation to fixed points,
- an arrow indicating the North direction
- detailed drawings can be provided as attachments no larger than legal size (8.5" by 14")
- vidigital pictures of inside of well can also be provided

Date Well Completed (yyyy/mm/dd)	Was the well owner's information package delivered?	Date the Well Record and Package Delivered to Well Owner (yyyy/mm/dd)
08/06/19	☒ Yes ☐ No	08/06/19

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
Sam	3501

Business Address (Street No./Name, number, RR)	Municipality
R2 Shelburne	

Province	Postal Code	Business E-mail Address
Ont	L0N1S6	

Bus. Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name)
5199925096 5	Sam

Well Technician's Licence No.	Signature of Technician	Date Submitted (yyyy/mm/dd)
7298		

Results of Well Yield Testing

Check box if after test of well yield, water was:
☒ Clear and sand free
☐ Cannot develop to sand-free state

If pumping discontinued, give reason:

Pumping test method: Pump

Pump intake set at (Metres): 20

Pumping rate (Litres/min): 12

Duration of pumping: 2 hrs + ____ min

Final water level end of pumping (Metres): 12-8

Recommended pump type: ☒ Shallow ☐ Deep

Recommended pump depth: 20 Metres

Recommended pump rate (Litres/min): 12

If flowing give rate (Litres/min)

	Draw Down Time (Min)	Draw Down Water Level (Metres)	Recovery Time (Min)	Recovery Water Level (Metres)
Static Level		10-9	Static Level	12-8
1		12	1	11-6
2		12-2	2	11-3
3		12-4	3	11-3
4		12-6	4	11-2 1/2
5		12-6	5	11-2
10		12-8	10	11-2
15		12-8	15	
20			20	
25			25	
30			30	
40			40	
50			50	
60		12-8	60	11-2

Water Details

Water found at Depth	Kind of Water
30 Metres ☐ Gas	☒ Fresh ☐ Salty ☐ Sulphur ☐ Minerals
45 Metres ☐ Gas	☒ Fresh ☐ Salty ☐ Sulphur ☐ Minerals
Metres ☐ Gas	☐ Fresh ☐ Salty ☐ Sulphur ☐ Minerals

Casing Used	Screen Used
☐ Galvanized	☐ Galvanized
☒ Steel	☐ Steel
☐ Fibreglass	☐ Fibreglass
☐ Plastic	☐ Plastic
☐ Concrete	☐ Concrete

No Casing and Screen Used

☒ Open Hole 23 - 45

Disinfected? ☒ Yes ☐ No

Casing and Well Details

Diameter of the Hole (Centimetres): 6

Depth of the Hole (Metres): 45

Wall Thickness (Metres): 158

Inside Diameter of the Casing (Metres): 6

Depth of the Casing (Metres): 23

Ministry Use Only

Audit No.	Well Contractor No.
z63213	
Date Received (yyyy/mm/dd) JUL 03 2008	**Date of Inspection (yyyy/mm/dd)**
Remarks	

0506E (11/2006) **Ministry's Copy**

Ontario — Ministry of the Environment

Measurements recorded in: ☐ Metric ☐ Imperial

Well Tag No. (Place Sticker Here): 84702 A 084702

Well Record

Regulation 903 Ontario Water Resources Act

Page ____ of ____

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
HIGHLAND COMPANIES			

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
477476 THIRD LINE	SHELBURNE	ONT	L0N1S6	

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
	MELANTHON	15	4

County/District/Municipality	City/Town/Village	Province	Postal Code
DUFFERIN		Ontario	

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	17	560745	4889111		

Overburden and Bedrock Materials/Abandonment Sealing Record *(see instructions on the back of this form)*

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	Depth (m/ft) To
brown	clay & stones			0	19ft
grown	gravel			19ft	41ft
gray	clay & stones			41ft	51ft
brown	rock			51ft	89ft
gray	rock			89ft	122ft

Annular Space

Depth Set at (m/ft) From	Depth Set at (m/ft) To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0	58ft	BENTONITE SLURRY	

Method of Construction

☐ Cable Tool ☐ Diamond
☒ Rotary (Conventional) ☐ Jetting
☐ Rotary (Reverse) ☐ Driving
☐ Boring ☐ Digging
☐ Air percussion
☐ Other, *specify*

Well Use

☐ Public ☐ Commercial ☐ Not used
☒ Domestic ☐ Municipal ☐ Dewatering
☐ Livestock ☐ Test Hole ☐ Monitoring
☐ Irrigation ☐ Cooling & Air Conditioning
☐ Industrial
☐ Other, *specify*

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	Depth (m/ft) To
6¼	steel	.188	0	58ft
6in	open hole		58ft	122ft

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	Depth (m/ft) To

Status of Well

☒ Water Supply
☐ Replacement Well
☐ Test Hole
☐ Recharge Well
☐ Dewatering Well
☐ Observation and/or Monitoring Hole
☐ Alteration (Construction)
☐ Abandoned, Insufficient Supply
☐ Abandoned, Poor Water Quality
☐ Abandoned, other, *specify*
☐ Other, *specify*

Water Details

Water found at Depth (m/ft)	Kind of Water	Gas	Other, specify
116ft	☒ Fresh ☐ Untested	☐	
(m/ft)	☐ Fresh ☐ Untested	☐	
(m/ft)	☐ Fresh ☐ Untested	☐	

Hole Diameter

Depth (m/ft) From	Depth (m/ft) To	Diameter (cm/in)
0	58ft	8.75in
58ft	122ft	6in

Results of Well Yield Testing

After test of well yield, water was:
☒ Clear and sand free
☐ Other, *specify*

If pumping discontinued, give reason:

Pump intake set at (m/ft): 60ft

Pumping rate (l/min / GPM): 10gpm

Duration of pumping: 1 hrs + -0 min

Final water level end of pumping (m/ft): 37ft

If flowing give rate (l/min / GPM):

Recommended pump depth (m/ft): 60ft

Recommended pump rate (l/min / GPM): 10gpm

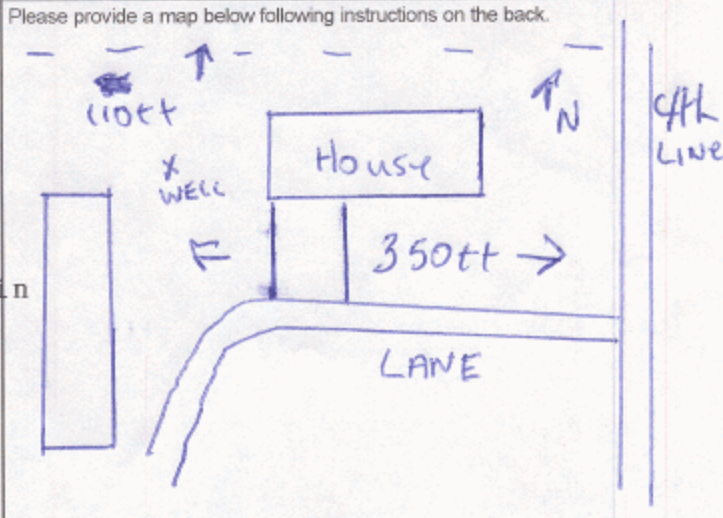
Well production (l/min / GPM):

Disinfected? ☒ Yes ☐ No

	Draw Down Time (min)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level		33ft		
1			1	
2			2	
3			3	
4			4	
5	35ft		5	33ft
10	37ft		10	
15			15	
20			20	
25			25	
30			30	
40			40	
50			50	
60	37ft		60	33ft

Map of Well Location

Please provide a map below following instructions on the back.



Comments:

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
KEITH LANG WELL DRILLING INC	7154

Business Address (Street Number/Name)	Municipality	Province	Postal Code	Business E-mail Address
251 ELDON ST GODERICH ONT			N7A3R9	

Bus. Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name)	Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
	KEITH LANG	T446	K Lang	

Well owner's information package delivered	Date Package Delivered	Date Work Completed
☒ Yes ☐ No		2010 12 3

Ministry Use Only

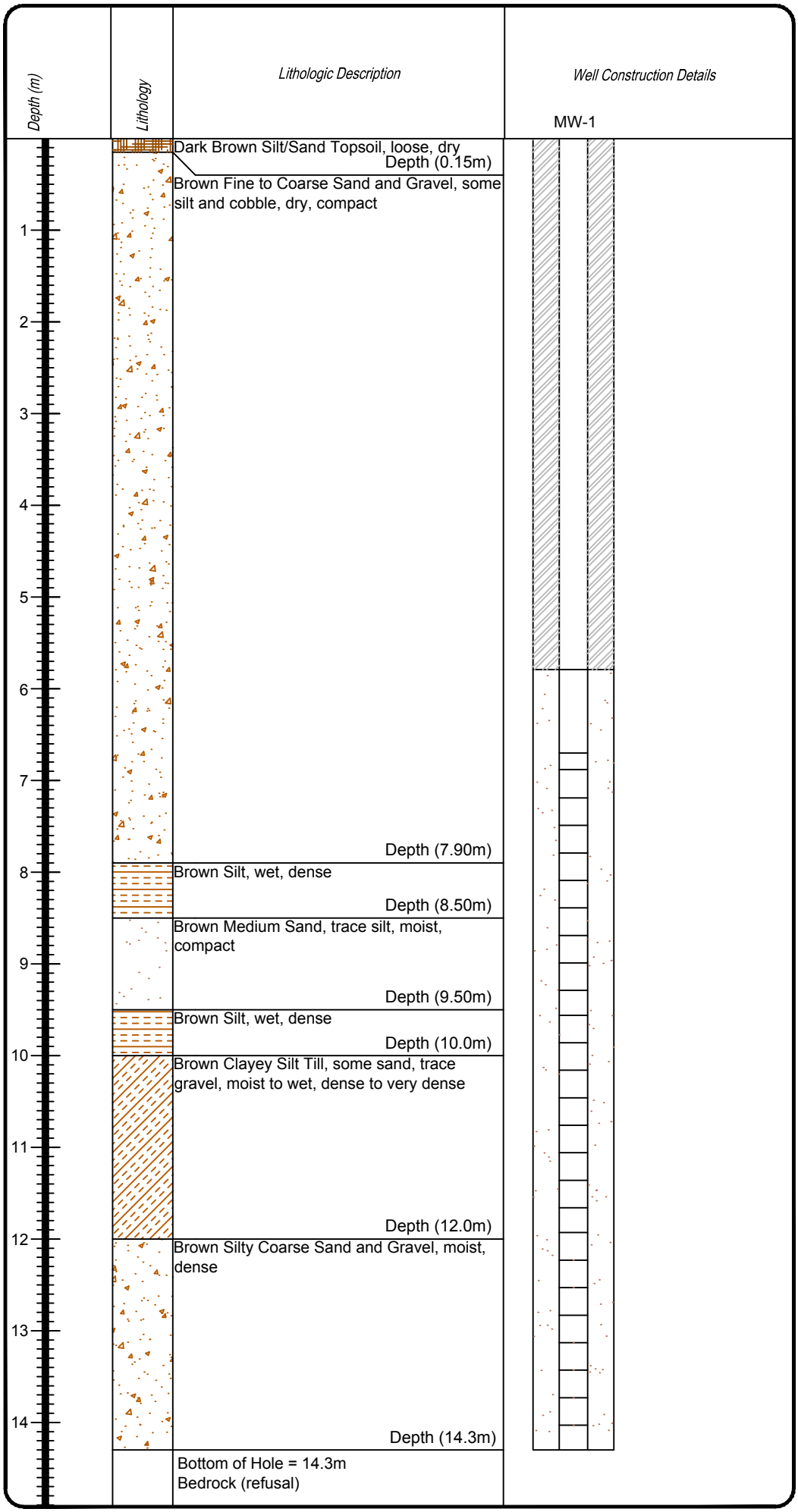
Audit No. z119189

Received APR 29 2011

Ministry's Copy

APPENDIX C

Borehole Logs



Monitoring Well

MW-1

Duivenvoorden Gravel Pit Expansion

Melancthon, ON

DRILLING DETAILS

Drill Date:	Sept. 15, 2017
Drilling Method:	-
Driller:	Orbit Garant
Geologist:	Drew West

MONITORING WELL INFORMATION

NAD Easting: 560990
Northing: 4888189

Monitoring Well	MW-1		
Ground Elev.			
Top of Casing Elev.			
Stick Up (m)	1.0		
Well Depth (m)	14.3		
High Water Level (date of water level)	- -		

All units expressed as metres above sea level unless otherwise noted

LEGEND

- Water Level Elevation
- Perched Water Table Elevation
- Grout
- Bentonite
- Silica Sand
- Schedule 40 (2") PVC Riser Pipe
- Schedule 40 (2") 10-slot PVC Screen
- Steel Casing (6")

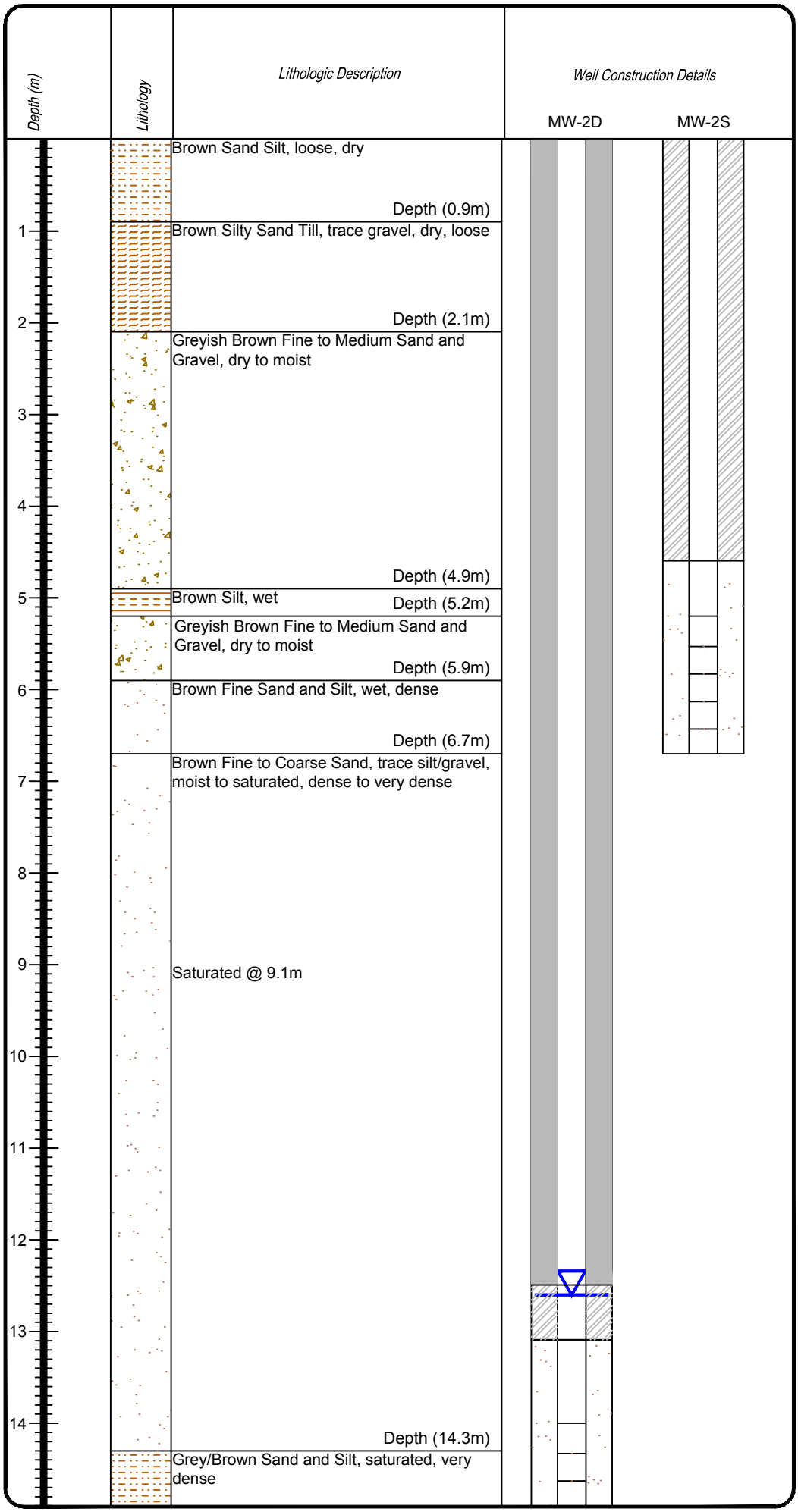
Geologic materials recovered and evaluated by: _____

AZIMUTH ENVIRONMENTAL CONSULTING, INC.

Date Issued:	November 2017
Created By:	JLM
Project No.	17-178a
File Name:	17-178bh

Page 1 of 1

Plotted by: JMCCARTNEY on April 1, 2019 at 1:37pm
File: C:\Users\jmccartney\appdata\local\temp\AcPublish_10876\17-178bh.dwg Layout: MW1 Plotscale: 40



Monitoring Well

MW-2

Duivenvoorden Gravel Pit Expansion

Melancthon, ON

DRILLING DETAILS

Drill Date:	*Sept. 18, 2017*
Drilling Method:	*-*
Driller:	*Orbit Garant*
Geologist:	*Drew West*

MONITORING WELL INFORMATION

NAD *Easting:* *560655*
Northing: *4888409*

Monitoring Well	*MW-2D*	*MW-2S*	
Ground Elev.			
Top of Casing Elev.			
Stick Up (m)	*0.95*	*0.95*	
Well Depth (m)	*15.5*	*6.70*	
High Water Level (date of water level)	*12.6 18/09/17*	*- -*	

All units expressed as metres above sea level unless otherwise noted

LEGEND

- *Water Level Elevation*
- *Perched Water Table Elevation*
- *Grout*
- *Bentonite*
- *Silica Sand*
- *Schedule 40 (2") PVC Riser Pipe*
- *Schedule 40 (2") 10-slot PVC Screen*
- *Steel Casing (6")*

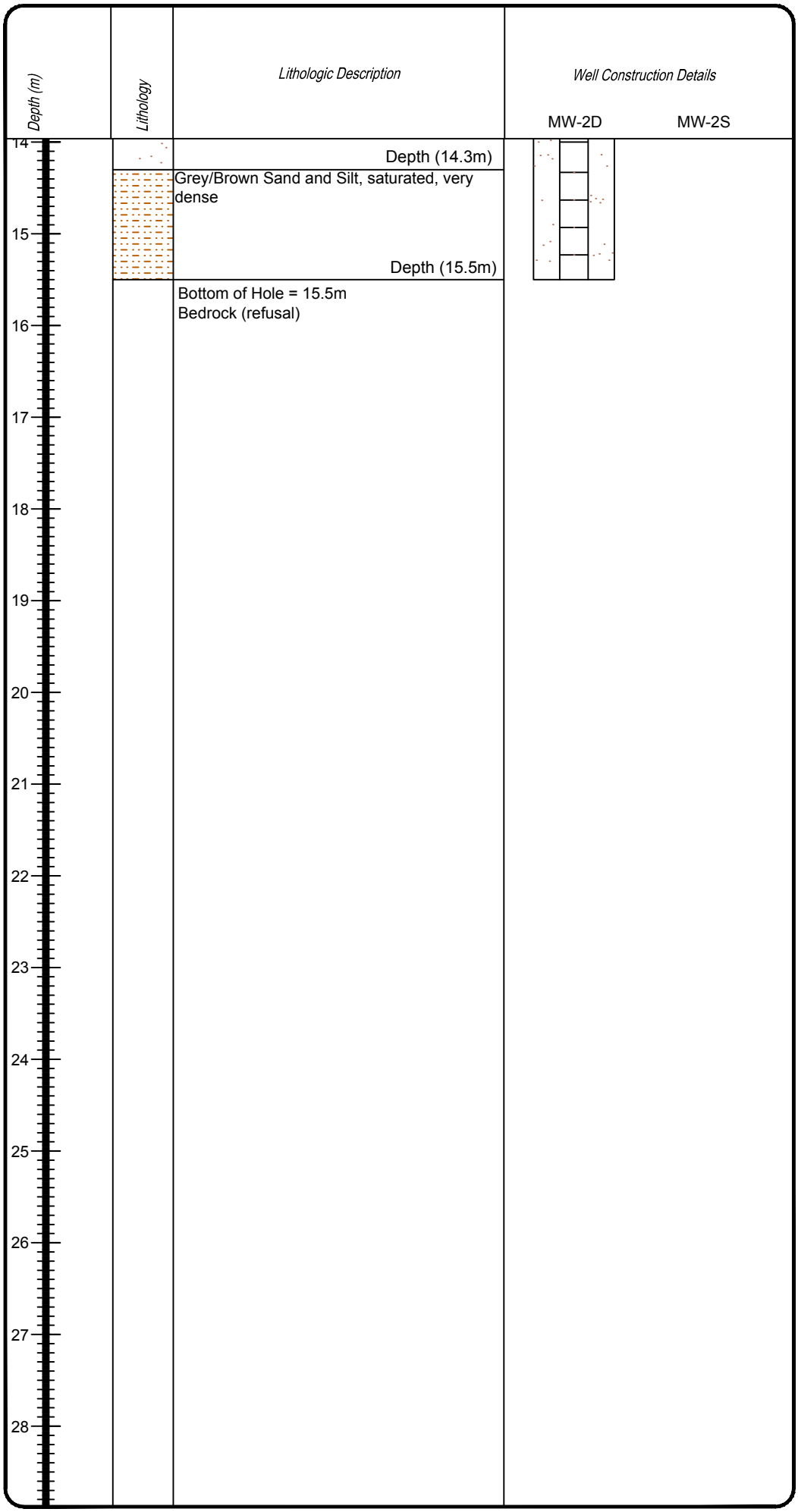
Geologic materials recovered and evaluated by: _____

AZIMUTH ENVIRONMENTAL CONSULTING, INC.

Date Issued:	*November 2017*
Created By:	*JLM*
Project No.	*17-178a*
File Name:	*17-178bh*

Page *1 of 2*

Plotted by: JMCCARTNEY on April 1, 2019 at 1:37pm
File: C:\Users\jmccartney\appdata\local\temp\AcPublish_10876\17-178bh.dwg Layout: MW2(1) Plotscale: 40



Monitoring Well

MW-2

Duivenvoorden Gravel Pit Expansion

Melancthon, ON

DRILLING DETAILS

Drill Date:	Sept. 18, 2017
Drilling Method:	-
Driller:	Orbit Garant
Geologist:	Drew West

MONITORING WELL INFORMATION

NAD Easting: 560655
Northing: 4888409

Monitoring Well	MW-2D	MW-2S	
Ground Elev.			
Top of Casing Elev.			
Stick Up (m)	0.95	0.95	
Well Depth (m)	15.5	6.70	
High Water Level (date of water level)	12.6 18/09/17	- -	

All units expressed as metres above sea level unless otherwise noted

LEGEND

- Water Level Elevation
- Perched Water Table Elevation
- Grout
- Bentonite
- Silica Sand
- Schedule 40 (2") PVC Riser Pipe
- Schedule 40 (2") 10-slot PVC Screen
- Steel Casing (6")

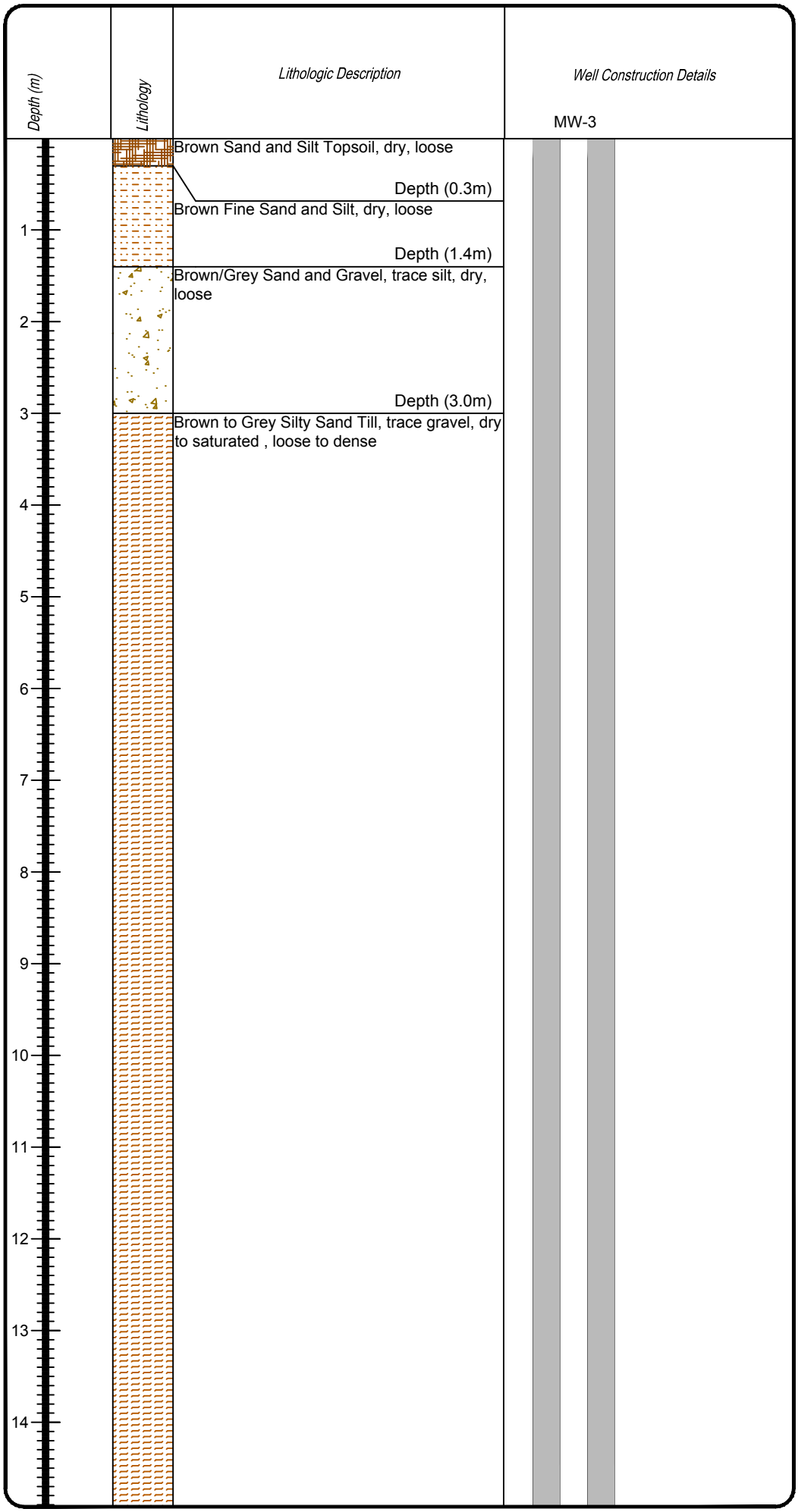
Geologic materials recovered and evaluated by:_____

AZIMUTH ENVIRONMENTAL CONSULTING, INC.

Date Issued:	November 2017
Created By:	JLM
Project No.	17-178a
File Name:	17-178bh

Page 2 of 2

Plotted by: JMCCARTNEY on April 1, 2019 at 1:37pm
File: C:\Users\jmccartney\appdata\local\temp\AcPublish_10876\17-178bh.dwg Layout: MW2(2) Plotscale: 40



Monitoring Well

MW-3

Duivenvoorden Gravel Pit Expansion

Melancthon, ON

DRILLING DETAILS

Drill Date:	Sept. 19, 2017
Drilling Method:	-
Driller:	Orbit Garant
Geologist:	Steven Krbavcic

MONITORING WELL INFORMATION

NAD Easting: 560483
Northing: 4888249

Monitoring Well	MW-3		
Ground Elev.			
Top of Casing Elev.			
Stick Up (m)	0.95		
Well Depth (m)	19.7		
High Water Level (date of water level)	18.56mbgs 19/09/17		

All units expressed as metres above sea level unless otherwise noted

LEGEND

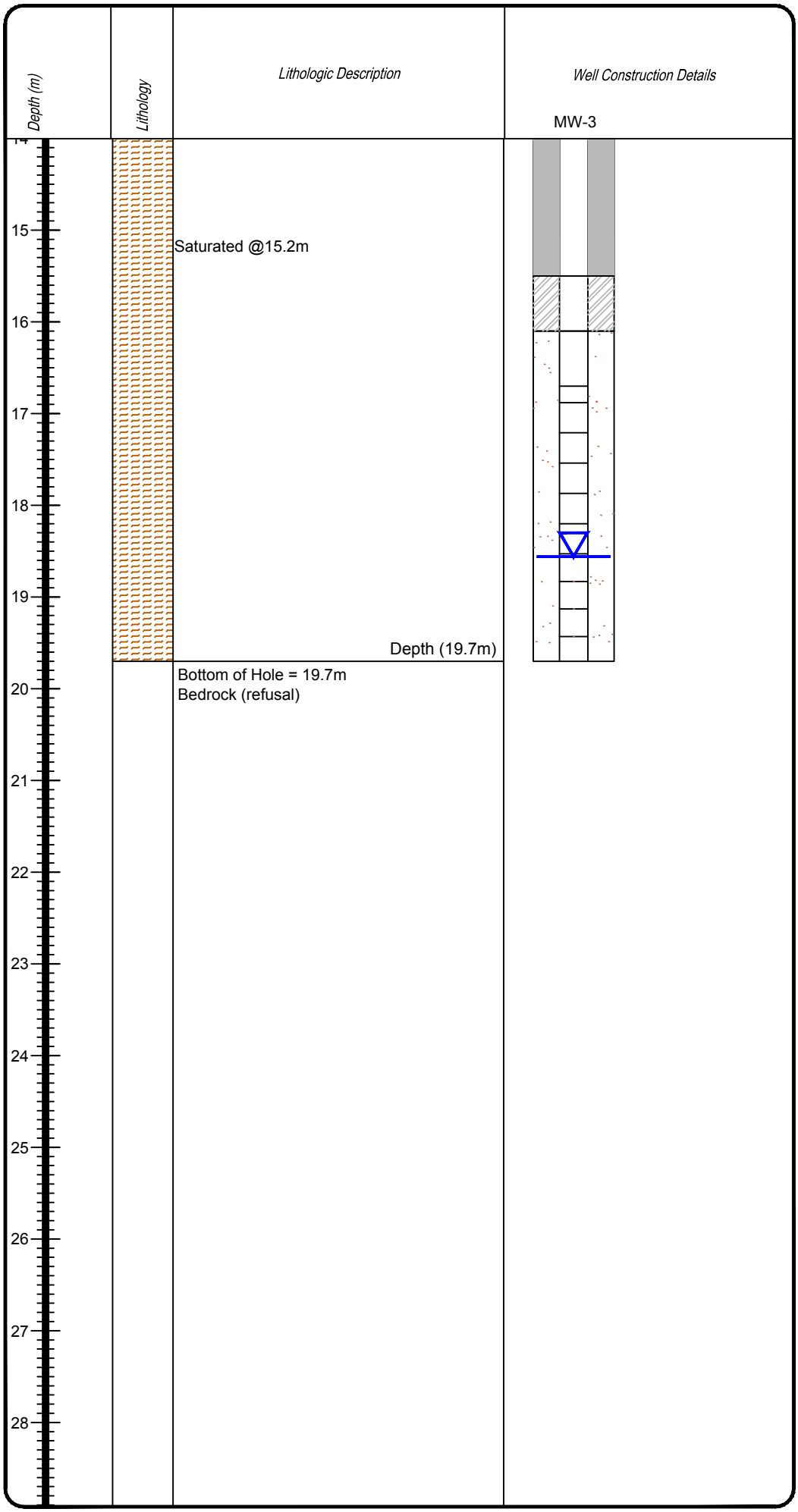
- Water Level Elevation
- Perched Water Table Elevation
- Grout
- Bentonite
- Silica Sand
- Schedule 40 (2") PVC Riser Pipe
- Schedule 40 (2") 10-slot PVC Screen
- Steel Casing (6")

Geologic materials recovered and evaluated by: _____

AZIMUTH ENVIRONMENTAL CONSULTING, INC.

Date Issued:	November 2017
Created By:	JLM
Project No.	17-178a
File Name:	17-178bh

Plotted by: JMCCARTNEY on April 1, 2019 at 1:37pm
File: C:\Users\jmccartney\appdata\local\temp\AcPublish_10876\17-178bh.dwg Layout: MW3(1) Plotscale: 40



Monitoring Well

MW-3

Duivenvoorden Gravel Pit Expansion

Melancthon, ON

DRILLING DETAILS

Drill Date:	Sept. 19, 2017
Drilling Method:	-
Driller:	Orbit Garant
Geologist:	Steven Krbavcic

MONITORING WELL INFORMATION

NAD Easting: 560483
Northing: 4888249

Monitoring Well	MW-3		
Ground Elev.			
Top of Casing Elev.			
Stick Up (m)	0.95		
Well Depth (m)	19.7		
High Water Level (date of water level)	18.56mbgs 19/09/17		

All units expressed as metres above sea level unless otherwise noted

LEGEND

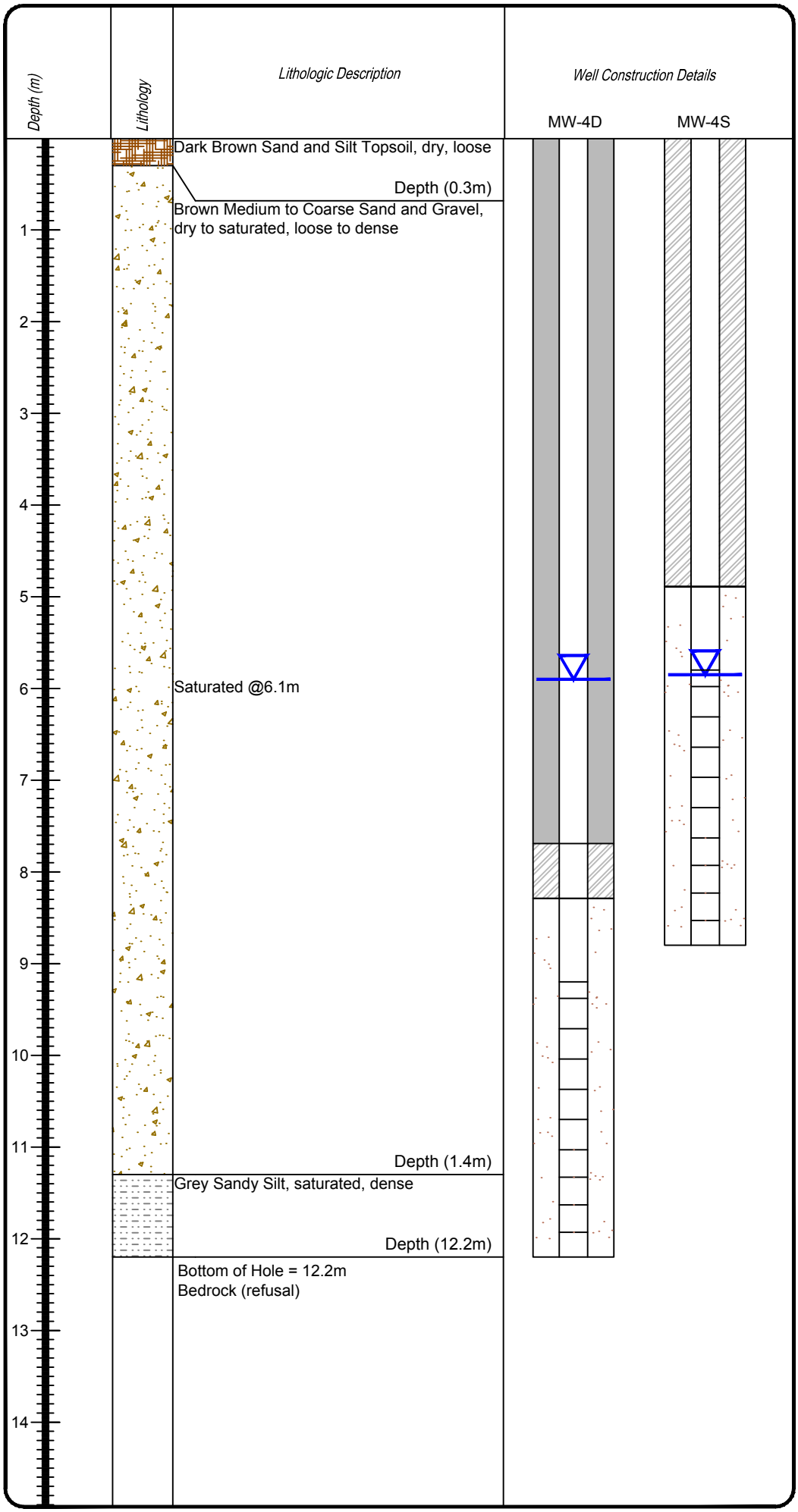
- Water Level Elevation
- Perched Water Table Elevation
- Grout
- Bentonite
- Silica Sand
- Schedule 40 (2") PVC Riser Pipe
- Schedule 40 (2") 10-slot PVC Screen
- Steel Casing (6")

Geologic materials recovered and evaluated by:_____

AZIMUTH ENVIRONMENTAL CONSULTING, INC.

Date Issued:	November 2017
Created By:	JLM
Project No.	17-178a
File Name:	17-178bh

Plotted by: JMCCARTNEY on April 1, 2019 at 1:37pm
File: C:\Users\jmccartney\appdata\local\temp\AcPublish_10876\17-178bh.dwg Layout: MW3(2) Plotscale: 40



Monitoring Well

MW-4

Duivenvoorden Gravel Pit Expansion

Melancthon, ON

DRILLING DETAILS

Drill Date:	Sept. 18, 2017
Drilling Method:	-
Driller:	Orbit Garant
Geologist:	Steve Krbavcic

Monitoring Well	MW-4D	MW-4S	
Ground Elev.			
Top of Casing Elev.			
Stick Up (m)	1.0	1.0	
Well Depth (m)	12.2	8.80	
High Water Level (date of water level)	5.9mbgs 18/09/17	5.85mbgs 18/09/17	

All units expressed as metres above sea level unless otherwise noted

LEGEND

- Water Level Elevation
- Perched Water Table Elevation
- Grout
- Bentonite
- Silica Sand
- Schedule 40 (2") PVC Riser Pipe
- Schedule 40 (2") 10-slot PVC Screen
- Steel Casing (6")

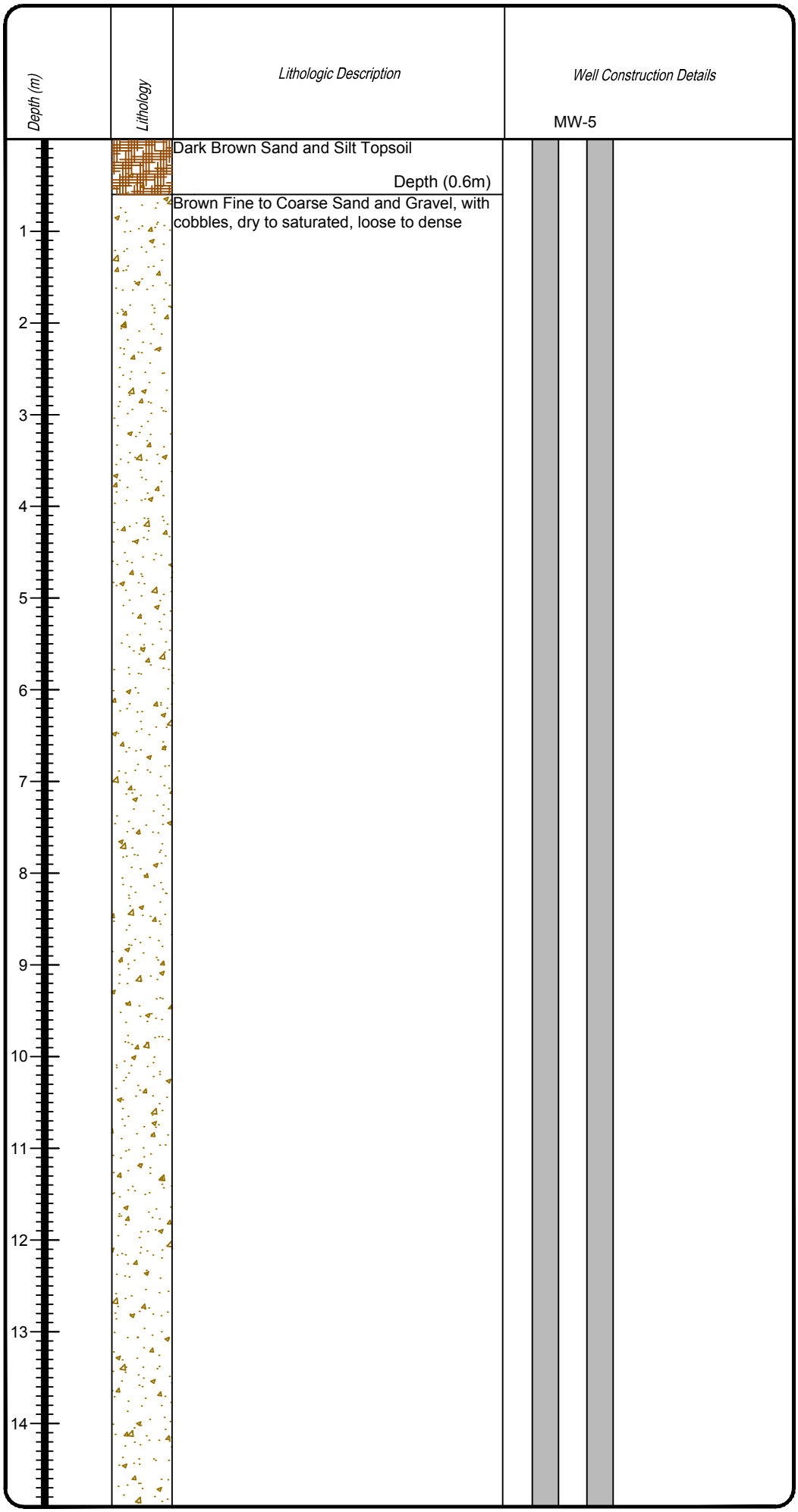
Geologic materials recovered and evaluated by: _____

AZIMUTH ENVIRONMENTAL CONSULTING, INC.

Date Issued:	November 2017
Created By:	JLM
Project No.	17-178a
File Name:	17-178bh

Page 1 of 1

Plotted by: JMCCARTNEY on April 1, 2019 at 1:37pm
File: C:\Users\jmccartney\appdata\local\temp\AcPublish_10876\17-178bh.dwg Layout: MW4 Plotscale: 40



Monitoring Well

MW-5

Duivenvoorden Gravel Pit Expansion

Melancthon, ON

DRILLING DETAILS

Drill Date:	Sept. 18, 2017
Drilling Method:	-
Driller:	Orbit Garant
Geologist:	Steve Krbavcic

Monitoring Well	MW-5		
Ground Elev.			
Top of Casing Elev.			
Stick Up (m)	0.85		
Well Depth (m)	20.7		
High Water Level (date of water level)	16.6mbgs 18/09/17		

All units expressed as metres above sea level unless otherwise noted

LEGEND

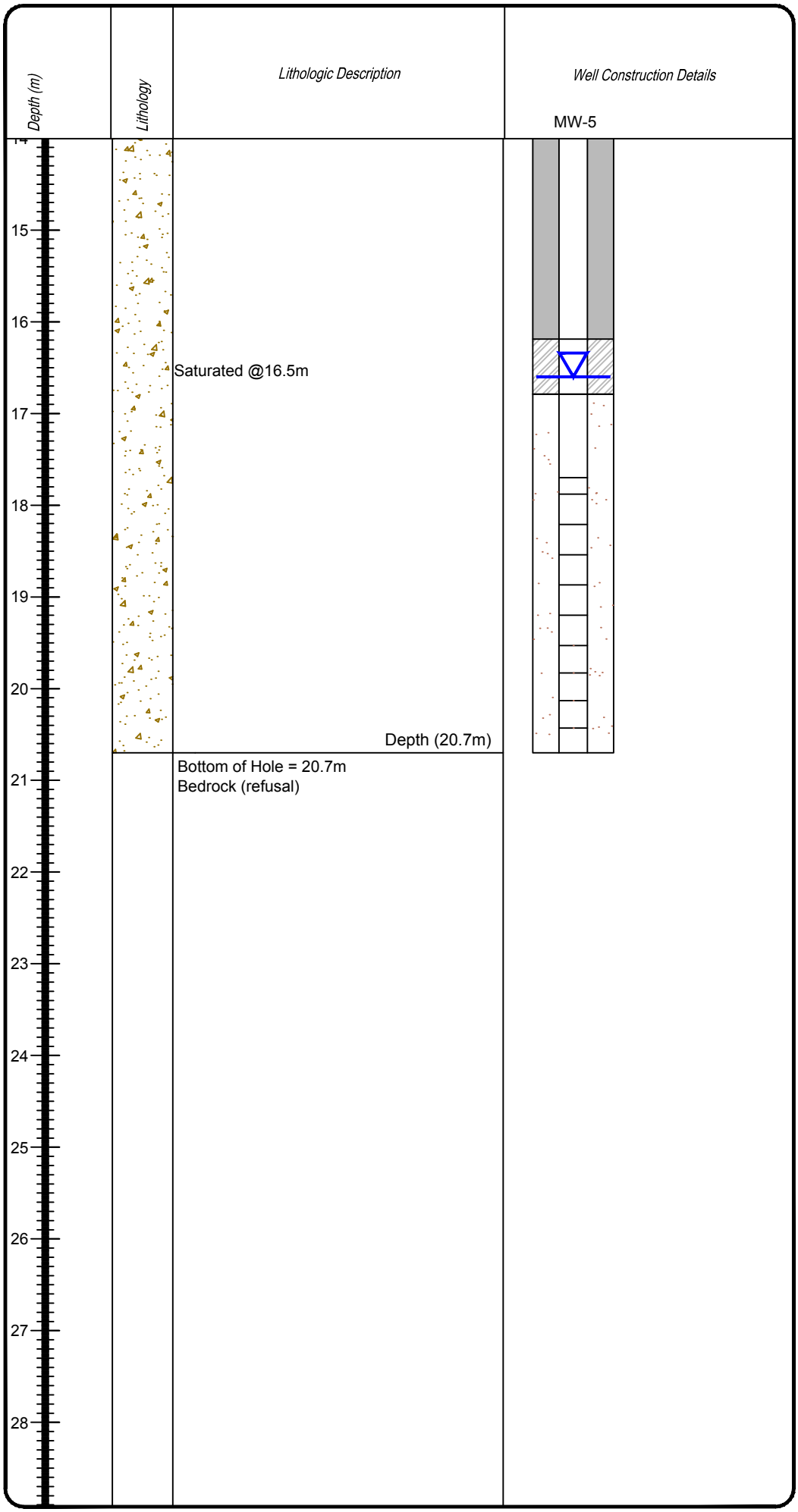
- Water Level Elevation
- Perched Water Table Elevation
- Grout
- Bentonite
- Silica Sand
- Schedule 40 (2") PVC Riser Pipe
- Schedule 40 (2") 10-slot PVC Screen
- Steel Casing (6")

Geologic materials recovered and evaluated by:_____

AZIMUTH ENVIRONMENTAL CONSULTING, INC.

Date Issued:	November 2017
Created By:	JLM
Project No.	17-178a
File Name:	17-178bh

Plotted by: JMCCARTNEY on April 1, 2019 at 1:37pm
File: C:\Users\jmccartney\appdata\local\temp\AcPublish_10876\17-178bh.dwg Layout: MW5(1) Plotscale: 40



Monitoring Well

MW-5

Duivenvoorden Gravel Pit Expansion

Melancthon, ON

DRILLING DETAILS

Drill Date:	Sept. 18, 2017
Drilling Method:	-
Driller:	Orbit Garant
Geologist:	Steve Krbavcic

Monitoring Well	MW-5		
Ground Elev.			
Top of Casing Elev.			
Stick Up (m)	0.85		
Well Depth (m)	20.7		
High Water Level (date of water level)	16.6mbgs 18/09/17		

All units expressed as metres above sea level unless otherwise noted

LEGEND

- Water Level Elevation
- Perched Water Table Elevation
- Grout
- Bentonite
- Silica Sand
- Schedule 40 (2") PVC Riser Pipe
- Schedule 40 (2") 10-slot PVC Screen
- Steel Casing (6")

Geologic materials recovered and evaluated by:_____

AZIMUTH ENVIRONMENTAL CONSULTING, INC.

Date Issued:	November 2017
Created By:	JLM
Project No.	17-178a
File Name:	17-178bh

Page 2 of 2

Plotted by: JMCCARTNEY on April 1, 2019 at 1:37pm
File: C:\Users\jmccartney\appdata\local\temp\AcPublish_10876\17-178bh.dwg Layout: MW5(2) Plotscale: 40

APPENDIX D

Water Quality Results

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: AZIMUTH ENVIRONMENTAL CONSULTING,
642 WELHAM ROAD
BARRIE, ON L4N9A1
(705) 721-8451

ATTENTION TO: Drew West

PROJECT: 17-178a

AGAT WORK ORDER: 18T364819

WATER ANALYSIS REVIEWED BY: Mike Muneswar, BSc (Chem), Senior Inorganic Analyst

DATE REPORTED: Jul 31, 2018

PAGES (INCLUDING COVER): 8

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 18T364819

PROJECT: 17-178a

CLIENT NAME: AZIMUTH ENVIRONMENTAL CONSULTING,

ATTENTION TO: Drew West

SAMPLING SITE:

SAMPLED BY:

Water Quality Assessment (excl. Hg) - Surface & Ground Water Samples

DATE RECEIVED: 2018-07-20

DATE REPORTED: 2018-07-31

		SAMPLE DESCRIPTION:		Pond		MW2d	MW4s		MW5
		SAMPLE TYPE:		Water		Water	Water		Water
		DATE SAMPLED:		2018-07-19		2018-07-19	2018-07-19		2018-07-19
Parameter	Unit	G / S	RDL	9416466	RDL	9416471	9416472	RDL	9416473
pH, Saturation				7.62		7.08	6.86		6.89
pH	pH Units		NA	7.90	NA	8.03	7.65	NA	7.63
Langelier Index				0.28		0.95	0.79		0.74
Alkalinity (as CaCO3)	mg/L		5	115	5	237	307	5	273
Bicarbonate (as CaCO3)	mg/L		5	115	5	237	307	5	273
Carbonate (as CaCO3)	mg/L		5	<5	5	<5	<5	5	<5
Hydroxide (as CaCO3)	mg/L		5	<5	5	<5	<5	5	<5
Electrical Conductivity	uS/cm		2	219	2	467	669	2	747
Fluoride	mg/L		0.05	<0.05	0.05	<0.05	<0.05	0.10	<0.10
Chloride	mg/L		0.10	1.53	0.10	8.66	4.03	0.20	20.6
Nitrate as N	mg/L		0.05	<0.05	0.05	4.90	0.68	0.10	9.59
Nitrite as N	mg/L		0.05	<0.05	0.05	<0.05	<0.05	0.10	<0.10
Bromide	mg/L		0.05	<0.05	0.05	<0.05	<0.05	0.10	<0.10
Sulphate	mg/L		0.10	0.20	0.10	8.62	3.83	0.20	25.9
Calcium	mg/L		0.05	34.6	0.05	71.8	87.1	0.05	84.8
Magnesium	mg/L		0.05	9.07	0.05	18.8	25.8	0.05	32.0
Sodium	mg/L		0.05	2.01	0.05	3.77	1.77	0.05	3.43
Potassium	mg/L		0.05	0.85	0.05	1.10	0.47	0.05	0.86
Ammonia as N	mg/L		0.02	<0.02	0.02	<0.02	<0.02	0.10	3.82
Phosphate as P	mg/L		0.10	<0.10	0.10	<0.10	<0.10	0.20	<0.20
Total Phosphorus	mg/L		0.02	0.08	0.02	<0.02	4.80	0.02	0.13
Reactive Silica	mg/L		0.05	1.23	0.05	7.38	9.89	0.05	10.7
Total Organic Carbon	mg/L		0.5	15.6	0.5	41.1	31.4	0.5	30.8
Colour	TCU		5	17	5	6	<5	5	<5
Turbidity	NTU		0.5	5.5	15	42500	13500	15	79700
Aluminum	mg/L		0.004	0.068	0.004	0.006	<0.004	0.004	0.028
Arsenic	mg/L		0.003	<0.003	0.003	<0.003	<0.003	0.003	<0.003
Barium	mg/L		0.002	0.014	0.002	0.022	0.014	0.002	0.051
Boron	mg/L		0.010	0.020	0.010	0.012	<0.010	0.010	<0.010
Cadmium	mg/L		0.002	<0.002	0.002	<0.002	<0.002	0.002	<0.002

Certified By:

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 18T364819

PROJECT: 17-178a

CLIENT NAME: AZIMUTH ENVIRONMENTAL CONSULTING,

ATTENTION TO: Drew West

SAMPLING SITE:

SAMPLED BY:

Water Quality Assessment (excl. Hg) - Surface & Ground Water Samples

DATE RECEIVED: 2018-07-20

DATE REPORTED: 2018-07-31

		SAMPLE DESCRIPTION:		Pond		MW2d	MW4s		MW5
		SAMPLE TYPE:		Water		Water	Water		Water
		DATE SAMPLED:		2018-07-19		2018-07-19	2018-07-19		2018-07-19
Parameter	Unit	G / S	RDL	9416466	RDL	9416471	9416472	RDL	9416473
Chromium	mg/L		0.003	<0.003	0.003	<0.003	<0.003	0.003	<0.003
Copper	mg/L		0.003	<0.003	0.003	0.006	0.003	0.003	<0.003
Iron	mg/L		0.010	2.39	0.010	<0.010	<0.010	0.010	<0.010
Lead	mg/L		0.001	<0.001	0.001	<0.001	<0.001	0.001	<0.001
Manganese	mg/L		0.002	0.439	0.002	<0.002	<0.002	0.002	<0.002
Molybdenum	mg/L		0.002	<0.002	0.002	<0.002	<0.002	0.002	<0.002
Nickel	mg/L		0.003	<0.003	0.003	<0.003	<0.003	0.003	<0.003
Selenium	mg/L		0.004	<0.004	0.004	<0.004	<0.004	0.004	<0.004
Silver	mg/L		0.002	<0.002	0.002	<0.002	<0.002	0.002	<0.002
Strontium	mg/L		0.005	0.044	0.005	0.109	0.104	0.005	0.148
Thallium	mg/L		0.006	<0.006	0.006	<0.006	<0.006	0.006	<0.006
Tin	mg/L		0.002	<0.002	0.002	<0.002	<0.002	0.002	<0.002
Titanium	mg/L		0.002	0.003	0.002	<0.002	<0.002	0.002	<0.002
Uranium	mg/L		0.002	<0.002	0.002	<0.002	<0.002	0.002	<0.002
Vanadium	mg/L		0.002	<0.002	0.002	<0.002	<0.002	0.002	<0.002
Zinc	mg/L		0.005	<0.005	0.005	0.011	<0.005	0.005	0.006
Total Dissolved Solids	mg/L		20	148	20	308	314	20	396
Total Hardness (as CaCO3)	mg/L		0.5	124	0.5	257	324	0.5	344
% Difference/ Ion Balance	%		NA	4.77	NA	1.76	1.37	NA	0.287

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

9416466-9416473 Elevated RDLs indicate the degree of sample dilutions prior to analysis in order to keep the analytes within the calibration range of the instruments and to reduce matrix interferences.

Certified By:

AGAT Laboratories
5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Quality Assurance

CLIENT NAME: AZIMUTH ENVIRONMENTAL CONSULTING,

AGAT WORK ORDER: 18T364819

PROJECT: 17-178a

ATTENTION TO: Drew West

SAMPLING SITE:

SAMPLED BY:

Water Analysis

RPT Date: Jul 31, 2018

PARAMETER	Batch	Sample Id	DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
			Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Water Quality Assessment (excl. Hg) - Surface & Ground Water Samples															
pH	9414642		6.36	6.31	0.8%	NA	100%	90%	110%						
Alkalinity (as CaCO3)	9414642		149	143	4.1%	< 5	83%	80%	120%						
Bicarbonate (as CaCO3)	9414642		149	143	4.1%	< 5	NA	80%	120%						
Carbonate (as CaCO3)	9414642		<5	<5	NA	< 5	NA	80%	120%						
Hydroxide (as CaCO3)	9414642		<5	<5	NA	< 5	NA	80%	120%						
Electrical Conductivity	9414642		947	948	0.1%	< 2	112%	80%	120%						
Fluoride	9415370		<0.25	<0.25	NA	< 0.05	97%	90%	110%	97%	90%	110%	98%	80%	120%
Chloride	9415370		39.3	38.4	2.3%	< 0.10	92%	90%	110%	103%	90%	110%	108%	80%	120%
Nitrate as N	9415370		0.31	0.32	3.2%	< 0.05	91%	90%	110%	102%	90%	110%	103%	80%	120%
Nitrite as N	9415370		<0.25	<0.25	NA	< 0.05	NA	90%	110%	106%	90%	110%	112%	80%	120%
Bromide	9415370		<0.25	<0.25	NA	< 0.05	106%	90%	110%	104%	90%	110%	104%	80%	120%
Sulphate	9415370		309	301	2.6%	< 0.10	91%	90%	110%	97%	90%	110%	99%	80%	120%
Calcium	9418955		46.7	47.6	1.9%	< 0.05	101%	90%	110%	102%	90%	110%	105%	70%	130%
Magnesium	9418955		8.65	8.75	1.1%	< 0.05	99%	90%	110%	98%	90%	110%	101%	70%	130%
Sodium	9418955		60.1	61.0	1.5%	< 0.05	97%	90%	110%	97%	90%	110%	98%	70%	130%
Potassium	9418955		5.21	5.30	1.7%	< 0.05	97%	90%	110%	97%	90%	110%	99%	70%	130%
Ammonia as N	9414614		<0.02	<0.02	NA	< 0.02	95%	90%	110%	102%	90%	110%	108%	80%	120%
Phosphate as P	9415370		<0.50	<0.50	NA	< 0.10	105%	90%	110%	97%	90%	110%	100%	80%	120%
Total Phosphorus	9416209		10.4	10.3	1.0%	< 0.02	98%	80%	120%	101%	90%	110%	91%	70%	130%
Reactive Silica	9421674		20.1	19.5	3.0%	< 0.05	108%	90%	110%	107%	90%	110%	107%	80%	120%
Total Organic Carbon	9416466	9416466	15.6	15.8	1.3%	< 0.5	96%	90%	110%	97%	90%	110%	85%	80%	120%
Colour	9415557		17	18	NA	< 5	106%	90%	110%						
Turbidity	9416466	9416466	5.5	5.5	0.0%	< 0.5	101%	90%	110%						
Aluminum	9414614		0.071	0.072	1.4%	< 0.004	100%	90%	110%	96%	90%	110%	80%	70%	130%
Arsenic	9414614		<0.003	<0.003	NA	< 0.003	101%	90%	110%	96%	90%	110%	102%	70%	130%
Barium	9414614		0.075	0.072	4.1%	< 0.002	107%	90%	110%	100%	90%	110%	97%	70%	130%
Boron	9414614		0.032	0.034	NA	< 0.010	102%	90%	110%	105%	90%	110%	85%	70%	130%
Cadmium	9414614		<0.002	<0.002	NA	< 0.002	104%	90%	110%	103%	90%	110%	106%	70%	130%
Chromium	9414614		<0.003	<0.003	NA	< 0.003	104%	90%	110%	101%	90%	110%	96%	70%	130%
Copper	9414614		<0.003	<0.003	NA	< 0.003	103%	90%	110%	103%	90%	110%	90%	70%	130%
Iron	9414614		0.075	0.087	14.8%	< 0.010	98%	90%	110%	97%	90%	110%	114%	70%	130%
Lead	9414614		<0.001	<0.001	NA	< 0.001	105%	90%	110%	103%	90%	110%	95%	70%	130%
Manganese	9414614		0.144	0.146	1.4%	< 0.002	101%	90%	110%	99%	90%	110%	88%	70%	130%
Molybdenum	9414614		<0.002	<0.002	NA	< 0.002	98%	90%	110%	98%	90%	110%	103%	70%	130%
Nickel	9414614		<0.003	<0.003	NA	< 0.003	103%	90%	110%	103%	90%	110%	94%	70%	130%
Selenium	9414614		<0.004	<0.004	NA	< 0.004	100%	90%	110%	101%	90%	110%	113%	70%	130%
Silver	9414614		<0.002	<0.002	NA	< 0.002	104%	90%	110%	109%	90%	110%	103%	70%	130%
Strontium	9414614		0.284	0.303	6.5%	< 0.005	98%	90%	110%	97%	90%	110%	98%	70%	130%
Thallium	9414614		<0.006	<0.006	NA	< 0.006	105%	90%	110%	101%	90%	110%	95%	70%	130%

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Quality Assurance

CLIENT NAME: AZIMUTH ENVIRONMENTAL CONSULTING,

AGAT WORK ORDER: 18T364819

PROJECT: 17-178a

ATTENTION TO: Drew West

SAMPLING SITE:

SAMPLED BY:

Water Analysis (Continued)

RPT Date: Jul 31, 2018			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Tin	9414614		<0.002	<0.002	NA	< 0.002	106%	90%	110%	110%	90%	110%	109%	70%	130%
Titanium	9414614		0.006	0.007	NA	< 0.002	100%	90%	110%	97%	90%	110%	97%	70%	130%
Uranium	9414614		<0.002	<0.002	NA	< 0.002	104%	90%	110%	102%	90%	110%	103%	70%	130%
Vanadium	9414614		<0.002	<0.002	NA	< 0.002	101%	90%	110%	94%	90%	110%	100%	70%	130%
Zinc	9414614		<0.005	<0.005	NA	< 0.005	103%	90%	110%	102%	90%	110%	93%	70%	130%
Total Dissolved Solids	9416323		60	62	NA	< 20	102%	80%	120%						

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the Reporting Limit (RL), the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Certified By:

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Method Summary

CLIENT NAME: AZIMUTH ENVIRONMENTAL CONSULTING,

AGAT WORK ORDER: 18T364819

PROJECT: 17-178a

ATTENTION TO: Drew West

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Water Analysis			
pH, Saturation		SM 2320 B	CALCULATION
pH	INOR-93-6000	SM 4500-H+ B	PC TITRATE
Langelier Index		SM 2330B	CALCULATION
Alkalinity (as CaCO3)	INOR-93-6000	SM 2320 B	PC TITRATE
Bicarbonate (as CaCO3)	INOR-93-6000	SM 4500-H+ B	PC TITRATE
Carbonate (as CaCO3)	INOR-93-6000	SM 4500-H+ B	PC TITRATE
Hydroxide (as CaCO3)	INOR-93-6000	SM 4500-H+ B	PC TITRATE
Electrical Conductivity	INOR-93-6000	SM 2510 B	PC TITRATE
Fluoride	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Chloride	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Nitrate as N	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Nitrite as N	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Bromide	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Sulphate	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Calcium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Magnesium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Sodium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Potassium	MET-93-6105	EPA SW-846 6010C & 200.7	ICP/OES
Ammonia as N	INOR-93-6059	QuikChem 10-107-06-1-J & SM 4500 NH3-F	LACHAT FIA
Phosphate as P	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Total Phosphorus	INOR-93-6057	QuikChem 10-115-01-3-A & SM 4500-P I	LACHAT FIA
Reactive Silica	INOR-93-6047	SmartChem Method SIL-001-A & SM 4500 Si-F 18 &19th	DISCRETE ANALYZER
Total Organic Carbon	INOR-93-6049	EPA 415.1 & SM 5310 B	SHIMADZU CARBON ANALYZER
Colour	INOR93-6046	SM 2120 B	SPECTROPHOTOMETER
Turbidity	INOR-93-6044	SM 2130 B	NEPHELOMETER
Aluminum	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Arsenic	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Barium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Boron	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Cadmium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Chromium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Copper	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Iron	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Lead	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Manganese	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Molybdenum	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Nickel	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Selenium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Silver	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Strontium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Thallium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Tin	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Titanium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Uranium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Vanadium	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Zinc	MET-93-6103	EPA SW-846 6020A & 200.8	ICP-MS
Total Dissolved Solids	INOR-93-6028	SM 2540 C	BALANCE

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Method Summary

CLIENT NAME: AZIMUTH ENVIRONMENTAL CONSULTING,

AGAT WORK ORDER: 18T364819

PROJECT: 17-178a

ATTENTION TO: Drew West

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Total Hardness (as CaCO3)	MET-93-6105	EPA SW-846 6010C & 200.7	CALCULATION
% Difference/ Ion Balance		SM 1030 E	CALCULATION

AGAT Laboratories

5835 Coopers Avenue
Mississauga, ON
L4Z 1Y2
www.agatlabs.com · webearth.agatlabs.com

P: 905.712.5100 · F: 905.712.5122

Chain of Custody Record

/ BLUE CORGE

Laboratory Use Only
Arrival Temperature: 18T364819
AGAT WO #:
Lab Temperature: 6.8/6.9/6.5
Notes: 8 coolers

Client Information
Company: Azimuth Environmental
Contact: Drew West
Address: 642 Welham Road
Barrie, ON
Phone: 705-721-8451 Fax:
Project: 17-178a PO:
AGAT Quotation #:
Please note, if quotation number is not provided, client will be billed full price for analysis.

Regulatory Requirements
☐ Regulation 153/04 (reg. 511 Amend.)
Table ____ Indicate one
☐ Ind/Com
☐ Res/Park
☐ Agriculture
Soil Texture (check one) ☐ Coarse ☐ Fine

☐ Sewer Use
Region ____ Indicate one
☐ Sanitary
☐ Storm

☐ Regulation 558
☐ CCME
☐ Other (specify)
☐ Prov. Water Quality Objectives (PWQO)
☑ None

Turnaround Time Required (TAT) Required*
Regular TAT
☑ 5 to 7 Working Days
Rush TAT (please provide prior notification)
Rush Surcharges Apply
☐ 3 Working Days
☐ 2 Working Days
☐ 1 Working Day
OR
Date Required (Rush surcharges may apply):
*TAT is exclusive of weekends and statutory holidays

Invoice To
Same: Yes ☑ No ☐
Company:
Contact: Lana Salgado
Address:

Is this a drinking water sample? (potable water intended for human consumption) ☐ Yes ☑ No
If "Yes", please use the *Drinking Water Chain of Custody Form*

Is this submission for a **Record of Site Condition?** ☐ Yes ☑ No

Legend Matrix
GW Ground Water O Oil
SW Surface Water P Paint
SD Sediment S Soil

Report Information – reports to be sent to:
1. Name: Drew West
Email:
2. Name:
Email:

Sample Identification	Date Sampled	Time Sampled	Sample Matrix	# of Containers	Comments Site/Sample Information	Metals and Inorganics	Metal Scan	Hydride Forming Metals	Client Custom Metals	ORPs: ☐ B-HWS ☐ Cl- ☐ CN- ☐ EC ☐ FOC ☐ Cr+6- ☐ SAR ☐ N- Total ☐ Hg ☐ pH ☐ NO_3/NO_2	Nutrients: ☐ TP ☐ NH_3 ☐ TKN ☐ NO_3 ☐ NO_2 ☐ NO_3/NO_2	VOC: ☐ VOC ☐ THM ☐ BTEX	CCME Fractions 1 to 4	ABNs	PAHs	Chlorophenols	PCBs	Organochlorine Pesticides	TCLP Metals/Inorganics	Sewer Use	93-179
POND	Jul 19	13:00	SW	4	no field filtering																X
MW2d	↓	14:00	GW	↓	metals filtered																X
MW4s		13:30	GW		"																X
MW5	↓	14:30	GW	↓	"																X

Samples Relinquished By (Print Name and Sign):	Date/Time	Samples Received By (Print Name and Sign):	Date/Time
Drew West	Jul 20/18	PARDEEP BONGA	July 20/18 5:30PM
Samples Relinquished By (Print Name and Sign):	Date/Time	Samples Received By (Print Name and Sign):	Date/Time

Pink Copy - Client
Yellow Copy - AGAT
White Copy- AGAT

Page 1 of 1
N°: 50917

Document ID: DIV-78-1511.008
Date Issued: May 31, 2013