APPENDIX E

Hydrogeology

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Orlando North Porta Commercial Development – Hydrogeological Investigation and Water Balance Assessment

Palmer Project #
180041

Prepared For
Orlando Corporation

April 21, 2022

Palmer™

74 Berkeley Street, Toronto, On, M5A 2W7
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April 21, 2022

Steve Hollingworth
The Municipal Infrastructure Group Ltd. (TMIG)
8800 Dufferin Street, Suite 200
Vaughan, Ontario L4K 0C5

Dear Mr. Steve Hollingworth:

Re: **Orlando North Porta Commercial Development – Hydrogeological Investigation and Water Balance Assessment**
Project #: **180041**

Palmer Environmental Consulting Group Inc. (Palmer) is pleased to submit the attached report describing the results of our hydrogeological investigation and site water budget assessment for the proposed commercial land development project located in Milton, Ontario. The hydrogeological assessment was designed to support the Functional Servicing Report (FSR) in support of the draft plan of subdivision currently being completed by The Municipal Infrastructure Group Ltd. (TMIG) and the Environmental Impact Study (EIS) being completed by Savanta Inc. (Savanta). These items include recommendations regarding stormwater design planning and the use of Low Impact Development (LID) measures, as well as input to the proposed channel realignment and an assessment of impacts to natural features.

This report summarizes the results of the hydrogeological assessment, including a characterization of site geology and hydrostratigraphy, groundwater conditions (i.e. groundwater levels, hydraulic gradient, and flow direction), the hydrologic function of targeted wetlands and watercourses, and defining the overall pre-development site water balance. Infiltration testing of the surficial soils was also completed to provide input into proposed LID mitigation strategies post-development.

Should you have any questions, please do not hesitate to contact Jason Cole at 416-605-5797 or jason.cole@pecg.ca.

Yours truly,
Palmer Environmental Consulting Group Inc.

J. Cole

Jason Cole, M.Sc., P.Geo.
Principal, Senior Hydrogeologist

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1 Introduction

Palmer Environmental Consulting Group Inc. (Palmer) was retained by The Municipal Infrastructure Group Ltd. (TMIG) to complete a hydrogeological investigation for the North Milton Business Park located in Milton, Ontario (herein referred to as the “site” or “study area”). The site area is approximately 136.5 hectares (ha) and is generally bounded by James Snow Parkway to the south, the CN Railway to the west, Esquesing Line to the east and a mix of rural residential and natural environmental lands to the north up to 5 Side Road (**Figure 1**). The 2021 Site Plan for the project is provided in **Appendix A**.

The site is within the Middle Sixteen Mile Creek Watershed and is within the regulatory limits of Conservation Halton (CH). Middle Sixteen Mile Creek, a tributary to Sixteen Mile Creek, is present north of the site boundary and bisects the site area near Esquesing Line. The study area is dominated by agricultural land use, with the majority of natural features associated with the Middle Sixteen Mile Creek river valley.

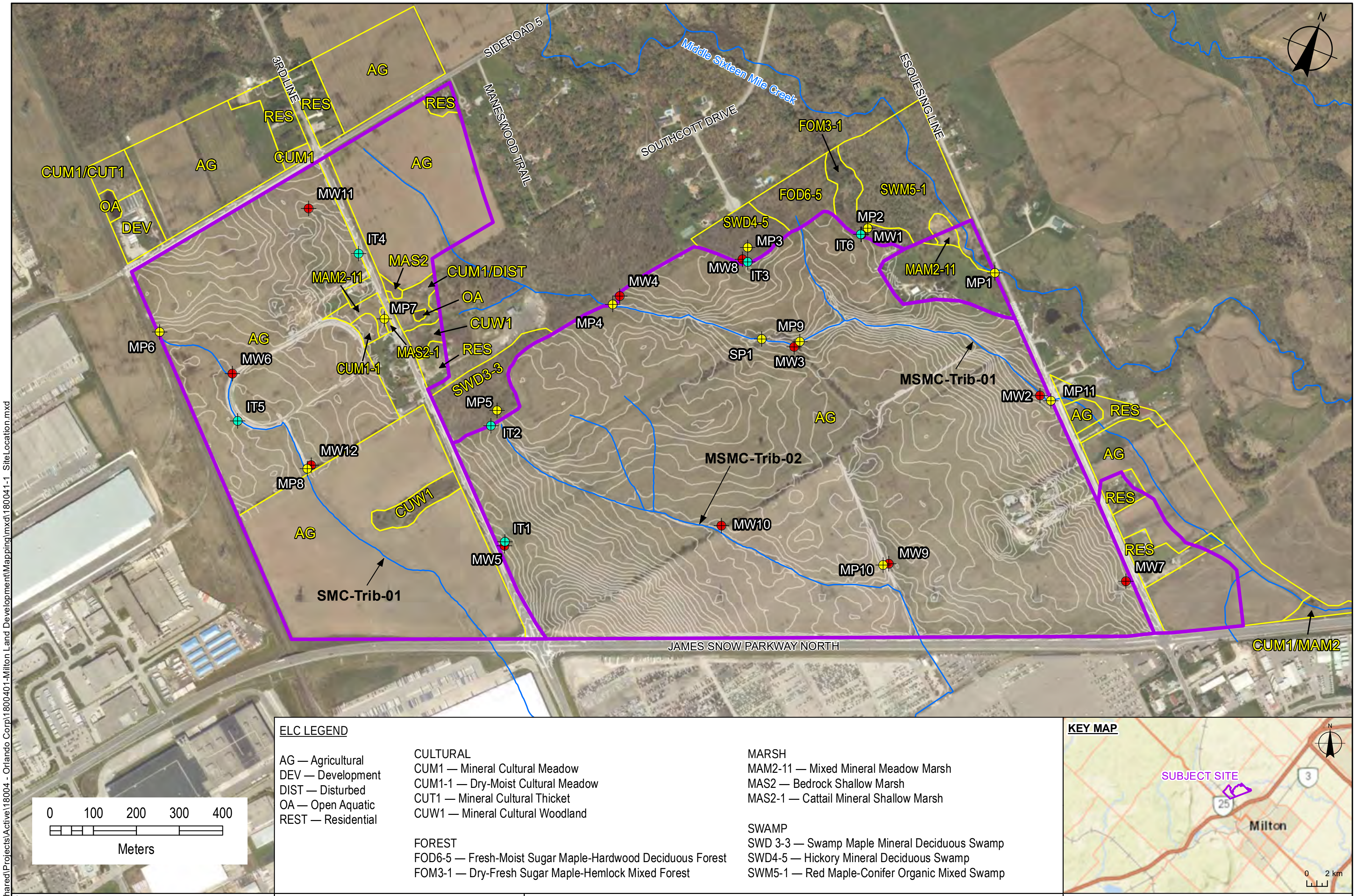
Palmer staff have been involved with the project since 2015. The focus of our hydrogeological study is to characterize groundwater conditions at the site and collect data on groundwater/ surface water interactions within the natural environmental features (i.e., wetlands, drainage features, creeks) and key project elements (i.e., stormwater ponds, building foundations, creek realignments) to support the Environmental Impact Study (EIS) being completed by Savanta and the Functional Servicing Report (FSR) being completed by TMIG. In July 2015, Palmer completed the installation of six (6) monitoring wells, and ten (10) mini-piezometers. Surface water and groundwater levels at each monitoring location were monitored monthly over a period of 9 months, between July 2015 and May 2016. The intent of this initial study was to establish baseline groundwater and surface water conditions over a period of approximately 1-year.

A Terms of Reference (TOR) was developed and submitted to the Town and CH in December 2017. To address the TOR, between December 2017 and March 2018, the wetland and groundwater level monitoring program resumed and was expanded upon in order to gather additional groundwater and surface water conditions at proposed SWM Pond locations, along the southeastern portion of the site, as well as along the proposed creek realignment of MSMC-Trib-01 (**Figure 1**). Six (6) monitoring wells and five (5) additional MP locations were added to the overall monitoring program. Surface water and groundwater levels at each monitoring location were monitored monthly from December 2017 to May 2018. Three additional monitoring events occurred in August 2018, January 2019, and April 2019.

As part of the development, the drainage swale exiting the deciduous swamp located at MP5 is also recommended for realignment to the east. To support this assessment, Palmer installed an additional MP in this swale to confirm groundwater and surface water conditions. Since this installation, five monitoring events have occurred in June 2019, August 2019, October 2019, March 2020, and June 2020.

1.1 Scope of Work

Starting in 2015, Palmer initiated a hydrogeological assessment and wetland monitoring program, that included the following scope of work:



ELC LEGEND

AG — Agricultural
DEV — Development
DIST — Disturbed
OA — Open Aquatic
REST — Residential

CULTURAL
CUM1 — Mineral Cultural Meadow
CUM1-1 — Dry-Moist Cultural Meadow
CUT1 — Mineral Cultural Thicket
CUW1 — Mineral Cultural Woodland

FOREST
FOD6-5 — Fresh-Moist Sugar Maple-Hardwood Deciduous Forest
FOM3-1 — Dry-Fresh Sugar Maple-Hemlock Mixed Forest

MARSH
MAM2-11 — Mixed Mineral Meadow Marsh
MAS2 — Bedrock Shallow Marsh
MAS2-1 — Cattail Mineral Shallow Marsh

SWAMP
SWD 3-3 — Swamp Maple Mineral Deciduous Swamp
SWD4-5 — Hickory Mineral Deciduous Swamp
SWM5-1 — Red Maple-Conifer Organic Mixed Swamp

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CLIENT:
Orlando Corp

PREPARED:
Palmer™

PROJECT:
Milton Land Development

PROJECT NO.	1800401	REVISION:	2
DATE:	Jun 29, 2020	SCALE:	1:12000
DRAWN:	BE/CV	DATUM:	NAD 1983
CHECKED:	NB	PROJECTION:	UTM zone 17

LEGEND:
- Infiltration Test
- Mini Piezometer
- Monitoring Well
- Watercourse
- Surface Elevation Contour (25 cm)
- Ecological Land Classification
- Subject Site

Site Location

Figure 1

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Imagery (2018 - DigitalGlobe) provided by Esri basemap service

- Collection and review of background geology and hydrogeology data from published maps and reports, Ministry of the Environment, Conservation and Parks (MECP) water well records, and previously conducted hydrogeological studies in the area;
- Characterize the surface and sub-surface geological and hydrogeological conditions through the installation six (6) monitoring wells and ten (10) mini-piezometers.
- Conducting single well response testing (i.e., slug tests) at each well to determine the hydraulic conductivity of the geological material;
- Collection of groundwater chemistry samples at two (2) locations; and
- Monthly groundwater level and wetland water level monitoring between July 2015 and May 2016.

Between December 2017 and March 2018, the wetland and groundwater level monitoring program resumed and was expanded upon as part of the ToR in order to gather groundwater and surface water conditions at proposed SWM Pond locations, along the southeastern portion of the site, as well as along the proposed creek realignment. This expanded work program included:

- Installation of six (6) additional monitoring wells and five (5) wetland MPs;
- Resumption of the groundwater and wetland water level monitoring program;
- Evaluation of the potential impacts from site development on groundwater levels, aquifer units and the hydroperiod of each wetland unit;
- Install ten (10) leveloggers in the MWs and MPs to provide continuous hourly water level data over the monitoring period;
- Complete a pre- and post-development water balance for each of the four (4) development Parcels;
- Provide hydrogeological considerations and recommendations for the proposed channel realignment;
- Provide LID recommendations to maintain the pre-development water balance and the hydrological function of site and wetlands post-development;
- Produce a Hydrogeological Investigation report outlining the results of the investigation; and,
- Recommend future monitoring and mitigation measures based on the results of the study.

2 Regional Existing Conditions

2.1 Physiography and Surficial Geology

The study area is situated primarily within the Peel Plain physiographic region, with a small section in the northwest corner located within the South Slope physiographic region (Chapman and Putnam, 1984). The Peel Plain covers a large portion of Halton, Peel, and York Regions, and is characterized by the presence of a thin veneer of glaciolacustrine silt and clay, overlying clay till. Localized surficial deposits of glaciolacustrine sand are also present within this physiographic region. The topography of the Peel Plain is generally level to gently rolling, with a consistent downwards slope towards Lake Ontario.

The South Slope physiographic region (Chapman and Putnam, 1984), which forms a horseshoe shape around the Peel Plain, is located immediately north and west of the project site boundary. The region is characterized by predominately clay till soils derived from former glacial lakes. In Halton Region, the South Slope begins on the south side of the Niagara Escarpment and slopes downwards towards the Peel Plain. The topography of the area is gently rolling with numerous drumlins oriented upslope.

2.2 Hydrogeology

2.2.1 Regional Aquifers and Aquitards

Hydrostratigraphic units can be subdivided into two distinct groups based on their ability to allow groundwater movement. An aquifer is classically defined as a layer of soil that is permeable enough to permit a usable supply of water to be extracted. An aquitard is a layer of soil that inhibits groundwater movement due to its low permeability. Shallow groundwater flow within the analysis area is influenced by three (3) key hydrostratigraphic units: glaciolacustrine silt and clay aquitard, the Halton Till aquitard, and localized interstadial sand aquifer(s).

A surficial ***glaciolacustrine silt and clay*** was identified in OGS surficial geology mapping as being present over the study area, and is comprised of silt and clay with minor sand and gravel, and interbedded silt and clay and gritty, pebbly flow till and rainout deposits. Generally, this unit has a low permeability, and therefore forms a thin surficial aquitard that inhibits horizontal groundwater flow and recharge.

The ***Halton Till*** is a clayey silt to silty clay textured till unit representing the final advance of ice at the end of the Wisconsinan glaciations. Locally the Halton Till can exceed 15 to 30 m in areas west of Brampton. It has a predominantly silty clay to silt matrix and contains isolated lenses of laminated sand, silt, and clay. Regionally the unit acts as a surficial aquitard, with hydraulic conductivities ranging from about 10^{-10} to 10^{-6} m/s (Interim Waste Authority, 1994). The low bulk permeability acts to inhibit local groundwater recharge and reducing the exposure of underlying aquifers to contamination (Sharp et al., 1996). Groundwater flow within till soils is typically downwards towards more permeable, confined aquifer units. The water table is expected to be fairly shallow in the clay rich till soils, and perched water table conditions may form because of the poorly drained nature of the soil.

In this area of Milton, ***interstadial sand*** aquifer deposits are occasionally present within the Halton Till. These coarse-grained sediments (deposited between periods of glacial till deposition) of silt, sand and gravel generally extend in finger-like protrusions southwards towards Lake Ontario. Where the overlying Halton Till is thin, gravel pits have been established to extract aggregate from this unit. These deposits have the capacity to act as small confined aquifers and may provide localized groundwater discharge to natural features.

2.2.2 Private Water Wells

Based on a review of the MECP water well record database, approximately 95 water wells are situated within 500 m of the project boundary. Of these wells, approximately 55 wells are used for domestic water supply, and 10 are used for commercial water supply. The remaining 30 wells are classified as abandoned or are used as an observational or test well. The domestic supply wells range in depth from 6.10 m to 33.22 m, and are generally screened in the shale bedrock, or sand and gravel interstadial aquifer units. A summary of the MECP water well records, including depth, water level, water use, and screened lithology is provided in **Table 1**.

Table 1. MECP Water Well Records with 500 m of Study Area

Well ID	Elevation (m)	Depth (m)	Water Level (m)	Water use	Water status	Screened Lithology
2800805	213.36	26.21	7.32	Domestic	Water Supply	Shale
2800809	220.98	29.26	5.79	Domestic	Water Supply	Gravel
2800810	213.36	9.14	2.13	Not Used	Abandoned-Quality	Clay Gravel
2800879	213.36	13.72	4.57	Domestic	Water Supply	Shale
2800880	213.36	24.99	7.01	Domestic	Water Supply	Shale
2800881	220.98	22.86	10.67	Domestic	Water Supply	Shale
2800882	220.98	17.68	0.91	Domestic	Water Supply	Shale
2800884	220.98	22.56	6.71	Domestic	Water Supply	Shale
2800885	220.98	21.95	10.67	Domestic	Water Supply	Shale
2800886	220.98	13.72	10.67	Domestic	Water Supply	Gravel
2800887	220.98	30.48	7.62	Domestic	Water Supply	Shale
2800888	220.98	18.90	8.84	Domestic	Water Supply	Shale
2800889	220.98	31.39	6.40	Domestic	Water Supply	Sand
2800890	220.98	21.03	8.84	Domestic	Water Supply	Shale
2800891	213.36	12.50	7.62	Domestic	Water Supply	Shale
2800950	213.36	25.60	7.62	Domestic	Water Supply	Shale
2800951	205.74	20.12	3.66	Domestic	Water Supply	Clay Gravel
2800952	205.74	20.42	9.14	Domestic	Water Supply	Gravel
2800953	213.36	12.80	7.62	Domestic	Water Supply	Gravel
2800954	205.74	12.19	3.05	Domestic	Water Supply	Sand
2802746	219.46	29.57	10.67	Domestic	Water Supply	Sand Gravel
2802967	213.36	13.72	4.57	Domestic	Water Supply	Sand
2802971	213.36	10.97	3.05	Domestic	Water Supply	Shale
2803159	219.46	14.33	1.22	Industrial	Water Supply	Clay Gravel
2803247	220.98	10.67	6.40	Not Used	Unfinished	Sand Silt Clay
2803272	220.98	26.52	7.62	Domestic	Water Supply	Shale
2803287	213.36	15.54	2.44	Domestic	Water Supply	Shale
2803359	225.55	9.14	0.00	Commercial	Water Supply	Clay Silt
2803464	221.59	12.19	N/A	Domestic	Water Supply	Sand Gravel
2803894	213.36	13.11	6.10	Domestic	Water Supply	Shale
2803948	219.46	33.22	5.79	Domestic	Water Supply	Shale
2803975	213.36	17.07	5.49	Domestic	Water Supply	Shale Gravel
2804016	213.36	6.10	3.66	Domestic	Water Supply	Shale
2804065	213.36	7.32	4.88	Domestic	Water Supply	Shale

Well ID	Elevation (m)	Depth (m)	Water Level (m)	Water use	Water status	Screened Lithology
2804066	213.36	6.10	N/A	Domestic	Water Supply	Shale
2804067	213.36	6.71	3.66	Domestic	Water Supply	Shale
2804212	217.93	31.70	3.35	Domestic	Water Supply	Clay Gravel Shale
2804213	221.89	29.87	5.49	Domestic	Water Supply	Shale
2804224	205.74	25.60	7.32	Domestic	Water Supply	Gravel Sand Clay
2804275	219.46	12.19	1.52	Domestic	Water Supply	Gravel
2804360	220.98	19.81	7.92	Domestic	Water Supply	Shale
2804495	213.36	11.58	4.88	Domestic	Water Supply	Sand Clay
2804501	215.80	26.82	2.44	Domestic	Water Supply	Shale
2805033	228.60	18.90	3.96	Irrigation	Test Hole	Clay Sand Gravel
2805204	211.84	23.77	8.53	Domestic	Water Supply	Gravel
2805694	204.22	25.30	8.23	Domestic	Water Supply	Sand Gravel Unknown material
2805781	214.88	20.12	4.57	Domestic	Abandoned-Quality	Shale Unknown material
2805819	214.88	14.63	4.57	Domestic	Water Supply	Clay Gravel
2805849	216.41	19.81	10.67	Domestic	Water Supply	Shale
2805850	213.36	11.28	2.44	Domestic	Water Supply	Sand Clay
2805869	214.88	19.81	3.35	Domestic	Water Supply	Shale
2806039	N/A	24.99	9.14	Domestic	Water Supply	Shale Bedrock
2806040	N/A	11.28	6.10	Domestic	Water Supply	Sand Gravel
2806204	221.00	30.48	6.10	Commercial	Water Supply	Shale Unknown material
2806281	218.00	14.02	4.88	Domestic	Water Supply	Clay Gravel Unknown material
2806522	N/A	24.08	6.71	Domestic	Water Supply	Shale Bedrock
2806669	217.00	24.38	8.53	Domestic	Water Supply	Shale
2807167	222.00	28.96	5.18	Domestic	Water Supply	Shale Bedrock
2807856	223.00	22.25	6.40	Domestic	Water Supply	Shale Unknown material Limestone
2807922	N/A	26.21	18.29	N/A	Abandoned-Supply	Shale
2808275	221.00	N/A	N/A	N/A	N/A	N/A
2808767	209.00	16.46	4.57	Domestic	Water Supply	Shale
2809090	N/A	23.16	3.05	Industrial	Water Supply	Gravel Sand
2809188	N/A	7.32	1.83	Domestic	Water Supply	Shale Gravel
2809368	N/A	23.47	0.61	Domestic	Water Supply	Sand Gravel
2809404	N/A	N/A	N/A	N/A	Abandoned-Supply	N/A
2809405	N/A	71.93	6.40	Not Used	Observation Wells	Shale
2809406	N/A	39.32	7.62	Not Used	Observation Wells	Shale
2809541	N/A	10.36	5.18	Commercial	Water Supply	Silt
2809555	N/A	21.34	3.05	Not Used	Test Hole	Shale
2809556	N/A	16.15	1.22	Industrial	Test Hole	Shale

Well ID	Elevation (m)	Depth (m)	Water Level (m)	Water use	Water status	Screened Lithology
2809557	N/A	27.74	6.71	Not Used	Test Hole	Shale Unknown material
2809558	N/A	10.36	N/A	Not Used	Observation Wells	Gravel Sand
2809559	N/A	8.53	N/A	N/A	Observation Wells	Sand Silt
2809560	N/A	18.90	1.22	Industrial	Test Hole	Shale
2809561	N/A	26.21	3.66	Industrial	Test Hole	Shale
2809562	N/A	18.90	1.52	Industrial	Test Hole	Shale
2809563	N/A	28.96	10.36	Not Used	Test Hole	Unknown material
2809698	N/A	18.59	0.91	Industrial	Water Supply	Shale Unknown material
2809871	N/A	19.81	3.35	Commercial	Water Supply	Shale
2809872	N/A	20.12	8.53	Commercial	Water Supply	Shale
2809873	N/A	21.03	9.14	Commercial	Water Supply	Shale
2809881	N/A	N/A	N/A	Domestic	Abandoned-Other	N/A
2810088	N/A	6.71	5.18	N/A	Abandoned-Other	N/A
2810173	N/A	3.60	N/A	N/A	Observation Wells	Clay Silt
2810197	N/A	3.66	N/A	N/A	Observation Wells	Silt Sand Gravel
2810499	N/A	35.00	3.08	N/A	Water Supply	Shale Limestone Unknown material
2810545	N/A	6.10	N/A	N/A	Observation Wells	Silt Clay
7040993	N/A	14.81	2.43	Not Used	Abandoned-Other	N/A
7049696	N/A	3.70	N/A	Not Used	Test Hole	N/A
7110514	N/A	N/A	N/A	N/A	Abandoned-Other	N/A
7114647	N/A	1.46	N/A	Not Used	Abandoned-Other	N/A
7114648	N/A	2.44	N/A	Not Used	Abandoned-Other	N/A
7117505	N/A	5.50	N/A	Monitoring	Other Status	Silt Sand Unknown material
7123280	N/A	5.50	N/A	Monitoring	Other Status	Sand Gravel Unknown material

2.3 Drainage

The study area is located in the Middle Sixteen Mile Creek Subwatershed, which is part of the Sixteen Mile Creek Watershed. Sixteen Mile Creek Watershed is one of the three main watersheds under the jurisdiction of Conservation Halton (CH). This watershed covers an area of approximately 357 square kilometers (km) within the towns of Halton Hills, Milton, Oakville, and Mississauga. The headwaters of

Sixteen Mile Creek originate at the Niagara Escarpment and flows southwards to ultimately discharge to Lake Ontario at Oakville, ON.

Middle Sixteen Mile Creek Subwatershed has a catchment area of approximately 55.4 km^2 within Sixteen Mile Creek Watershed. The main branch of Middle Sixteen Mile Creek, which bisects the northeast corner of site boundary (not proposed for development), extends over 18 km from the headwaters on the Niagara Escarpment to the confluence with the Main Eastern Tributary.

The existing drainage areas of each watercourse within the site boundary (MSMC-Trib-01, MSMC-Trib-02, and SMC-Trib-01) were delineated by Savanta (2020) and are provided in **Appendix A3**. Reach delineation for each tributary was determined through a Headwater Drainage Feature (HDF) assessment completed by Savanta as part of the EIS.

Generally, MSMC-Trib-01 has the largest catchment area at 140.12 ha, and drainage is directed across agricultural land as an open channel watercourse to its confluence with Middle Sixteen Mile Creek. This tributary has headwaters near the intersection of No. 5 Sideroad and Boston Church Road and generally flows in an easterly direction, crossing the woodlot/wetlands north of the site and agricultural land before turning to flow adjacent to James Snow Parkway.

Approximately 1 km of MSCM-Trib-01 is proposed to be realigned as part of the concept plan for the development (provided in **Appendix A2**). The segment to be realigned, known as “MSCM-Trib-01 (downstream)” extends from where the drainage channel enters the agricultural lands within the site boundary from the woodlot to the outflow culvert at Esquesing Line. Based on the Concept Plan, this segment will be realigned to border the identified buffer limits for the woodlot, wetlands and protected countryside. The Palmer hydrogeological investigation has focused a series of boreholes and monitoring wells along the present and proposed channel alignments to characterize the hydrogeological conditions to make recommendations for deign of the realigned channel. An upstream portion of the same tributary is also proposed to be relocated as a conveyance swale adjacent to Boston Church Road. This segment is referred to as “MSCM-Trib-01 (upstream)”, and has been identified as a HDF that can be managed through mitigation.

MSCM-Trib-02 has a catchment area of 60.81 ha, and drainage is directed to a stormwater pond within an industrial area located approximately 800 m south, and ultimately discharges to Middle Sixteen Mile Creek. This tributary has headwaters within the woodlot near Boston Church Road, approximately 650 m south of No. 5 Sideroad, and collects drainage through the central portion of the site. Ultimately this feature converges with Middle Sixteen Mile Creek. Within the site, this feature has historically been realigned and straightened for agricultural purposes.

SMC-Trib-01 has the smallest catchment area at 43.58 ha and drains across James Snow Parkway through a series of culverts. This tributary has headwaters northeast of the intersection of the intersection of No. 5 Sideroad and the Canadian National Railway (CNR). The feature drains the west portion of the site, and discharges towards Milton’s urban stormwater management system ultimately leading to Sixteen Mile Creek. Within the site, this feature is poorly defined, and has been altered for agricultural and/or other purposes (i.e. edge of the watercourse has been realigned to follow edge of horse track).

MSCM-Trib-02 and SMC-Trib-01 were assessed through an HDFs. Mitigation for the removal of MSCM-Trib-02 is proposed to be provided through the conveyance swale connecting the woodlot to MSMC-Trib-01, and SMC-Trib-02 is proposed to be relocated to border the west boundary of the site

3 Local Existing Conditions

3.1 Site Geology and Hydrogeology

Site specific surficial geological conditions were determined through a borehole drilling program completed by Palmer staff. Twelve boreholes (MW1 – MW12) were drilled during two separate events, one from July 14 - 15, 2015, and the second from March 27 – 28, 2018. The boreholes in 2015 were drilled by Pontil Drilling, and in 2018 were drilled by Drilltech Drilling Ltd., under the supervision of Palmer staff. Borehole depths ranged from 5.1 metres below ground surface (mbgs) to 12.2 mbgs. Drilling methodologies using a combination of hollow stem and solid stem auger methods, and soil samples were collected using a 0.61 m long split spoon. The location of each borehole is presented on **Figure 1**. Borehole logs are presented in **Appendix B**.

Following drilling, each borehole was completed as a monitoring well in accordance with Ontario Regulation 903. The monitoring wells were constructed with of 51 mm (2 inch) diameter schedule 40 polyvinyl chloride (PVC) pipe, with either a 1.5 m (5 foot) or 3 m (10 ft) long screened interval. Each monitoring well was sealed using a J-plug and completed using stick up casing. Details of the monitoring well installations are provided on **Table 2**.

Table 2. Borehole and Monitoring Well Installation Details

Borehole ID	Ground Elevation (masl)[1]	Year of Installation	Stick Up (m)	Total Depth (mbgs)	Screened Depth (mbgs)	Screened Geology
MW1	217.0	2015	0.83	9.8	7.6 – 9.1	Silty Sand
MW2	212.9	2015	0.97	6.8	3.1 – 6.1	Silty Sand Till
MW3	216.1	2015	0.89	6.8	3.1 – 6.1	Silty Sand Till
MW4	217.4	2015	0.97	5.1	1.5 – 4.5	Silt to Silty Sand
MW5	219.5	2015	1.00	6.7	2.1 – 5.1	Clayey Silt Till
MW6	220.1	2015	0.88	6.7	3.1 – 6.1	Clayey Silt Till
MW7	214.8	2018	0.63	12.2	4.9 – 6.4	Silt
MW8	217.8	2018	0.89	8.2	6.4 – 7.9	Sand
MW10	216.3	2018	0.70	6.7	3.1 – 6.1	Clayey Silt
MW11	220.8	2018	0.72	8.2	5.8 – 7.3	Silty Clay Till
MW12	219.8	2018	0.66	7.3	5.8 – 7.3	Silt to Silty Sand

[1] *Ground elevation values approximated from topographical survey (TMIG, 2014)*

The results of the borehole drilling investigations were generally consistent with the regional OGS surficial geology mapping (**Figure 2**). The stratigraphy of the site as encountered during borehole drilling is described below:

Glaciolacustrine silt and clay: Dark brown / Grey silt and clay deposits with some sand and trace gravel were encountered at surface in boreholes 4, 7, 9, 10, 11 and 12. This unit varied in thickness between 0.2 and 1.4 m. Generally, this unit was moist and loose to compact.

Silty Sand to Silty Clay Till (Halton Till): Red-brown silty clay to sandy silt till was encountered in all boreholes. This unit contained trace to some sand, occasional fine sand lenses, and trace gravel. This unit varied in thickness between 1.2 – 10.6 m. This unit was often broken up by interstadial sand deposits discussed below. This unit was dry to wet, and loose to very dense.

Interstadial Sand/Silt: Brown to grey deposits of sand and silt were encountered in all boreholes. This unit varied in lithology between fine to medium grain sand with trace gravel, to silt with trace to some sand. This unit was often found below the till units, or breaking up till units. This unit ranged in thickness from 0.5 – 5.1 m. This unit was dry to wet, and loose to very dense.

Two hydrostratigraphic cross sections were created based on borehole drilling investigation results. Cross section locations are from A-A' and B-B', as shown on **Figure 2**, and are provided on **Figure 3** and **Figure 4**.

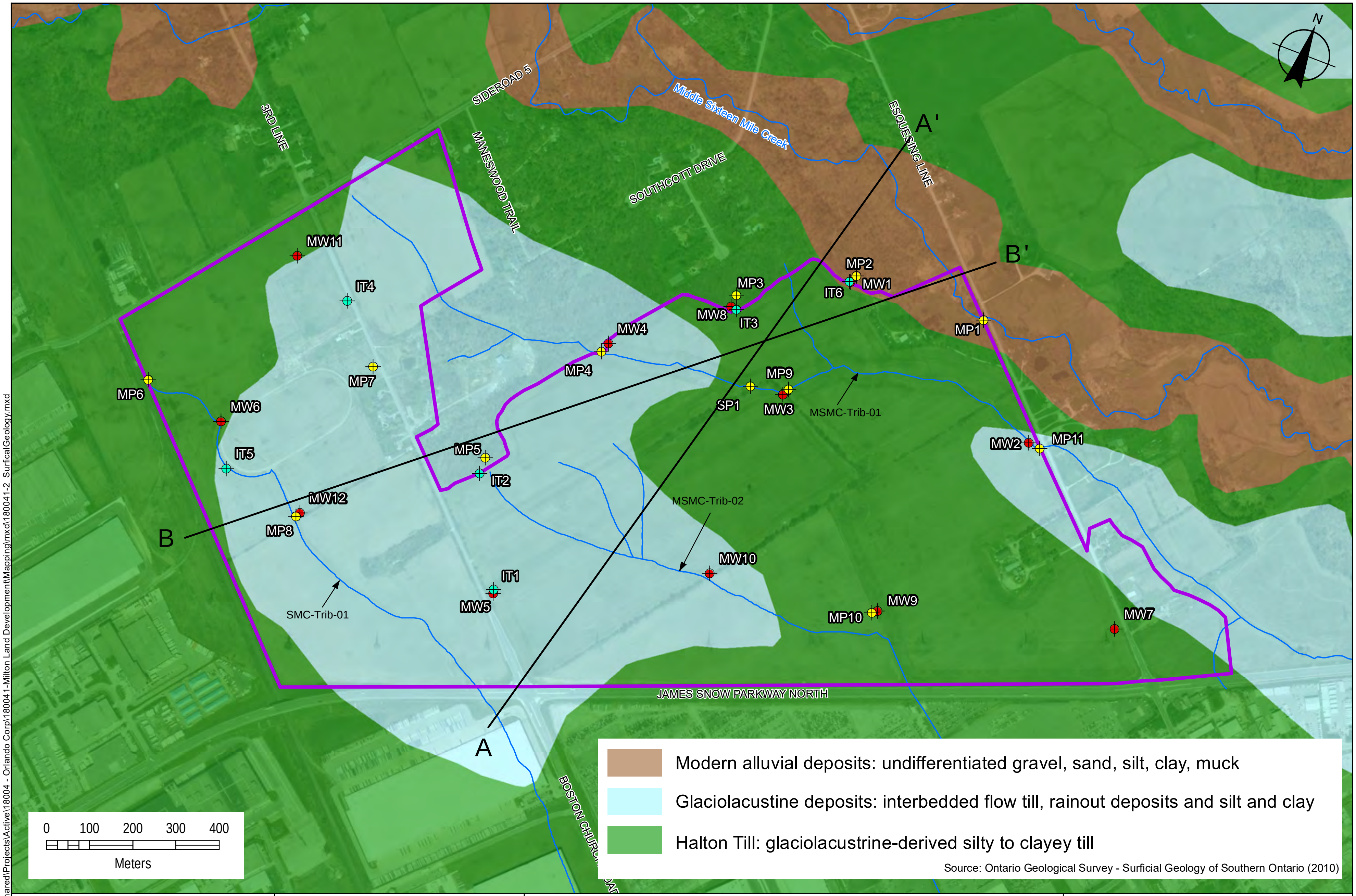
3.2 Groundwater and Surface Water Monitoring

Groundwater and surface water monitoring was designed to characterize groundwater level and groundwater/ surface water interactions at the site. The existing drainage features and wetlands within the site were specifically instrumented to assess the hydrogeological flow regimes and to provide hydrogeological input into the proposed channel realignment. Manual monitoring of groundwater and surface water levels was completed in approximate monthly intervals from June 2015 to May 2016, and quarterly from November 2017 to June 2020. A water level tape was used to measure the depth to the water table to the nearest centimeter. Select monitoring wells (MW1, MW2, MW3, MW4, and MW10) were instrumented with dataloggers to obtained continuous hourly water level data in the vicinity of the proposed channel realignment and future stormwater mitigation measures. A summary of the water level monitoring results is provided in the following sections.

3.2.1 Groundwater Level and Flow

Based on the results of manual groundwater monitoring and logger data, groundwater levels measured across the site range from 7.00 meters below ground surface (mbgs) at MW1 (January 22, 2018) to 0.05 mbgs at MW5 (March 26, 2016). A summary of the manual water levels at each monitoring well is provided in **Table 3**, and the logger and manual water level data are plotted on **Figure 5**. Groundwater levels measured in April and May of 2017 and 2018 are representative of seasonal highs due to the spring freshet. It is important to note however that groundwater levels fluctuate seasonally in response to precipitation and can vary with the total annual precipitation volumes.

The seasonal high groundwater level elevations collected in May 2018 were utilized to construct a groundwater equipotential map and determine the direction of groundwater flow (**Figure 6**). At this time, groundwater elevations ranged from 210.44 meters above sea level (masl) at MW1 to 219.72 masl at MW6 (**Table 3**).



Document Path: C:\Egnyte\Shared\Projects\Active\18004 - Orlando Corp\180041-Milton Land Development\Mapping\mxd\180041-2_SurficalGeology.mxd

CLIENT:
Orlando Corp

PREPARED BY:
Palmer™

PROJECT:
Milton Land Development

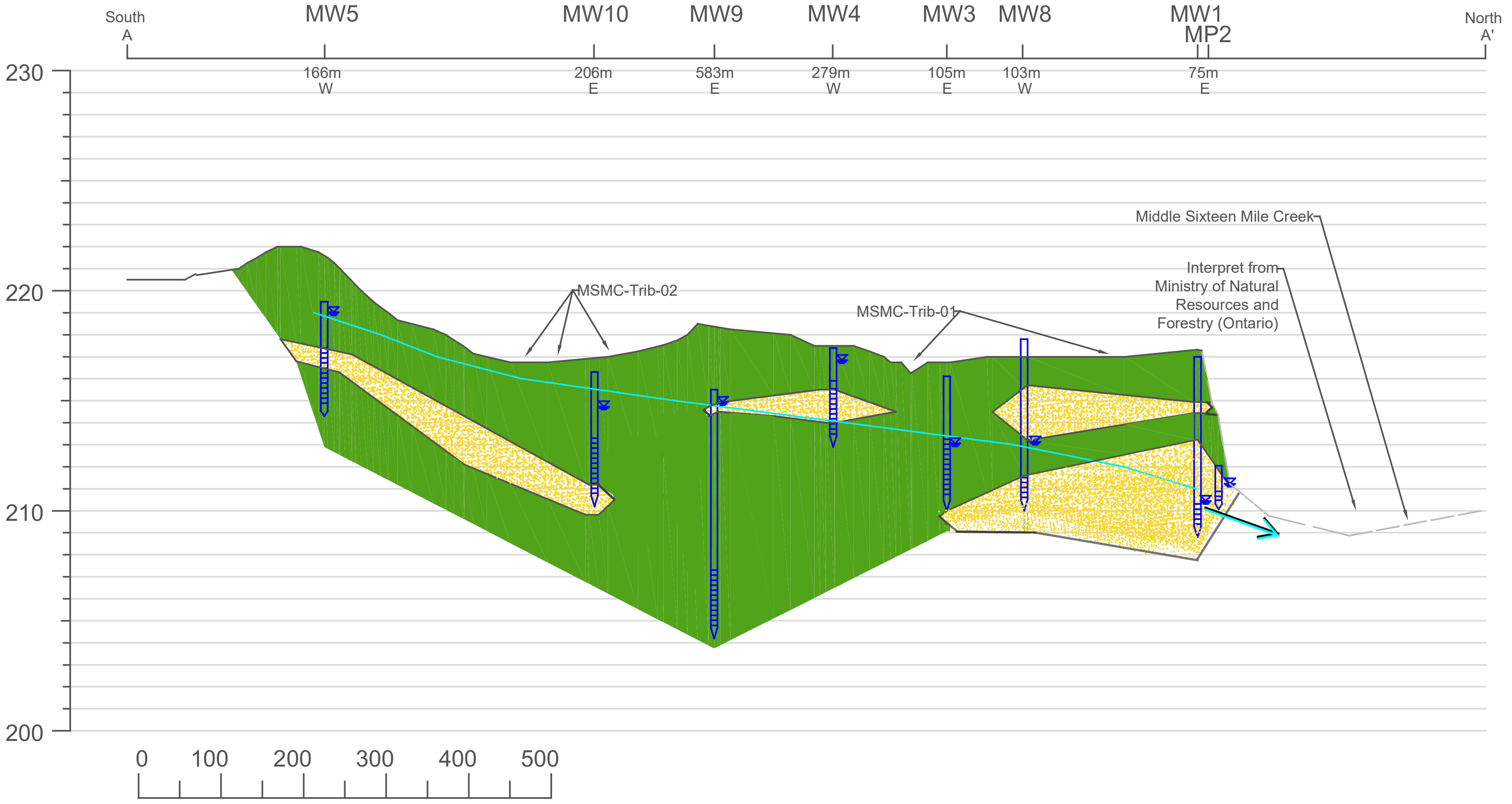
PROJECT NO.	180041	REVISION:	0
DATE:	Jan 14, 2019	SCALE:	1:12000
DRAWN:	BE	DATUM:	NAD 1983
CHECKED:	CH	PROJECTION:	UTM zone 17

LEGEND:
- ✛ Infiltration Test
- ✛ Mini Piezometer
- ✛ Monitoring Well
- ～ Watercourse
- ▭ Subject Site

Surficial Geology

Figure 2

Imagery (2018 - DigitalGlobe) provided by Esri basemap service



Legend

🟩 Halton Till

▨ Interstadial Sand and Silt

▽ Water Level

— Piezometric Head

→ Groundwater Flow

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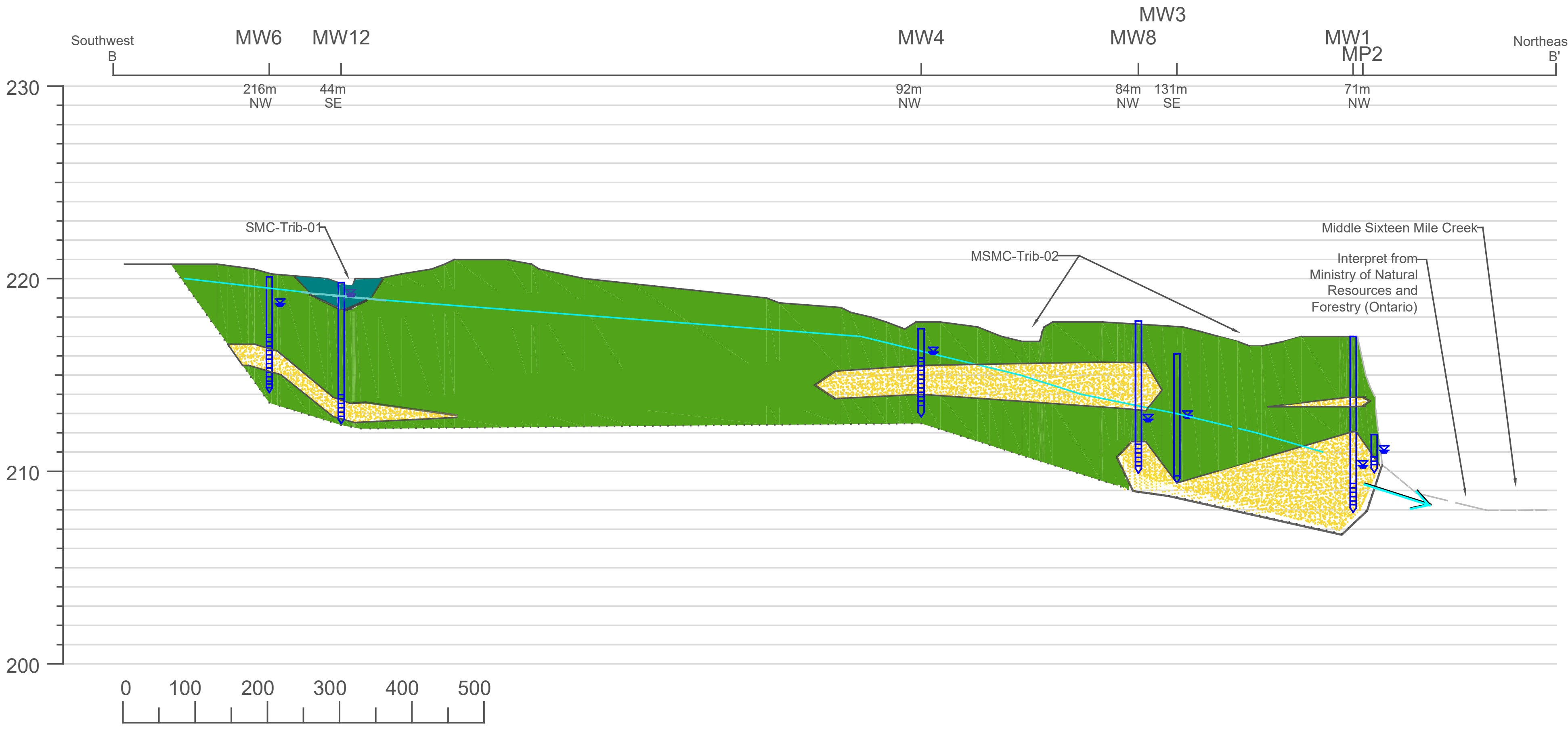
CLIENT:
Orlando Corporation
6205 Airport Road
Mississauga, Ontario
L4V 1E3

FIGURE: Figure 3

TITLE:
Milton, Ontario
Cross-Section A-A'

SCALE AT 11 X 8: See inset	**DATE:** June 2020	**DRAWN:** AL	**CHECKED:** JC
PROJECT NO: 180041	**SITE:** Milton, ON		**REVISION:** A



Legend

🟩 Halton Till

🟨 Interstadial Sand and Silt

🟦 Fine-Textured Glaciolacustrine Deposits

▽ Water Level

— Piezometric Head

→ Groundwater Flow

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CLIENT:
Orlando Corporation
6205 Airport Road
Mississauga, Ontario
L4V 1E3

FIGURE: Figure 4

TITLE:
Milton, Ontario
Cross-Section A-A'

SCALE AT 11 X 8: See inset	**DATE:** June 2020	**DRAWN:** AL	**CHECKED:** JC
PROJECT NO: 180041	**SITE:** Milton, ON		**REVISION:** A

These groundwater level measurements and flow map confirm that groundwater flow is strongly influenced by the presence of Middle Sixteen Mile Creek, and the dominant groundwater flow direction is to the north/ northeast towards the river valley and associated wetland features near MP2 (**Figure 6**). The water table ranges by approximately 8.7 m from the southwest side of the site to the northeast side, with an overall horizontal gradient of 0.0058 m/m.

The monitoring results confirm that the dominant groundwater flow direction does not match the surface water catchment areas for the intermittent and ephemeral tributaries or the wetland features (**Figure 6**). This result suggests that these features are primarily supported by surface water run-off and not by groundwater discharge.

Groundwater levels along the alignment of MSCM-Trib-01 was monitored using MW4, MW3, and MW2. Based on the monitoring results, groundwater levels below the tributary range from 3.99 mbgs at MW3 (December 2017) to 0.12 mbgs at MW2 (June 2020), or between an elevation of 211.57 masl at MW2 (December 2017) and 217.24 masl at MW4 (June 2020). High groundwater elevations measured at MW4 in the spring indicate that this feature receives seasonal groundwater discharge originating from the shallow lens of interstadial silt and sand identified at this borehole.

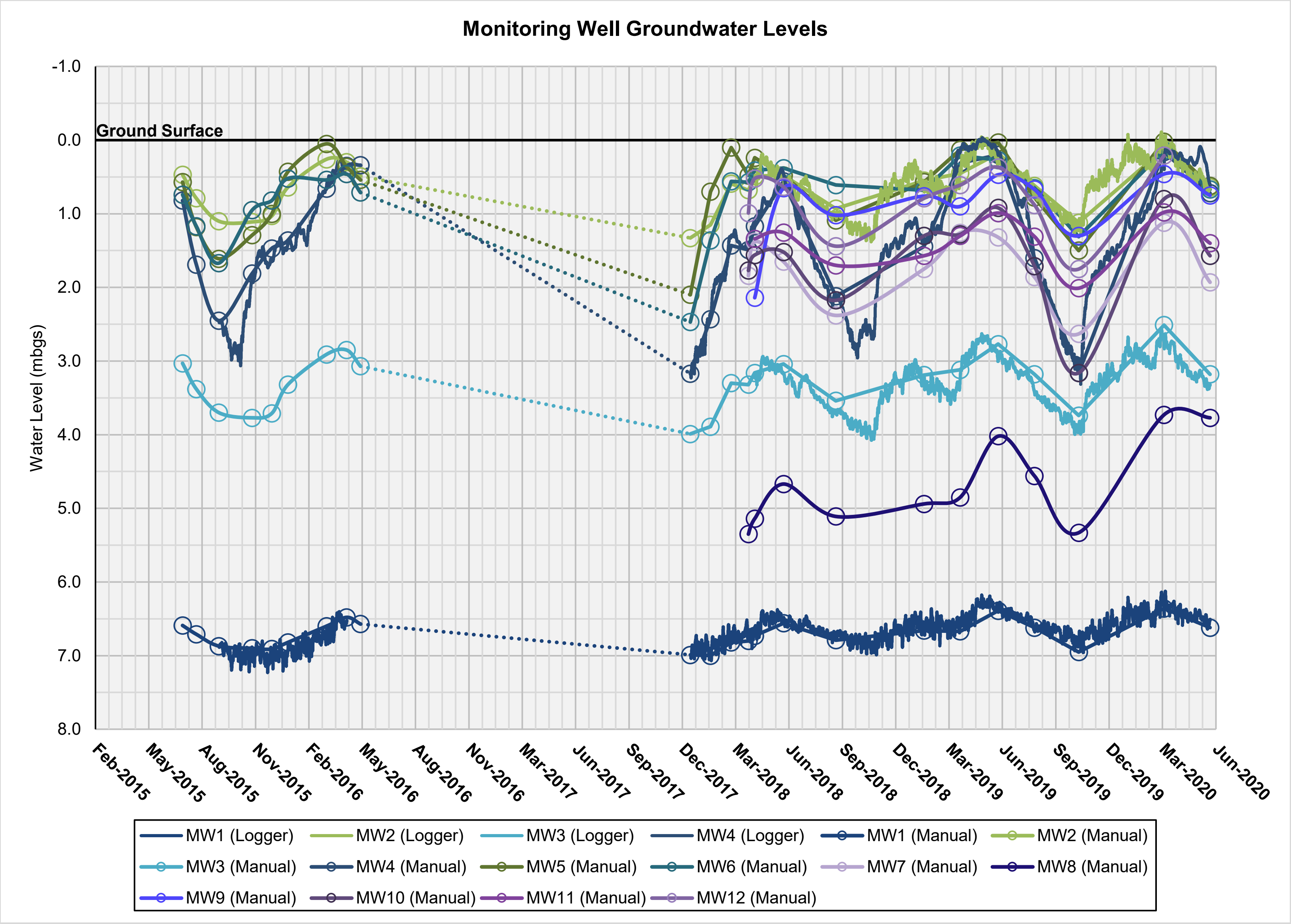
Table 3. Groundwater Level Monitoring Data

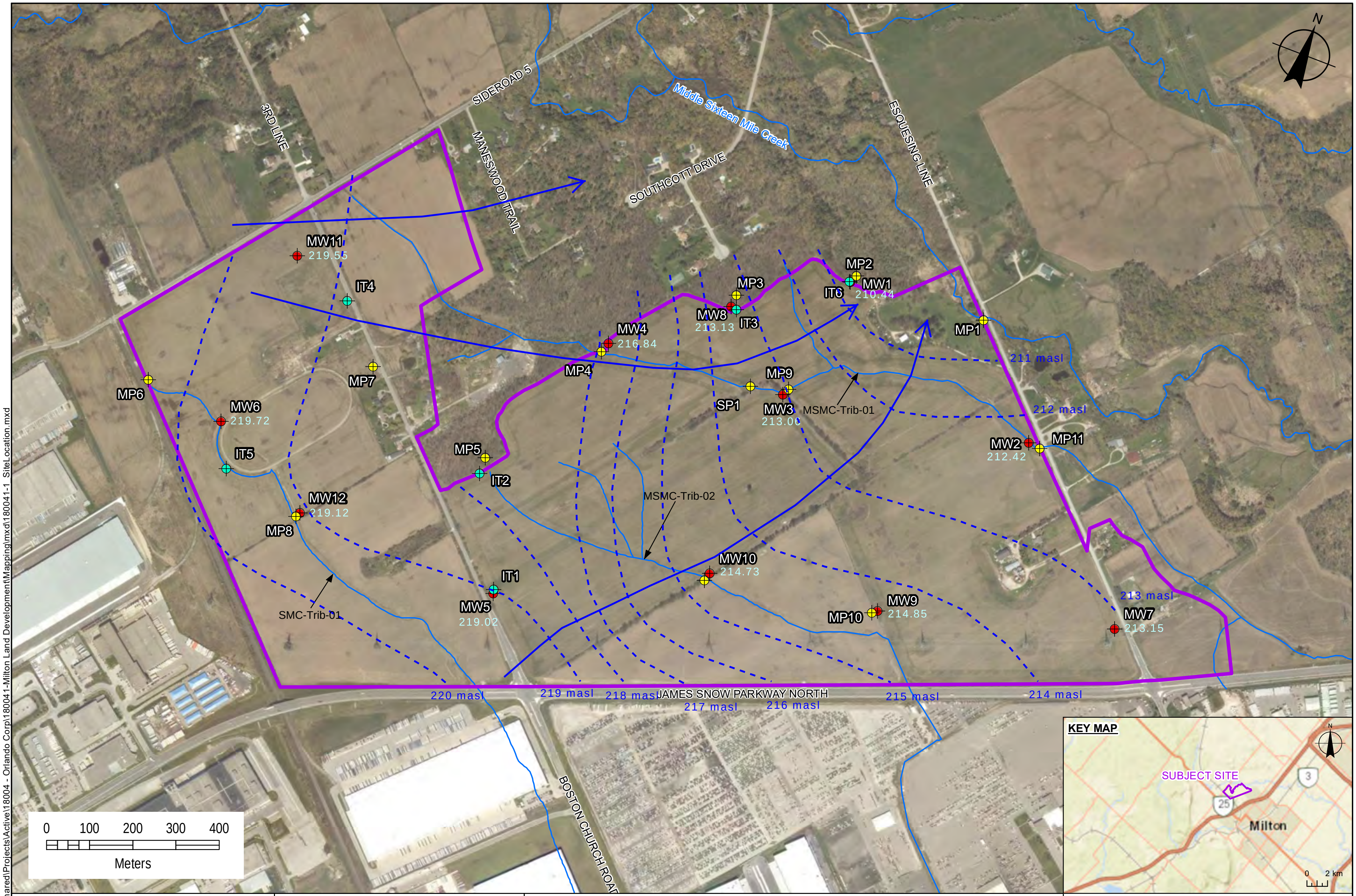
Monitoring Well ID	Groundwater Level																							
	Ground Elevation[1] (masl)	Units	20-Jul-2015	13-Aug-2015	21-Sep-2015	18-Nov-2015	22-Dec-2015	19-Jan-2016	26-Mar-2016	30-Apr-2016	24-May-2016	18-Dec-2017	22-Jan-2018	27-Feb-2018	29-Mar-2018	9-Apr-2018	29-May-2018	28-Aug-2018	28-Jan-2019	01-Apr-2019	06-Jun-2019	08-Aug-2019	24-Oct-2019	20-Mar-2020	08-Jun-2020
MW1	217.0	mbgs	6.59	6.71	6.87	6.9	6.91	6.82	6.6	6.48	6.57	6.99	7.00	6.82	6.8	6.73	6.56	6.79	6.66	6.67	6.39	6.62	5.95	6.36	6.62
		masl	210.41	210.29	210.13	210.1	210.09	210.18	210.4	210.52	210.43	210.01	210	210.18	210.2	210.27	210.44	210.21	210.34	210.33	210.61	210.38	211.05	210.64	210.38
MW2	212.9	mbgs	0.47	0.79	1.10	1.11	1.03	0.64	0.26	0.3	0.49	1.33	1.15	0.59	0.68	0.49	0.48	0.93	0.55	0.45	0.18	0.62	1.12	0.12	0.64
		masl	212.43	212.11	211.8	211.79	211.87	212.26	212.64	212.6	212.41	211.57	211.75	212.31	212.22	212.41	212.42	211.97	212.35	212.45	212.72	212.28	211.78	212.78	212.26
MW3	216.1	mbgs	3.03	3.38	3.70	3.77	3.71	3.32	2.91	2.85	3.07	3.99	3.89	3.3	3.32	3.16	3.04	3.54	3.19	3.12	2.77	3.18	3.74	2.51	3.18
		masl	213.07	212.72	212.4	212.33	212.39	212.78	213.19	213.25	213.03	212.11	212.21	212.8	212.78	212.94	213.06	212.56	212.91	212.98	213.33	212.92	212.36	213.59	212.92
MW4	217.4	mbgs	0.82	1.69	2.45	1.81	1.47	1.36	0.66	0.35	0.34	3.17	2.43	1.43	1.49	1.17	0.56	2.12	1.45	0.31	0.2	1.6	3.16	0.16	0.72
		masl	216.58	215.71	214.95	215.59	215.93	216.04	216.74	217.05	217.06	214.23	214.97	215.97	215.91	216.23	216.84	215.28	215.96	217.09	217.2	215.8	214.24	217.24	216.68
MW5	219.5	mbgs	0.57	1.18	1.61	1.29	1.00	0.43	0.05	0.36	0.54	2.1	0.7	0.1	0.48	0.24	0.48	1.09	0.57	0.13	0.03	0.78	1.5	0.02	0.62
		masl	218.93	218.32	217.89	218.21	218.5	219.07	219.45	219.14	218.96	217.4	218.8	219.4	219.02	219.26	219.02	218.41	218.93	219.37	219.47	218.72	218	219.48	218.88
MW6	220.1	mbgs	0.74	1.17	1.67	0.95	0.82	0.52	0.54	0.46	0.71	2.47	1.36	0.56	0.57	0.41	0.38	0.61	0.68	0.21	0.27	0.65	1.31	0.14	0.67
		masl	219.36	218.93	218.43	219.15	219.28	219.58	219.56	219.64	219.39	217.63	218.74	219.54	219.53	219.69	219.72	219.49	219.42	219.89	219.83	219.45	218.79	219.96	219.43
MW7	214.8	mbgs	*Monitoring Well installed March 2018*												1.84	1.38	1.65	2.38	1.75	1.26	1.32	1.86	2.63	1.12	1.93
		masl													212.96	213.42	213.15	212.42	213.05	213.54	213.48	212.94	212.17	213.68	212.87
MW8	217.8	mbgs	*Monitoring Well installed March 2018*												5.35	5.14	4.67	5.11	4.94	4.85	4.02	4.56	5.33	3.73	3.77
		masl													212.45	212.66	213.13	212.69	212.86	212.95	213.78	213.24	212.47	214.07	214.03
MW9	215.5	mbgs	*Monitoring Well installed March 2018*												8.82[2]	2.14	0.65	1.02	0.76	0.9	0.47	0.67	1.3	0.46	0.75
		masl													206.68[2]	213.36	214.85	214.48	214.74	214.6	215.03	214.83	214.2	215.04	214.75
MW10	216.3	mbgs	*Monitoring Well installed March 2018*												1.77	1.56	1.52	2.175	1.30	1.28	0.92	1.71	3.16	0.8	1.57
		masl													214.48	214.69	214.73	214.075	214.95	214.97	215.33	214.54	213.09	215.45	214.68
MW11	220.8	mbgs	*Monitoring Well installed March 2018*												4.55[2]	1.34	1.255	1.7	1.57	1.3	0.99	1.31	2.01	0.98	1.4
		masl													216.25[2]	219.46	219.55	219.1	219.23	219.5	219.81	219.49	218.79	219.82	219.4
MW12	219.8	mbgs	*Monitoring Well installed March 2018*												0.99	0.52	0.635	1.44	0.79	0.61	0.37	0.88	1.75	0.21	-
		masl													218.76	219.23	219.12	218.31	218.96	219.14	219.38	218.87	218	219.54	-

[1] *Ground elevation estimated base on topographical survey provided by TMIG (2014)*

[2] *Groundwater levels not representative of static conditions*

Figure 5. Groundwater Monitoring





CLIENT:

Orlando Corp

PREPARED BY:

Palmer™

PROJECT:

Milton Land Development

PROJECT NO.	180041	REVISION:	0
DATE:	Dec 10, 2018	SCALE:	1:12000
DRAWN:	BE	DATUM:	NAD 1983
CHECKED:	CH	PROJECTION:	UTM zone 17

LEGEND:

- ⊕ Infiltration Test
- ⊕ Mini Piezometer
- ⊕ Monitoring Well
- ～ Watercourse
- ▢ Subject Site
- - - - Equipotential Line
- → Flow Direction

Groundwater Flow

Figure 6

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Imagery (2018 - DigitalGlobe) provided by Esri basemap service

through MW3 and MW2. Based on the equipotential contours shown in **Figure 6**, it is expected that the groundwater elevations below the proposed location for the realigned channel are in the same range.

3.2.2 Natural Features

The majority of the on-site drainage features and wetlands were instrumented with MPs in order to characterize groundwater or surface water contributions to each feature (**Figure 1**). Targeted wetlands were selected based on Ecological Land Classification (ELC) mapping of the site completed by Savanta, which is provided in **Appendix E**. Surface water and groundwater levels collected at each MP were used to assess the magnitude of groundwater recharge or discharge at each location, and results are summarized in **Table 4**. Plots of the water levels within these features are shown on **Figures 7 – 21**.

MP1 was installed within Middle Sixteen Mile Creek. Based on the monitoring results, the hydraulic gradient is generally positive (i.e., groundwater discharge), but seasonally can be negative (i.e., groundwater recharge) in the late fall and winter. This is a major watercourse that controls groundwater flow in the area (as shown on **Figure 6**), and surface water was present within the feature throughout the monitoring period. This MP was destroyed during bridge rehabilitation construction in August 2018.

MP2s, MP2d, and MP2(new) are installed within a mixed swamp wetland feature in the northeast corner of the site within the Middle Sixteen Mile Creek valley. MP2s displayed a neutral to slightly negative hydraulic gradient throughout the monitoring period, whereas the gradients at MP2d and MP2(new) were neutral to positive. The measurements made at MP2d and MP2(new) are likely more representative of the hydraulic characteristics of the marsh wetland community as they are screened below the layer of organic material that was encountered to 0.9 mbgs (based on the results of shallow hand auger excavations in June 2015). This suggests that groundwater discharge is occurring at this location, which is consistent with the presence of thick organic material (which requires anaerobic conditions to form and groundwater naturally has low concentrations of dissolved oxygen), the presence of surface water in all months except May 2016, December 2017, and January 2018, and the direction of groundwater flow towards this location (**Figure 6**). This is also demonstrated within the hydrostratigraphic cross section through the wetland (**Figures 3 and 4**), which shows the wetland intersects a lower interstadial silt and sand unit providing discharge to the feature.

MP3 is within a mineral deciduous swamp wetland community within a woodlot along the northern boundary of the site. Based on the surface water and groundwater monitoring, the hydraulic gradient was strongly negative, neutral, or dry at all monitoring events. This indicates that this feature is fed through precipitation and surface water runoff, which is consistent with a swamp community, the presence of low permeability Halton Till sediments, and direction of groundwater flow (**Figure 6**).

MP4, SP1, MP9, and MP11 are installed within the intermittent drainage feature (MSMC-Trib-01) within the site boundary. In general, the hydraulic gradients measured at each of these MPs were negative, indicative of groundwater recharge. However, positive gradients were measured in the MPs in May and April during the spring freshet, as well as following a small melt event in February 2018. This suggests the seasonal occurrence of groundwater discharge following significant precipitation or freshet events. This observation is further supported by the direction of groundwater flow (**Figure 6**),

Table 4. Mini-Piezometer Water Levels and Hydraulic Gradients

MP ID	Depth of Screen (m)	Measurement	Units	18-Jun-2015	20-Jul-2015	13-Aug-2015	21-Sep-2015	18-Nov-2015	22-Dec-2015	19-Jan-2016	26-Mar-2016	30-Apr-2016	24-May-2016	18-Dec-2017	22-Jan-2018	27-Feb-2018	29-Mar-2018	9-Apr-2018	29-May-2018	28-Aug-2018	28-Jan-2019	01-Apr-2019	06-Jun-2019	08-Aug-2019	24-Oct-2019	20-Mar-2020	08-Jun-2020
MP1	0.67	GW Level	mags	-0.69[1]	0.03	0.18	-0.03	0.1	0.17	0.45	0.32	0.17	0.22	0.12	0.17	0.71	0.09	0.25	0.12	*MP destroyed*							
		SW Level	mags	0.15	0.07	0.01	0	0.05	0.09	0.52	0.52	0.16	0.1	0.14	0.64	0.63	0.06	0.195	0.07								
		Hydraulic Gradient	-	***-1.25[1]***	***-0.06***	***0.25***	***-0.04***	***0.07***	***0.12***	***-0.10***	***-0.30***	***0.01***	***0.18***	***-0.03***	***-0.70***	***0.12***	***0.04***	***0.08***	***0.07***								
MP2s	0.64	GW Level	mags	0.08	0.23	0.24	0.26	0.25	0.23	0.26	-0.07	-0.19	0.2	0.11	0.09	-0.04	0.04	0	-0.19	0.12	0.11	dry	0.03	0.08	0.12	-0.07	-0.19
		SW Level	mags	0.225	0.25	0.24	0.26	0.25	0.22	0.25	0.21	0.2	dry	dry	dry	0.08	0	0.1	0.05	0.1	dry	0.03	0.03	0.05	0.22	0.16	0.14
		Hydraulic Gradient	-	***-0.23***	***-0.03***	***0.00***	***0.00***	***0.00***	***0.02***	***0.02***	***-0.44***	***-0.61***	-	-	-	***-0.19***	***0.06***	***-0.16***	***-0.38***	***0.03***	-	***-0.05***	***0.00***	***0.05***	***-0.16***	***-0.36***	***-0.52***
MP2d	1.76	GW Level	mags	-2.08[1]	0.17	0.16	0.15	0.12	-0.01	0.14	0.18	0.19	0.17	0.07	0.05	0.08	-0.12	-0.15	0.17	0.135	0.13	0.11	0.14	0.11	0.09	-0.12	-0.14
		SW Level	mags	0.045	0.06	0.06	0.08	0.06	0.07	0.09	0.05	0.04	dry	dry	dry	0	0.01	0.02	0.01	0.01	dry	0	0.01	0	0.01	0	0.02
		Hydraulic Gradient	-	***-1.21[1]***	***0.06***	***0.06***	***0.04***	***0.03***	***-0.05***	***0.03***	***0.07***	***0.09***	-	-	-	***0.05***	***-0.07***	***-0.10***	***0.09***	***0.07***	-	***0.07***	***0.09***	***0.07***	***0.06***	***-0.05***	***-0.02***
MP2 (new)	1.06	GW Level	mags	MP installed December 2017										dry	0.03	0.05	-0.04	-0.01	0.09	0.10	0.13	0.08	0.17	0.09	dry	-0.07	0.13
		SW Level	mags											dry	dry	0	0.02	0.03	0.02	0.02	dry	0	0.01	0.01	0	0	0.02
		Hydraulic Gradient	-											-	-	***0.05***	***-0.06***	***-0.04***	***0.07***	***0.08***	-	***0.09***	***0.16***	***0.07***	-	***-0.02***	***0.06***
MP3	0.86	GW Level	mags	-0.8	-0.57	-0.54	-0.52	dry	dry	-0.25	0.19	-0.07	-0.13	dry	-0.22	-0.25	-0.5	-0.23	-0.27	dry	-0.56	-0.24	0.13	-0.52	dry	dry	dry
		SW Level	mags	0.02	0.12	dry	dry	dry	dry	0.12	0.19	0.14	dry	dry	dry	0.13	0.15	0.14	dry	dry	dry	dry	0.15	dry	dry	dry	dry
		Hydraulic Gradient	-	***-0.95***	***-0.80***	-	-	-	-	***-0.43***	***0.00***	***-0.24***	-	-	-	***-0.44***	***-0.76***	***-0.43***	-	-	-	***-0.16***	***-0.02***	-	-	-	-
MP4	0.85	GW Level	mags	-1.21[1]	-0.35	-0.82	-1.16	-0.52	-0.27	-0.09	-0.17	0.16	0.39	-0.32	-0.12	0.14	-0.01	0.1	-0.07	dry	0.1	0.2	0.02	dry	dry	-0.06	-0.37
		SW Level	mags	0.065	0.03	dry	dry	0.01	0.05	0.22	0.18	dry	dry	dry	0.08	0.12	0.03	0.07	dry	dry	0.16	0.2	0.07	dry	dry	0.09	dry
		Hydraulic Gradient	-	***-1.50[1]***	***-0.45***	-	-	***-0.62***	***-0.38***	***-0.36***	***-0.41***	-	-	-	***-0.24***	***0.02***	***-0.05***	***0.04***	-	-	***-0.07***	***0.00***	***-0.06***	-	-	***-0.18***	-
MP4 (new)	0.88	GW Level	mags	MP installed December 2017										dry	-0.33	0.09	-0.02	0.07	-0.04	dry	0.07	0.08	0.02	dry	dry	0.01	-0.52
		SW Level	mags											0	0.08	0.15	0.03	0.05	dry	dry	0.22	0.19	0.07	dry	dry	dry	dry
		Hydraulic Gradient	-											-	***-0.47***	***-0.07***	***-0.06***	***0.02***	-	-	***-0.18***	***-0.13***	***-0.06***	-	-	-	-
MP5	0.91	GW Level	mags	-0.86[1]	-0.57	-1.09	-1.25	-1.21	-1.21	-1.01	0.14	0.22	0.03	-1.24	-0.89	0.02	0.03	0.085	-0.02	dry	-0.03	0.14	0.1	dry	dry	0.1	dry
		SW Level	mags	-0.02	0.02	dry	dry	dry	dry	0.02	0.09	0.07	dry	dry	dry	0.08	0.04	0.06	-0.08	dry	0.10	0.11	0.09	dry	dry	0.1	dry
		Hydraulic Gradient	-	***-0.92***	***-0.65***	-	-	-	-	***-1.13***	***0.05***	***0.16***	-	-	-	***-0.07***	***-0.01***	***0.03***	***0.07***	-	***-0.14***	***0.03***	***0.01***	-	-	***0***	-
MP6	0.85	GW Level	mags	MP installed August 2015		-0.6	-0.96	-0.57	-1.07	-0.16	-0.23	0.05	0.24	-0.37	-0.22	-0.05	-0.04	0.03	0.21	-0.16	-0.03	0.09	0.19	-0.01	-1.08	0	0.04
		SW Level	mags			dry	dry	-0.02	0.05	0.14	0.06	0.03	dry	dry	0.07	0.01	0.01	0.03	dry	dry	0.13	0.03	dry	dry	dry	0.03	dry
		Hydraulic Gradient	-			-	-	***-0.65***	***-1.32***	***-0.35***	***-0.34***	***0.02***	-	-	***-0.34***	***-0.07***	***-0.06***	***0.00***	-	-	***-0.19***	***0.07***	***0.25***	-	-	***-0.04***	-
MP7	0.85	GW Level	mags	MP installed December 2017										-1.3[1]	0.28	0.12	0.04	0.08	-0.06	MP Removed							
		SW Level	mags											dry	dry	0.1	0.04	0.08	0								
		Hydraulic Gradient	-											-	-	***0.02***	***0.00***	***0.00***	***-0.07***								
MP8	0.76	GW Level	mags	MP installed December 2017										-1.22[1]	-0.47	-0.04	-0.12	0.09	0.06	-0.33	0.17	0.13	0.1	-0.45	-1.09	-0.42	-0.11

MP ID	Depth of Screen (m)	Measurement	Units	18-Jun-2015	20-Jul-2015	13-Aug-2015	21-Sep-2015	18-Nov-2015	22-Dec-2015	19-Jan-2016	26-Mar-2016	30-Apr-2016	24-May-2016	18-Dec-2017	22-Jan-2018	27-Feb-2018	29-Mar-2018	9-Apr-2018	29-May-2018	28-Aug-2018	28-Jan-2019	01-Apr-2019	06-Jun-2019	08-Aug-2019	24-Oct-2019	20-Mar-2020	08-Jun-2020
		SW Level	mags											dry	0.11	0.1	0.08	0.11	dry	dry	0.14	0.15	0.12	dry	dry	0.19	dry
		Hydraulic Gradient	-											-	***-0.76***	***-0.18***	***-0.26***	***-0.03***	-	-	***0.04***	***-0.03***	***-0.03***	-	-	***-0.80***	-
MP9	0.31	GW Level	mags	MP installed December 2017										-0.25	-0.05	0.14	0.16	0.33	0.55	0.16	0.30	0.39	0.54	0.19	-0.49	-0.19	0.29
		SW Level	mags											0.13	0.4	0.36	0.3	0.32	0.33	dry	0.50	0.43	0.33	0.28	dry	0.37	dry
		Hydraulic Gradient	-											***-1.23***	***-1.45***	***-0.71***	***-0.45***	***0.03***	***0.71***	-	***-0.65***	***-0.13***	***0.68***	-	-	***-1.81***	-
MP10	0.57	GW Level	mags	MP installed December 2017										dry	-0.05	0.16	-0.98	0.04	-0.54	-0.18	-0.55	0.2	0.13	-0.19	-0.85	0.02	-0.02
		SW Level	mags											dry	0.05	0.04	0.01	0.04	dry	dry	0.10	0.06	0.04	dry	dry	0.07	dry
		Hydraulic Gradient	-											-	***-0.18***	***0.21***	***-1.74***	***0.00***	-	-	***-1.14***	***0.25***	***0.16***	-	-	***-0.09***	-
MP11	0.63	GW Level	mags	MP installed December 2017										dry	-0.07	0.3	0.01	0.22	0.15	-0.17	0.21	0.26	0.11	-0.57	-0.76	0.09	-0.29
		SW Level	mags											dry	0.1	0.15	0.04	0.13	dry	dry	dry	0.28	0.15	dry	dry	0.21	dry
		Hydraulic Gradient	-											-	***-0.27***	***0.24***	***-0.05***	***0.14***	-	-	-	***-0.03***	***-0.06***	-	-	***-0.19***	-
SP1	0.98	GW Level	mags	-0.12	-0.24	-0.45	-0.61	0.06	0.09	0.31	0.01	-0.28	-0.1	0.15	0.09	0.09	0.06	0.07	0.06	-0.34	0.30	0.05	0.24	-0.57	-0.66	-0.2	-0.27
		SW Level	mags	0.17	dry	dry	dry	0.06	0.18	0.28	0.34	0.19	dry	0.15	dry	0.08	0.18	0.23	0.07	dry	0.43	0.42	0.235	dry	dry	0.04	dry
		Hydraulic Gradient	-	***-0.30***	-	-	-	***0***	***-0.09***	***0.03***	***-0.34***	***-0.48***	-	***0***	-	***0.01***	***-0.12***	***-0.16***	***-0.01***	-	***-0.13***	***-0.38***	***0.01***	-	-	***-0.24***	-

which shows that groundwater is directed towards the tributary in the spring between the location of MW4 and MW8. Within this reach, there may be a hydraulic connection to the confined sand lenses observed in the Halton Till at MW3, MW4, and MW8 (**Appendix B**).

MP5 is installed within a swamp wetland community near the headwaters of the central ephemeral drainage channel (MSMC-Trib-02). The hydraulic gradients measured within this wetland were generally negative, indicative of a swamp wetland, with the exception of positive gradients noted in March, April, and May 2016, April and May 2018, and April and June 2019. This indicates this wetland is likely supported through seasonal, shallow groundwater discharge during the spring freshet, and is supported by surface water runoff for the remainder of the year.

MP6 and MP8 are installed within the southwestern most drainage feature (SMC-Trib-01) on the west side of Boston Church Road. All hydraulic gradients measured at these locations were negative, neutral, or dry. This indicated that these drainage channels are ephemeral and supported through surface water runoff and are not connected to the water table.

MP7 is within a mineral meadow marsh wetland along Boston Church Road. The hydraulic gradients measured were each neutral to slightly negative, indicating that this feature is supported through precipitation and surface water runoff creating long periods of standing water. This is consistent with the surficial geology and groundwater flow direction in this area. This MP was destroyed in August 2018.

MP10 is installed within the central drainage feature within the site boundary (MSMC-Trib-02) (**Figure 1**). The hydraulic gradients measured at this MP were negative or dry, indicative of groundwater recharge. The monitoring results support the conclusion that this drainage feature is ephemeral, which is consistent with the presence of low permeability Halton Till and fine grained glaciolacustrine deposits in this area, as well as direction of groundwater flow (**Figure 6**).

3.3 Hydraulic Conductivity

3.3.1 Slug Testing

3.3.1.1 Methodology

Palmer personnel conducted single well response tests (i.e., slug tests) at each monitoring well to determine the hydraulic conductivity (K) of the hydrostratigraphic unit surrounding the well screen. Slug testing consisted of both rising head (RH) and falling head (FH) tests, which act to create a head change through the insertion (FH Test) or removal (RH Test) of a 1-m long slug. The rate of recovery in the water level in response to the head change was measured using a datalogger to record water levels at 2-second intervals. Manual water level measurements were also collected during the tests in order to gauge recovery. Tests were terminated once either 80% recovery had been attained, or 30 minutes had elapsed.

K values were calculated using the displacement-time data and were analysed using either the Hvorslev (1951) method or the Cooper-Bredehoeft-Papadopulos (1967) method for confined aquifers, as modelled

Figure 7. MP1 – East Sixteen Mile Creek

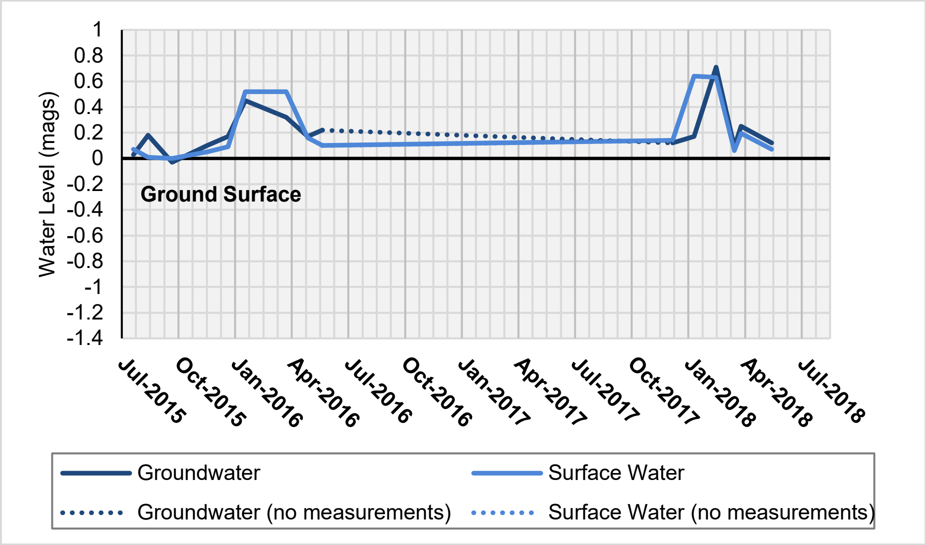


Figure 8. MP2s – Mixed Swamp (Northeast Wetland)

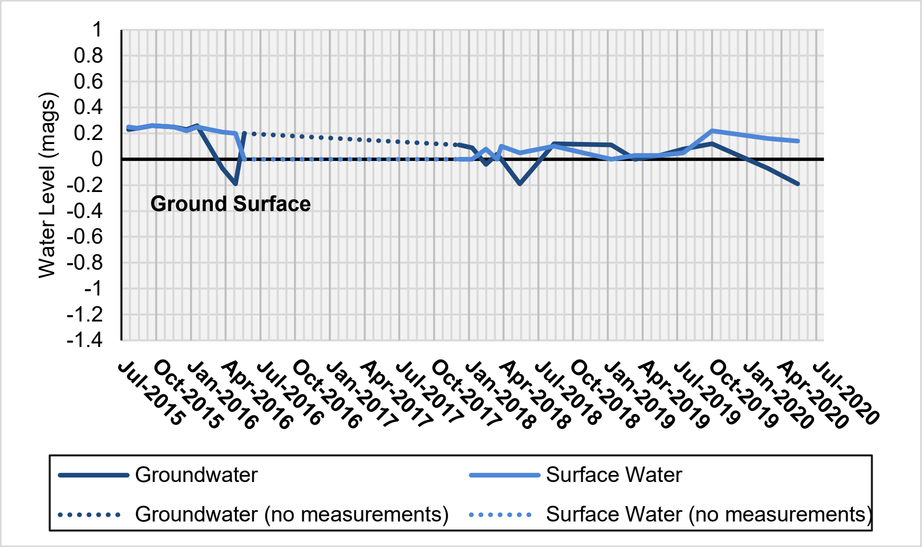


Figure 9. MP2d – Mixed Swamp (Northeast Wetland)

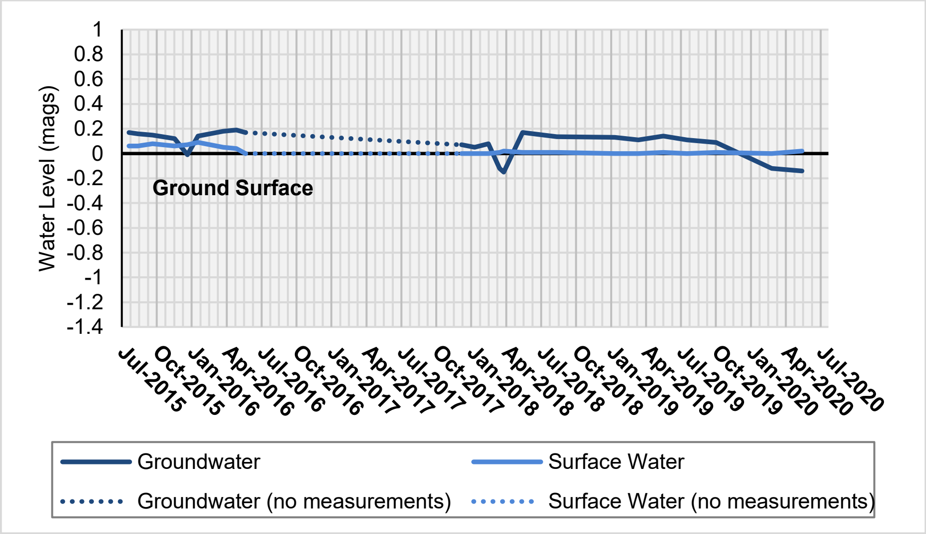


Figure 10. MP2 (New) – Mixed Swamp (Northeast Wetland)

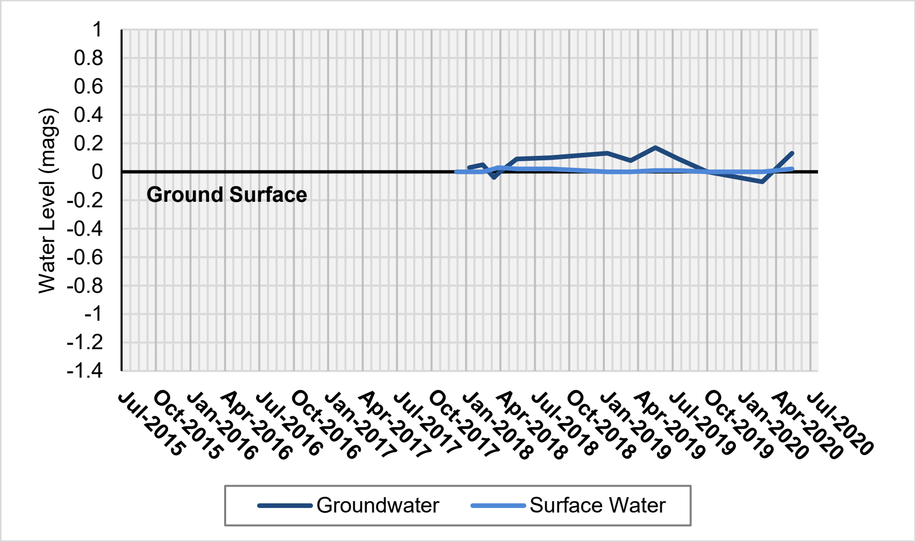


Figure 11. MP3 – Mineral Deciduous Swamp (Northern Woodlot)

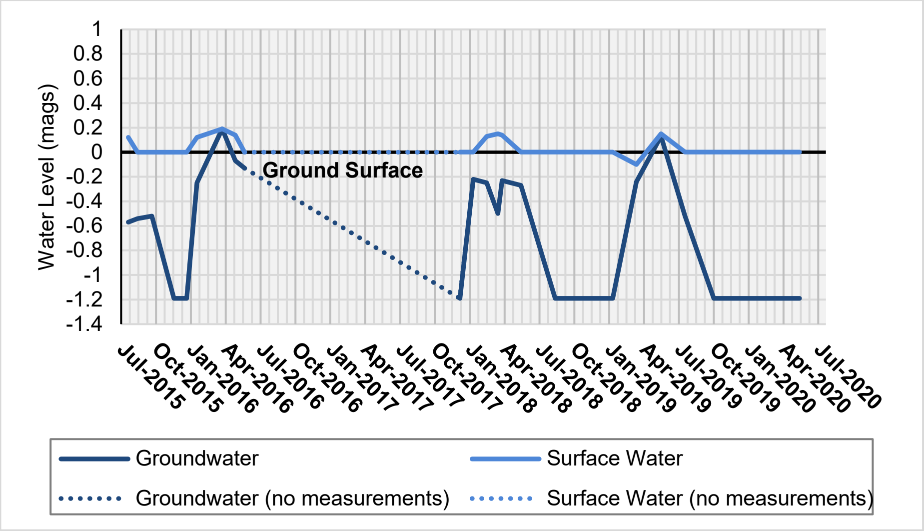


Figure 12. MP4 - Northern Drainage Channel

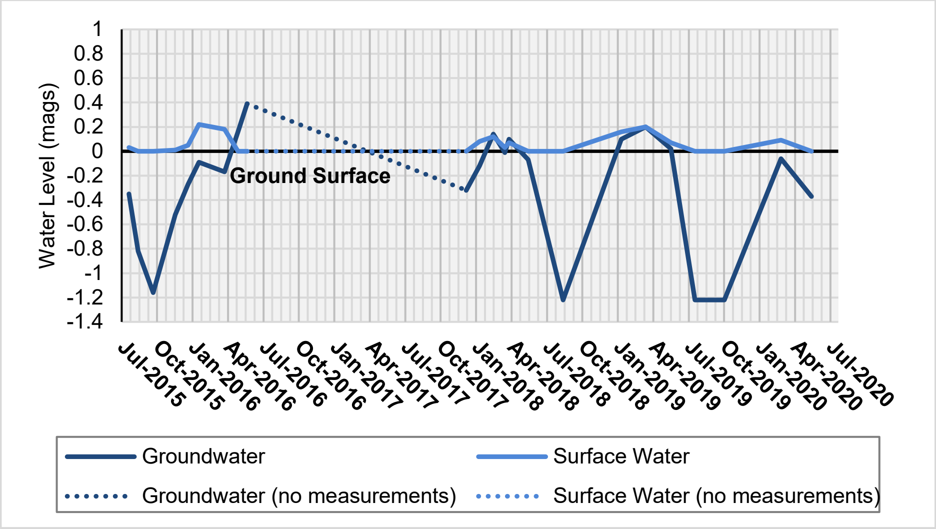


Figure 13. MP4 (new) - Northern Drainage Channel

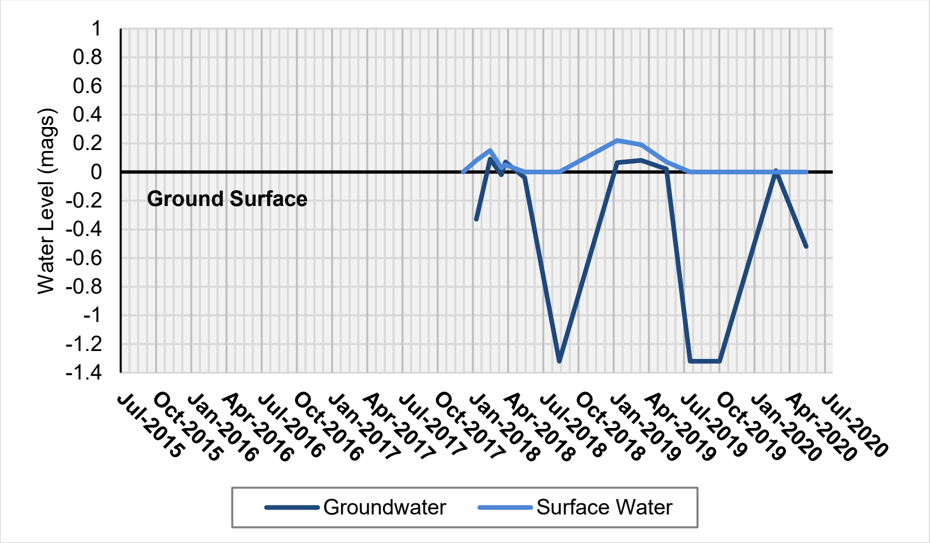


Figure 14. MP5 – Mineral Deciduous Channel

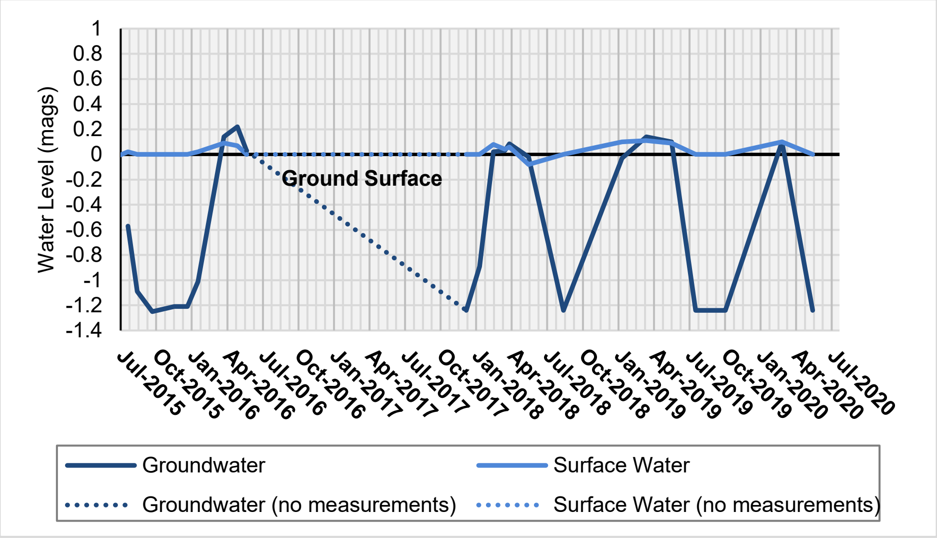


Figure 15. MP6 - Southern Drainage Channel

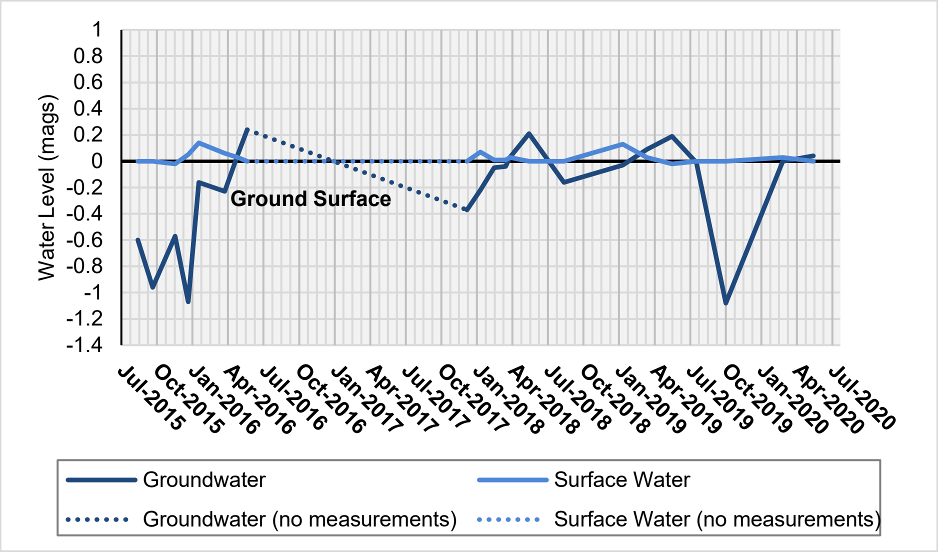


Figure 16. MP7 - Cattail Marsh

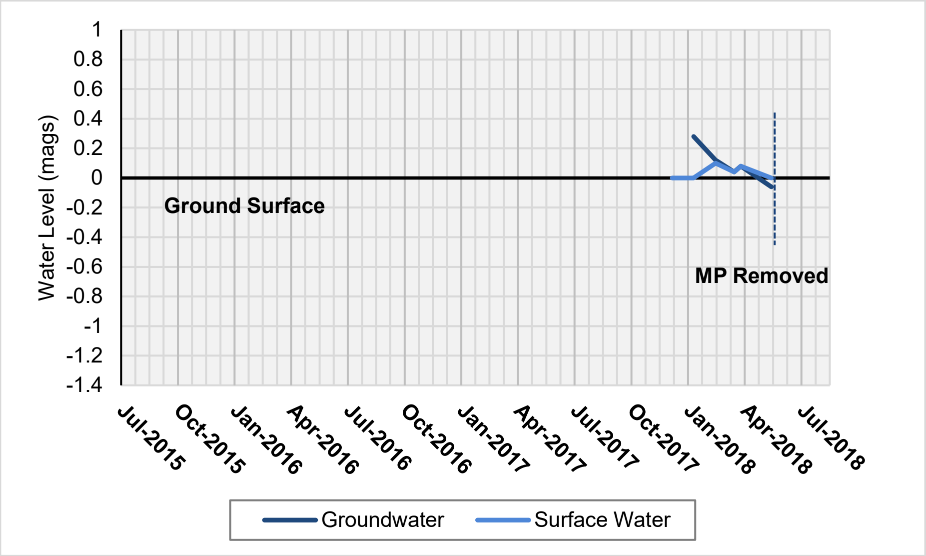


Figure 17. MP8 - Southern Drainage Channel

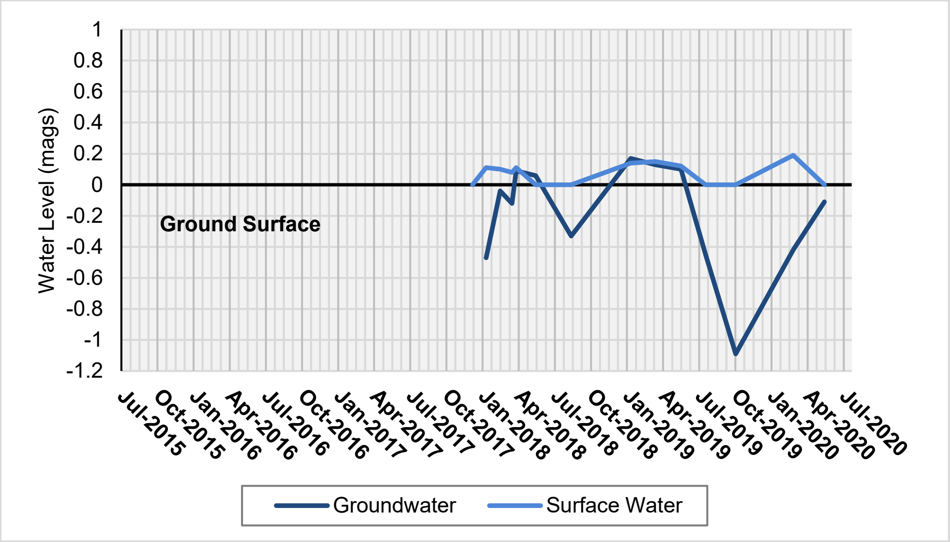


Figure 18. MP9 - Northern Drainage Channel

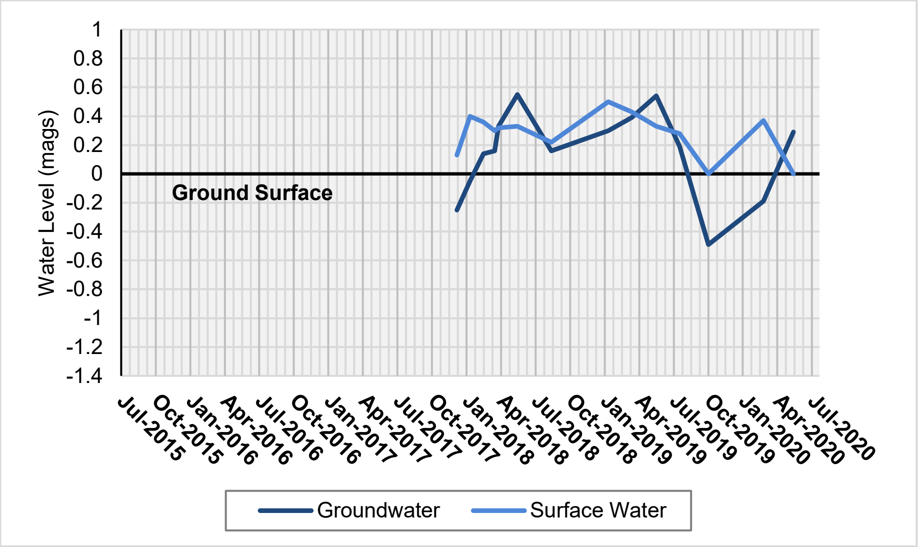


Figure 19. MP10 - Central Drainage Channel

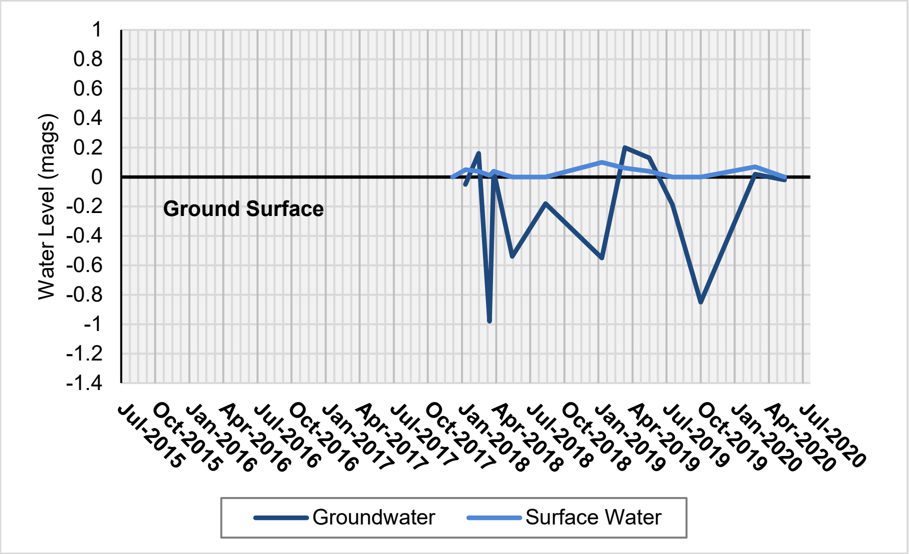


Figure 20. MP11 - Northern Drainage Channel

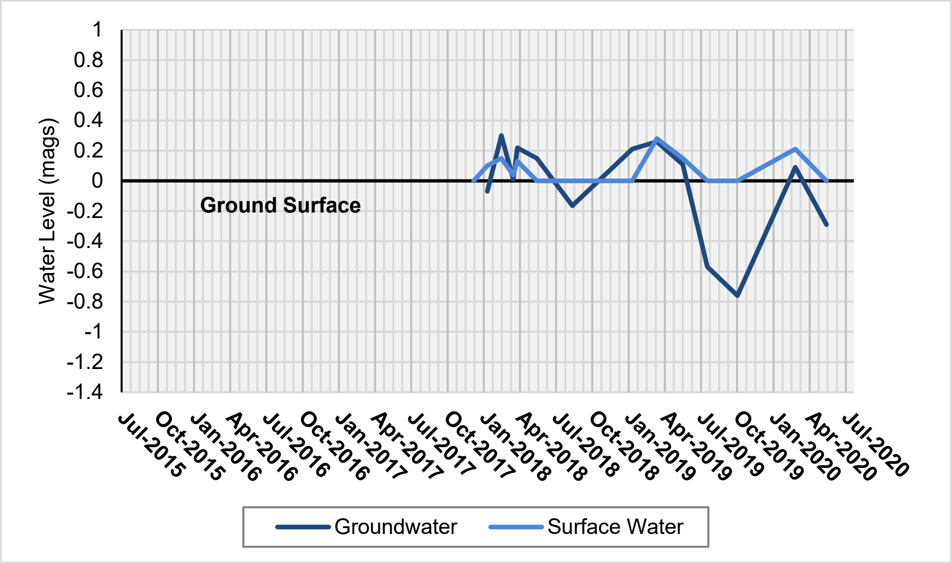
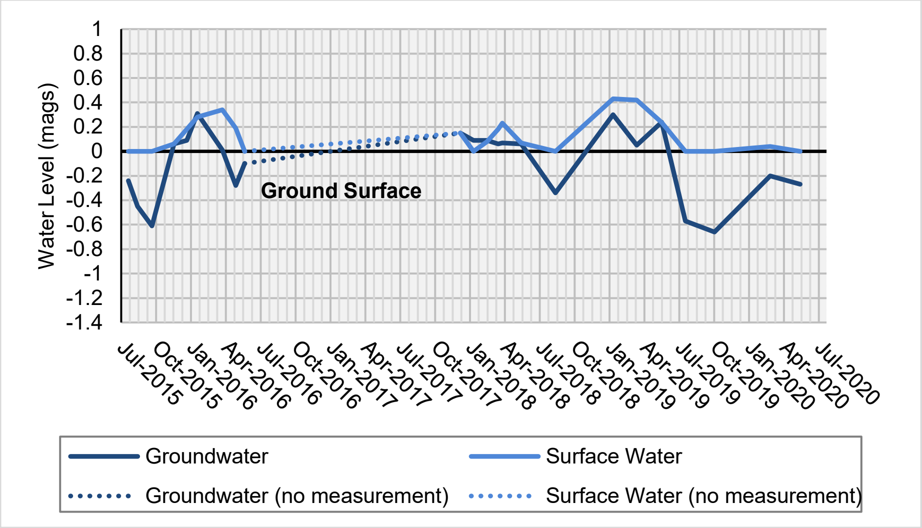


Figure 21. SP1 - Northern Drainage Channel



by Aqtesolv™ software. The analysis results are presented in **Appendix C**, and the range of calculated hydraulic conductivity values are summarized in **Table 5**.

Based on the results of the single well response testing, the geometric mean hydraulic conductivity of the silty clay Halton Till is approximately 9.7x10^{-7} m/sec, and ranges from 4.7x10^{-8} m/sec to 8.0x10^{-6} m/sec. This is within the accepted range of hydraulic conductivity of between 10^{-10} m/sec and 10^{-6} m/sec for Halton Till soils (Interim Waste Authority, 1994). The variability of the k values within the till are a result of the heterogeneity of the soils, which range from dense silty sand till, to fine grained seams of glaciolacustrine silty sand and silty clay soils.

The k values measured within the interstadial silty sand soils have a geometric mean of 5.7x10^{-6} m/sec. The measured values range from 3.0x10^{-7} m/sec to 5.1x10^{-5} m/sec.

Table 5. Summary of Hydraulic Conductivity

Well ID	Hydrostratigraphic Unit	Test Type	Hydraulic Conductivity (K) (m/sec)	K Geometric Mean (m/sec)
MW1	Interstadial Deposits – Silty Sand	FH1	3.8x10^{-5}	5.7x10^{-6}
		RH1	3.1x10^{-5}	
		FH2	3.6x10^{-5}	
		RH2	3.1x10^{-5}	
MW4		FH1	1.2x10^{-5}	
		RH1	2.4x10^{-5}	
MW5		FH1	2.2x10^{-6}	
		RH1	2.4x10^{-6}	
MW6		FH1	1.7x10^{-6}	
		RH1	9.1x10^{-7}	
MW7		FH1	1.1x10^{-6}	
		RH1	1.2x10^{-6}	
MW8		FH1	6.0x10^{-6}	
		RH1	9.0x10^{-6}	
MW10		FH1	5.1x10^{-5}	
		RH1	3.2x10^{-5}	
MW12		FH1	3.8x10^{-7}	
		RH1	3.0x10^{-7}	
MW11	Silty Clay Till	FH1	4.4x10^{-7}	9.7x10^{-7}
		RH1	3.0x10^{-7}	
MW2		FH1	8.0x10^{-6}	
		RH1	7.3x10^{-6}	
MW3		FH1	5.4x10^{-6}	
		RH1	4.2x10^{-6}	
MW9		FH1	4.7x10^{-8}	
		RH1	9.8x10^{-8}	

3.3.2 Infiltration Testing

3.3.2.1 Methodology

Infiltration tests were planned and conducted with consideration of the Low Impact Development (LID) Stormwater Management Planning and Design Guide, Appendix C – Site Evaluation and Soil Testing Protocol for Stormwater Infiltration (TRCA/CVC, 2010), and the identified landscaped areas in the Concept Plan (**Appendix A2**). Six locations (IT1 – IT6) were selected to provide good spatial distribution through the proposed landscaped areas, which are likely locations for potential LID mitigation. Infiltration test locations are shown on **Figure 1**. Infiltration testing was completed using a Guelph Permeameter (GP), which can be used to calculate the field saturated hydraulic conductivity (K_{fs}) of the shallow subsurface.

Infiltration testing involves measuring the steady state rate of infiltration within a 3.75 cm diameter auger hole by maintaining a constant hydraulic head pressure (H) within the GP water reservoir (Reynolds and Elrick, 1986). Once the head pressure has been applied, the rate of fall within the reservoir is monitored until a steady state of change (r) is achieved. This value is used to determine K_{fs} by applying it to the Reynolds and Elrick (1985) equations.

3.3.2.2 Results

Infiltration testing at the site was completed on August 28, 2018 at the six locations (IT1 – IT6) shown on **Figure 1**. Based on the recovery from shallow hand augering each location, testing generally occurred within soils consisting of unsaturated clay, silt, and fine sand. Test depths ranged between 0.5 meters below ground surface (mbgs) and 0.9 mbgs. The results of the infiltration tests and field observations at each site, including descriptions of the soils, applied change in hydraulic head (H), measured steady state rate of change (r), and resulting infiltration rates are summarized in **Table 6**.

Table 6. Summary of Infiltration Testing Results

Site ID	Soil Description	Total Depth (cm)	Applied Change in Hydraulic Head (H) (cm)	Steady State Rate of Change (r) (cm/min)	K_{fs} (m/sec)	Infiltration Rate (mm/hour)
IT1	0 – 15 cm: brown disturbed soils 15 – 90 cm: brown clay, some silt, trace sand, moist	90	10	0.05	$9.0x10^{-9}$	13.1
IT2	0 – 30 cm: brown disturbed soils 30 – 73 cm: brown to red silty clay, some fine sand, dry and non-cohesive	73	10	0.15	$5.0x10^{-8}$	20.7
IT3	0 – 50 cm: light brown fine sand and silt, some clay, dry and non-cohesive	50	20	0.05	$8.6x10^{-9}$	12.9
IT4	0 – 15 cm: brown disturbed soils 15 – 82 cm: light brown/red clay with silt, moist, slightly cohesive	82	10	0.05	$9.0x10^{-9}$	13.1
IT5	0 – 90 cm: brown clayey silt with some sand, moist	90	10	0.075	$1.4x10^{-8}$	14.6
IT6	0 – 77 cm: brown clay and silt and fine sand, dry and non-cohesive	77	10	0.375	$6.8x10^{-8}$	22.5

The infiltration rate of the shallow soils ranged between 12.9 and 22.5 mm/hour, with an average rate of 16.2 mm/hour, which is a suitable rate to implement LID. Note that the selected LID measures should be designed to take into consideration the low permeability silt and clay composition of the surficial soils. Infiltration trenches, vegetated swales, bioretention areas, and the application of topsoil can all be effective strategies in low permeability soils to increase infiltration. It is expected that the use of infiltration trenches should be effective in most areas of the site, as the groundwater table elevation is typically greater than 1 m below ground surface. During the spring freshet in May 2018, the measured water table ranged from 6.56 mbgs (MW1) to 0.38 mbgs (MW6). Infiltration trenches generally require approximately 1 m of separation between the base of the trench and the top of the seasonally high water table.

3.4 Groundwater Chemistry

Groundwater chemistry samples were collected on August 14, 2015 from two monitoring wells, MW1 and MW5, and analyzed for a suite of water quality parameters including turbidity, total dissolved solids (TDS), pH, dissolved metals, cations and anions. A summary table of the groundwater analysis results is presented on **Table 7**, and the Certificate of Analysis is provided in **Appendix D**. Results were compared against Ontario Drinking Water Standards (ODWS) and the Provincial Water Quality Objectives (PWQO). The results show the sample from MW1 exceeded PWQO standards in colour and hardness, and the sample from MW5 exceeded PWQO in colour, turbidity, aluminum, arsenic, copper, molybdenum, and uranium and exceeded ODWS in sodium. These results are indicative of natural groundwater conditions related to high TDS.

Table 7. Groundwater Quality Results

Parameter	Detection Limit	Units	Regulatory Standards		Sample Concentration	
			ODWS	PWQO	MW1	MW5
Physical Tests						
Colour, Apparent	1.0	C.U.		5	46.8	207
Conductivity	3	umhos/cm			739	967
pH	0.10	pH units		6.5-8.5	8.01	8.47
Total Dissolved Solids	20*	mg/L			403	629
Turbidity	0.10	NTU		5	2.32	34.2
Anions and Nutrients (Water)						
Alkalinity, Bicarbonate (as $CaCO_3$)	10	mg/L			305	276
Alkalinity, Carbonate (as $CaCO_3$)	10	mg/L			<10	<10
Alkalinity, Hydroxide (as $CaCO_3$)	10	mg/L			<10	<10
Alkalinity, Total (as $CaCO_3$)	10	mg/L		30-500	305.0	276.0
Ammonia, Total (as N)	0.050	mg/L			<0.050	0.63
Bromide (Br)	0.10	mg/L			<0.10	<0.10
Chloride (Cl)	0.50	mg/L		250	48.70	27.20
Computed Conductivity		uS/cm			696	845
Conductivity % Difference		%			-5.9	-13.5
Fluoride (F)	0.020	mg/L	1.5		0.12	1.06
Hardness (as $CaCO_3$)		mg/L		80-100	373	84.9
Ion Balance		%			107	101
Langelier Index		-			1.00	0.70
Nitrate and Nitrite as N	0.0220	mg/L	10		2.16	5.47
Nitrate (as N)	0.020	mg/L	10		2.16	4.79
Nitrite (as N)	0.010	mg/L	1		<0.010	0.68
Saturation pH		pH			6.97	7.77
Phosphate-P (ortho)	0.0030	mg/L		0.002	<0.0030	0.01
TDS (Calculated)		mg/L			427	584
Sulfate (SO4)	0.30	mg/L			41.5	162
Anion Sum		me/L			7.45	9.20

Parameter	Detection Limit	Units	Regulatory Standards		Sample Concentration	
			ODWS	PWQO	MW1	MW5
Cation Sum		me/L			7.96	9.25
Cation - Anion Balance		%			3.30	0.30
Organic/Inorganic Carbon (Water)						
Dissolved Organic Carbon	1.0	mg/L		5.0	1.2	3.1
Inorganic Parameters (Water)						
Silica	0.11	mg/L			19.3	10.7
Dissolved Metals (Water)						
Aluminum (Al)-Dissolved	0.0050	mg/L		0.015	<0.0050	0.018
Antimony (Sb)-Dissolved	0.00010	mg/L	0.006	0.02	<0.00010	0.00218
Arsenic (As)-Dissolved	0.00010	mg/L	0.025	0.005	<0.00010	0.0123
Barium (Ba)-Dissolved	0.00010	mg/L	1.0		0.151	0.038
Beryllium (Be)-Dissolved	0.00010	mg/L		0.011	<0.00010	<0.00010
Bismuth (Bi)-Dissolved	0.000050	mg/L			<0.000050	<0.000050
Boron (B)-Dissolved	0.010	mg/L	5.0	0.2	0.045	0.152
Cadmium (Cd)-Dissolved	0.000010	mg/L	0.005	0.0001	<0.000010	0.000033
Calcium (Ca)-Dissolved	0.050	mg/L			103	18.0
Chromium (Cr)-Dissolved	0.0005	mg/L	0.05		0.0010	0.00061
Cobalt (Co)-Dissolved	0.0001	mg/L		0.0009	<0.00010	0.0002
Copper (Cu)-Dissolved	0.0002	mg/L		0.001	0.00074	0.00241
Iron (Fe)-Dissolved	0.0100	mg/L		0.3	<0.010	<0.010
Lead (Pb)-Dissolved	0.00005	mg/L	0.01	0.001	<0.000050	<0.000050
Magnesium (Mg)-Dissolved	0.050	mg/L			28.2000	9.6700
Manganese (Mn)-Dissolved	0.00050	mg/L			0.0094	0.0166
Molybdenum (Mo)-Dissolved	0.000050	mg/L		0.04	0.00137	0.124
Nickel (Ni)-Dissolved	0.00050	mg/L		0.025	<0.00050	0.00167
Phosphorus (P)-Dissolved	0.050	mg/L		0.01	<0.050	<0.050
Potassium (K)-Dissolved	0.050	mg/L			2.5	10.4
Selenium (Se)-Dissolved	0.000050	mg/L	0.01	0.1	<0.000050	0.00517
Silicon (Si)-Dissolved	0.050	mg/L			9.01	4.99
Silver (Ag)-Dissolved	0.000050	mg/L		0.0001	<0.000050	<0.000050
Sodium (Na)-Dissolved	0.50**	mg/L	20		10.200	167
Strontium (Sr)-Dissolved	0.0010	mg/L			0.512	0.146
Sulfur (S)-Dissolved	5.0	mg/L			14.9	52.6
Thallium (Tl)-Dissolved	0.000010	mg/L		0.0003	0.000011	0.000018
Tin (Sn)-Dissolved	0.00010	mg/L			<0.00010	<0.00010
Titanium (Ti)-Dissolved	0.00030	mg/L			<0.00030	<0.00030
Tungsten (W)-Dissolved	0.00010	mg/L		0.03	<0.00010	0.00119
Uranium (U)-Dissolved	0.000010	mg/L	0.02	0.005	0.0006	0.0149
Vanadium (V)-Dissolved	0.00050	mg/L		0.006	<0.00050	0.00241
Zinc (Zn)-Dissolved	0.0010	mg/L		0.02	0.0026	0.0030
Zirconium (Zr)-Dissolved	0.00030	mg/L		0.004	<0.00030	<0.00030

🟦	Sample concentration exceeds standards outlined in Provincial Water Quality Objectives
🟪	Sample concentration exceeds standards outlined in Ontario Drinking Water Standards

* Detection limit adjusted for required dilution
** Detection limit adjusted due to sample matrix effects

3.5 Source Water Protection

In October 2017, a Source Water Protection Plan was completed that encompasses the Halton Region Source Protection Area (HHSPC, 2017). The Source Water Protection Plan identifies three main regulatory factors under the *Clean Water Act (2006)* relating to local hydrogeology to consider for site development: Significant Groundwater Recharge Areas (SGRAs), Highly Vulnerable Aquifers (HVAs), and Wellhead Protection Areas (WHPAs).

Based on available MECP Source Protection Information mapping, the proposed development is approximately 3.5 km from the nearest WHPAs associated with the Kelso Municipal Supply Well Field and are outside of designated WHPA-Q1 and WHPA-Q2 recharge management areas. The study area is additionally not within any designated HVA or SGRA areas **(Appendix E).**

Overall, through Source Water Protection, the site was determined to not have a significant groundwater function that requires maintaining the pre-to-post development infiltration rates. However, our assessment has also focused on identifying local natural environmental features that could be supported by groundwater and making recommendations to maintain groundwater recharge and discharge for these areas.

4 Hydrogeological LID Design Considerations

The use of LID measures are recommended as part of the overall stormwater management plan to match pre-development conditions. As stated in *Low Impact Development Stormwater Management Planning and Design Guide Version 1.0* (2010) by CVC and TRCA,

> “Developing stormwater management plans requires an understanding of the depth to water table, depth to bedrock, native soil infiltration rates, estimated annual groundwater recharge rates, locations of significant groundwater recharge and discharge, groundwater flow patterns and the characteristics of the aquifers and aquitards that underlay the area” (TRCA and CVC, 2010).

For sites with deep water table conditions and high permeability soils, LID practices can significantly improve infiltration and groundwater recharge to maintain the groundwater characteristics of the underlying aquifer. However, for sites with low permeability soils and high water table conditions, the amount of infiltration is limited by the saturated hydraulic conductivity of the soil or percolation rate (i.e., the rate at which water can infiltrate). Infiltration trenches, vegetated swales, and bioretention areas can all be effective in low permeability soils to increase infiltration.

The site has the following characteristics that are supportive of infiltration-based LID measures:

- The spring high groundwater level as measured in March 2020 range in elevation from approximately 211.05 to 218.79 masl or between 1.31 and 5.95 mbgs at MW1 and MW6;
- Groundwater levels are shallowest in the western portion of the site and deepest in the eastern portion near the Middle Sixteen Mile Creek valley;
- The percolation rate of the surficial till is estimated to be 12.9 and 22.5 mm/hour, with an average rate of 16.2 mm/hour; and
- Groundwater recharge near MW1, MW3 and MW8 supports observed groundwater discharge in the wetland unit within the Middle Sixteen Mile Creek valley. Positively, this area is also is optimal for infiltration based LIDs due to the deep water table and the presence of unsaturated interstadial sand and silt deposits. The other wetlands on site were found to be surface water supported from upgradient lands.

Based on the results of the hydrogeological investigation, it is our opinion that the area in the vicinity of MW1, MW3 and MW8 near the proposed channel realignment is an optimal place for infiltration based LID that can maintain groundwater recharge/ discharge to the valleyland wetland communities in this area. This will also help to maintain the seasonal groundwater discharge observed in the tributary MSMC-Trib-01 that is planned to be realigned to be adjacent with the wetland buffer. It is recommended that clean rooftop drainage from the proposed buildings be utilized to protect groundwater quality. No other groundwater supported features were identified on site that require specific LID measures to support. The Pre-to-Post Development water balance described in the following sections will demonstrate our recommendations for groundwater mitigation measures to support site development.

5 Pre-Development Water Balance

This assessment focuses on the overall site as well as each of the individual parcel areas. As development is currently only planned for Parcel 1 and Parcel 4, the water balance will only include these areas (**Appendix A1**).

5.1 Methodology

A pre-development water budget was calculated over the site area using a monthly soil-moisture balance approach as described in Thornthwaite and Mather (1957). The water balance calculation estimates average annual evapotranspiration (evaporation and plant transpiration) using factors such as monthly precipitation, temperature and latitude. Long term climate data were obtained from the nearest meteorological station to the study area, the Georgetown WWTP (43^0 38’ 24” N, 79^0 52’ 45” W) which is approximately 10 km from the study area, over the 30-year duration from 1981 to 2010.

The average available water surplus, which is the water available for infiltration and runoff, was calculated by subtracting the average annual evapotranspiration from the average annual precipitation. A soil moisture retention value of 250 mm was utilized to represent the clay and silt textured till and agricultural land cover at the site, in accordance with the Ministry of the Environment (MOE) Stormwater Management Planning and Design Manual (MOE, 2003). In areas where forest cover is the dominant vegetation cover, a soil moisture retention of 400 mm was utilized.

The resulting annual water surplus was then partitioned using infiltration coefficients based on MOEE (1995) and modified based on site specific conditions. This approach takes into consideration three factors: topography/slope, soil type, and land cover, which are summed to provide a representative infiltration factor for the area. A summary of the infiltration factors for each descriptor used in the water balance assessment are provided in **Table 8**. The total average annual infiltration over pervious areas was then calculated by multiplying the applicable water surplus value by the sum of the three individual factors. A summary of the surplus values calculated for each soil moisture retention over the site is provided in **Table 9**.

Table 8. Summary of Infiltration Factors

Area Description	Infiltration Factor Value
SOIL TYPE	
• Till: Clay to silt-textured till (derived from glaciolacustrine deposits or shale)	0.10
• Fine textured glaciolacustrine deposits: silt and clay, minor sand and gravel	0.10
TOPOGRAPHY/SLOPE	
• 2.5% slope	0.15
PRE-DEVELOPMENT LAND COVER	
• Agriculture	0.10
• Forested	0.15
OVERALL INFILTRATION COEFFICIENTS FOR SITE	
• Silty Clay/ 2.5% slope/ agricultural	**0.35**
• Silty Clay/ 2.5% slope/ forested	**0.40**

Table 9. Surplus Calculation

	WATER BALANCE	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	YEAR
SOIL MOISTURE RETENTION = 250 mm	Precipitation (P)	67.8	60	57.2	76.5	79.3	74.8	73.5	79.3	86.2	68.3	88.5	65.9	877.3
	Temperature (T)	-6.3	-5.2	-0.9	6	12.3	17.4	20	19	14.8	8.4	2.8	-2.9	7
	Potential Evapotranspiration (PET)	0	0	0	32	77	112	132	115	77	38	10	0	593
	P-PET	68	60	57	45	2	-37	-58	-36	10	30	78	66	285
	Change in Soil Moisture Storage	0	0	0	-80	-35	-22	-11	9	24	30	25	0	-60
	Soil Moisture Storage	250	250	250	170	135	113	102	111	135	165	190	250	-
	Actual Evapotranspiration (AET)	0	0	0	32	77	97	85	70	77	38	10	0	486
	Soil Moisture Deficit (mm)	0	0	0	0	0	15	47	45	0	0	0	0	107
	Surplus (P-AET)	68	60	57	45	2	-22	-11	9	10	30	78	66	**391.7**
SOIL MOISTURE RETENTION = 400 mm	Precipitation (P)	67.8	60	57.2	76.5	79.3	74.8	73.5	79.3	86.2	68.3	88.5	65.9	877.3
	Temperature (T)	-6.3	-5.2	-0.9	6	12.3	17.4	20	19	14.8	8.4	2.8	-2.9	7.1
	Potential Evapotranspiration (PET)	0	0	0	32	77	112	132	115	77	38	10	0	593
	P-PET	68	60	57	45	2	-37	-58	-36	10	30	78	66	285
	Change in Soil Moisture Storage	0	0	0	-31	-40	-27	-15	13	0	35	26	0	-39
	Soil Moisture Storage	400	400	400	369	329	302	287	300	329	364	390	400	-
	Actual Evapotranspiration (AET)	0	0	0	32	77	102	89	66	77	38	10	0	491
	Soil Moisture Deficit (mm)	0	0	0	0	0	10	43	49	0	0	0	0	102
	Surplus (P-AET)	**68**	**60**	**57**	**45**	**2**	**-27**	**-15**	**13**	**10**	**30**	**78**	**66**	**386.7**

5.2 Tertiary Plan Boundary Pre-Development Water Balance Results

The calculated actual ET (or AET) based on the Thornthwaite and Mather monthly water balance model is approximately 486 mm/year, or approximately 55% of the total annual precipitation (**Table 9**). The actual evapotranspiration is calculated based on a potential ET (or PET) and soil-moisture storage withdrawal. Monthly PET is estimated using monthly temperature data and is defined as a water loss from a homogeneous vegetation covered area that never lacks water (Thornthwaite, 1948; Mather, 1978). The calculated PET for the study area is 593 mm/year, or about 68% of the total precipitation. In general, there is a soil moisture deficit of 107 mm/year.

The estimated water surplus within the tertiary plan boundary was calculated using the soil moisture retention value for agricultural land cover and silty clay geology, and is approximately 392 mm/year (**Table 9**). The water surplus has two components: a runoff component which occurs when the soil moisture capacity is exceeded leading to overland flow, and an infiltration component. Using the method in the MOE SWM manual and MOEE (1995) for guidance it is estimated that approximately 65% (255 mm/year) of the surplus runs off, and the remaining 35% (137 mm/year) infiltrates. Over the full site area of 136.5 ha, this represents approximately 187,080 m^3/year of infiltration and 347,434 m^3/year of runoff.

Results are summarized in **Table 10**. Runoff may eventually either recharge the local groundwater system, or form part of a perched water table.

The estimated infiltration rate of 137 mm/yr represents 15.5% of the total annual precipitation, which compares well with the reported value of 17% in the Halton Region Source Protection Report (Halton-Hamilton Source Protection Committee, 2017).

5.3 Parcel Based Pre-Development Water Balance Results

To support the Site Plan Application (SPA), a water balance assessment was completed for Development Parcels 1 and 4 described in the Proposed Development Plan, and in the Concept Plan (**Appendix A1, A2**). Using the same methodology as for the overall Tertiary Lands, the results of the Parcel based pre-development water balance is presented in **Table 11**.

The pre-development infiltration for Parcel 1 was calculated to be 41,581 m^3/yr. The pre-development infiltration for Parcel 4 was calculated to be 152,001 m^3/yr. Combined, the both parcels have a total pre-development infiltration of 193,582 m^3/yr.

Table 10. Pre-Development Water Balance (Tertiary Plan Boundary)

PRE-DEVELOPMENT WATER BALANCE (mm)	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**YEAR**
Precipitation (P)	67.8	60	57.2	76.5	79.3	74.8	73.5	79.3	86.2	68.3	88.5	65.9	877.3
Temperature (T)	-6.3	-5.2	-0.9	6	12.3	17.4	20	19	14.8	8.4	2.8	-2.9	7
Potential Evapotranspiration (PET)	0	0	0	32	77	112	132	115	77	38	10	0	593
P-PET	68	60	57	45	2	-37	-58	-36	10	30	78	66	285
Change in Soil Moisture Storage	0	0	0	-80	-35	-22	-11	9	24	30	25	0	-60
Soil Moisture Storage	250	250	250	170	135	113	102	111	135	165	190	250	-
Actual Evapotranspiration (AET)	0	0	0	32	77	97	85	70	77	38	10	0	486
Soil Moisture Deficit (mm)	0	0	0	0	0	15	47	45	0	0	0	0	107
Surplus (P-AET)	68	60	57	45	2	-22	-11	9	10	30	78	66	**391.7**
PARTITIONING BETWEEN INFILTRATION AND RUNOFF													
Soil Factor[1]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Slope Factor[1]	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Vegetation Factor[1]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Infiltration Coefficient	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	**0.35**
Runoff Coefficient	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	**0.65**
WATER BUDGET													
Potential Infiltration (mm)	24	21	20	16	1	-8	-4	3	3	10	27	23	137.1
Potential Runoff (mm)	44	39	37	29	2	-14	-7	6	6	19	51	43	254.6
Site Area (m^2)	1,364,600												
Potential Infiltration (m^3)	**32,382**	**28,657**	**27,319**	**21,303**	**1,152**	**-10,507**	**-5,254**	**4,298**	**4,540**	**14,318**	**37,414**	**31,474**	**187,096**
Potential Runoff (m^3)	**60,138**	**53,219**	**50,736**	**39,562**	**2,140**	**-19,514**	**-9,757**	**7,983**	**8,431**	**26,591**	**69,483**	**58,453**	**347,464**

Table 11. Pre-Development Water Balance (Development Parcels)

Parcel	**Surficial Geology**	**Vegetation**	**Total (ha)**	**Water Surplus on Vegetated Pervious Areas (m/year)**	**Runoff Coefficient**	**Infiltration Coefficient**	**Total Runoff Volume (m^3/year)**	**Total Infiltration Volume (m^3/year)**
1	Silty Clay	Agriculture	30.30	0.392	0.65	0.35	77,222	41,581
4	Silty Clay	Agriculture	89.53	0.392	0.65	0.35	227,948	122,741
	Silty Clay	Forested	16.60	0.392	0.55	0.45	35,762	29,260
Total	-	-	**136.5**	-	-	-	**340,932**	**193,582**

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[1] *Infiltration Factors determined using MOEE (1995)*

6 Post-Development Water Balance

6.1 Methodology

A post-development water budget for the site was completed using a soil-moisture balance approach (Thornthwaite and Mather, 1957) combined with the land use plan (**Appendix A5**). As impervious surfaces lack vegetation and prevent infiltration, the transpiration component of evapotranspiration is removed from the water balance. The available water for infiltration and runoff is therefore considered to be Precipitation minus Evaporation (P-E), whereas over pervious vegetated surfaces it's considered to be Precipitation minus Evapotranspiration (P-ET). Evaporation is approximately 10% of annual precipitation, such that the water surplus available over impervious surfaces is equal to 90% of annual precipitation. Over pervious surfaces, the water surplus calculated in the pre-development water balance was utilized.

Similarly to the pre-development water budget, the surplus was partitioned using the site-specific infiltration and runoff factors determined under pre-development conditions (MOEE, 1995). These factors have been modified from the pre-development condition to take into consideration the lot-level controls such as increased topsoil depth, reduced lot grading, and increased infiltration in the proposed buffer lands and along the new channel corridor. Overall infiltration and runoff estimates for the pervious surfaces were then calculated by multiplying the water surplus value by the factors.

6.2 Post-Development Water Budget Results

Based on the proposed land use plans (**Appendix A5**), the total infiltration and runoff volumes within the tertiary plan area (136.5 ha) following development are 50,539 m^3/year and 913,547 m^3/year, respectively. The results of the calculations are provided in **Table 12**. This represents a decrease in infiltration by approximately 74% from the pre-development scenario (193,582 m^3/year), and an increase in runoff by approximately 268% from pre-development (340,932 m^3/year). The 74% decrease in infiltration assumes no mitigation strategies are in place, and therefore represents a "worst case" scenario. This volume is therefore the target when designing and implementing LID measures on site. A summary of the pre- to post-development changes in the water balance are provided in **Table 12**.

6.3 Parcel Based Post-Development Water Budget Results

To support the SPA, the post-development water balance was calculated for Parcel 1 and Parcel 4 based on the proposed land use plans (**Appendix A5**). As previously mentioned, this post-development water budget assessment focuses on the lands proposed to be developed under the current SPA.

Under pre-development conditions approximately 141.8 mm/yr or about 16% of precipitation was estimated to infiltrate on both Parcels 1 and 4 combined (**Table 11**). Infiltration is slightly higher for the parcel based assessment due to the forested lands to the north of Parcel 4, increasing the infiltration amount. The post development infiltration rates are estimated to range from 3,263 to 47,275 m^3/yr, which represents a decrease of between 69% and 92% from the pre-development condition. **Table 13** presents the unmitigated post-development water balance for Parcels 1 and 4.

Table 12. Post-Development Water Balance (Tertiary Plan Boundary)

Proposed Land Use	Surficial Geology	Total Area (ha)	Percent Imperviousness (%)	Impervious area (ha)	Surplus on Impermeable Surfaces (m/year)	Runoff from Impervious Area (m^3/year)	Estimated Pervious Area (ha)	Surplus on Vegetated Pervious Areas (m/year)	Runoff Coefficient	Runoff from Pervious Area (m^3/year)	Infiltration Coefficient	Infiltration from Pervious Area (m^3/year)	Total Runoff Volume (m^3/year)	Total Infiltration Volume (m^3/year)
Buildings and Roadways	Silty Clay	101.91	1.00	101.91	0.790	805,089	0.00	0.392	1.00	0	0.00	0	805,089	0
Channel Corridor / Landscape Area / Wetland and Forest Area	Silty Clay	28.65	0.00	0.00	0.790	0	28.65	0.392	0.55	61,769	0.45	50,539	61,769	50,539
SWM Pond	Silty Clay	5.91	1.00	5.91	0.790	46,689	0.00	0.392	1.00	0	0.00	0	46,689	0
Post-Development Parcel Total													**913,547**	**50,539**
Pre-Development Parcel Total													**340,932**	**193,582**
Difference													**572,616**	**-143,043**
% Change													**267.96%**	**-73.89%**

Table 13. Post-Development Water Balance (Development Parcels)

Parcel	Proposed Land Use	Total Area (ha)	Percent Impervious (%)	Impervious area (ha)	Surplus on Impermeable Surfaces (m/year)	Runoff from Impervious Area (m^3/year)	Estimated Pervious Area (ha)	Surplus on Pervious Areas (m/year)	Runoff Coefficient	Runoff from Pervious Area (m^3/year)	Infiltration Coefficient	Infiltration from Pervious Area (m^3/year)	Total Runoff Volume (m^3/year)	Total Infiltration Volume (m^3/year)
1	Buildings and Roadways	26.97	1.0	26.97	0.790	213,063	0.0	0.392	1.00	0	0.00	0	213,063	0
	Channel Corridor / Landscape Area / Wetland and Forest Area	1.85	0.0	0.0	0.790	0	1.85	0.392	0.55	9,055	0.45	3,263	3,989	3,263
	SWM Pond	1.52	1.0	1.52	0.790	12,008	0.0	0.392	1.00	0	0.00	0	12,008	0
	Total	**30.34**	**Post-Development Parcel 1 Total**										**229,060**	**3,263**
Pre-Development Parcel 1 Total													**77,222**	**41,581**
Difference													**151,838**	**-38,318**
% Change													**296.63%**	**-92.15%**
4	Buildings and Roadways	74.94	1.0	74.94	0.790	592,026	0.00	0.392	1.00	0	0.00	0	592,026	0
	Channel Corridor / Landscape Area / Wetland and Forest Area	26.80	0.0	0	0.790	0	26.80	0.392	0.55	7,115	0.45	47,275	57,781	47,275
	SWM Pond	4.39	1.0	4.39	0.790	34,681	0.00	0.392	1.00	0	0.00	0	34,681	0
	Total	**106.13**	**Post-Development Parcel 4 Total**										**684,488**	**47,275**
Pre-Development Parcel 4 Total													**263,710**	**152,001**
Difference													**420,778**	**-104,726**
% Change													**259.56%**	**-68.90%**
PARCELS TOTAL		**136.5**	**-**	**107.82**	**-**	**913,547**	**28.65**	**-**	**-**	**61,769**	**-**	**50,539**	**913,547**	**50,539**

6.4 Water Balance Mitigation Considerations

While balancing the pre-to-post development water budget is not a requirement of the site based on Source Water Protection, to mitigate the pre-to-post development change in infiltration, the TMIG SWM plan proposes to capture 5 mm runoff volume from the building rooftops within Parcels 1 and 4 and direct this water to LID features located within the landscaped areas.

The primary environmental reason for maintaining infiltration is to support groundwater discharge this was found to occur in the re-aligned channel and features within the 16 Mile Creek valley. Opportunities to maintain or enhance infiltration rates post-development within Parcel 4 using clean rooftop runoff are seen as a overall benefit for the project.

To maintain groundwater quality, clean rooftop runoff water is planned be directed to infiltration based LIDs in each Parcel (**Appendix A**). **Table 14** presents the approximate rooftop area and 5 mm storm volume from each Parcel that could be infiltrated to maintain the water balance for the site. This assessment assumes that based on long-term climate date from Pearson Airport, the total annual equivalent rainfall depth of all 5 mm storms is 452.9 mm/yr and assumed 10% lost to evaporation.

A pre-to-post development water budget for this site provided in **Table 14**. Based on the site conditions of groundwater levels ranging from 1.31 to 5.95 mbgs and infiltration rates ranging from 12.9 to 22.5 mm/hr, infiltration based LIDs can be suitably designed. Assuming an average LID depth of 1 m and a void ratio of 0.3, LID mitigation is expected to be effective to maintain infiltration on Parcels 1 and 4. Due to the low permeability soils, the LID should be enhanced with granular materials to increase the void space and allow for additional infiltration time.

Based on the pre-to-post development water balance presented in Table 14 for the site, infiltration has been maintained on Parcels 1 and 4 overall (+3%), with infiltration being increased on Parcel 4 to help support the natural features adjacent to this site.

Table 14. LID Infiltration Targets for Water Balance Mitigation

Parcel	Total Rooftop Area Directed to LID (ha)	5 mm Runoff Volume (m^3)	5 mm Equivalent Yearly Rainfall Depth	Proposed Infiltration Volume (m^3/yr)	Proposed Infiltration Volume less 10% Evaporation (m^3/yr)
1	14.13	70.65	452.90	63,995	57,595
4	21.90	109.50	452.90	99,185	89,267
			Total	**163,180**	**146,862**
				Infiltration Deficit (from Table 12)	**-143,043**
				% Change in Infiltration with LID Mitigation	**+3.0%**

6.5 Feature Based Water Budget

Three wetlands have been identified to be retained post-development. Each wetland was identified as a deciduous swamp community (**Appendix F**). In order to determine whether a feature based water budget would be required for each wetland, the groundwater/surface water monitoring data as well as the catchment areas for each wetland have been assessed.

6.5.1 Mineral Deciduous Swamps (MP3)

MP3 is located in a deciduous swamp found at the northern border of the site boundary adjacent to an existing rural residential community (**Figure 1**). Monitoring data from this MP indicate the swamp is surface water supported from flow that occurs from the north of the site. This wetland is located north of the proposed development and upgradient of the proposed land-use change and channel realignments. Our assessment concludes that the surface water catchment for this wetland will not be affected and is not groundwater supported. As a result, no impact to the wetland or the wetland hydroperiod is expected from the development.

6.5.2 Mineral Deciduous Swamps (MP5)

MP5 is also located in a deciduous swamp found on the north-east side of Boston Church Road (**Figure 1**). Monitoring data from this MP indicate the swamp is surface water supported from flow that occurs from the north to northeast of the site. This wetland is located north of the proposed development and upgradient of the proposed land-use change and channel realignments. Our assessment concludes that the surface water catchment for this wetland will not be affected and is not groundwater supported. As a result, no impact to the wetland or the wetland hydroperiod is expected from the development.

6.5.3 Mixed Swamp (MP2)

MP2 is located in a mixed swamp at the north east border of the site boundary. Monitoring data from this MP indicates that this wetland is both surface water and groundwater supported. The surface water catchment area for this wetland is located outside and upgradient from the proposed footprint of the development. Because of this, the surface water catchment will not be affected. However, because groundwater flows north-east through the proposed development, this wetland is directly supported by groundwater flow through the site boundary. The area that was identified to support the function of this wetland was Parcel 4. Fortunately, the area in the vicinity of MW1, MW3 and MW8 located in Parcel 4 is an optimal place for infiltration based LID that can maintain groundwater recharge/ discharge to this wetland community. It is recommended that clean rooftop drainage from the proposed buildings be utilized to protect groundwater quality. LID recommendations were provided in **Section 6.4** to assist in maintaining infiltration post development.

7 Hydrogeological Effect Assessment

7.1 Pre-to-Post Development Infiltration

The expected alterations to runoff and infiltration volumes within the tertiary plan boundary were calculated under pre- and post- development scenarios in **Sections 5 and 6**. Without mitigation, it is expected that infiltration volumes within the site boundary will be reduced from 193,582 m^3/year to 50,539 m^3/year, and runoff will be increased from 340,932 m^3/year to 913,547 m^3/year. This represents a decrease in infiltration by 74% from pre-development.

Source Water Protection for the site area does not require the balancing of the pre-to-post infiltration values. However, Parcel 4 contains two partially groundwater supported features (the swamp located at MP2, and tributary MSMC-Trib-01) that supports maintaining or enhancing infiltration values post development. The area surrounding these features are optimal for infiltration based LID due to the deep water table and permeable soils. The use of infiltration based LID would support maintaining or enhancing of infiltration values in Parcel 4.

For the overall site, it is expected that redirecting rooftop runoff from the proposed buildings would be sufficient to meet an overall site infiltration volume of 193,582 m^3/year.

7.2 Wetland Impact Assessment

Wetland and surface water hydroperiod monitoring showed that the wetland communities retained post-development located at MP3, and MP5 are surface water supported. These wetlands are located up-gradient, and outside the site boundary post-development. The surface water catchment areas of these wetlands are not expected to be affected by the development.

Wetland and surface water hydroperiod monitoring showed that the wetland containing MP2 is both surface water and groundwater discharge supported. Based on the results of groundwater monitoring at the site (**Section 3.2.1**), it was also recognized that the groundwater catchment to this feature is not restricted to the surface water catchment, as groundwater flow direction is not influenced by topography. The surface water catchment is outside of the proposed development and not is expected to be affected (TMIG, 2020). Groundwater discharge to this wetland is expected to occur from groundwater flow through the majority of the tertiary plan boundary (**Figure 6**). It is expected that groundwater discharge to this feature will be maintained through implementing the selected LID strategies on Parcel 4 to balance overall infiltration volumes and maintain groundwater discharge to this feature.

7.3 Channel Realignment

Based on the Concept Plan (**Appendix A2**), the intermittent channel running through the site (MSMC-Trib-01) is proposed to be realigned from its existing location to along the buffer limits for the woodlot and wetlands areas and protected countryside. This channel is characterized as intermittent as it receives seasonal groundwater discharge during the spring freshet and is supported through surface water runoff for the remainder of the year. This is supported through field observations of above ground surface water measurements and positive hydraulic gradients measured at the MPs installed within the feature annually in April and May. It is expected that the discharge to the feature originates from the sand and silt lens noted near the surface of MW4 (**Figures 3 and 4**). Following the spring freshet, it is expected that this channel is supported primarily through surface water runoff, and water present within the feature is perched on top of the low permeability Halton Till and fine grained glaciolacustrine soils.

Based on the results of the hydrogeological investigation, the proposed location for the channel realignment will be sufficient in supporting the natural hydrologic behaviour of the existing intermittent channel. The surficial geology of the proposed location is comprised of the same low permeability Halton Till and fine grained glaciolacustrine soils as the existing location and intersects the near surface silt and sand lens identified at MW4 and continues to MW8. In addition, as the channel realignment is situated along the same groundwater equipotential lines as the existing channel (**Figure 6**), the elevation of the groundwater table under the realigned channel is in the same range as the existing location (211.57 masl to 217.24 masl). It is therefore expected the stage of the realigned channel will follow the same behaviour, where it is primarily supported through surface water runoff through the year, with seasonal groundwater discharge during the early spring near MW4. Some added recharge may occur near MW1 due to the deep-water table and the hydraulic effects of the valleyland, however this will only increase the groundwater recharge and subsequent groundwater discharge to the wetland at MP2 and Middle Sixteen Mile Creek. It is recommended that the surface elevation of the new channel bed is regraded to approximately the same elevation as the existing channel to ensure the natural hydrologic conditions of the channel are preserved.

7.4 Long Term Foundation Dewatering

The commercial site development foundations have been proposed to be constructed using shallow slab-on-grade methods. The final floor elevations are expected to range from 219.08 masl to 225.36 masl according to preliminary engineering design drawings provided by TMIG (2018) (**Appendix A6**). Based on the water level monitoring described in **Section 3.2.1** and groundwater flow equipotential contour mapping shown on **Figure 6**, there is a minimum of 3 m of separation between the foundation elevations and the seasonally high groundwater table plus one meter, which is expected to range from approximately 210 masl in the northeast portion of the site to approximately 220 masl in the west. Construction dewatering for building foundations is therefore not expected to be required, and as such a Permit To Take Water (PTTW) from the MECP and/or registration on the Environmental and Sector Registry (EASR) is not expected to be required for the propose building foundations. Additional analysis is recommended at detailed design.

7.5 Short Term Construction Dewatering

Short term construction dewatering may be required for the installation of the storm and sanitary sewer pipelines beneath the roadways. Due to the low hydraulic conductivity of the soils (geometric mean k = 9.7×10^{-7} m/sec) and the expected shallow depths of the excavation, it is expected that groundwater seepage will be limited.

It is however recommended that a comprehensive dewatering assessment is completed once the servicing design drawings are finalized to confirm this assessment. Any dewatering greater than 50,000 L/day requires an EASR registration with the MECP.

8 Monitoring Recommendations

In accordance with the approved TOR, continuing groundwater and wetland water level monitoring for the retained wetlands and the area within the vicinity of the channel realignment is recommended to ensure these features are maintained during, and post-development. A recommended monitoring plan is outlined below:

Table 15. Groundwater and Wetland Water Level Monitoring Plan

Groundwater and Wetland Water Level Monitoring	
Monitoring Locations	**Monitoring Frequency**
• **Monitoring Well locations in the vicinity of channel realignment. (MW1, MW2, MW4, MW8)**	• **Quarterly manual monitoring during construction, and for 3-years post-construction.** • **Install dataloggers for continuous monitoring.**
Surface Water Monitoring	
• **Mini-piezometer locations in the vicinity of channel realignment and within retained wetland communities. (MP2, MP3, MP4, MP5, MP11)**	• **Quarterly monitoring during construction, and for 3-years post-construction.** • **Install dataloggers for continuous monitoring.**

9 Summary and Conclusions

Based on the results of our investigation, the following summary of conclusions and recommendations are presented:

- The project site consists of approximately 136.5 ha of land at the intersection of James Snow Parkway and Esquesing Line in Milton, Ontario. Within the site area, approximately 107.8 ha has been proposed for commercial land development. Currently, the site consists mainly of agricultural land uses.

- The surficial geology at the site as encountered through borehole drilling investigations consists of clayey silt textured Halton Till. The hydraulic conductivity of this unit was estimated to be $9.7\text{x}10^{-7}$ m/sec based on single well response testing. More permeable shallow lenses of glaciolacustrine silty to sandy silt soils are common within the till. The hydraulic conductivity of these soils was estimated to be $5.7\text{x}10^{-6}$ m/sec.

- Groundwater flow direction is interpreted to be strongly influenced by the presence of Middle Sixteen Mile Creek, and is generally towards the north/northeast.

- Measurements from the fifteen (15) mini-piezometers installed within the site indicated that seasonal groundwater discharge occurs at the mixed swamp wetland in the northern corner of the site containing MP2, as well as to the intermittent drainage channel bisecting the site (MSMC-Trib-01), and the portion of Middle Sixteen Mile Creek containing MP1. These features are supported through runoff for the remainder of the year. The remaining natural features (the mineral deciduous swamp containing MP3, the mineral meadow marsh containing MP7, and the MSMC-Trib-02 and SMC-Trib-01 drainage features) are supported through surface water runoff only.

- Groundwater levels were investigated at the twelve (12) monitoring wells installed by Palmer between June 2015 – May 2016, November 2017 – August 2018, and January 2019 – June 2020. The seasonally high water table was recorded in the spring of each year, and at its highest recorded period ranged from 210 masl (MW1) to 219.96 masl (MW6). The groundwater elevation beneath MSMC-Trib-02 ranged from 211.5 masl to 216.84 masl.

- Hydraulic conductivity (k) was estimated using Single Well Response Tests (SWRTs) completed at each monitoring well. Based on these results, the geometric mean k value of the Halton Till was $9.7\text{x}10^{-7}$ m/sec, and ranged from $4.7\text{x}10^{-8}$ m/sec to $8.0\text{x}10^{-6}$ m/sec. The k value of the glaciolacustrine silt to sandy silt soils had a geometric mean of $5.7\text{x}10^{-6}$ m/sec, and ranged from $3.0\text{x}10^{-7}$ m/sec to $5.1\text{x}10^{-5}$ m/sec. This unit was encountered during drilling between 1.9 mbgs (MW4) and 6.2 mbgs (MW2 and MW8).

- Infiltration testing of the native soils at the site indicated infiltration rates of between 12.9 and 22.5 mm/hour, with an average rate of 16.2 mm/hour. These values are within a suitable range to implement LID measures to maintain the water budget post-development.

- Source Water Protection mapping determined that the proposed development is approximately 3.5 km from the nearest WHPAs associated with the Kelso Municipal Supply Well Field and are outside of designated WHPA-Q1 and WHPA-Q2 recharge management areas. The study area is additionally not within any designated HVA or SGRA areas

- Under pre-development conditions, infiltration volumes within the tertiary plan boundary are approximately 193,582 m^3/year, and runoff is approximately 340,932 m^3/year. Based on the proposed development land use and without the use of mitigation techniques, infiltration volumes will decrease post development to 50,539 m3/year, which is a decrease of 74% from pre-development.

- Source Water Protection mapping determined that the study area does not have significant groundwater function that requires maintaining the pre-to-post development infiltration rates. However, two groundwater supported natural features (the swamp located at MP2, and tributary MSMC-Trib-01) identified in Parcel 4 require infiltration be maintained post development.

- Maintaining infiltration values in Parcel 4 will support the function of the groundwater supported natural features. It is recommended that clean rooftop drainage from the proposed buildings be utilized to protect groundwater quality. It is expected that infiltration based LIDs should be sufficient to meet the infiltration target of 193,582 m^3/year.

- The proposed foundation base levels are expected to be above the seasonally high water table plus one meter, and therefore it is not expected that significant construction dewatering will be required.

- The elevation of the realigned channel is expected to follow the same behaviour and natural hydrologic conditions as the existing channel. The surficial geology is the same in the realigned location, such that the low permeability silt and clay soils at surface restricts infiltration and discharge. In addition, the realigned channel includes the same near surface silt and sand lens that promotes seasonal groundwater discharge and an intermittent regime. As the realigned channel is situated along the same groundwater equipotential lines as the existing channel, it is recommended that the surface elevation of the new channel bed is regraded to approximately the same elevation as the existing channel, as this will ensure possible groundwater contributions to the channel remain consistent. Additional groundwater recharge may occur near MW1 due to the deep water table and hydraulic effects of the valleyland in this location.

10 Signatures

This report was prepared and reviewed by the undersigned:

Prepared By: ______________________________

Nolan Boyes, M.Sc.
Environmental Scientist

PROFESSIONAL GEOSCIENTIST
R. JASON COLE
PRACTISING MEMBER
1902
ONTARIO

Reviewed By: ______________________________

Jason Cole, M.Sc., P.Geo.
Principal, Senior Hydrogeologist

11 Statement of Limitations

The extent of this study was limited to the specific scope of work for which we were retained and that is described in this report. Palmer has assumed that the information provided by the client or any secondary sources of information are factual and accurate. Palmer accepts no responsibility for any deficiency, misstatement or inaccuracy contained in this report as a result of omissions, misinterpretations or negligent acts from relied upon data. Judgment has been used by Palmer in the interpretation of the information provided but subsurface physical and chemical characteristics may differ from regional scale geology mapping and vary between or beyond well/borehole locations given the inherent variability in geological conditions.

Palmer is not a guarantor of the geological or groundwater conditions at the subject site, but warrants only that its work was undertaken and its report prepared in a manner consistent with the level of skill and diligence normally exercised by competent geoscience professionals practicing in the Province of Ontario. Our findings, conclusions and recommendations should be evaluated in light of the limited scope of our work.

The information and opinions expressed in the Report are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT PALMER'S WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS PALMER MAY EXPRESSLY APPROVE. Ownership in and copyright for the contents of the Report belongs to Palmer. Any use which a third party makes of the Report is the sole responsibility of such third party. Palmer accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without Palmer's express written permission. Should the project design change following issuance of the Report, Palmer must be provided the opportunity to review and revise the Report in light of such alteration or variation.

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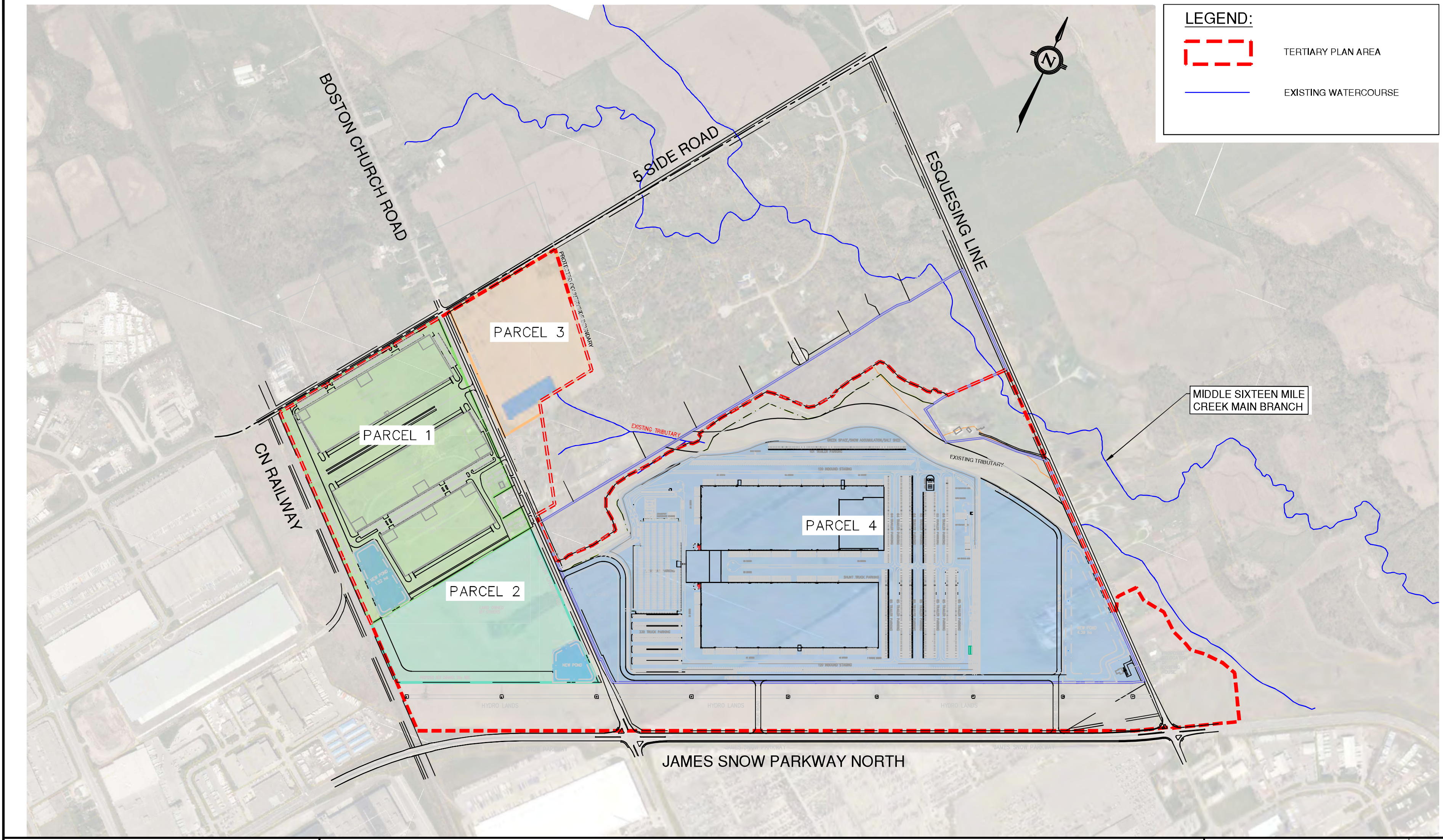
Appendix A

Site Drawings

A1. Proposed Development Plan (TMIG, March, 2021)
A2. Concept Plan A-1 (Orlando, March 29, 2021)
A3. Existing Watercourses and Drainage Areas (TMIG, 2021)
A4. Proposed Conditions Drainage Areas (TMIG, 2021)
A5. Development Parcel Land Use Plan (GSAI, 2020)
A6. Grading Plan (TMIG, 2018)

Appendix A1

Proposed Development Plan (TMIG, March, 2021)



File : G:\Projects\2017\17197 - Orlando - North Porta\3. Drawings\6. SWM\FSR FIGURES\FIG 1-2 - Proposed development Plan.dwg,   Layout : 1-2   Date : Mar 23, 2021 - 1:49pm,   Edit By : TCASTOR

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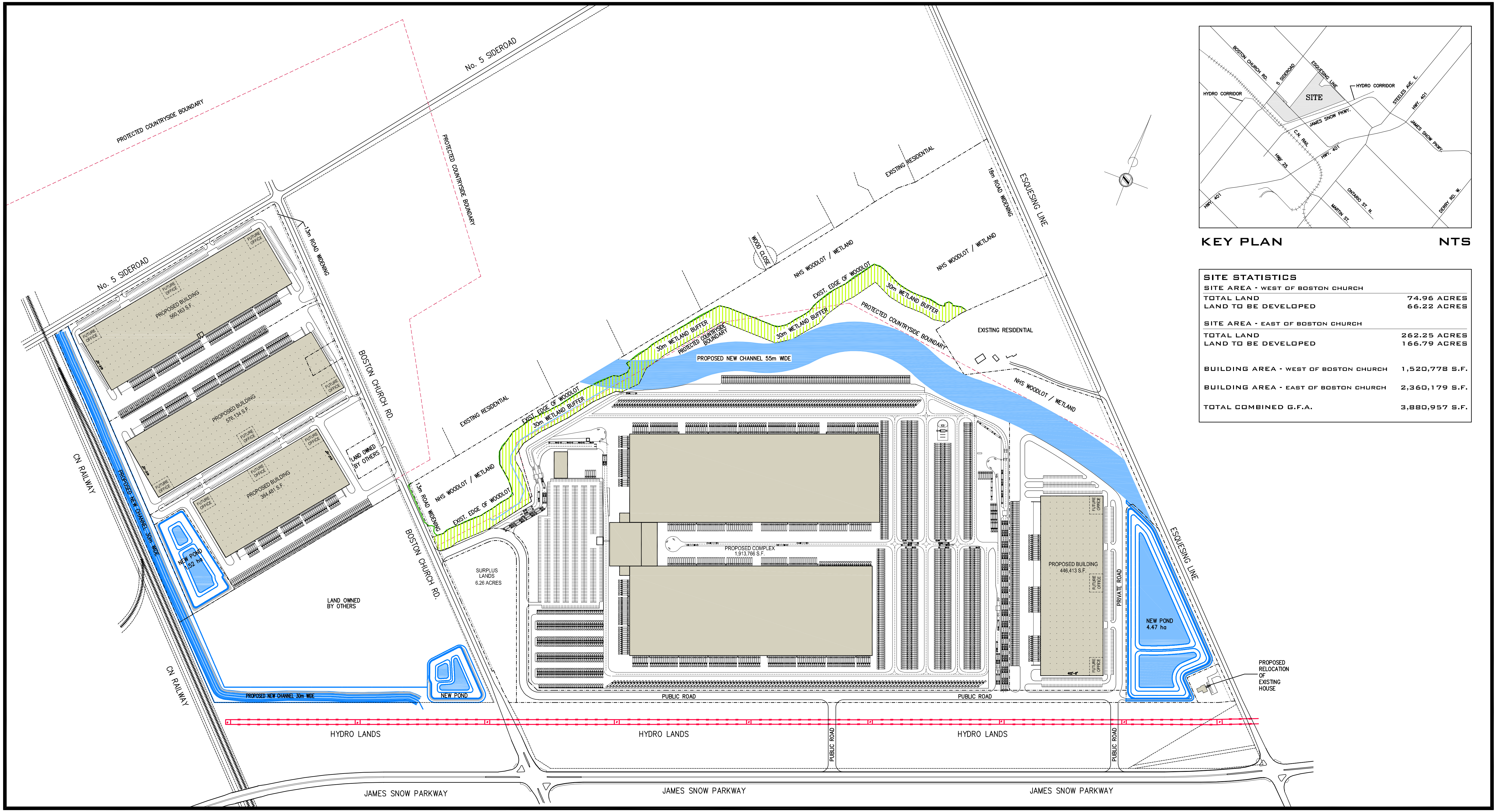
ORLANDO - NORTH PORTA

PROPOSED DEVELOPMENT PLAN

SCALE: 1:10000
DATE: MARCH 2021
DESIGNED BY: T.D.
DRAWN BY: J.P./M.M.
CHECKED BY: E.T.
CHECKED BY: E.T.
PROJECT No. 17197
FIGURE No. 1-2

Appendix A2

Concept Plan A-1 (Orlando, March 29, 2021)



KEY PLAN NTS

SITE STATISTICS

SITE AREA - WEST OF BOSTON CHURCH	
TOTAL LAND	74.96 ACRES
LAND TO BE DEVELOPED	66.22 ACRES
SITE AREA - EAST OF BOSTON CHURCH	
TOTAL LAND	262.25 ACRES
LAND TO BE DEVELOPED	166.79 ACRES
BUILDING AREA - WEST OF BOSTON CHURCH	1,520,778 S.F.
BUILDING AREA - EAST OF BOSTON CHURCH	2,360,179 S.F.
TOTAL COMBINED G.F.A.	3,880,957 S.F.

N

ORLANDO

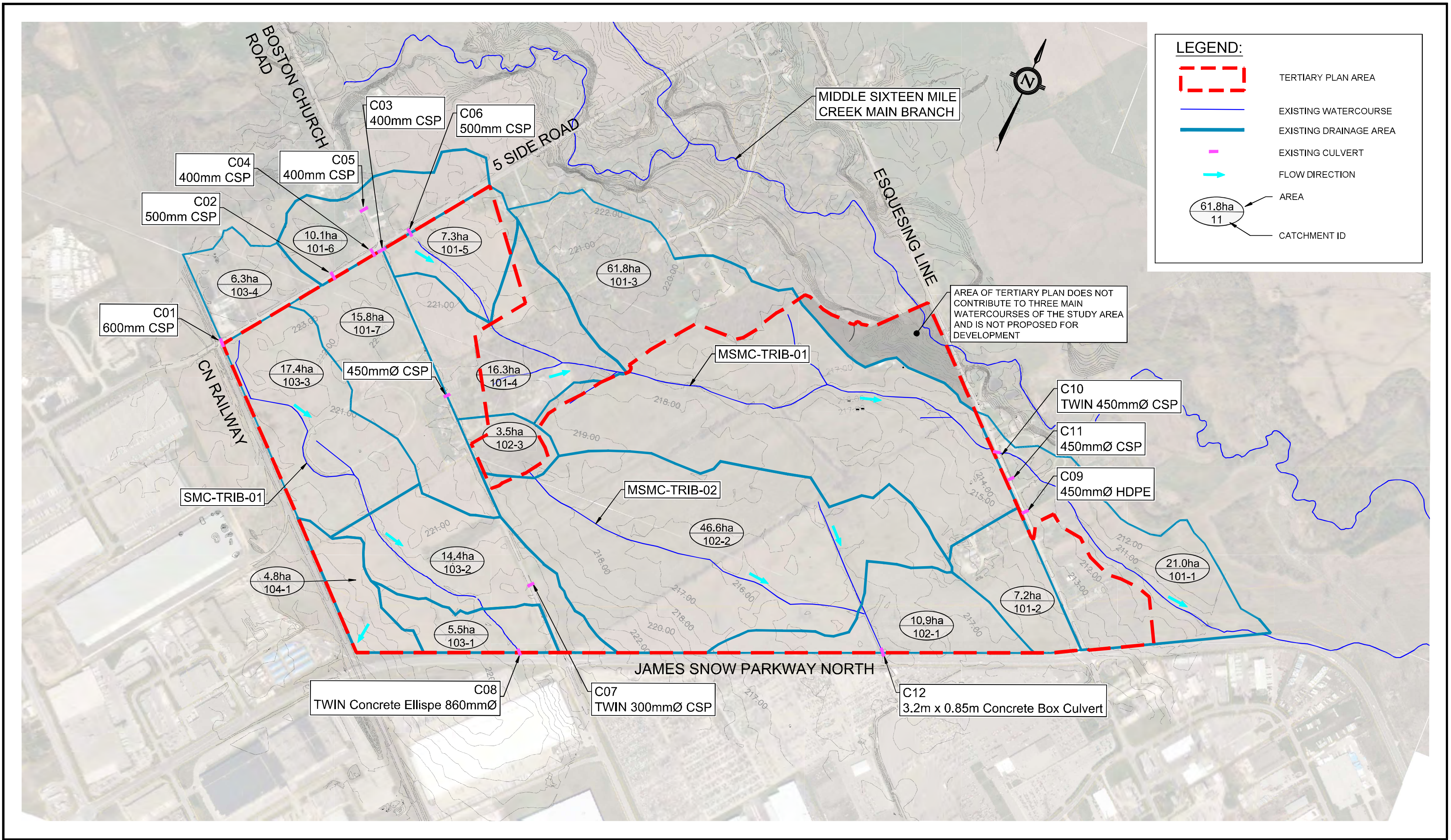
Milton North Business Park
Milton, Ontario

CONCEPT PLAN
SCALE: 1:2500
DATE: MARCH 29, 2021

A-1

Appendix A3

Existing Watercourses and Drainage Areas (TMIG, 2021)



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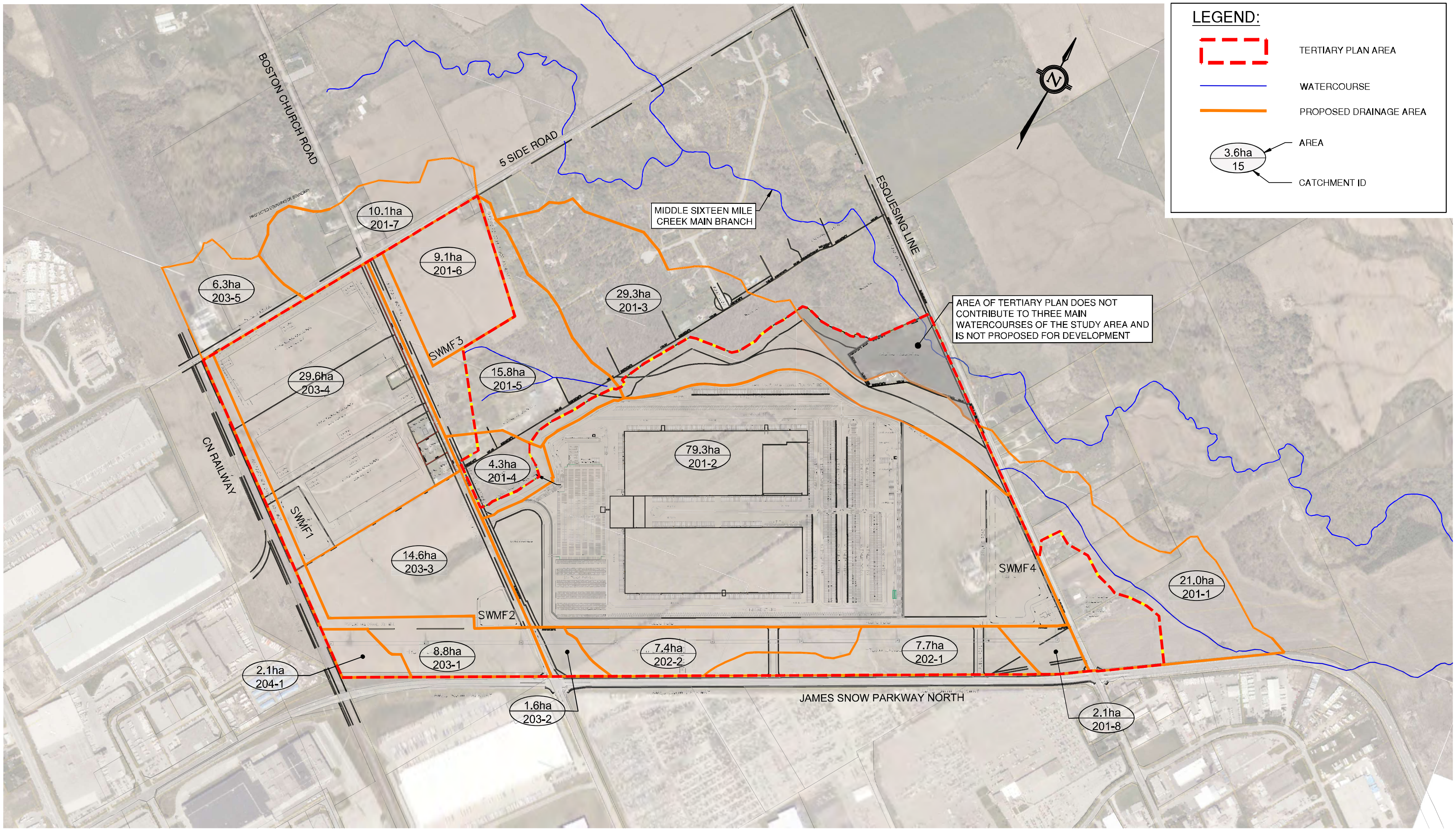
ORLANDO - NORTH PORTA
EXISTING WATERCOURSES AND DRAINAGE AREAS

SCALE: 1:10,000
DATE: MARCH 2021
DESIGNED BY: T.D.
DRAWN BY: J.P./M.M.
CHECKED BY: E.T.
CHECKED BY: E.T.
PROJECT No. 17197
FIGURE No. 2-1

File : G:\Projects\2017\17197 - Orlando - North Porta\3. Drawings\6. SWM\FSR FIGURES\FIG 2-1 - Existing Watercourses and Drainage Areas.dwg, Layout : 2-1 Date :Mar 22, 2021 - 11:18am, Edit By : TCASTOR

Appendix A4

Proposed Conditions Drainage Areas (TMIG, 2021)



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f: 905.738.0065

ORLANDO - NORTH PORTA
PROPOSED CONDITIONS DRAINAGE AREAS

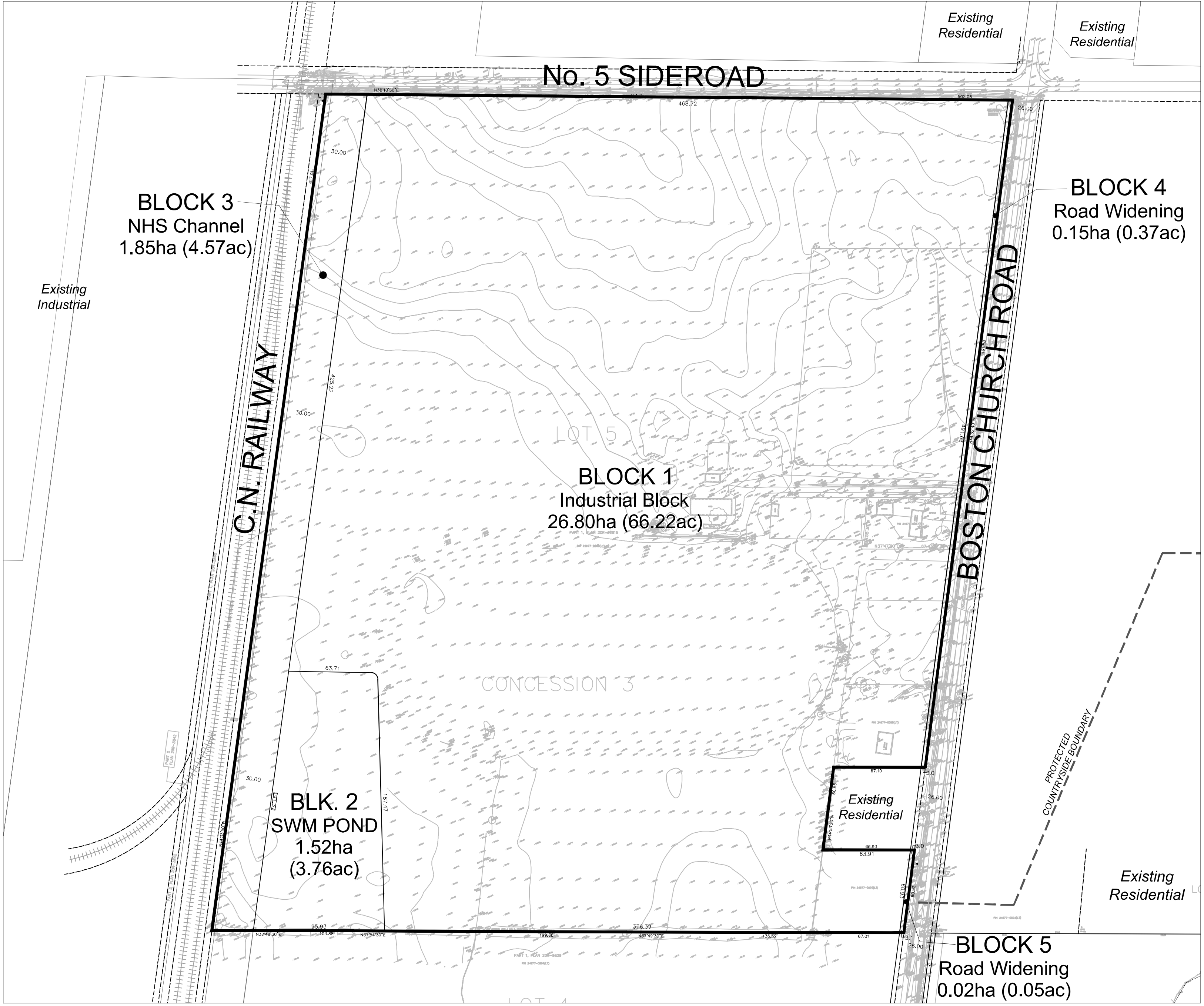
SCALE: 1:10,000
DATE: MARCH 2021
DESIGNED BY: T.D.
DRAWN BY: J.P./M.M.
CHECKED BY: E.T.
CHECKED BY: E.T.
PROJECT No. 17197
FIGURE No. 3-1

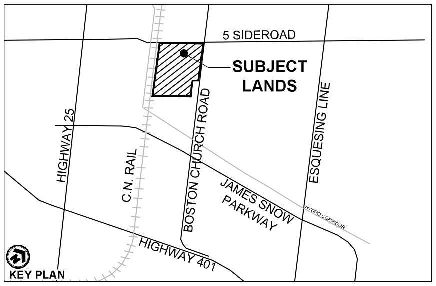
File : G:\Projects\2017\17197 - Orlando - North Porta\3. Drawings\6. SWM\FSR FIGURES\FIG 3-1 - Proposed Drainage Areas.dwg, Layout : 3-1 Date :Mar 23, 2021 - 2:11pm, Edit By : TCASTOR

Appendix A5

Development Parcel Land Use Plan (TMIG, 2020)

K:\314-006\2020 07 July\DP West July 23 20.dwg





DRAFT PLAN OF SUBDIVISION ORLANDO CORPORATION

PART OF LOT 5, CONCESSION 3,
TOWNSHIP OF ESQUESING
REGIONAL MUNICIPALITY OF HALTON

OWNERS CERTIFICATE

I HEREBY AUTHORIZE GLEN SCHNARR & ASSOCIATES INC. TO PREPARE AND SUBMIT THIS DRAFT PLAN OF SUBDIVISION TO THE TOWN OF MILTON FOR APPROVAL.

SIGNED ____________________ DATE ______________

PHIL KING, PRESIDENT
ORLANDO CORPORATION

SURVEYORS CERTIFICATE

I HEREBY CERTIFY THAT THE BOUNDARIES OF THE LANDS TO BE SUBDIVIDED AS SHOWN ON THIS PLAN AND THEIR RELATIONSHIP TO ADJACENT LANDS ARE CORRECTLY AND ACCURATELY SHOWN.

SIGNED ____________________ DATE ______________

ALISTER SANKEY, O.L.S.

David B.Searles Surveying Ltd.
ONTARIO LAND SURVEYORS
4284 VILLAGE CENTRE COURT, MISSISSAUGA, ONTARIO L4Z 1S2
(905) 273-6840 FAX: (905) 896-4410
E MAIL: DBSOLS @ ON.AIBN.COM

ADDITIONAL INFORMATION

(UNDER SECTION 51(17) OF THE PLANNING ACT) INFORMATION REQUIRED BY CLAUSES A,B,C,D,E,F,G, & J ARE SHOWN ON THE DRAFT AND KEY PLANS.

H) MUNICIPAL AND PIPED WATER TO BE PROVIDED
I) SANDY LOAM AND CLAY LOAM
K) SANITARY AND STORM SEWERS TO BE PROVIDED

LAND USE SCHEDULE

LAND USE	BLOCKS	AREA (ha)	AREA (ac)
Industrial Block	1	26.80	66.22
SWM Pond	2	1.52	3.76
NHS Channel	3	1.85	4.57
Road Widening	4,5	0.17	0.42
TOTAL	**5**	**30.34**	**74.97**

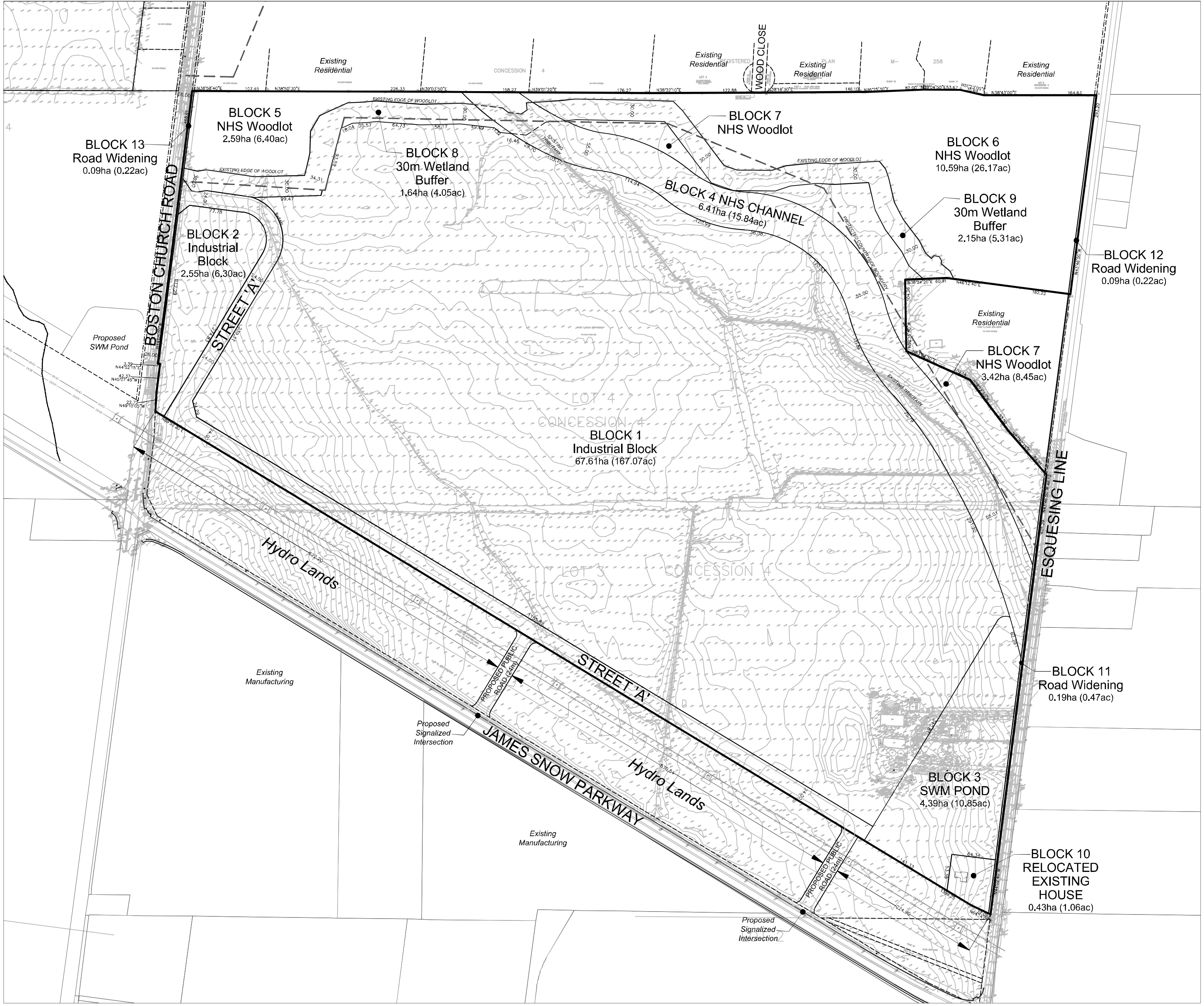
NOTES

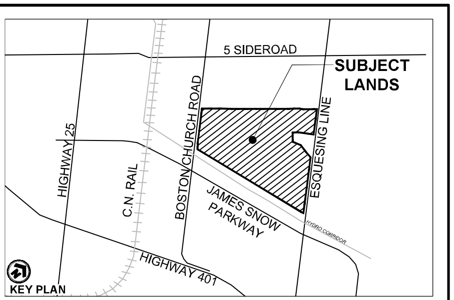
- Base mapping obtained from DB Searles

Scale 1:1250
(24 x 36)
JULY 23, 2020

GSAI

K:\314-006\2020 07 July\DP East July 23 20.dwg





DRAFT PLAN OF SUBDIVISION ORLANDO CORPORATION

PART OF LOT 3 AND 4, CONCESSION 4,
TOWNSHIP OF ESQUESING
REGIONAL MUNICIPALITY OF HALTON

OWNERS CERTIFICATE

I HEREBY AUTHORIZE GLEN SCHNARR & ASSOCIATES INC. TO PREPARE AND SUBMIT THIS DRAFT PLAN OF SUBDIVISION TO THE TOWN OF MILTON FOR APPROVAL.

SIGNED ____________________ DATE ____________________

PHIL KING, PRESIDENT
ORLANDO CORPORATION

SURVEYORS CERTIFICATE

I HEREBY CERTIFY THAT THE BOUNDARIES OF THE LANDS TO BE SUBDIVIDED AS SHOWN ON THIS PLAN AND THEIR RELATIONSHIP TO ADJACENT LANDS ARE CORRECTLY AND ACCURATELY SHOWN.

SIGNED ____________________ DATE ____________________

ALISTER SANKEY, O.L.S.

David B.Searles Surveying Ltd.
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ADDITIONAL INFORMATION

(UNDER SECTION 51(17) OF THE PLANNING ACT) INFORMATION REQUIRED BY CLAUSES A,B,C,D,E,F,G, & J ARE SHOWN ON THE DRAFT AND KEY PLANS.

H) MUNICIPAL AND PIPED WATER TO BE PROVIDED
I) SANDY LOAM AND CLAY LOAM
K) SANITARY AND STORM SEWERS TO BE PROVIDED

LAND USE SCHEDULE

LAND USE	BLOCKS	AREA (ha)	AREA (ac)
Industrial Block	1,2	70.16	173.37
SWM Pond	3	4.39	10.85
NHS Channel	4	6.41	15.84
NHS Woodlot	5 - 7	16.60	41.02
30m Wetland Buffer	8,9	3.79	9.37
Relocated Existing House	10	0.43	1.06
Road Widening	11 - 13	0.37	0.91
26.0m R.O.W. (1,645m Length)		3.98	9.83
TOTAL	**13**	**106.13**	**262.25**

NOTES

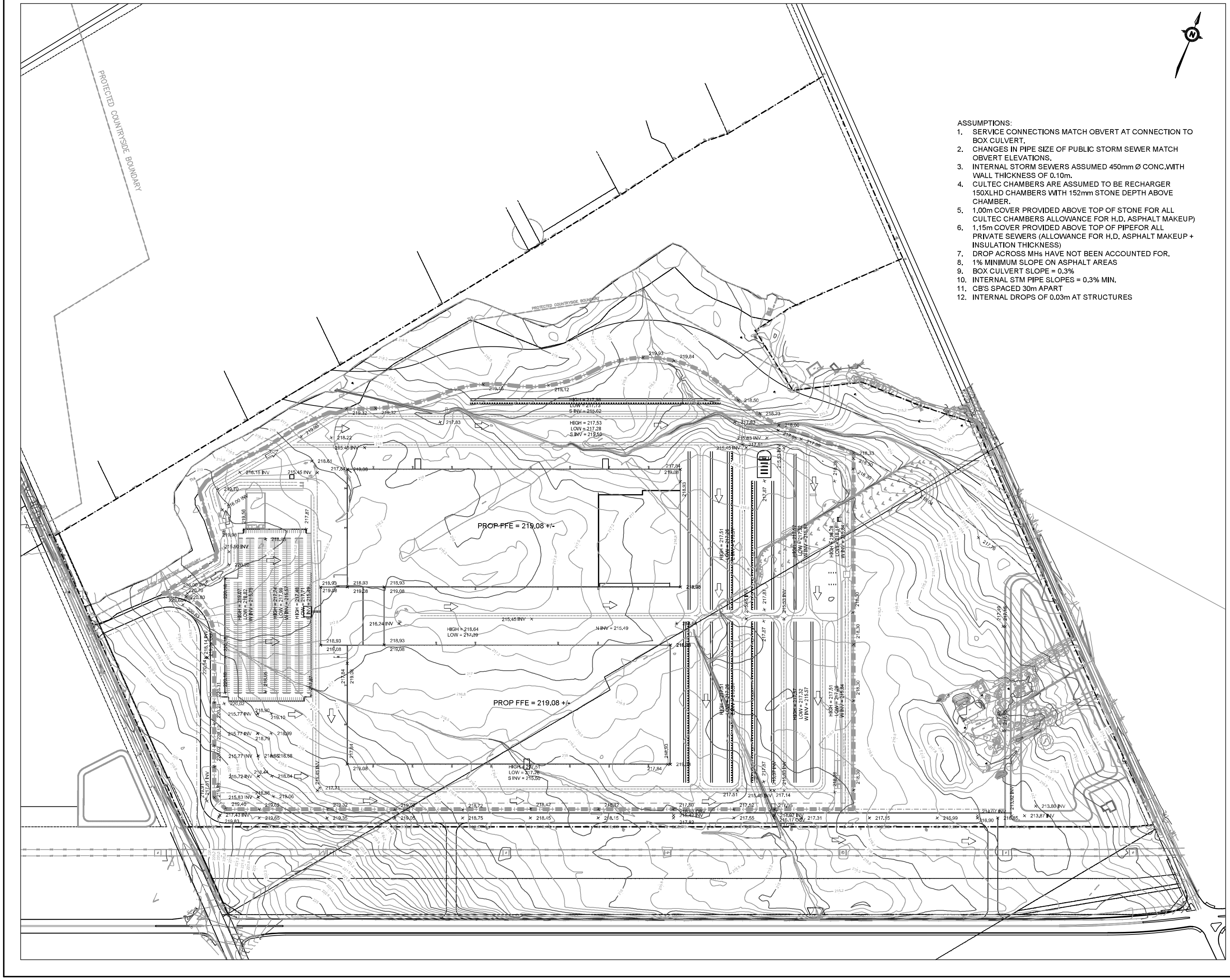
-Base mapping obtained from DB Searles
-daylight triangle at Street 'A' and Boston Church Road: 15m x 15m

Scale 1:2500
(24 x 36)
JULY 23, 2020

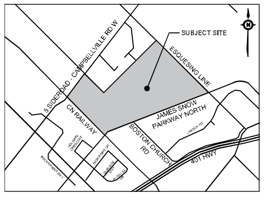
GSAI

Appendix A6

Grading Plan (TMIG, 2018)



ASSUMPTIONS:
1. SERVICE CONNECTIONS MATCH OBVERT AT CONNECTION TO BOX CULVERT.
2. CHANGES IN PIPE SIZE OF PUBLIC STORM SEWER MATCH OBVERT ELEVATIONS.
3. INTERNAL STORM SEWERS ASSUMED 450mm Ø CONC.WITH WALL THICKNESS OF 0.10m.
4. CULTEC CHAMBERS ARE ASSUMED TO BE RECHARGER 150XLHD CHAMBERS WITH 152mm STONE DEPTH ABOVE CHAMBER.
5. 1.00m COVER PROVIDED ABOVE TOP OF STONE FOR ALL CULTEC CHAMBERS ALLOWANCE FOR H.D. ASPHALT MAKEUP)
6. 1.15m COVER PROVIDED ABOVE TOP OF PIPEFOR ALL PRIVATE SEWERS (ALLOWANCE FOR H.D. ASPHALT MAKEUP + INSULATION THICKNESS)
7. DROP ACROSS MHs HAVE NOT BEEN ACCOUNTED FOR.
8. 1% MINIMUM SLOPE ON ASPHALT AREAS
9. BOX CULVERT SLOPE = 0.3%
10. INTERNAL STM PIPE SLOPES = 0.3% MIN.
11. CB'S SPACED 30m APART
12. INTERNAL DROPS OF 0.03m AT STRUCTURES



KEY PLAN
N.T.S.

ADDRESS:
PART OF LOT 3 & 4 CONCESSION 3
JAMES SNOW PARKWAY NORTH, MILTON, ON

LEGEND

SEE ABBREVIATIONS BELOW

× 200.00 0.5% MH 1A — PROPOSED ITEMS
× 200.00 0.5% EX MH 1A — EXISTING ITEMS
LIMIT OF PROPERTY LINE
LIMIT OF CONSTRUCTION
LIMIT OF BUILDING STRUCTURE
LIMIT OF UNDERGROUND STRUCTURE
LIMIT OF ROOF STRUCTURE
BUILDING ENTRANCE
× 200.00 — PROP ELEVATION TO MATCH EXISTING
EMERGENCY OVERLAND FLOW ROUTE
SANITARY MH
STM MH / CBMH / DCBMH / OGS
CB / DCB / AD / TD
HYDRANT / SIAMESE / METER CHAMBER
VALVE BOX / VALVE CHAMBER

BENCHMARK:	ELEVATIONS ARE GEODETIC, IN METRES, AND RELATED TO: CITY OF MILTON BENCHMARK No. 00820080018, ELEVATION OF 207.261m
BEARING:	BEARINGS ARE GRID BEARINGS DERIVED FROM SPECIFIED CONTROL POINTS 00820080018 & 00820080019
SITE PLAN:	ORLANDO CORPORATION, 170927
SURVEY:	DAVID D. SEARLES SURVEYING LTD., 171025

NO.	ISSUE	DATE	BY
1			B.D.

DRAWING NOTES

NOT FOR CONSTRUCTION

1. THIS DRAWING IS THE EXCLUSIVE PROPERTY OF THE MUNICIPAL INFRASTRUCTURE GROUP LTD (TMIG). THE REPRODUCTION OF ANY PART WITHOUT PRIOR WRITTEN CONSENT FROM TMIG IS STRICTLY PROHIBITED.
2. THIS DRAWING IS TO BE READ AND UNDERSTOOD IN CONJUNCTION WITH ALL OTHER DRAWINGS AND DOCUMENTS APPLICABLE TO THIS PROJECT.
3. THIS DRAWING IS NOT TO BE ISSUED FOR CONSTRUCTION UNTIL ALL REQUIRED PERMITS HAVE BEEN ISSUED.
4. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS, ELEVATIONS, INVERTS AND DATA ON SITE AND REPORT ANY DISCREPANCIES OR OMISSIONS TO TMIG 48 HOURS PRIOR TO ANY CONSTRUCTION.

ABBREVIATIONS

GENERAL:
PROP = PROPOSED
EX = EXISTING

ELEVATIONS:
TC = TOP OF CURB
BC = BOTTOM OF CURB

TW = TOP OF WALL
BW = BOTTOM OF WALL

SERVICING:
STM = STORM
SAN = SANITARY
WAT = WATER
PVC = POLYVINYL CHLORIDE

HDPE = HIGH DENSITY POLYETHYLENE
CONC = CONCRETE
MH = MAINTENANCE HOLE
CB = CATCH BASIN
DCB = DOUBLE CATCH BASIN
AD = AREA DRAIN
TD = TRENCH DRAIN

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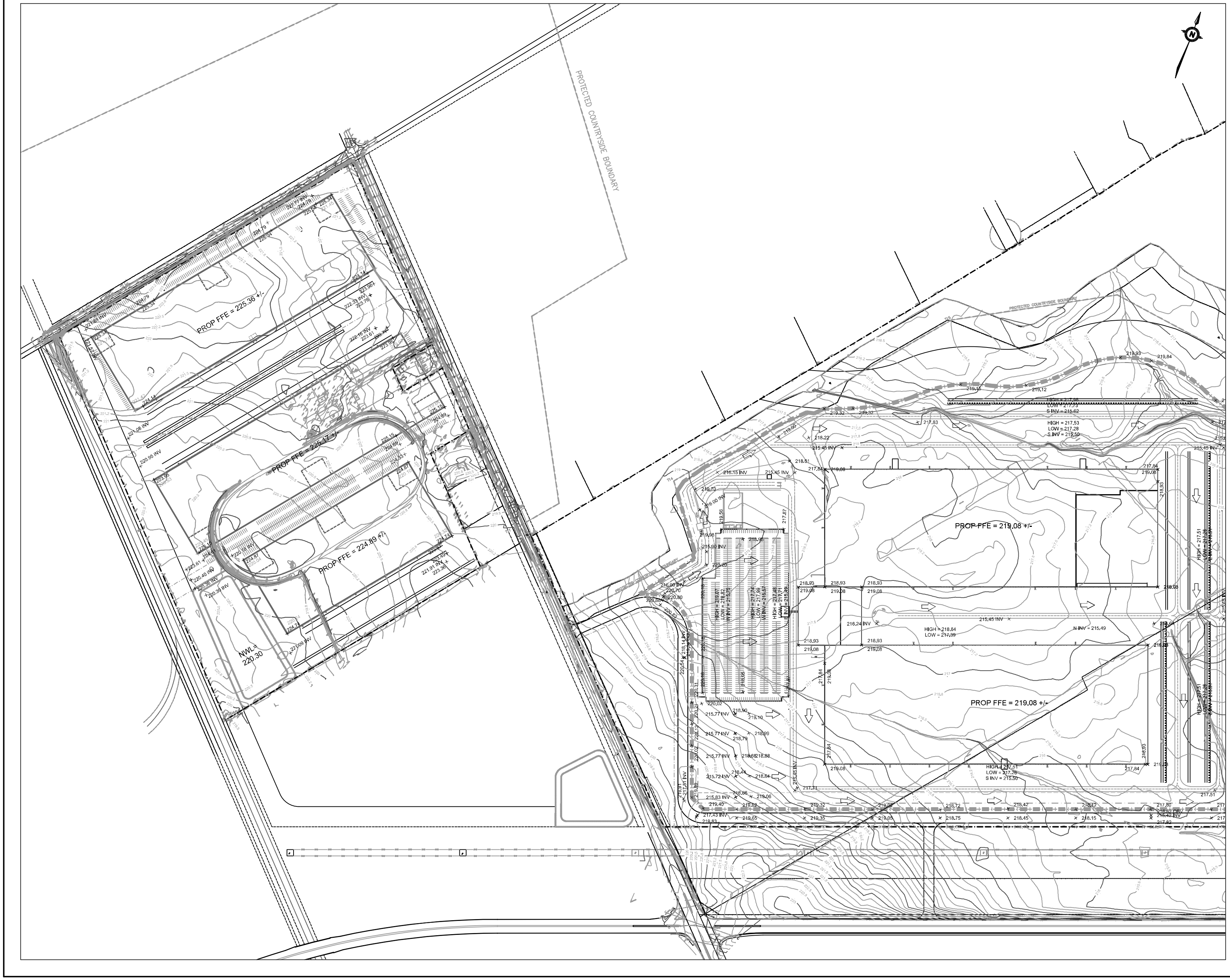
ORLANDO CORPORATION
NORTH PORTA

GRADING PLAN

SCALE:	1:2500 40m	PROJECT #	17197
DATE:	APRIL 2018		
DRAWN BY:	B.G.	DRAWING #	G1
DESIGNED BY:	B.G./B.D.		
CHECKED BY:	B.D.		

File : G:\Projects\2017\17197 - Orlando - North Porta\3. Drawings\3. Design Drawings\17197 DESIGN - GRADING 210322.dwg, Layout : G1 Date : Mar 23, 2021 - 12:44pm, Edit By : TCASTOR



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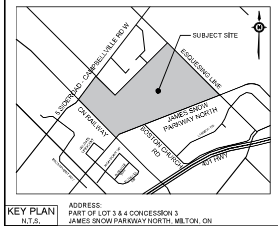

KEY PLAN
N.T.S.

ADDRESS:
PART OF LOT 3 & 4 CONCESSION 3
JAMES SNOW PARKWAY NORTH, MILTON, ON

LEGEND

SEE ABBREVIATIONS BELOW

200.00 0.5% MH 1A — PROPOSED ITEMS
200.00 0.5% EX MH 1A — EXISTING ITEMS
LIMIT OF PROPERTY LINE
LIMIT OF CONSTRUCTION
LIMIT OF BUILDING STRUCTURE
LIMIT OF UNDERGROUND STRUCTURE
LIMIT OF ROOF STRUCTURE
BUILDING ENTRANCE
200.00 — PROP ELEVATION TO MATCH EXISTING
EMERGENCY OVERLAND FLOW ROUTE
SANITARY MH
STM MH / CBMH / DCBMH / OGS
CB / DCB / AD / TD
HYDRANT / SIAMESE / METER CHAMBER
VALVE BOX / VALVE CHAMBER

BENCHMARK:	ELEVATIONS ARE GEODETIC, IN METRES, AND RELATED TO: CITY OF MILTON BENCHMARK No. 00820080018, ELEVATION OF 207.261m
BEARING:	BEARINGS ARE GRID BEARINGS DERIVED FROM SPECIFIED CONTROL POINTS 00820080018 & 00820080019
SITE PLAN:	ORLANDO CORPORATION, 170927
SURVEY:	DAVID D. SEARLES SURVEYING LTD., 171025

NO.	ISSUE	DATE	BY
1			B.D.

DRAWING NOTES

NOT FOR CONSTRUCTION

1. THIS DRAWING IS THE EXCLUSIVE PROPERTY OF THE MUNICIPAL INFRASTRUCTURE GROUP LTD (TMIG). THE REPRODUCTION OF ANY PART WITHOUT PRIOR WRITTEN CONSENT FROM TMIG IS STRICTLY PROHIBITED.
2. THIS DRAWING IS TO BE READ AND UNDERSTOOD IN CONJUNCTION WITH ALL OTHER DRAWINGS AND DOCUMENTS APPLICABLE TO THIS PROJECT.
3. THIS DRAWING IS NOT TO BE ISSUED FOR CONSTRUCTION UNTIL ALL REQUIRED PERMITS HAVE BEEN ISSUED.
4. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS, ELEVATIONS, INVERTS AND DATA ON SITE AND REPORT ANY DISCREPANCIES OR OMISSIONS TO TMIG 48 HOURS PRIOR TO ANY CONSTRUCTION.

ABBREVIATIONS

GENERAL:
PROP = PROPOSED
EX = EXISTING

ELEVATIONS:
TC = TOP OF CURB
BC = BOTTOM OF CURB

TW = TOP OF WALL
BW = BOTTOM OF WALL

SERVICING:
STM = STORM
SAN = SANITARY
WAT = WATER
PVC = POLYVINYL CHLORIDE

HDPE = HIGH DENSITY POLYETHYLENE
CONC = CONCRETE
MH = MAINTENANCE HOLE
CB = CATCH BASIN
DCB = DOUBLE CATCH BASIN
AD = AREA DRAIN
TD = TRENCH DRAIN

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W: www.tmig.ca

ORLANDO CORPORATION
NORTH PORTA

GRADING PLAN

SCALE:	
DATE:	APRIL 2018
DRAWN BY:	B.G.
DESIGNED BY:	B.G./B.D.
CHECKED BY:	B.D.

PROJECT #
17197

DRAWING #
G2

Appendix B

Borehole Logs (Palmer, 2015; Palmer, 2018)

Appendix B

Borehole Logs (Palmer, 2015; Palmer, 2018)

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

LOG OF BOREHOLE MW1

1 OF 1

PROJECT: Milton Land Development, Milton, ON
CLIENT: Orlando Corporation
PROJECT LOCATION: Milton, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan (UTM 17T) N 4822303 E 596967

Method: Hollow Stem Auger
Diameter: 215
Date: Jul-14-2015

REF. NO.: 180041
ENCL NO.: 1

SOIL PROFILE

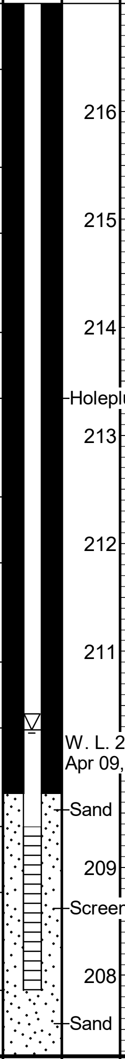
(m) ELEV / DEPTH	DESCRIPTION
217.0	Ground Surface
216.9 0.0 0.2	**SILT:** dark brown, organic-rich (rootlets), loose
	CLAYEY SILT TO SILT TILL: brown to red-brown, trace gravel, dry, loose mottled brown-grey below 1.8 m
214.0 213.9 3.1	**SAND:** grey, fine to medium sand, wet to moist, compact
213.6 3.4 3.5	**SILT:** light brown, trace sand, wet to moist, compact
	CLAYEY SILT TO SILT TILL: brown to red-brown, trace gravel, dry, compact to very dense cobbles @ 4.70 m
212.3 4.7	**SILTY SAND TO SANDY SILT:** brown, fine to medium sand, trace gravel, dry to wet, dense to very dense till lens with organics @ 6.10 m wet below 6.20 m
207.3 9.8	**END OF BOREHOLE** Notes: 1. Upon completion of drilling, a 50mm diameter monitoring well was installed in the borehole. 2. Water level measured on April 9, 2018: 6.73 mbgs Well Installation Details: Bentonite: 0-7.32 m Sand: 7.32-7.62m Screened Length: 7.62-9.14 m Sand: 9.14-9.75m

SAMPLES

NUMBER	TYPE	"N" BLOWS/0.3 m
1	SS	6
2	SS	5
3	SS	28
4	SS	64
5	SS	43
6	SS	33
7	SS	32

GROUND WATER CONDITIONS

ELEVATION



DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT W_P — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_L

WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m^3)

REMARKS AND GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES $+^3, \times^3$: Numbers refer to Sensitivity ○ ^{8}=3% Strain at Failure

LOG OF BOREHOLE MW10

PROJECT: Milton Land Development, Milton, ON
CLIENT: Orlando Corporation
PROJECT LOCATION: Milton, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan (UTM 17T) N 4821981.86 E 589168.23

Method: Solid Stem Auger
Diameter: 152.4
Date: Mar-27-2018

REF. NO.: 180041
ENCL NO.: 10

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS / 0.3 m	GROUND WATER CONDITIONS	ELEVATION
216.3	Ground Surface					
0.0	**SILTY CLAY:** dark brown, trace sand, trace organics, moist, firm to stiff	1	SS	5		216
		2	SS	9		215
214.9 1.4	**SILTY CLAY TILL:** brown to red-brown, mottled, trace gravel, occasional fine sand lens, dry to moist, very stiff to hard	3	SS	41	Holeplug W. L. 214.7 m Apr 09, 2018	
		4	SS	30		214
		5	SS	63	Sand	213
	grey below 3.6 m					212
		6	SS	38	Screen	
211.1 5.2	**SILTY SAND:** grey, moist, compact					211
		7	SS	24	Cave-in	210
209.7 ~~209.6~~	~~**SILTY CLAY:** grey, moist, compact~~					
6.7	**END OF BOREHOLE**					

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100
SHEAR STRENGTH (kPa): ○ UNCONFINED + FIELD VANE & Sensitivity ● QUICK TRIAXIAL × LAB VANE: 20 40 60 80 100
PLASTIC LIMIT W_P — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_L
WATER CONTENT (%): 10 20 30
POCKET PEN. (Cu) (kPa)
NATURAL UNIT WT (kN/m^3)
REMARKS AND GRAIN SIZE DISTRIBUTION (%): GR SA SI CL

Notes:
1. Upon completion of drilling, a 50mm diameter monitoring well was installed in the borehole.
2. Water level measured on April 9, 2018: 1.56 mbgs

Well Installation Details:
Bentonite: 0-2.74 m
Sand: 2.74-3.05m
Screened Length: 3.05-6.10 m
Cave-In: 6.10-6.71m

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3, \times^3$: Numbers refer to Sensitivity ○ ^{8}=3% Strain at Failure

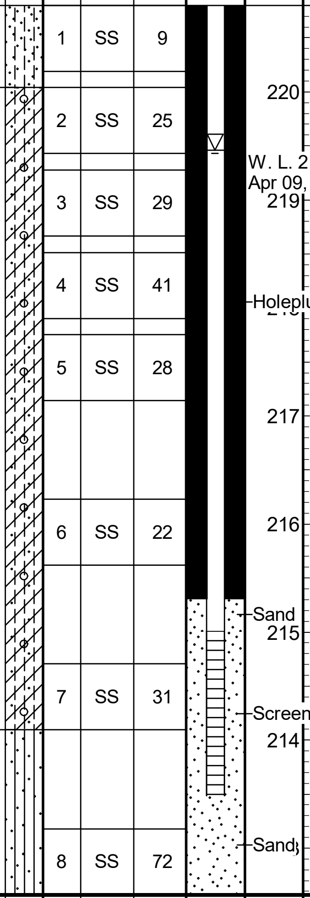
LOG OF BOREHOLE MW11

PROJECT: Milton Land Development, Milton, ON
CLIENT: Orlando Corporation
PROJECT LOCATION: Milton, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan (UTM 17T) N 4822326.39 E 588011.13

Method: Solid Stem Auger
Diameter: 152.4
Date: Mar-27-2018

REF. NO.: 180041
ENCL NO.: 11

SOIL PROFILE (m) ELEV DEPTH	DESCRIPTION	SAMPLES NUMBER	TYPE	"N" BLOWS/0.3 m
220.8	Ground Surface			
0.0	**SILTY SAND:** trace organics & rootlets, brown, dry, loose	1	SS	9
220.0 0.8	**SILTY CLAY TILL:** brown to red-brown, mottled, trace gravel, occasional fine sand lens, dry to moist, very stiff to hard	2	SS	25
		3	SS	29
		4	SS	41
		5	SS	28
	grey below 3.7 m			
	sandy silt lens from 4.7 m to 4.8 m	6	SS	22
		7	SS	31
214.1 6.7	**SANDY SILT:** grey, trace gravel, moist, very dense			
212.6		8	SS	72
8.2	**END OF BOREHOLE**			



DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100
SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT W_P — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_L
WATER CONTENT (%) 10 20 30

POCKET PEN. (Cu) (kPa)
NATURAL UNIT WT (kN/m^3)
REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

Notes:
1. Upon completion of drilling, a 50mm diameter monitoring well was installed in the borehole.
2. Water level measured on April 9, 2018: 1.34 mbgs

Well Installation Details:
Bentonite: 0-5.49 m
Sand: 5.49-5.79m
Screened Length: 5.79-7.32 m
Sand: 7.32-8.23m

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES $+^3, \times^3$: Numbers refer to Sensitivity
○ $^{\varepsilon}$=3% Strain at Failure

LOG OF BOREHOLE MW12

PROJECT: Milton Land Development, Milton, ON
CLIENT: Orlando Corporation
PROJECT LOCATION: Milton, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan (UTM 17T) N 4821771.64 E 588230.25

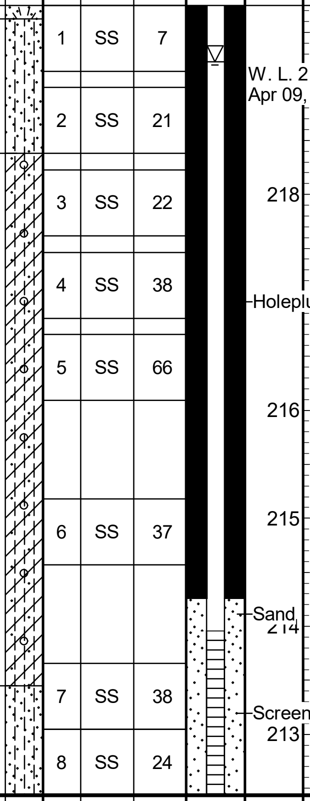
Method: Solid Stem Auger
Diameter: 152.4
Date: Mar-27-2018

REF. NO.: 180041
ENCL NO.: 12

ELEV (m) / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS / 0.3 m
219.8	Ground Surface			
219.7 0.1	**TOPSOIL:** trace rootlets, trace coarse sand, dark brown, moist	1	SS	7
	SILTY SAND: grey, trace gravel, moist, loose to compact	2	SS	21
218.4 1.4	**SILTY CLAY TILL:** brown to red-brown, mottled, trace gravel, occasional fine sand lens, dry to moist, very stiff to hard	3	SS	22
		4	SS	38
		5	SS	66
	grey below 3.66 m.			
		6	SS	37
213.5 6.3	**SILTY SAND:** grey, moist, compact to dense	7	SS	38
		8	SS	24
212.4 7.3	**END OF BOREHOLE**			

Notes:
1. Upon completion of drilling, a 50mm diameter monitoring well was installed in the borehole.
2. Water level measured on April 9, 2018: 0.52 mbgs

Well Installation Details:
Bentonite: 0-5.49 m
Sand: 5.49-5.79m
Screened Length: 5.79-7.32 m



DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH (kPa): ○ UNCONFINED + FIELD VANE & Sensitivity ● QUICK TRIAXIAL × LAB VANE — 20 40 60 80 100

PLASTIC LIMIT W_P — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_L

WATER CONTENT (%): 10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m^3)

REMARKS AND GRAIN SIZE DISTRIBUTION (%): GR SA SI CL

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity

○ ^{8}=3% Strain at Failure

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

LOG OF BOREHOLE MW2

1 OF 1

PROJECT: Milton Land Development, Milton, ON

CLIENT: Orlando Corporation

PROJECT LOCATION: Milton, ON

DATUM: Geodetic

BH LOCATION: See Borehole Location Plan (UTM 17T) N 4822578 E 589631

Method: Solid Stem Auger

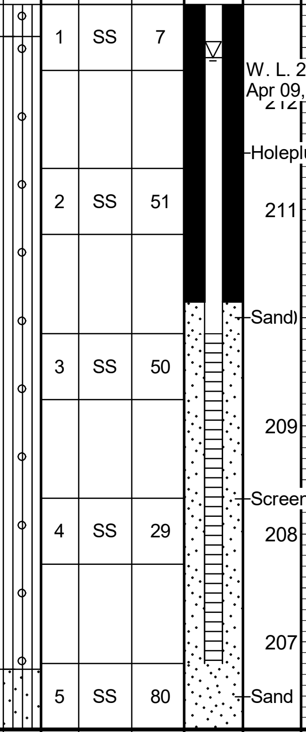
Diameter: 165.1

Date: Jul-15-2018

REF. NO.: 180041

ENCL NO.: 2

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS / 0.3 m
212.9	Ground Surface			
0.0	**SILT TILL:** dark brown, some organics, trace gravel, trace clay, loose	1	SS	7
212.6 0.3	**CLAYEY SILT TO SILT TILL:** brown to red-brown, mottled, trace gravel, occasional fine sand lens, dry to moist, loose to very dense			
		2	SS	51
	grey to red-grey below 3.2 m	3	SS	50
		4	SS	29
206.8 6.2	**SILTY SAND TO SANDY SILT:** brown, fine to medium sand, trace gravel, dry to moist, very dense	5	SS	80
206.2 6.7	**END OF BOREHOLE**			



Notes:
1. Upon completion of drilling, a 50mm diameter monitoring well was installed in the borehole.
2. Water level measured on April 9, 2018: 0.49 mbgs

Well Installation Details:
Bentonite: 0-2.75 m
Sand: 2.75-3.05m
Screened Length: 3.05-6.10 m
Sand: 6.10-6.71m

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH (kPa): ○ UNCONFINED; + FIELD VANE & Sensitivity; ● QUICK TRIAXIAL; × LAB VANE: 20 40 60 80 100

PLASTIC LIMIT W_P — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_L; WATER CONTENT (%): 10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m^3)

REMARKS AND GRAIN SIZE DISTRIBUTION (%): GR SA SI CL

SOIL-ROCK-JAN11-2019_PM_ROCK_HYDROG FORM_20190111 - COPY.GLB
PALMER SOIL - 2018 1DIG 180041-MILTONLANDDEV-BOREHOLES FEB 5, 2019.GPJ 19-2-6

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ^{8}=3% Strain at Failure

LOG OF BOREHOLE MW3

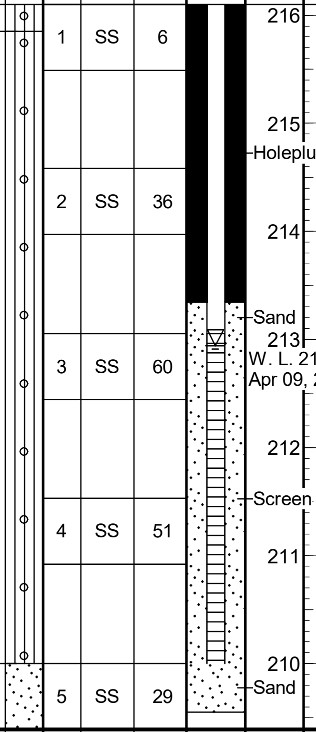
PROJECT: Milton Land Development, Milton, ON
CLIENT: Orlando Corporation
PROJECT LOCATION: Milton, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan (UTM 17T) N 4822430 E 589172

Method: Solid Stem Auger
Diameter: 165.1
Date: Jul-14-2015

REF. NO.: 180041
ENCL NO.: 3

SOIL PROFILE		SAMPLES		
(m) ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS/0.3 m
216.1	Ground Surface			
0.0	**SILT TILL:** dark brown, some organics, trace gravel, trace clay, loose	1	SS	6
215.9 0.3	**CLAYEY SILT TO SILT TILL:** brown to red-brown, mottled, trace gravel, occasional fine sand lens, dry to moist, loose to very dense grey below 4.6 m	2 3 4	SS SS SS	36 60 51
210.0 6.1	**SAND:** red-brown, fine to medium grained sand, trace gravel, wet, compact	5	SS	29
209.4 6.7	**END OF BOREHOLE**			

STRATA PLOT | GROUND WATER CONDITIONS | ELEVATION



DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT W_P | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W_L
WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m^3)

REMARKS AND GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

Notes:
1. Upon completion of drilling, a 50mm diameter monitoring well was installed in the borehole.
2. Water level measured on April 9, 2018: 3.16mbgs

Well Installation Details:
Bentonite: 0-2.75 m
Sand: 2.75-3.05m
Screened Length: 3.05-6.1m
Sand: 6.1-6.55m

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
$+^3, \times^3$: Numbers refer to Sensitivity
○ ^{8}=3% Strain at Failure

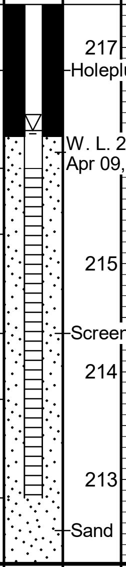
LOG OF BOREHOLE MW4

PROJECT: Milton Land Development, Milton, ON
CLIENT: Orlando Corporation
PROJECT LOCATION: Milton, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan (UTM 17T) N 4822409 E 588765

Method: Solid Stem Auger
Diameter: 165.1
Date: Jul-14-2015

REF. NO.: 180041
ENCL NO.: 4

SOIL PROFILE (m) ELEV DEPTH	DESCRIPTION	SAMPLES NUMBER	TYPE	"N" BLOWS/0.3 m
217.4	Ground Surface			
0.0	**CLAYEY SILT:** grey-black, contains organics, loose			
217.2 0.2	**CLAYEY SILT TO SILT TILL:** brown to red-brown, mottled, trace gravel, occasional fine sand lens, dry to moist, loose to dense	1	SS	4
215.5 1.9	**SILT:** brown to grey, trace sand, moist to wet, dense	2	SS	38
214.0 3.4	**CLAYEY SILT TO SILT TILL:** brown to grey, mottled, trace gravel, occasional fine sand lens, dry to moist, compact to dense	3	SS	42
		4	SS	26
212.2 5.2	**END OF BOREHOLE**			



DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT W_P — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_L

WATER CONTENT (%) 10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m^3)

REMARKS AND GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

Notes:
1. Upon completion of drilling, a 50mm diameter monitoring well was installed in the borehole.
2. Water level measured on April 9, 2018: 1.17 mbgs

Well Installation Details:
Bentonite: 0-1.22m
Sand: 1.22-1.52m
Screened Length: 1.52-4.57 m
Sand: 4.57-5.18m

SOIL-ROCK-JAN11-2019_PM_ROCK_HYDROG FORM_20190111 - COPY.GLB
PALMER SOIL - 2018 1DIG 180041-MILTONLANDDEV-BOREHOLES FEB 5, 2019.GPJ 19-2-6

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ 8=3% Strain at Failure

LOG OF BOREHOLE MW5

PROJECT: Milton Land Development, Milton, ON

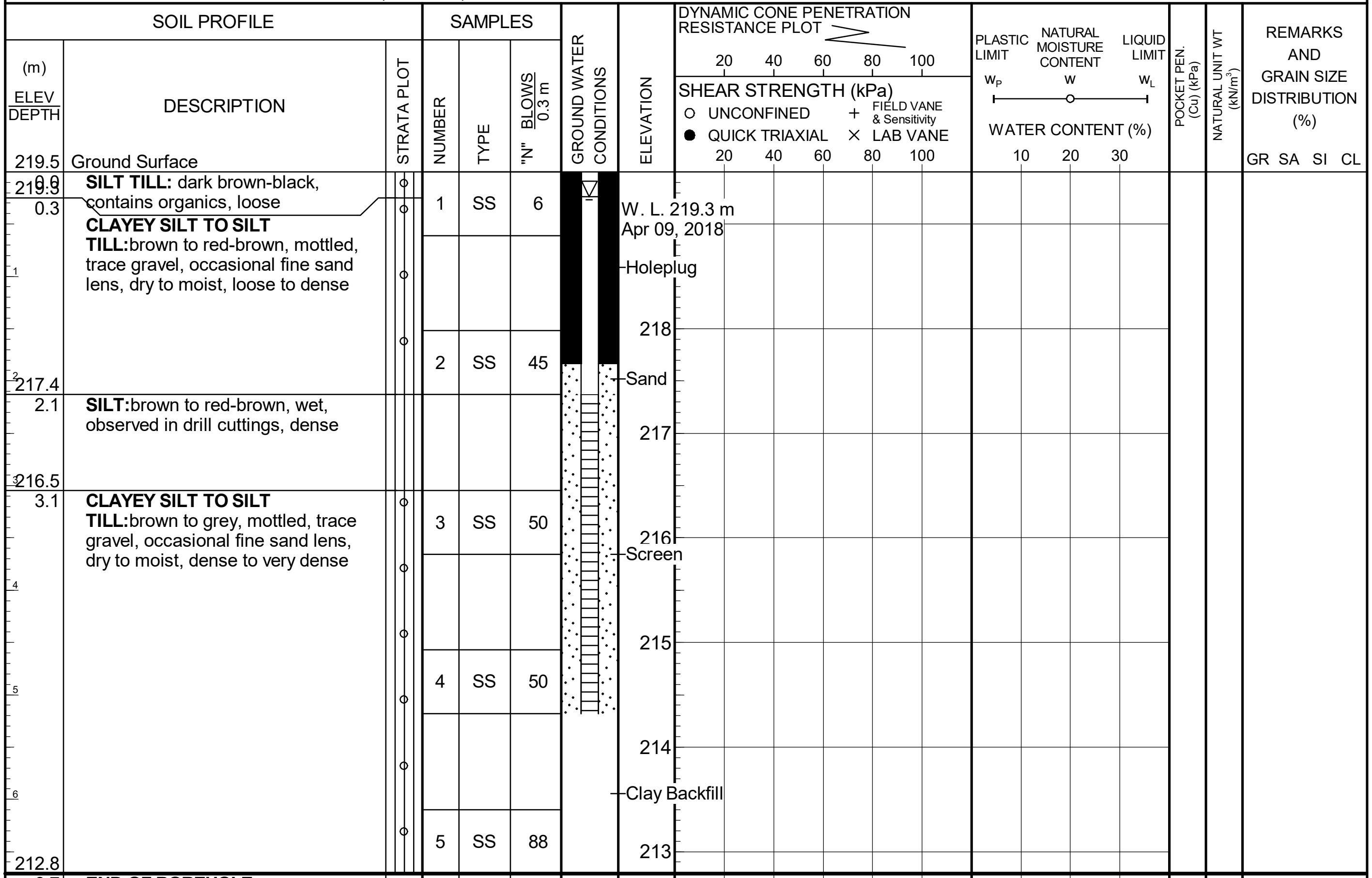
CLIENT: Orlando Corporation
Method: Solid Stem Auger

PROJECT LOCATION: Milton, ON
Diameter: 165.1
REF. NO.: 180041

DATUM: Geodetic
Date: Jul-14-2015
ENCL NO.: 5

BH LOCATION: See Borehole Location Plan (UTM 17T) N 4821772 E 588706

(m) ELEV DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	"N" BLOWS/0.3 m
219.5	Ground Surface			
219.3 0.0	**SILT TILL:** dark brown-black, contains organics, loose	1	SS	6
0.3	**CLAYEY SILT TO SILT TILL:** brown to red-brown, mottled, trace gravel, occasional fine sand lens, dry to moist, loose to dense	2	SS	45
217.4 2.1	**SILT:** brown to red-brown, wet, observed in drill cuttings, dense			
216.5 3.1	**CLAYEY SILT TO SILT TILL:** brown to grey, mottled, trace gravel, occasional fine sand lens, dry to moist, dense to very dense	3 4 5	SS SS SS	50 50 88
212.8 6.7	**END OF BOREHOLE**			



Notes:
1. Upon completion of drilling, a 50mm diameter monitoring well was installed in the borehole.
2. Water level measured on April 9, 2018: 0.24 mbgs

Well Installation Details:
Bentonite: 0-1.83m
Sand: 1.83-2.13m
Screened Length: 2.13-5.18 m
Clay Backfill: 5.18-6.71m

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
+³, ×³: Numbers refer to Sensitivity
○ ⁸=3% Strain at Failure

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

LOG OF BOREHOLE MW6

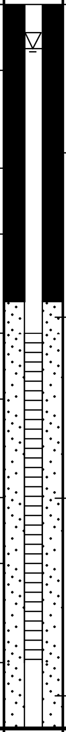
1 OF 1

PROJECT: Milton Land Development, Milton, ON
CLIENT: Orlando Corporation
PROJECT LOCATION: Milton, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan (UTM 17T) N 4821912 E 5879901

Method: Solid Stem Auger
Diameter: 165.1
Date: Jul-15-2018

REF. NO.: 180041
ENCL NO.: 6

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS / 0.3 m	GROUND WATER CONDITIONS	ELEVATION
220.1	Ground Surface					
0.0 219.8	**SILT TILL:** dark brown-black, trace gravel, contains organics, loose	1	SS	4	▽	220 W. L. 219.7 m Apr 09, 2018
0.3	**CLAYEY SILT TO SILT TILL:** brown to red-brown, mottled, trace gravel, occasional fine sand lens, dry to moist, loose to dense					219 Holeplug
	gravel layer below 1.98 m	2	SS	23		218
		3	SS	31		Sand 217
216.6 3.5	**SILT:** brown to grey, wet, dense					216 Screen
215.5 4.6	**CLAYEY SILT TO SILT TILL:** brown to red-brown, mottled, trace gravel, occasional fine sand lens, dry to moist, compact	4	SS	17		215
		5	SS	22		214 Sand
213.4 6.7	**END OF BOREHOLE**					



Notes:
1. Upon completion of drilling, a 50mm diameter monitoring well was installed in the borehole.
2. Water level measured on April 9, 2018: 0.41 mbgs

Well Installation Details:
Bentonite: 0-2.75m
Sand: 2.75-3.05m
Screened Length: 3.05-6.10 m
Sand: 6.10-6.71m

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100
SHEAR STRENGTH (kPa): ○ UNCONFINED; + FIELD VANE & Sensitivity; ● QUICK TRIAXIAL; × LAB VANE: 20 40 60 80 100
PLASTIC LIMIT W_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT W_L
WATER CONTENT (%): 10 20 30
POCKET PEN. (Cu) (kPa)
NATURAL UNIT WT (kN/m^3)
REMARKS AND GRAIN SIZE DISTRIBUTION (%): GR SA SI CL

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: +³, ×³: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF BOREHOLE MW7

PROJECT: Milton Land Development, Milton, ON
CLIENT: Orlando Corporation
PROJECT LOCATION: Milton, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan (UTM 17T) N 4822197.56 E 590090.97

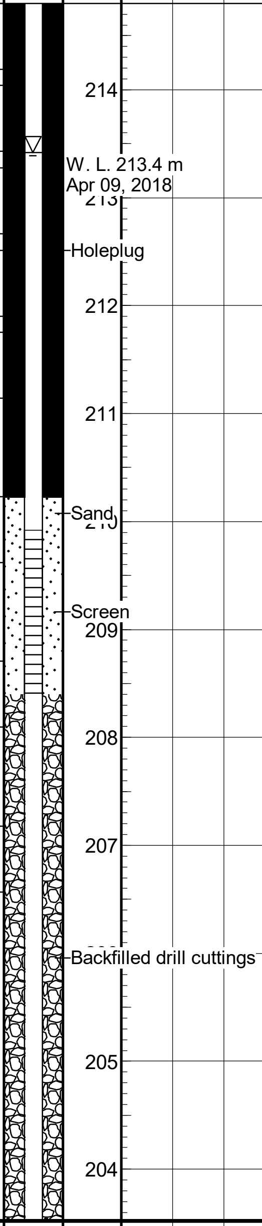
Method: Solid Stem Auger
Diameter: 152.4
Date: Mar-27-2018

REF. NO.: 180041
ENCL NO.: 7

SOIL PROFILE (m) ELEV DEPTH	DESCRIPTION	SAMPLES NUMBER	TYPE	"N" BLOWS/0.3 m	ELEVATION
214.8	Ground Surface				
0.0	**SILTY CLAY:** brown, mottled, trace organics, disturbed, loose	1	SS	8	
214.2 0.6	**CLAYEY SILT TO SILT TILL:** brown to red-brown, mottled, trace gravel, occasional fine sand lens, dry to moist, dense to very dense	2	SS	35	214
		3	SS	64	213
		4	SS	53	212
		5	SS	63	211
210.2 4.6	**SANDY SILT:** red-brown, fine grained sand, moist, dense	6	SS	50	210
209.6 5.2	**CLAYEY SILT TO SILT TILL:** brown to red-brown, mottled, trace gravel, occasional fine sand lens, dry to moist, dense				209
		7	SS	50	208
		8	SS	50	207
		9	SS		205
		10	SS		204
203.5 11.3	**END OF BOREHOLE**				

Notes:
1. Upon completion of drilling, a 50mm diameter monitoring well was installed in the borehole.
2. Water level measured on April 9, 2018: 1.38 mbgs

Well Installation Details:
Bentonite: 0-4.57 m
Sand: 4.57-4..88m
Screened Length: 4.88-6.40 m
Cutting Backfill: 6.40-11.28m



DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100
SHEAR STRENGTH (kPa): ○ UNCONFINED + FIELD VANE & Sensitivity ● QUICK TRIAXIAL × LAB VANE: 20 40 60 80 100
PLASTIC LIMIT W_P — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_L
WATER CONTENT (%): 10 20 30
POCKET PEN. (Cu) (kPa)
NATURAL UNIT WT (kN/m^3)
REMARKS AND GRAIN SIZE DISTRIBUTION (%): GR SA SI CL

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: + 3, × 3: Numbers refer to Sensitivity ○ 8=3% Strain at Failure

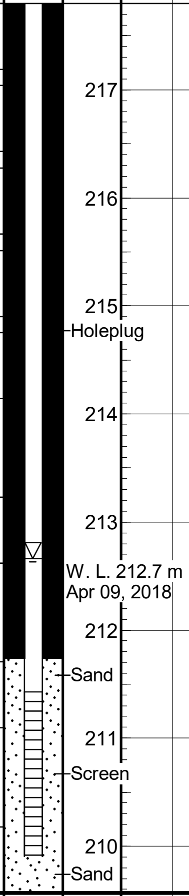
PALMER ENVIRONMENTAL CONSULTING GROUP INC.

LOG OF BOREHOLE MW8

1 OF 1

PROJECT: Milton Land Development, Milton, ON
CLIENT: Orlando Corporation
Method: Solid Stem Auger
PROJECT LOCATION: Milton, ON
Diameter: 152.4
REF. NO.: 180041
DATUM: Geodetic
Date: Mar-27-2018
ENCL NO.: 8
BH LOCATION: See Borehole Location Plan (UTM 17T) N 4822576.58 E 588992.45

SOIL PROFILE (m) ELEV / DEPTH	DESCRIPTION	SAMPLES NUMBER	TYPE	"N" BLOWS / 0.3 m
217.8	Ground Surface			
0.0	**TOPSOIL:** dark brown, disturbed organics & litter, moist	1	SS	5
217.7 0.1	**SILTY CLAY TILL:** brown to red-brown, mottled, trace gravel, occasional fine sand lens, dry to moist, firm to hard	2	SS	29
		3	SS	38
215.7 2.1	**SANDY SILT:** light brown, moist, dense to very dense	4	SS	94
		5	SS	50
213.2 4.6	**SILTY CLAY TILL:** brown to red-brown, mottled, trace gravel, occasional fine sand lens, moist, hard	6	SS	90
211.6 6.2	**SAND:** medium sand with silt and clay lamination, red-brown, wet, very dense	7	SS	54
		8	SS	65
209.7 8.1	**SILTY CLAY TILL:** brown to red-brown, mottled, trace gravel, occasional fine sand lens, moist, hard			
209.6 8.2	**END OF BOREHOLE**			



GROUND WATER CONDITIONS | ELEVATION | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 | SHEAR STRENGTH (kPa) ○ UNCONFINED + FIELD VANE & Sensitivity ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100 | PLASTIC LIMIT W_P NATURAL MOISTURE CONTENT W LIQUID LIMIT W_L WATER CONTENT (%) 10 20 30 | POCKET PEN. (Cu) (kPa) | NATURAL UNIT WT (kN/m³) | REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

Notes:
1. Upon completion of drilling, a 50mm diameter monitoring well was installed in the borehole.
2. Water level measured on April 9, 2018: 5.14 mbgs

Well Installation Details:
Bentonite: 0-6.06m
Sand: 6.06-6.37m
Screened Length: 6.37-7.89 m
Sand: 7.89-8.23m

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES $+^3, \times^3$: Numbers refer to Sensitivity ○ ^{8}=3% Strain at Failure

LOG OF BOREHOLE MW9

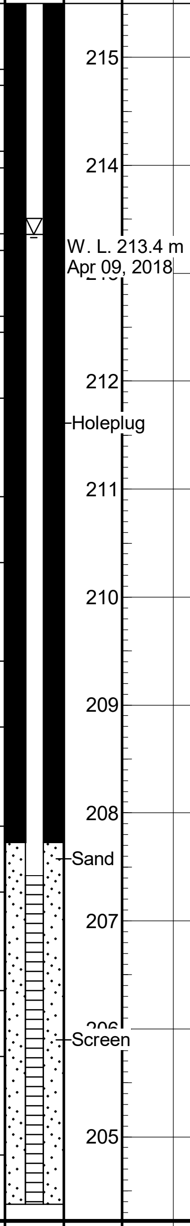
1 OF 1

PROJECT: Milton Land Development, Milton, ON
CLIENT: Orlando Corporation
PROJECT LOCATION: Milton, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan (UTM 17T) N 4822039.76 E 589562.58

Method: Solid Stem Auger
Diameter: 152.4
Date: Mar-27-2018

REF. NO.: 180041
ENCL NO.: 9

SOIL PROFILE (m) ELEV DEPTH	DESCRIPTION	SAMPLES NUMBER	TYPE	"N" BLOWS/0.3 m
215.5	Ground Surface			
0.0	**SILTY CLAY:** brown, mottled, trace organics, moist, disturbed, stiff	1	SS	9
214.9 0.6	**SAND:** medium grained sand, red-brown, dry-moist, dense			
214.7 0.8	**SILTY CLAY TILL:** brown to red-brown, mottled, trace gravel, occasional fine sand lens, dry to moist, dense to very dense	2	SS	31
		3	SS	41
		4	SS	40
		5	SS	67
	brown below 3.66 m			
		6	SS	31
		7	SS	50
		8	SS	79
		9	SS	66
		10	SS	98
204.2 11.3	**END OF BOREHOLE**			



STRATA PLOT | GROUND WATER CONDITIONS | ELEVATION

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100

SHEAR STRENGTH (kPa) ○ UNCONFINED + FIELD VANE & Sensitivity ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100

PLASTIC LIMIT W_P NATURAL MOISTURE CONTENT W LIQUID LIMIT W_L

WATER CONTENT (%) 10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m^3)

REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

Notes:
1. Upon completion of drilling, a 50mm diameter monitoring well was installed in the borehole.
2. Water level measured on April 9, 2018: 2.14 mbgs

Well Installation Details:
Bentonite: 0-7.77 m
Sand: 7.77-8.08m
Screened Length: 8.08-11.13 m

SOIL-ROCK-JAN11-2019_PM_ROCK_HYDROG FORM_20190111 - COPY.GLB
PALMER SOIL - 2018 1DIG 180041-MILTONLANDDEV-BOREHOLES FEB 5, 2019.GPJ 19-2-6

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

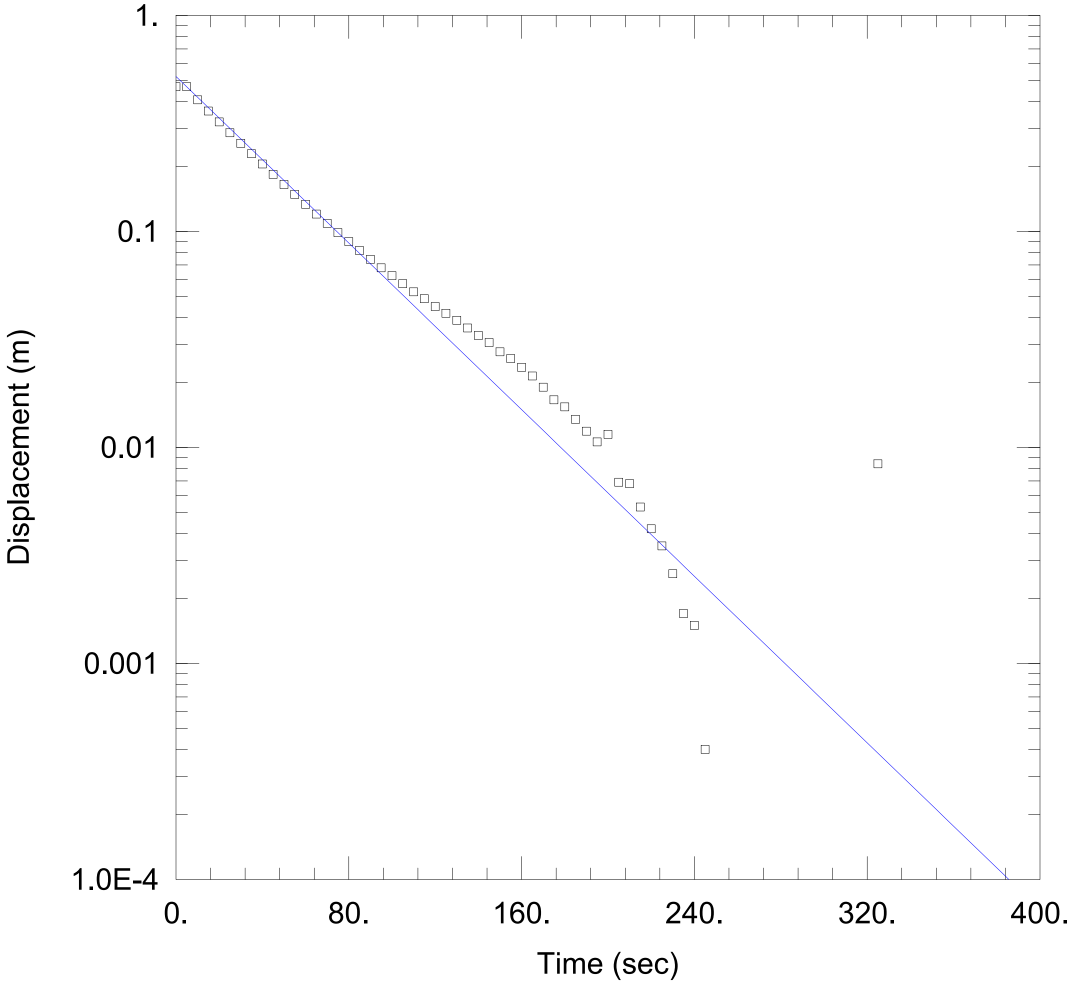
GRAPH NOTES $+^3, \times^3$: Numbers refer to Sensitivity ○ ^{8}=3% Strain at Failure

Appendix C

Slug Testing Results

Appendix C

Slug Testing Results



MW1 FH1

Data Set: C:\...\MW1 FH1.aqt
Date: 02/12/19 Time: 15:39:32

PROJECT INFORMATION

Company: Palmer Environmental
Project: 13118
Test Well: MW1
Test Date: 2015-08-13

AQUIFER DATA

Saturated Thickness: 3.63 m
Anisotropy Ratio (Kz/Kr): 1.

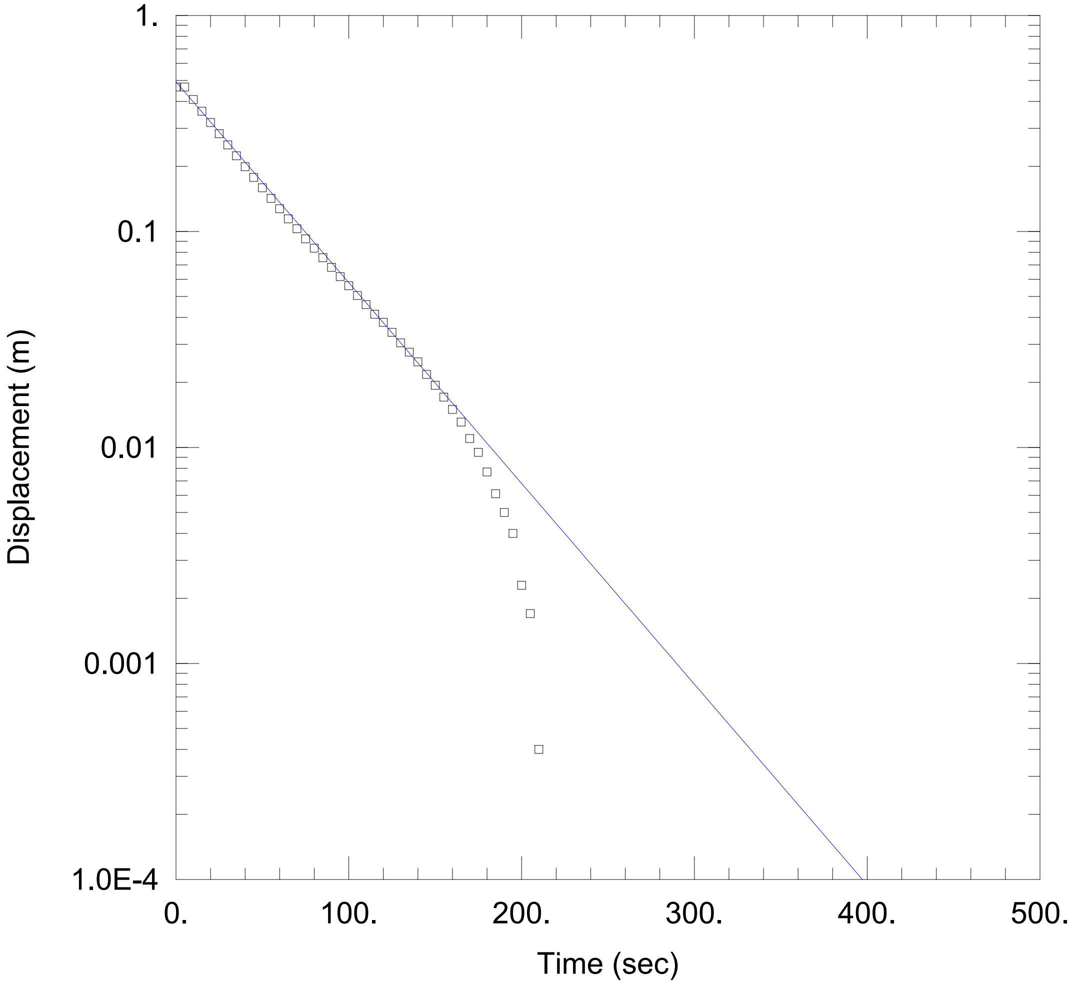
WELL DATA (MW1)

Initial Displacement: 0.4674 m
Total Well Penetration Depth: 3. m
Casing Radius: 0.0508 m
Static Water Column Height: 2.21 m
Screen Length: 1.5 m
Well Radius: 0.215 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev

K = 3.748E-5 m/sec
y0 = 0.5221 m



MW1 FH2

Data Set: C:\...\MW1 FH2.aqt
Date: 02/12/19 Time: 15:47:52

PROJECT INFORMATION

Company: Palmer Environmental
Project: 13118
Test Well: MW1
Test Date: 2015-08-13

AQUIFER DATA

Saturated Thickness: 3.63 m
Anisotropy Ratio (Kz/Kr): 1.

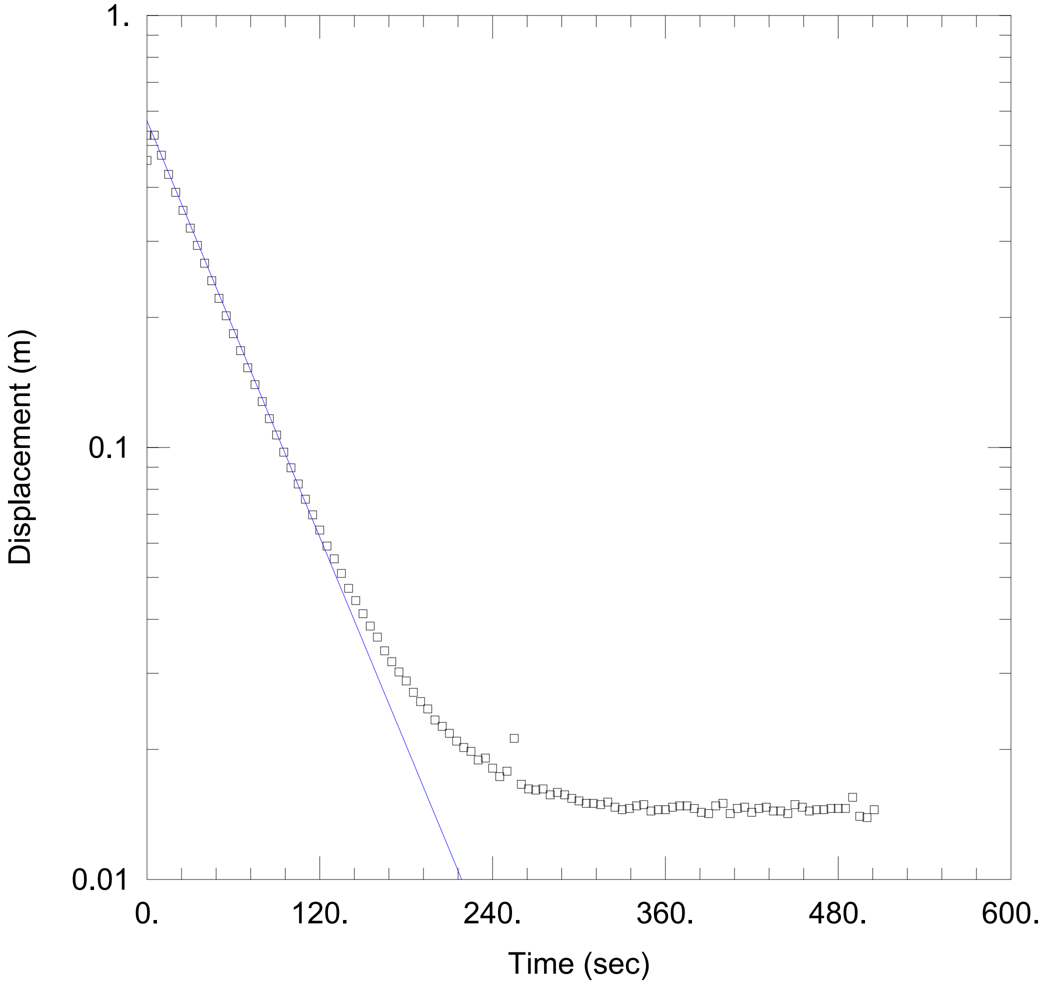
WELL DATA (MW1)

Initial Displacement: 0.4663 m
Total Well Penetration Depth: 3. m
Casing Radius: 0.0508 m
Static Water Column Height: 2.21 m
Screen Length: 1.5 m
Well Radius: 0.215 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev

K = 3.613E-5 m/sec
y0 = 0.4926 m



MW1 RH1

Data Set: C:\...\MW1 RH1.aqt
Date: 02/12/19
Time: 15:48:55

PROJECT INFORMATION

Company: Palmer Environmental
Project: 13118
Test Well: MW1
Test Date: 2015-08-13

AQUIFER DATA

Saturated Thickness: 3.63 m
Anisotropy Ratio (Kz/Kr): 1.

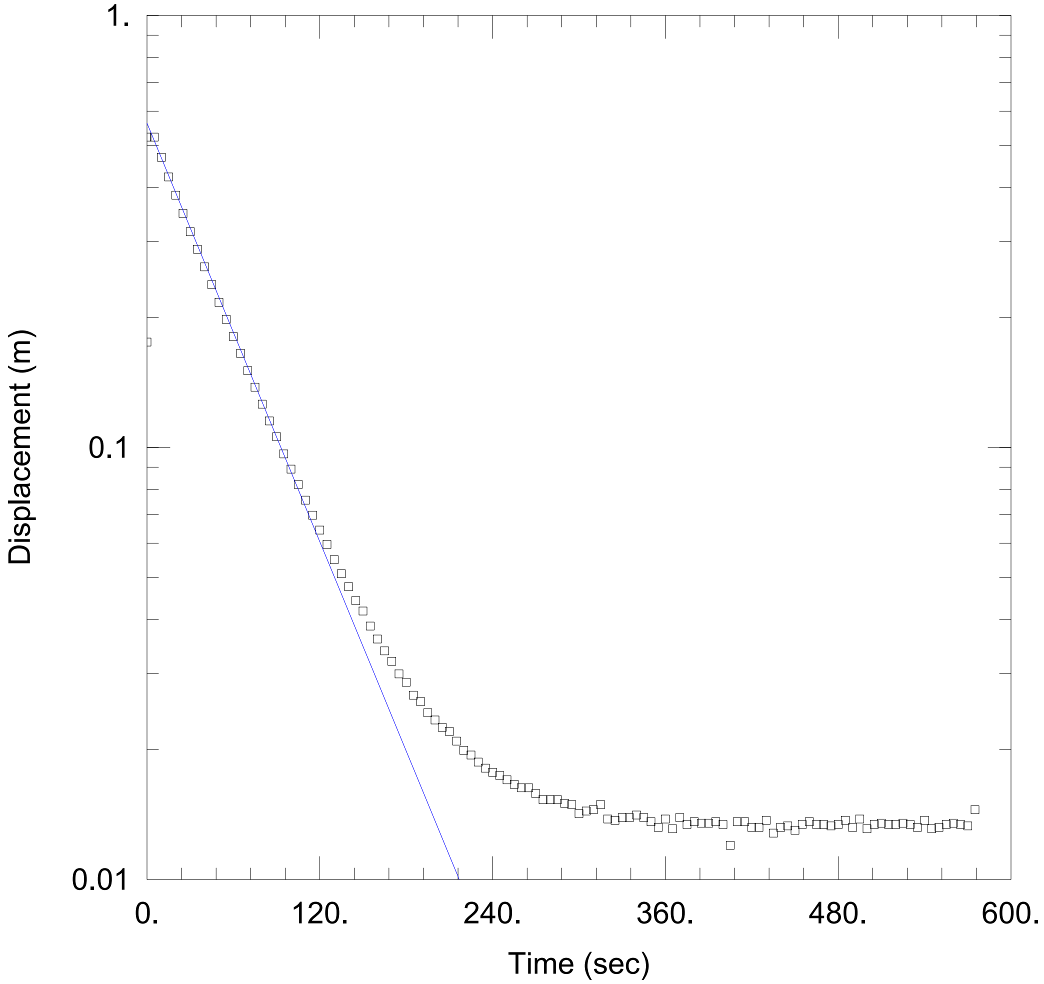
WELL DATA (MW1)

Initial Displacement: 0.5283 m
Total Well Penetration Depth: 3. m
Casing Radius: 0.0508 m
Static Water Column Height: 2.21 m
Screen Length: 1.5 m
Well Radius: 0.215 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev

K = 3.124E-5 m/sec
y0 = 0.5707 m



MW1 RH2

Data Set: C:\...\MW1 RH2.aqt
Date: 02/12/19
Time: 15:48:45

PROJECT INFORMATION

Company: Palmer Environmental
Project: 13118
Test Well: MW1
Test Date: 2015-08-13

AQUIFER DATA

Saturated Thickness: 3.63 m
Anisotropy Ratio (Kz/Kr): 1.

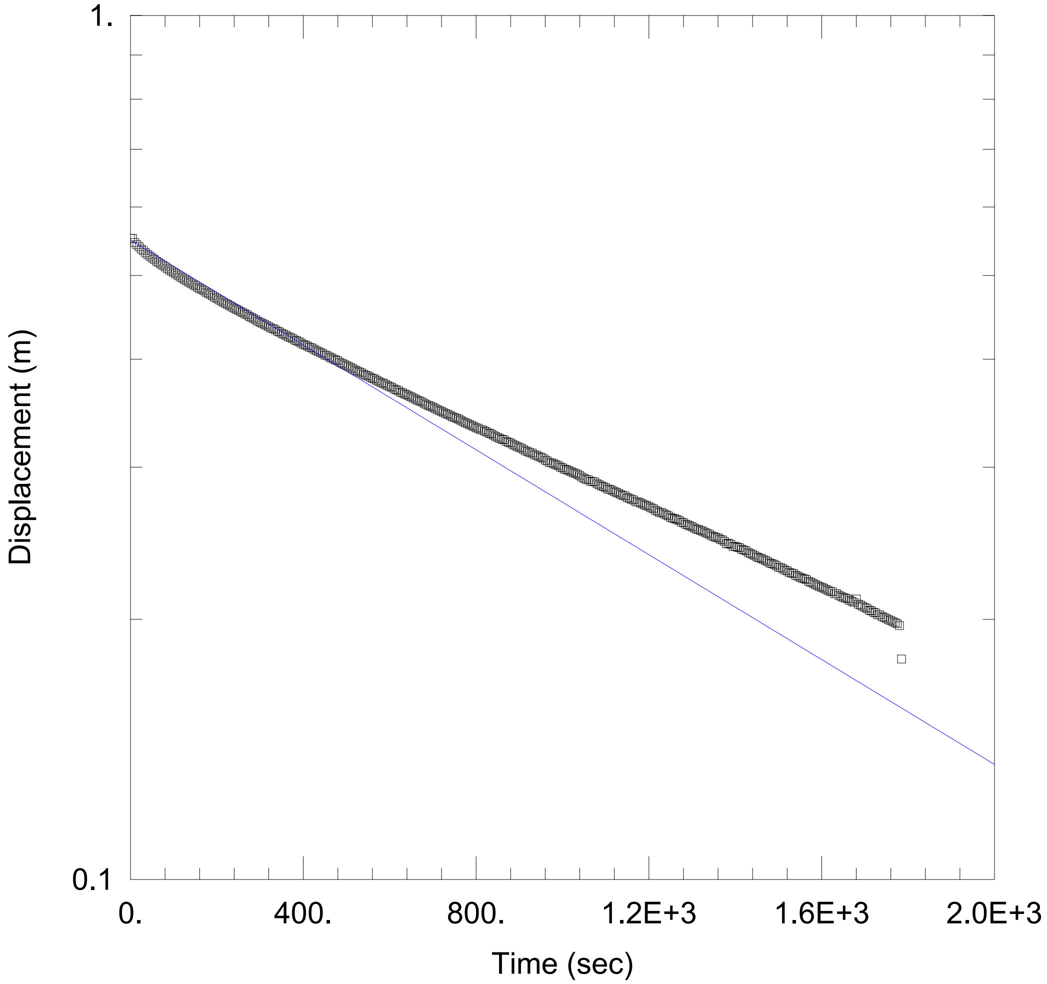
WELL DATA (MW1)

Initial Displacement: 0.5227 m
Total Well Penetration Depth: 3. m
Casing Radius: 0.0508 m
Static Water Column Height: 2.21 m
Screen Length: 1.5 m
Well Radius: 0.215 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev

K = 3.138E-5 m/sec
y0 = 0.5632 m



MW2 FH1

Data Set: C:\...\MW2 FH1.aqt
Date: 02/12/19 Time: 15:48:36

PROJECT INFORMATION

Company: Palmer Environmental
Project: 13118
Test Well: MW2
Test Date: 2015-08-13

AQUIFER DATA

Saturated Thickness: 0.6 m
Anisotropy Ratio (Kz/Kr): 1.

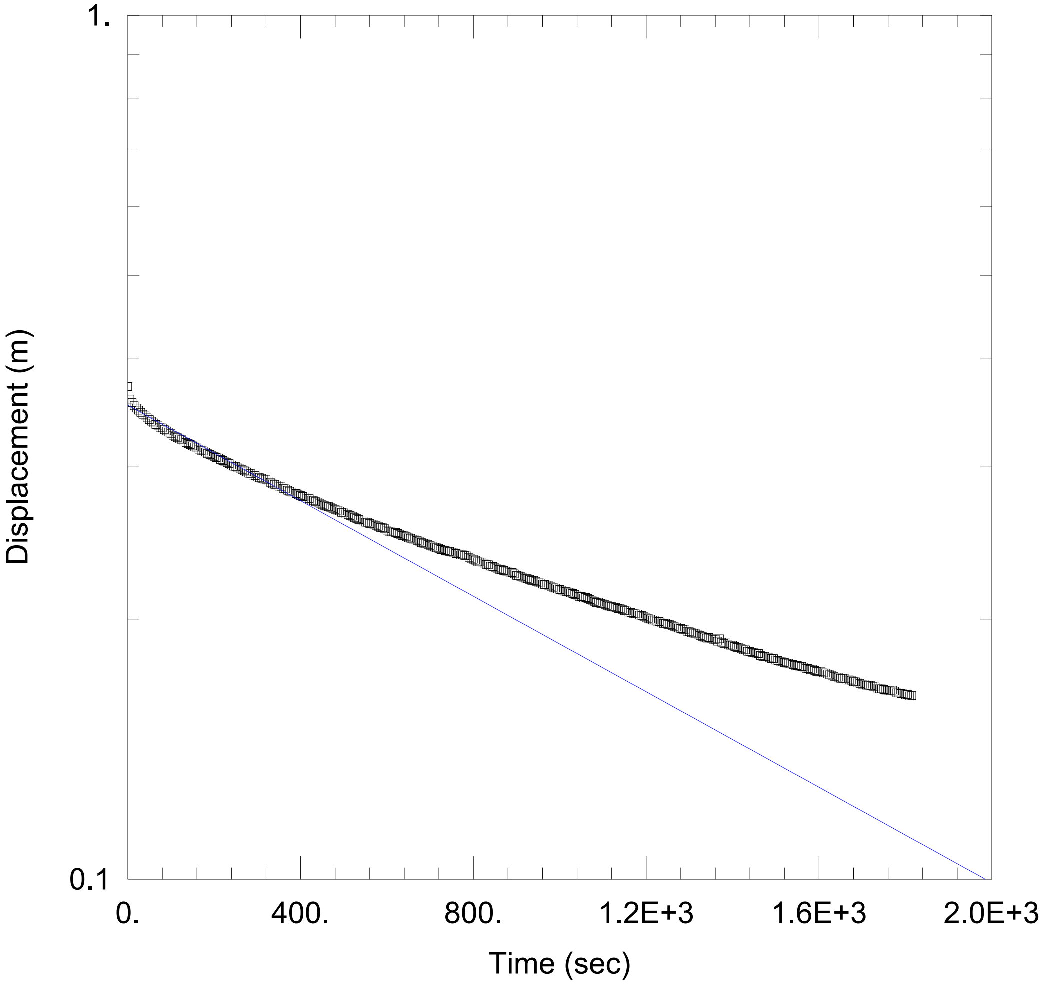
WELL DATA (MW2)

Initial Displacement: 0.5519 m
Total Well Penetration Depth: 0.6 m
Casing Radius: 0.0508 m
Static Water Column Height: 4.44 m
Screen Length: 0.6 m
Well Radius: 0.1645 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev

K = 7.962E-6 m/sec
y0 = 0.5496 m



MW2 RH1

Data Set: C:\...\MW2 RH1.aqt
Date: 02/12/19 Time: 15:48:25

PROJECT INFORMATION

Company: Palmer Environmental
Project: 13118
Test Well: MW2
Test Date: 2015-08-13

AQUIFER DATA

Saturated Thickness: 0.6 m
Anisotropy Ratio (Kz/Kr): 1.

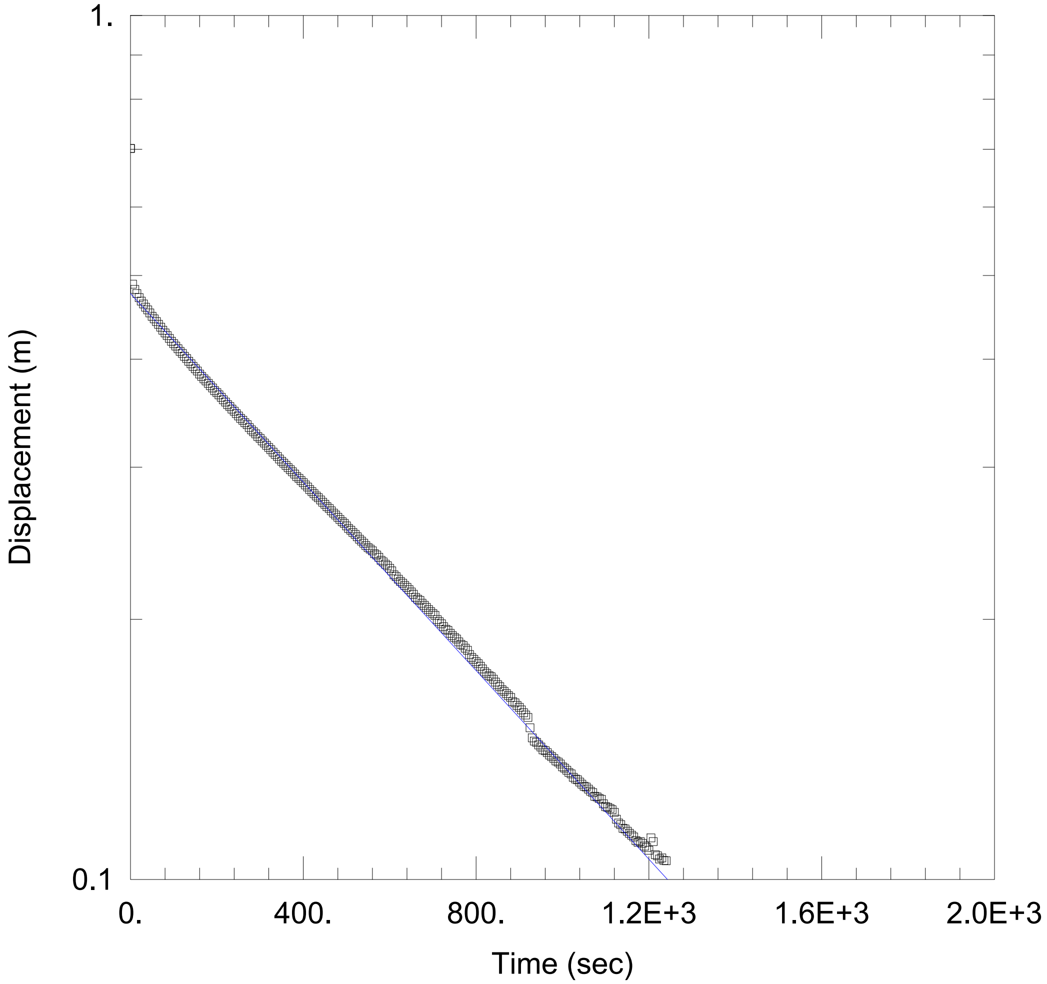
WELL DATA (MW2)

Initial Displacement: 0.3717 m
Total Well Penetration Depth: 0.6 m
Casing Radius: 0.0508 m
Static Water Column Height: 4.44 m
Screen Length: 0.6 m
Well Radius: 0.1645 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev

K = 7.251E-6 m/sec
y0 = 0.3536 m



MW 3 FH1

Data Set: C:\...\MW3 FH1.aqt
Date: 02/12/19 Time: 15:48:15

PROJECT INFORMATION

Company: Palmer Environmental
Project: 13118
Test Well: MW3
Test Date: 2015-08-13

AQUIFER DATA

Saturated Thickness: 1.98 m
Anisotropy Ratio (Kz/Kr): 0.1

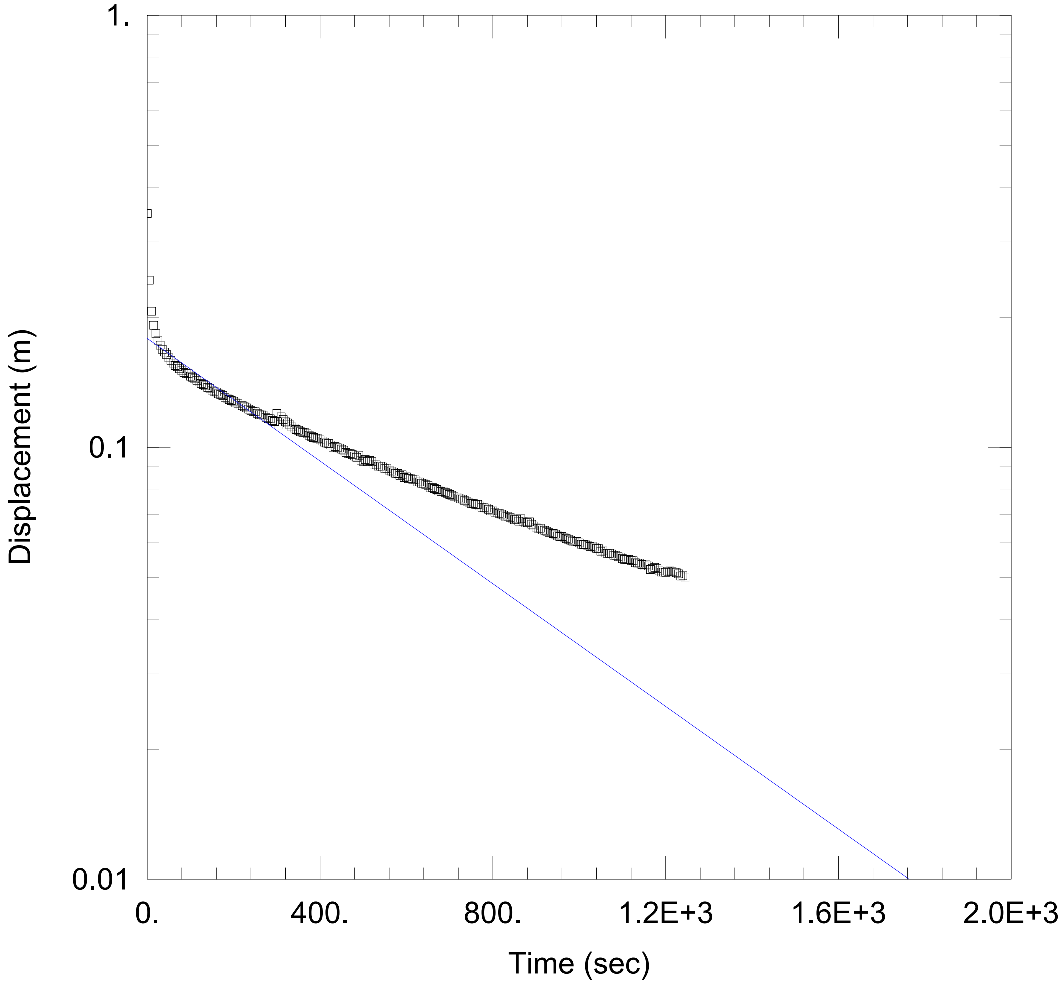
WELL DATA (MW3)

Initial Displacement: 0.7015 m
Total Well Penetration Depth: 1.6 m
Casing Radius: 0.0508 m
Static Water Column Height: 2.28 m
Screen Length: 1.6 m
Well Radius: 0.1645 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev

K = 4.174E-6 m/sec
y0 = 0.4766 m



MW 3 RH1

Data Set: C:\...\MW3 RH1.aqt
Date: 02/12/19
Time: 15:48:06

PROJECT INFORMATION

Company: Palmer Environmental
Project: 13118
Test Well: MW3
Test Date: 2015-08-13

AQUIFER DATA

Saturated Thickness: 1.98 m
Anisotropy Ratio (Kz/Kr): 0.1

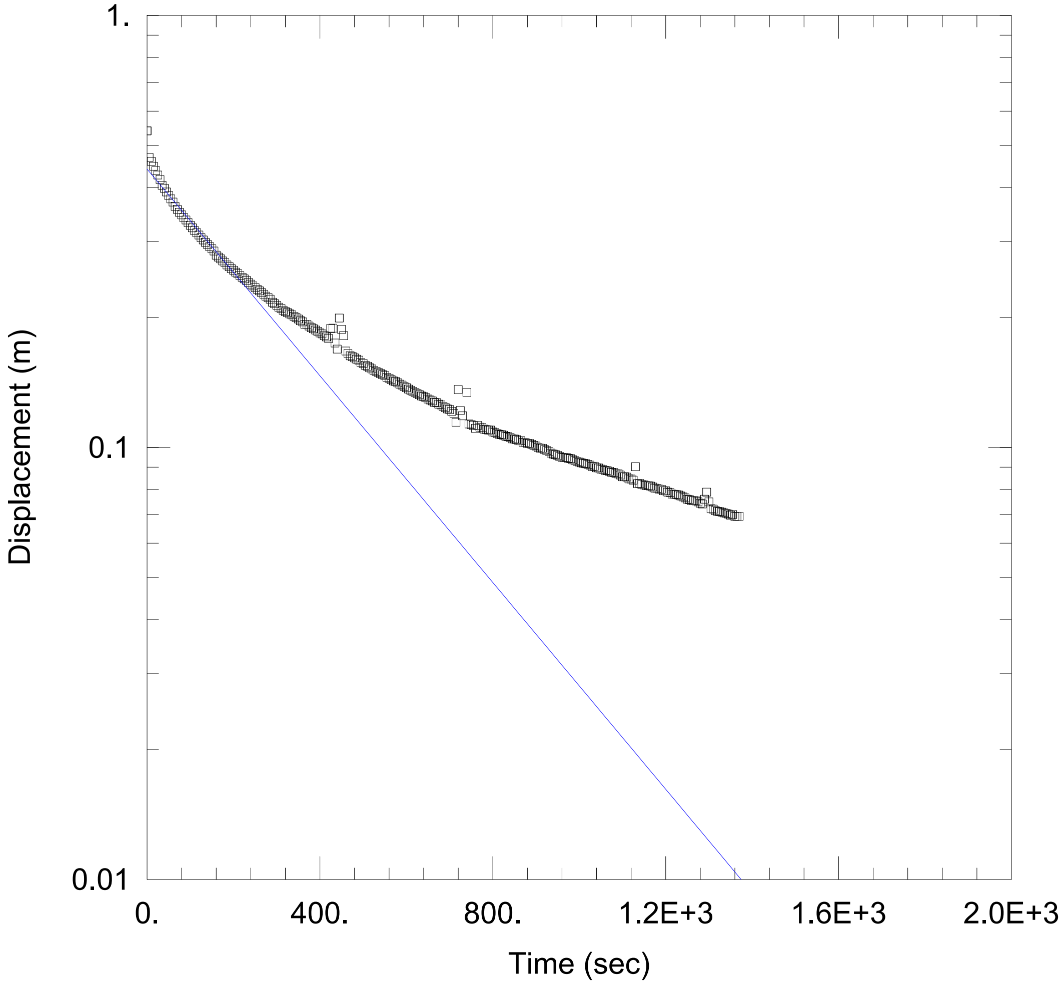
WELL DATA (MW3)

Initial Displacement: 0.3475 m
Total Well Penetration Depth: 1.6 m
Casing Radius: 0.0508 m
Static Water Column Height: 2.28 m
Screen Length: 1.6 m
Well Radius: 0.1645 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev

K = 5.43E-6 m/sec
y0 = 0.1785 m



MW4 FH1

Data Set: C:\...\MW4 FH1.aqt
Date: 02/12/19 Time: 15:57:54

PROJECT INFORMATION

Company: Palmer Environmental
Project: 13118
Test Well: MW4
Test Date: 2015-08-13

AQUIFER DATA

Saturated Thickness: 1.52 m Anisotropy Ratio (Kz/Kr): 1.

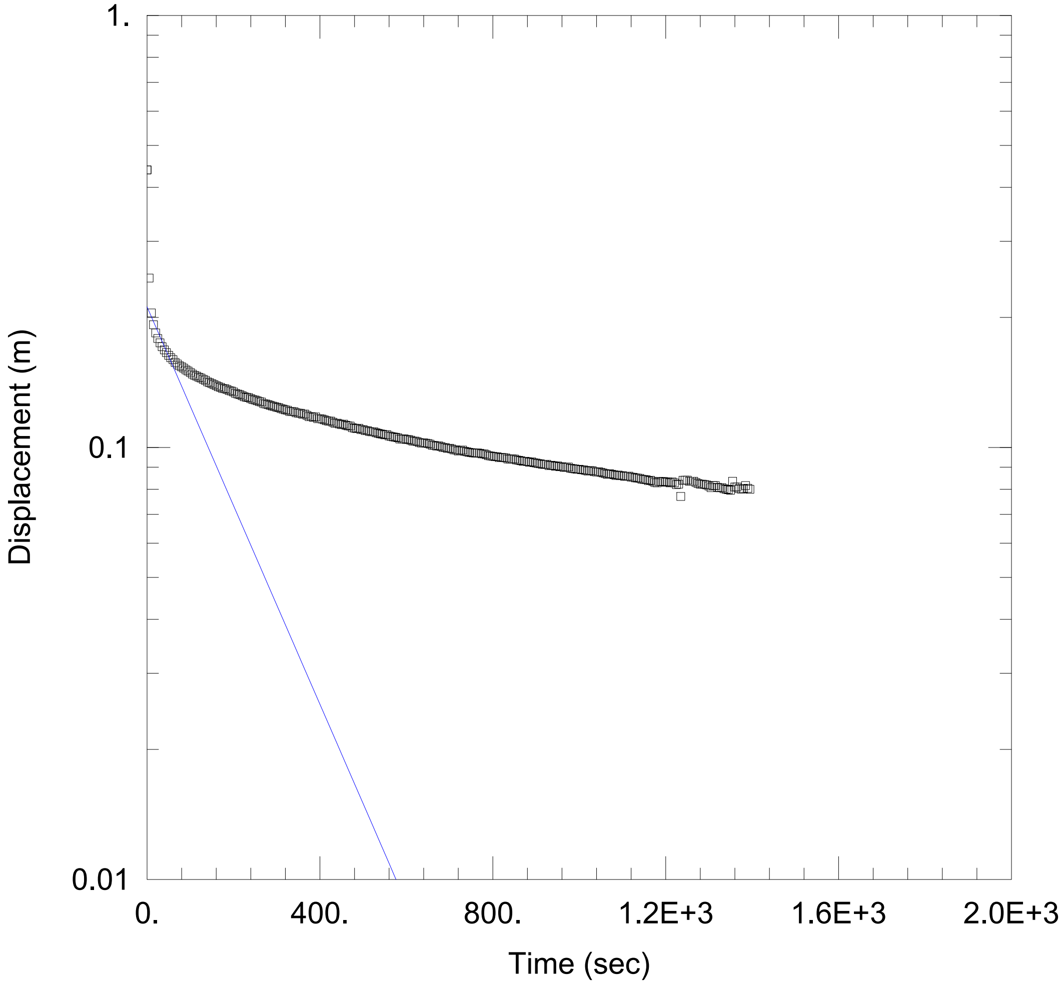
WELL DATA (MW4)

Initial Displacement: 0.5404 m
Total Well Penetration Depth: 1.8 m
Casing Radius: 0.0508 m
Static Water Column Height: 0.74 m
Screen Length: 1.8 m
Well Radius: 0.1645 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined Solution Method: Hvorslev

K = 1.239E-5 m/sec y0 = 0.4409 m



MW4 RH1

Data Set: C:\...\MW4 RH1.aqt
Date: 02/12/19
Time: 15:41:28

PROJECT INFORMATION

Company: Palmer Environmental
Project: 13118
Test Well: MW4
Test Date: 2015-08-13

AQUIFER DATA

Saturated Thickness: 1.52 m
Anisotropy Ratio (Kz/Kr): 1.

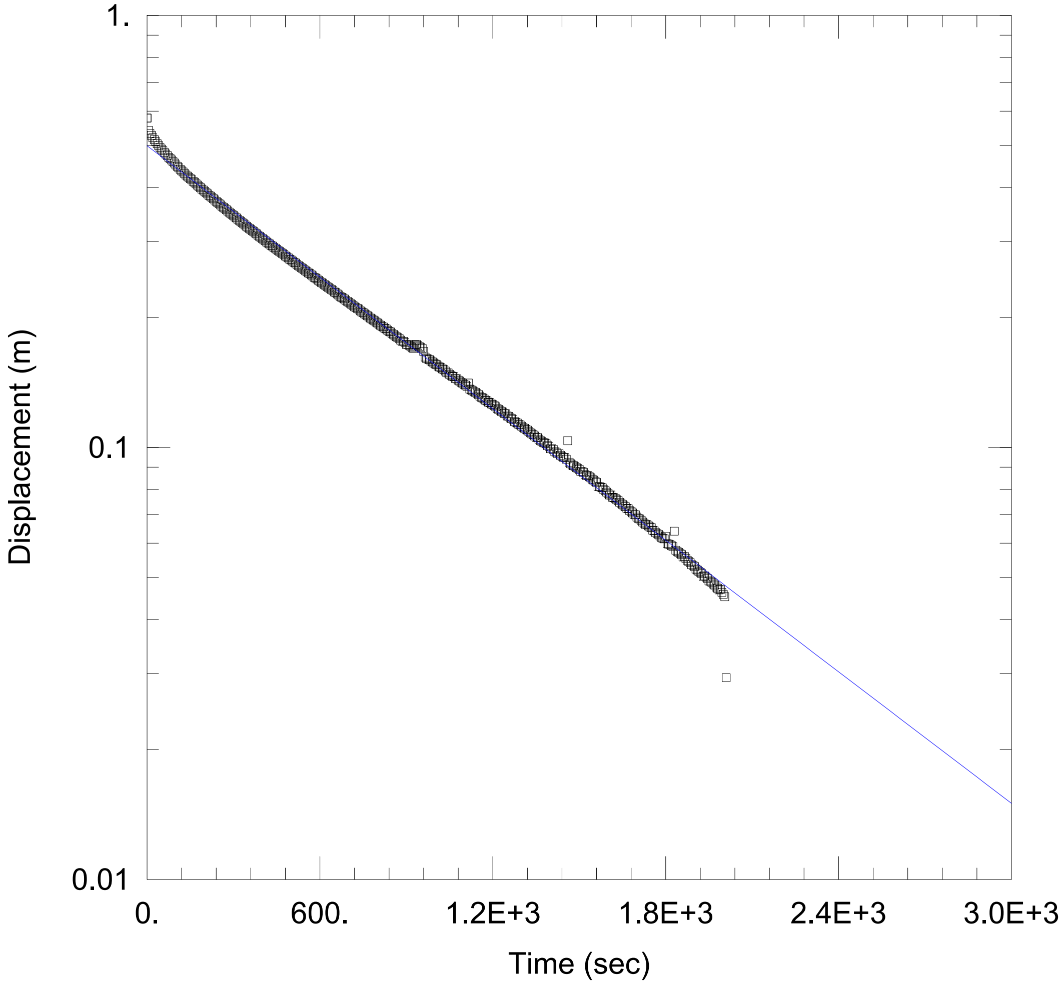
WELL DATA (MW4)

Initial Displacement: 0.4389 m
Total Well Penetration Depth: 1.8 m
Casing Radius: 0.0508 m
Static Water Column Height: 0.74 m
Screen Length: 1.8 m
Well Radius: 0.1645 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev

K = 2.382E-5 m/sec
y0 = 0.2116 m



MW5 FH1

Data Set: C:\...\MW5 FH1.aqt
Date: 02/12/19 Time: 15:41:12

PROJECT INFORMATION

Company: Palmer Environmental
Project: 13118
Test Well: MW5
Test Date: 2015-08-13

AQUIFER DATA

Saturated Thickness: 5.19 m
Anisotropy Ratio (Kz/Kr): 0.1

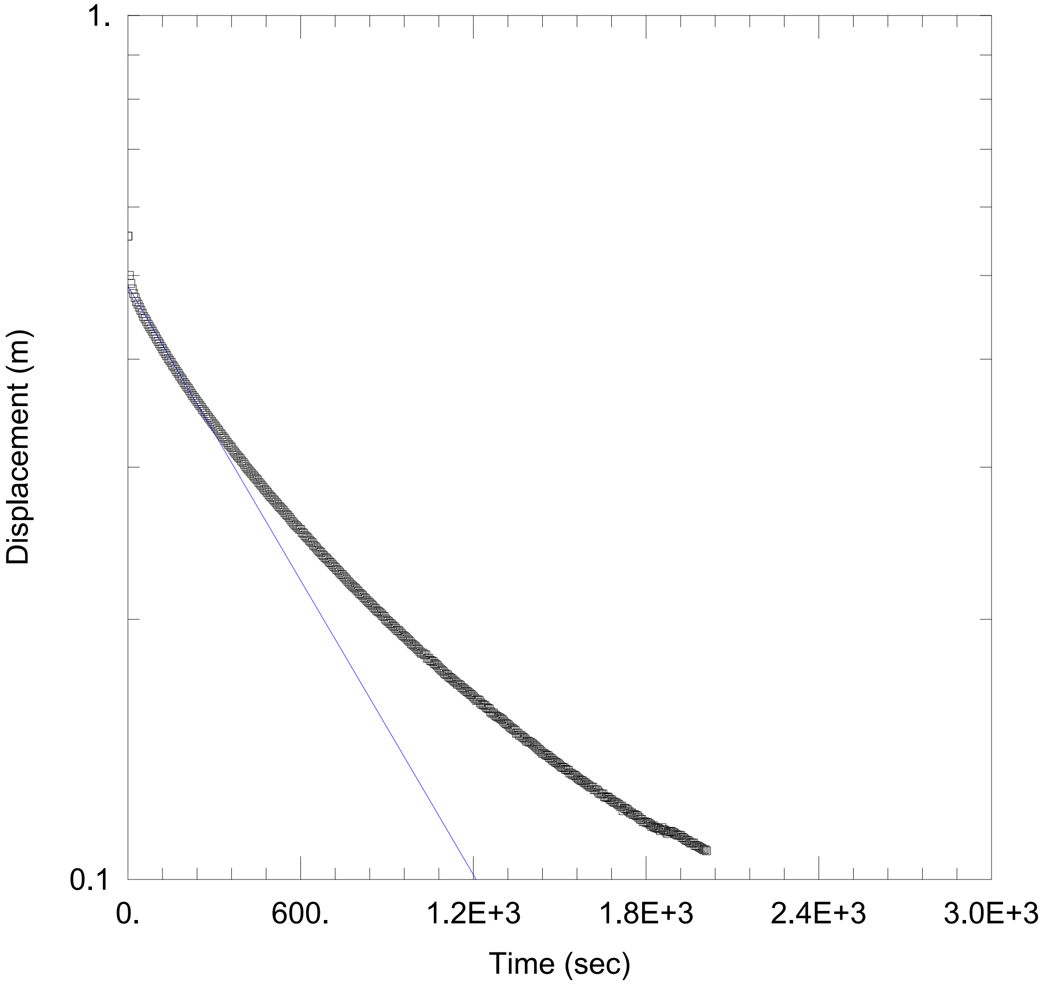
WELL DATA (MW5)

Initial Displacement: 0.5788 m
Total Well Penetration Depth: 7.03 m
Casing Radius: 0.0508 m
Static Water Column Height: 4.53 m
Screen Length: 2.5 m
Well Radius: 0.1645 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 2.171E-6 m/sec
y0 = 0.4993 m



MW5 RH1

Data Set: C:\...\MW5 RH1.aqt
Date: 02/12/19 Time: 15:40:45

PROJECT INFORMATION

Company: Palmer Environmental
Project: 13118
Test Well: MW5
Test Date: 2015-08-13

AQUIFER DATA

Saturated Thickness: 5.19 m
Anisotropy Ratio (Kz/Kr): 0.1

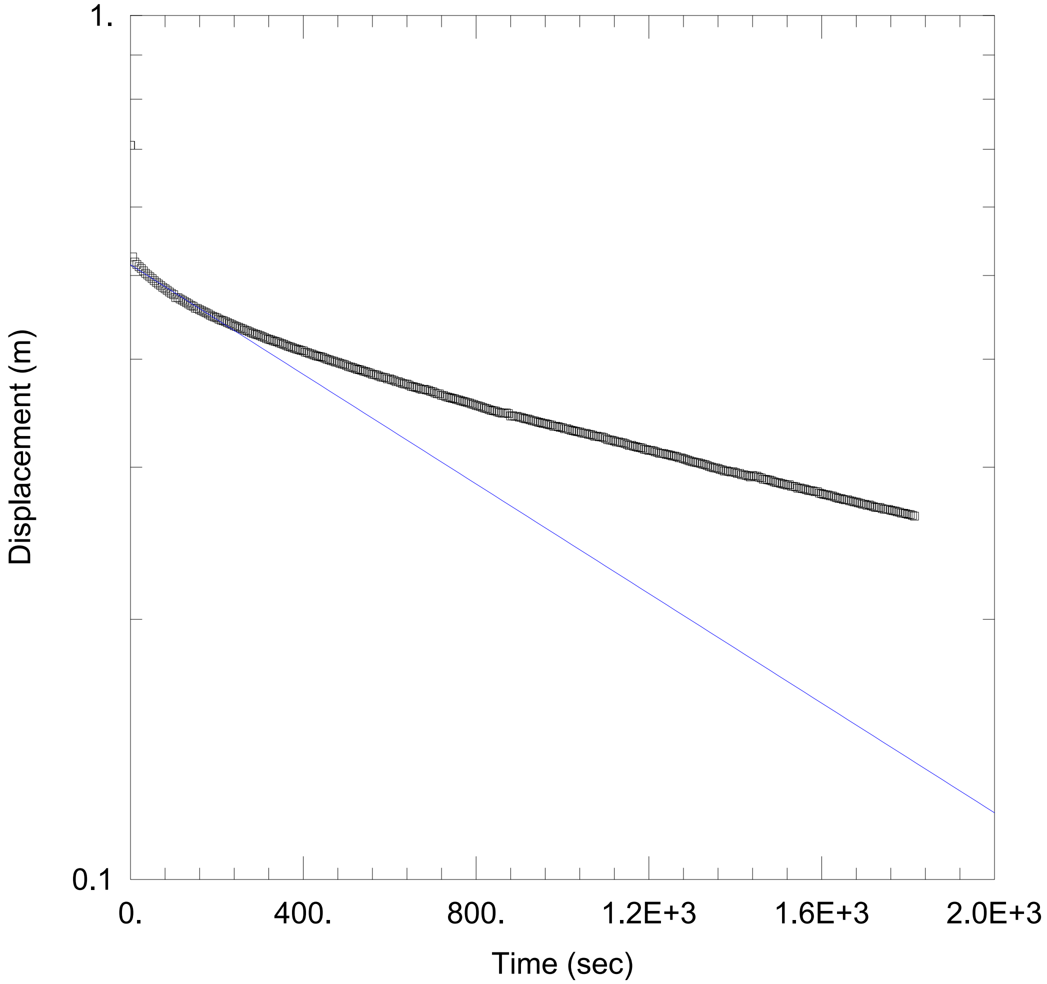
WELL DATA (MW5)

Initial Displacement: 0.5554 m
Total Well Penetration Depth: 7.03 m
Casing Radius: 0.0508 m
Static Water Column Height: 4.53 m
Screen Length: 2.5 m
Well Radius: 0.1645 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 2.429E-6 m/sec
y0 = 0.4861 m



MW6 FH1

Data Set: C:\...\MW6 FH1.aqt
Date: 02/12/19
Time: 15:40:29

PROJECT INFORMATION

Company: Palmer Environmental
Project: 13118
Test Well: MW6
Test Date: 2015-08-14

AQUIFER DATA

Saturated Thickness: 4.66 m
Anisotropy Ratio (Kz/Kr): 0.1

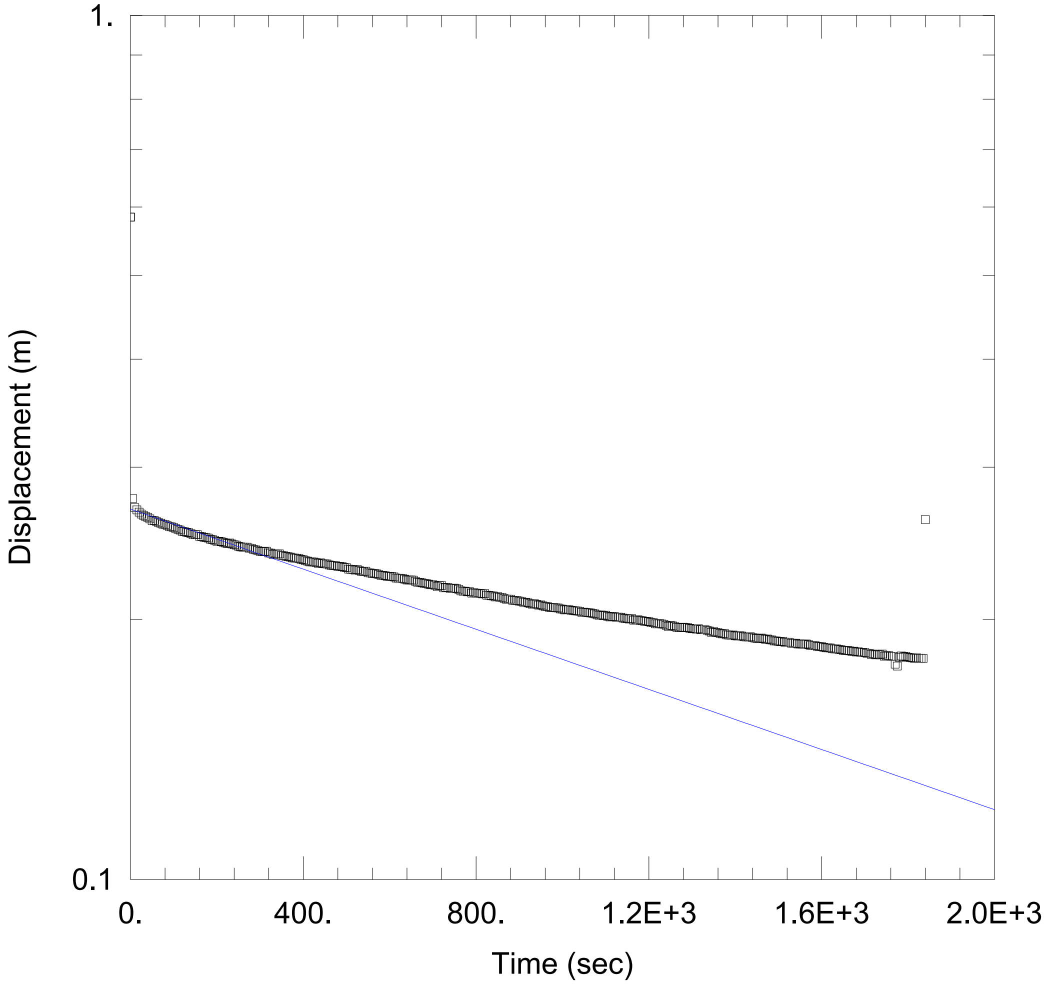
WELL DATA (MW6)

Initial Displacement: 0.7074 m
Total Well Penetration Depth: 2.3 m
Casing Radius: 0.0508 m
Static Water Column Height: 4.66 m
Screen Length: 1.3 m
Well Radius: 0.1645 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 1.654E-6 m/sec
y0 = 0.5145 m



MW6 RH1

Data Set: C:\...\MW6 RH1.aqt
Date: 02/12/19 Time: 15:40:01

PROJECT INFORMATION

Company: Palmer Environmental
Project: 13118
Test Well: MW6
Test Date: 2015-08-14

AQUIFER DATA

Saturated Thickness: 4.66 m
Anisotropy Ratio (Kz/Kr): 0.1

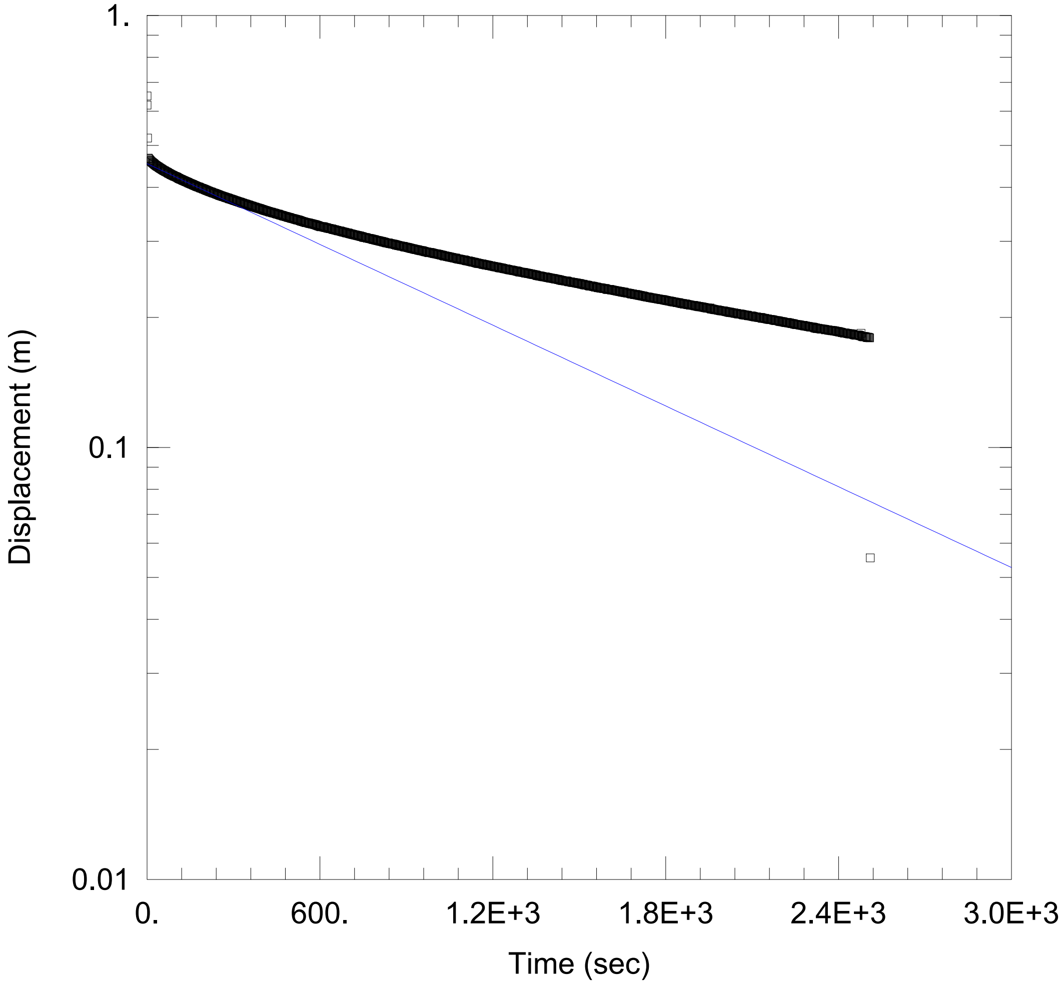
WELL DATA (MW6)

Initial Displacement: 0.5841 m
Total Well Penetration Depth: 2.3 m
Casing Radius: 0.0508 m
Static Water Column Height: 4.66 m
Screen Length: 1.3 m
Well Radius: 0.1645 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 9.07E-7 m/sec
y0 = 0.2683 m



WELL TEST ANALYSIS

Data Set: C:\...\180041MW7F_JC.aqt
Date: 02/12/19 Time: 15:52:26

PROJECT INFORMATION

Company: PECG
Client: Orlando Corp.
Project: 180041
Location: Milton
Test Well: MW7
Test Date: April 09, 2018

AQUIFER DATA

Saturated Thickness: 7. m
Anisotropy Ratio (Kz/Kr): 0.1

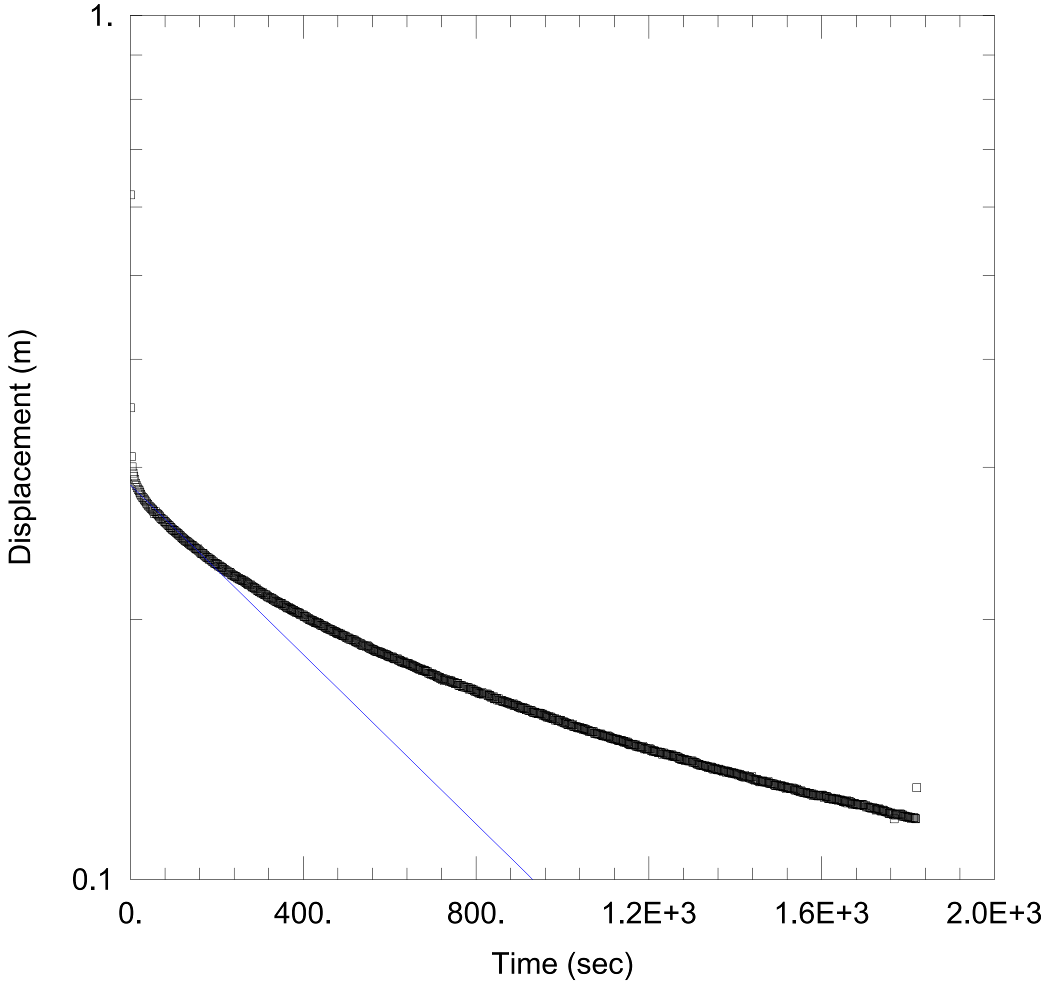
WELL DATA (MW7)

Initial Displacement: 0.62 m
Total Well Penetration Depth: 1.2 m
Casing Radius: 0.0254 m
Static Water Column Height: 5.021 m
Screen Length: 1.2 m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev

K = 1.1E-6 m/sec
y0 = 0.4539 m



WELL TEST ANALYSIS

Data Set: C:\...\180041MW7R_JC.aqt
Date: 02/12/19 Time: 15:52:10

PROJECT INFORMATION

Company: PECG
Client: Orlando Corp.
Project: 180041
Location: Milton
Test Well: MW7
Test Date: April 09, 2018

AQUIFER DATA

Saturated Thickness: 7. m
Anisotropy Ratio (Kz/Kr): 0.1

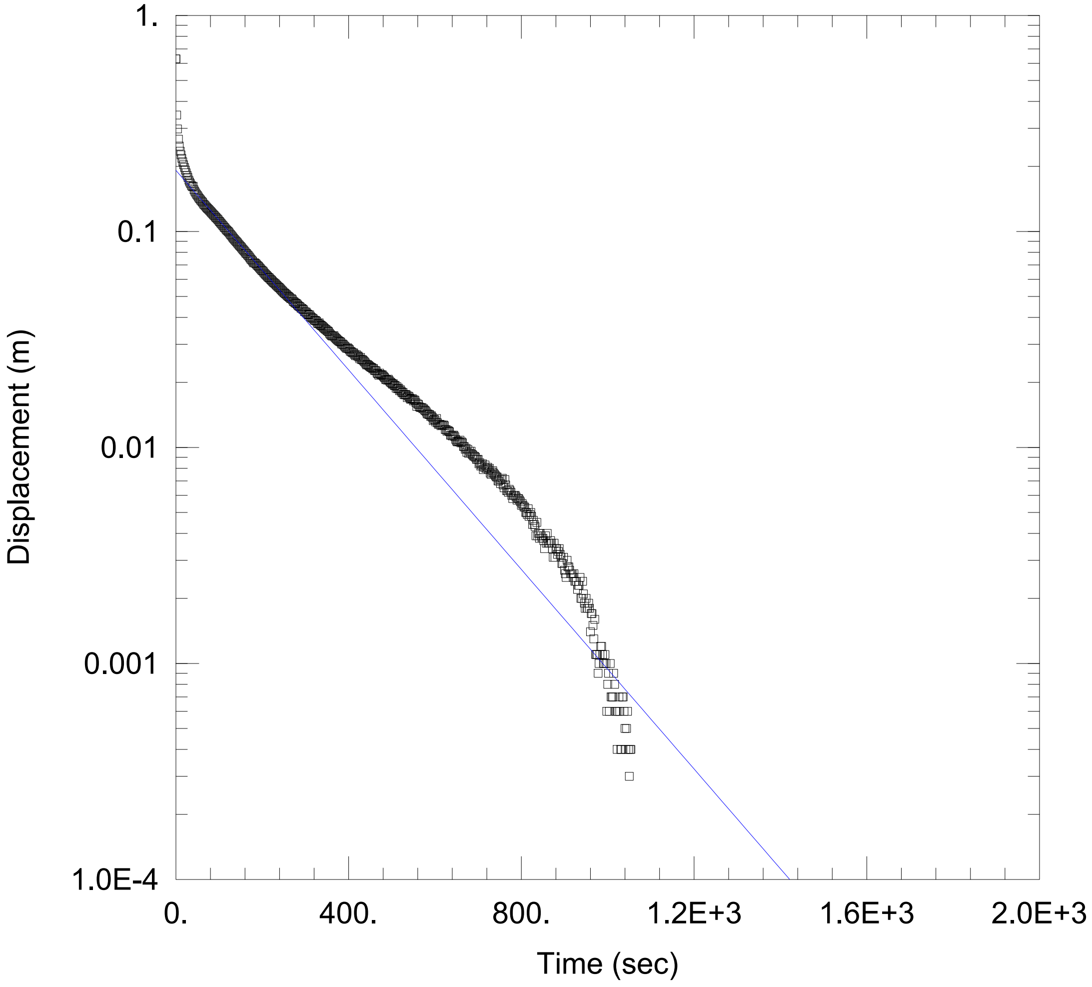
WELL DATA (MW7)

Initial Displacement: 0.62 m
Total Well Penetration Depth: 1.2 m
Casing Radius: 0.0254 m
Static Water Column Height: 5.021 m
Screen Length: 1.2 m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev

K = 1.73E-6 m/sec
y0 = 0.2861 m



WELL TEST ANALYSIS

Data Set: C:\...\180041MW8F.aqt
Date: 02/12/19 Time: 15:51:55

PROJECT INFORMATION

Company: PECG
Client: Orlando Corp.
Project: 180041
Location: Milton
Test Well: MW8
Test Date: April 09, 2018

AQUIFER DATA

Saturated Thickness: 1.9 m
Anisotropy Ratio (Kz/Kr): 0.1

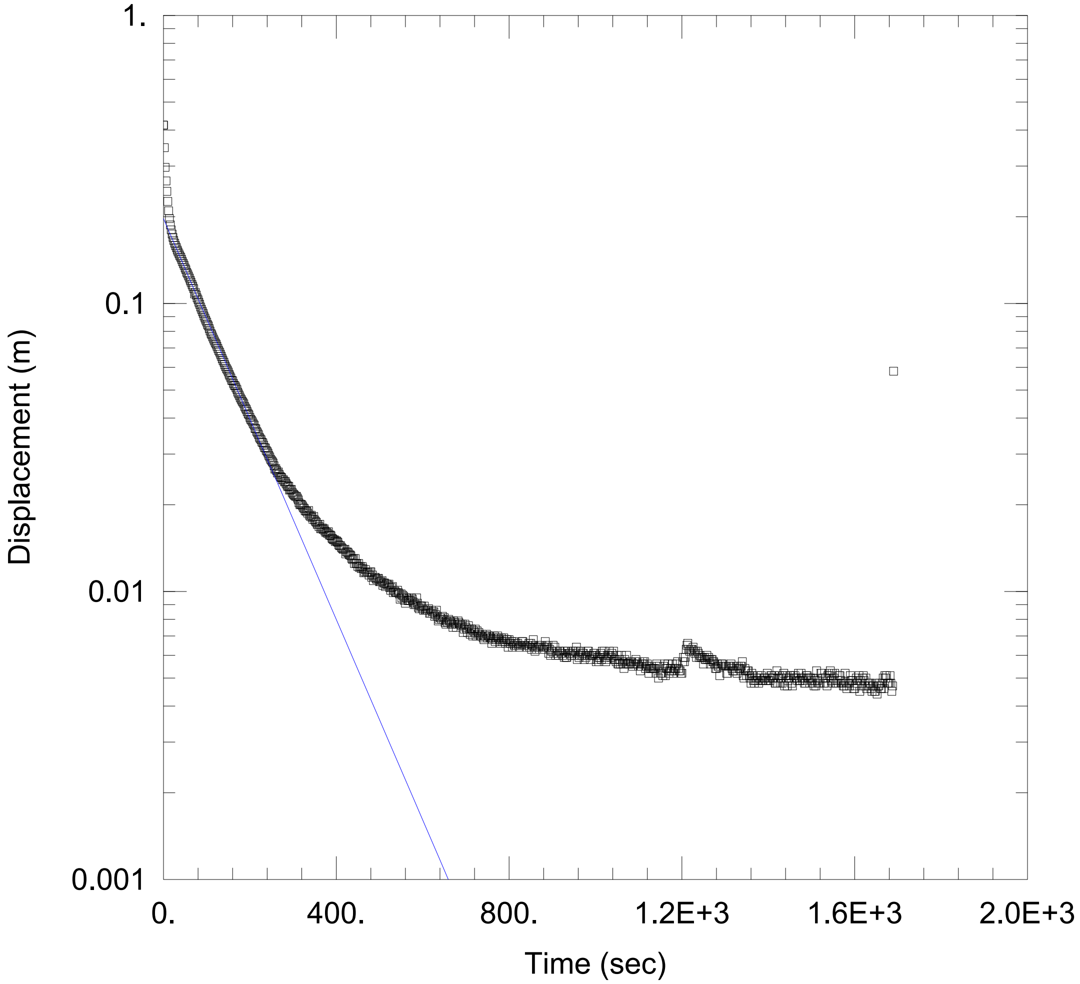
WELL DATA (MW8)

Initial Displacement: 0.6295 m
Total Well Penetration Depth: 1.7 m
Casing Radius: 0.0254 m
Static Water Column Height: 1.87 m
Screen Length: 1.5 m
Well Radius: 0.0254 m

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev

K = 5.981E-6 m/sec
y0 = 0.1917 m



WELL TEST ANALYSIS

Data Set: C:\...\180041MW8R.aqt
Date: 02/12/19 Time: 15:51:39

PROJECT INFORMATION

Company: PECG
Client: Orlando Corp.
Project: 180041
Location: Milton
Test Well: MW8
Test Date: April 09, 2018

AQUIFER DATA

Saturated Thickness: 1.9 m
Anisotropy Ratio (Kz/Kr): 0.1

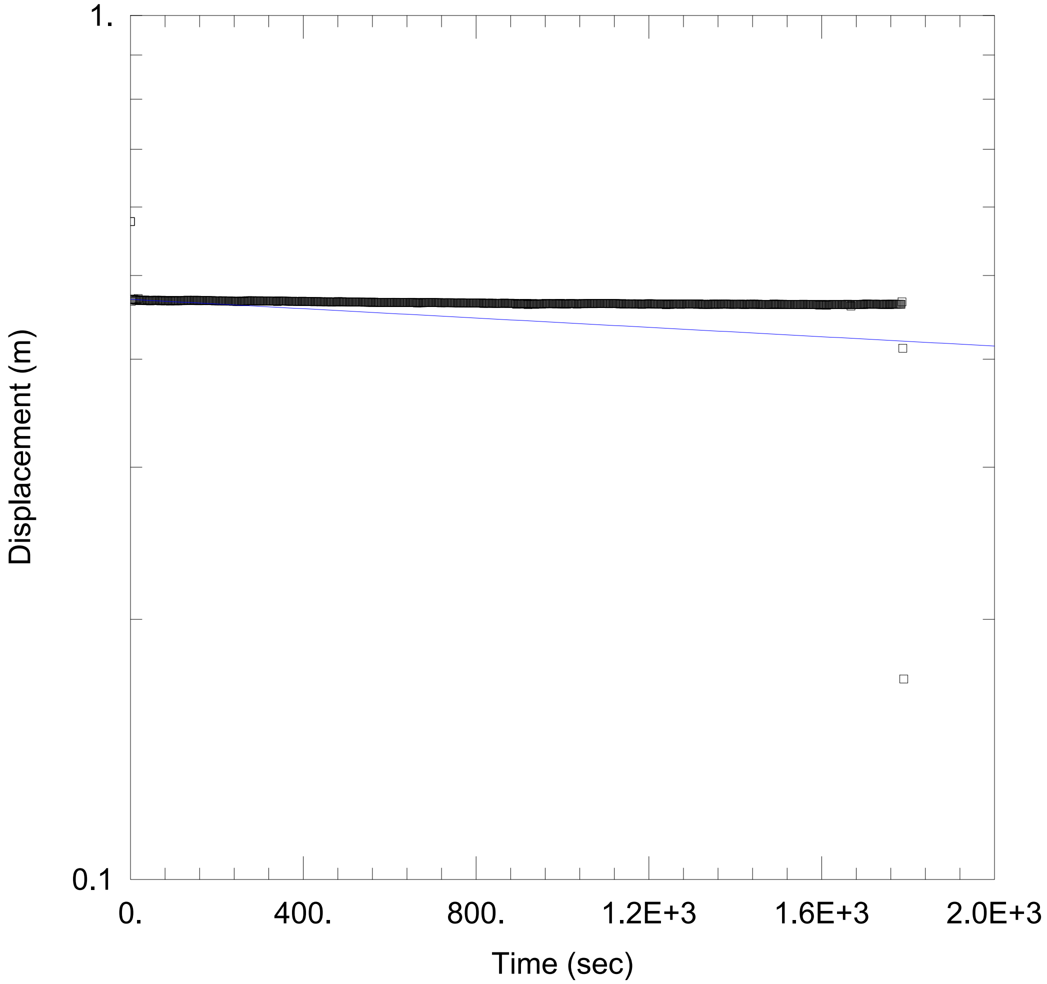
WELL DATA (MW8)

Initial Displacement: 0.416 m
Static Water Column Height: 1.87 m
Total Well Penetration Depth: 1.7 m
Screen Length: 1.5 m
Casing Radius: 0.0254 m
Well Radius: 0.0254 m

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev

K = 9.012E-6 m/sec
y0 = 0.197 m



WELL TEST ANALYSIS

Data Set: C:\...\180041MW9F-2.aqt
Date: 02/12/19 Time: 15:50:20

PROJECT INFORMATION

Company: PECG
Client: Orlando Corp.
Project: 180041
Location: Milton
Test Well: MW9
Test Date: April 09, 2018

AQUIFER DATA

Saturated Thickness: 2.28 m
Anisotropy Ratio (Kz/Kr): 0.1

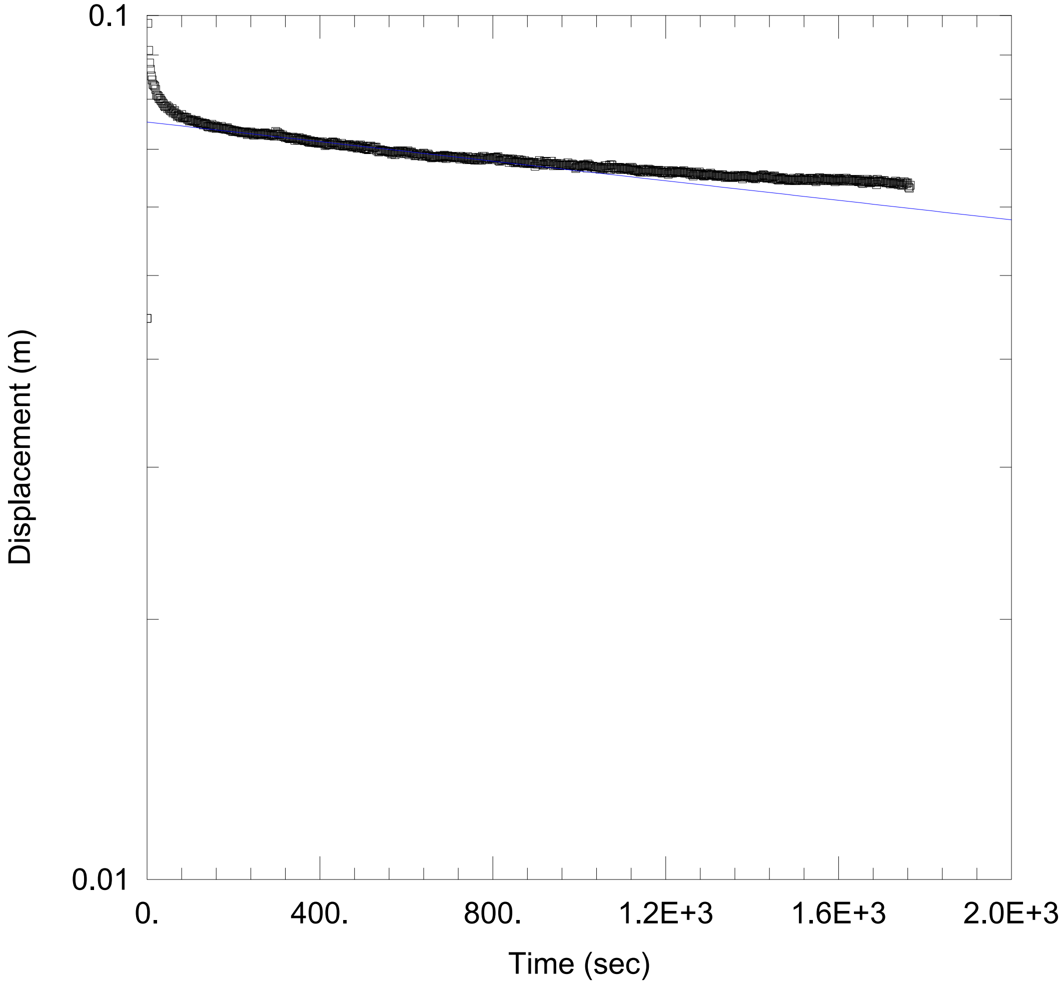
WELL DATA (MW9)

Initial Displacement: 0.5774 m
Static Water Column Height: 8.985 m
Total Well Penetration Depth: 2.28 m
Screen Length: 2.28 m
Casing Radius: 0.0254 m
Well Radius: 0.0254 m

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev

K = 4.666E-8 m/sec
y0 = 0.4692 m



WELL TEST ANALYSIS

Data Set: C:\...\180041MW9R-2.aqt
Date: 02/12/19 Time: 15:49:58

PROJECT INFORMATION

Company: PECG
Client: Orlando Corp.
Project: 180041
Location: Milton
Test Well: MW9
Test Date: April 09, 2018

AQUIFER DATA

Saturated Thickness: 2.28 m
Anisotropy Ratio (Kz/Kr): 0.1

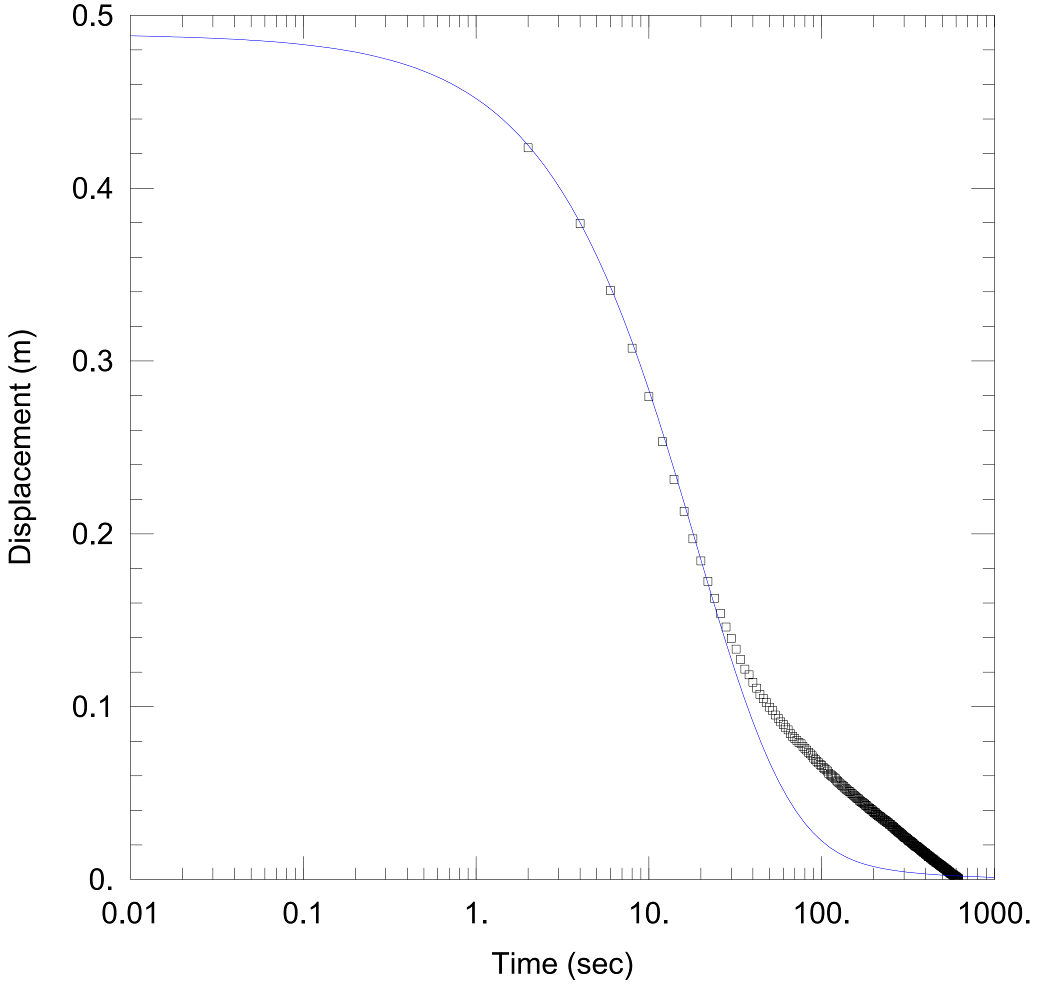
WELL DATA (MW9)

Initial Displacement: 0.0446 m
Static Water Column Height: 8.985 m
Total Well Penetration Depth: 2.28 m
Screen Length: 2.28 m
Casing Radius: 0.0254 m
Well Radius: 0.0254 m

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev

K = 9.772E-8 m/sec
y0 = 0.07526 m



WELL TEST ANALYSIS

Data Set: C:\...\180041MW10F.aqt
Date: 02/12/19 Time: 15:49:36

PROJECT INFORMATION

Company: PECG
Client: Orlando Corp.
Project: 180041
Location: Milton
Test Well: MW10
Test Date: April 09, 2018

AQUIFER DATA

Saturated Thickness: 1.4 m
Anisotropy Ratio (Kz/Kr): 0.1

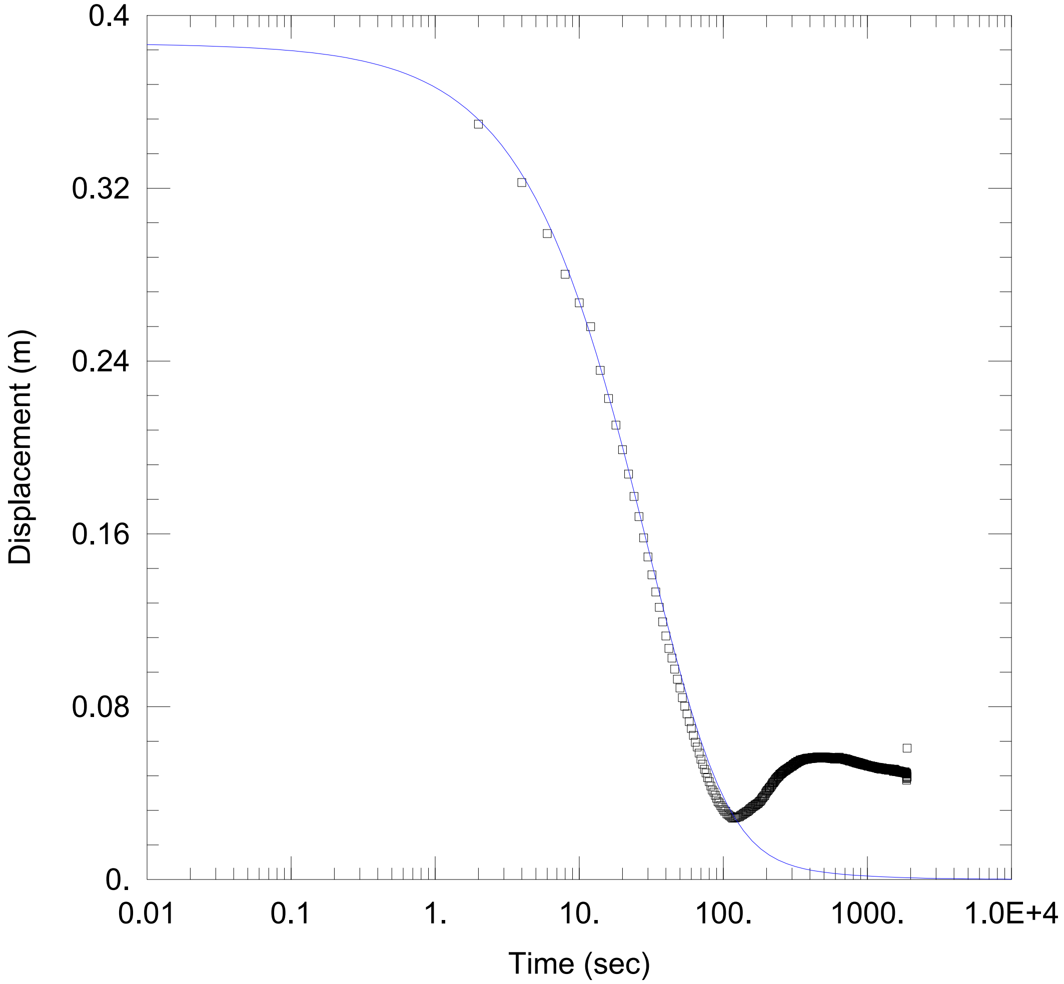
WELL DATA (MW10)

Initial Displacement: 0.4894 m
Static Water Column Height: 4.536 m
Total Well Penetration Depth: 0.9 m
Screen Length: 0.9 m
Casing Radius: 0.0254 m
Well Radius: 0.0254 m

SOLUTION

Aquifer Model: Confined
Solution Method: Cooper-Bredehoeft-Papadopulos

T = 7.08E-5 m^2/sec
S = 0.0004571



WELL TEST ANALYSIS

Data Set: C:\...\180041MW10R.aqt
Date: 02/12/19 Time: 15:53:53

PROJECT INFORMATION

Company: PECG
Client: Orlando Corp.
Project: 180041
Location: Milton
Test Well: MW10
Test Date: April 09, 2018

AQUIFER DATA

Saturated Thickness: 1.4 m Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (MW10)

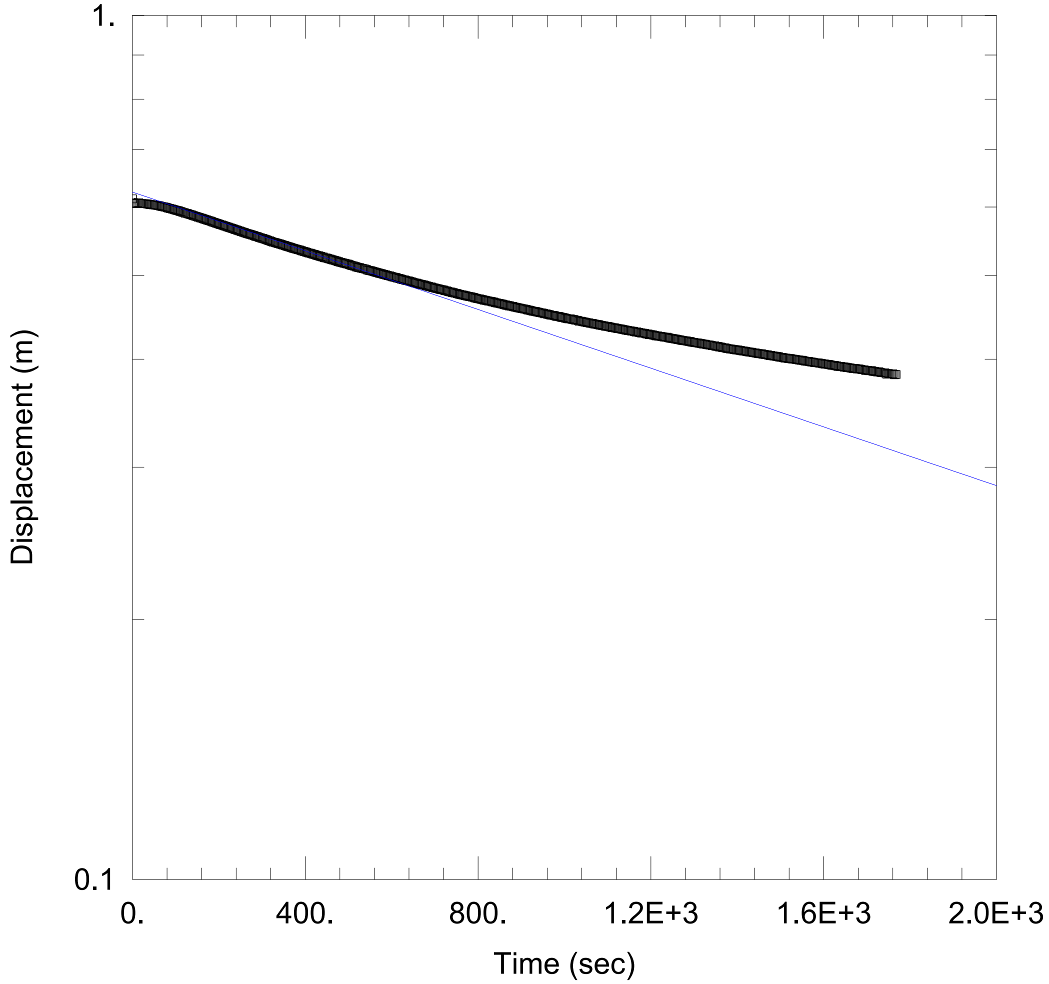
Initial Displacement: 0.3872 m
Total Well Penetration Depth: 0.9 m
Casing Radius: 0.0254 m

Static Water Column Height: 4.536 m
Screen Length: 0.9 m
Well Radius: 0.0254 m

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Bredehoeft-Papadopulos

$T = 4.435E-5\ m^2/sec$ S = 0.0004571



WELL TEST ANALYSIS

Data Set: C:\...\180041MW11F_JC.aqt
Date: 02/12/19 Time: 15:53:38

PROJECT INFORMATION

Company: PECG
Client: Orlando Corp.
Project: 180041
Location: Milton
Test Well: MW11
Test Date: April 09, 2018

AQUIFER DATA

Saturated Thickness: 3.05 m
Anisotropy Ratio (Kz/Kr): 0.1

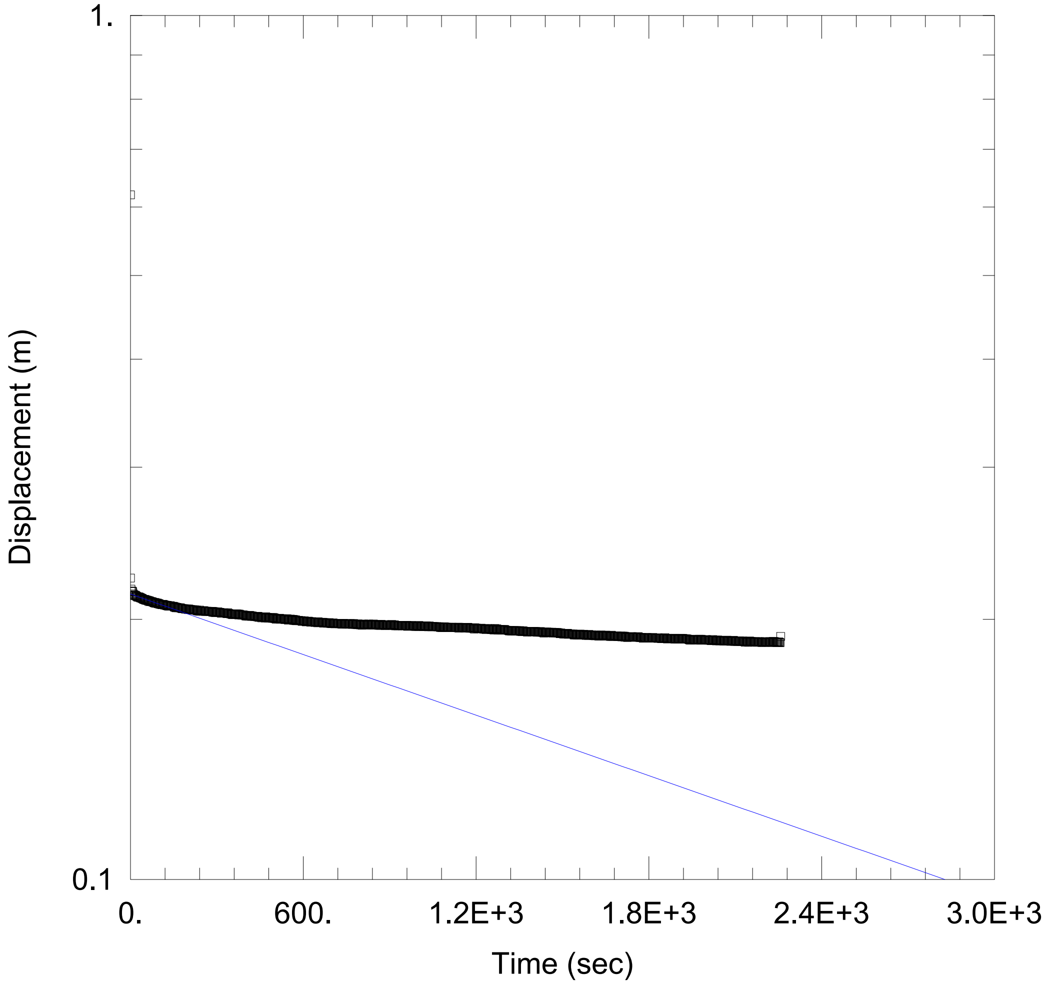
WELL DATA (MW11)

Initial Displacement: 0.6132 m
Total Well Penetration Depth: 2.75 m
Casing Radius: 0.0254 m
Static Water Column Height: 5.975 m
Screen Length: 1.5 m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev

K = 4.4E-7 m/sec
y0 = 0.6245 m



WELL TEST ANALYSIS

Data Set: C:\...\180041MW11R_JC.aqt
Date: 02/12/19 Time: 15:53:23

PROJECT INFORMATION

Company: PECG
Client: Orlando Corp.
Project: 180041
Location: Milton
Test Well: MW11
Test Date: April 09, 2018

AQUIFER DATA

Saturated Thickness: 3.05 m
Anisotropy Ratio (Kz/Kr): 0.1

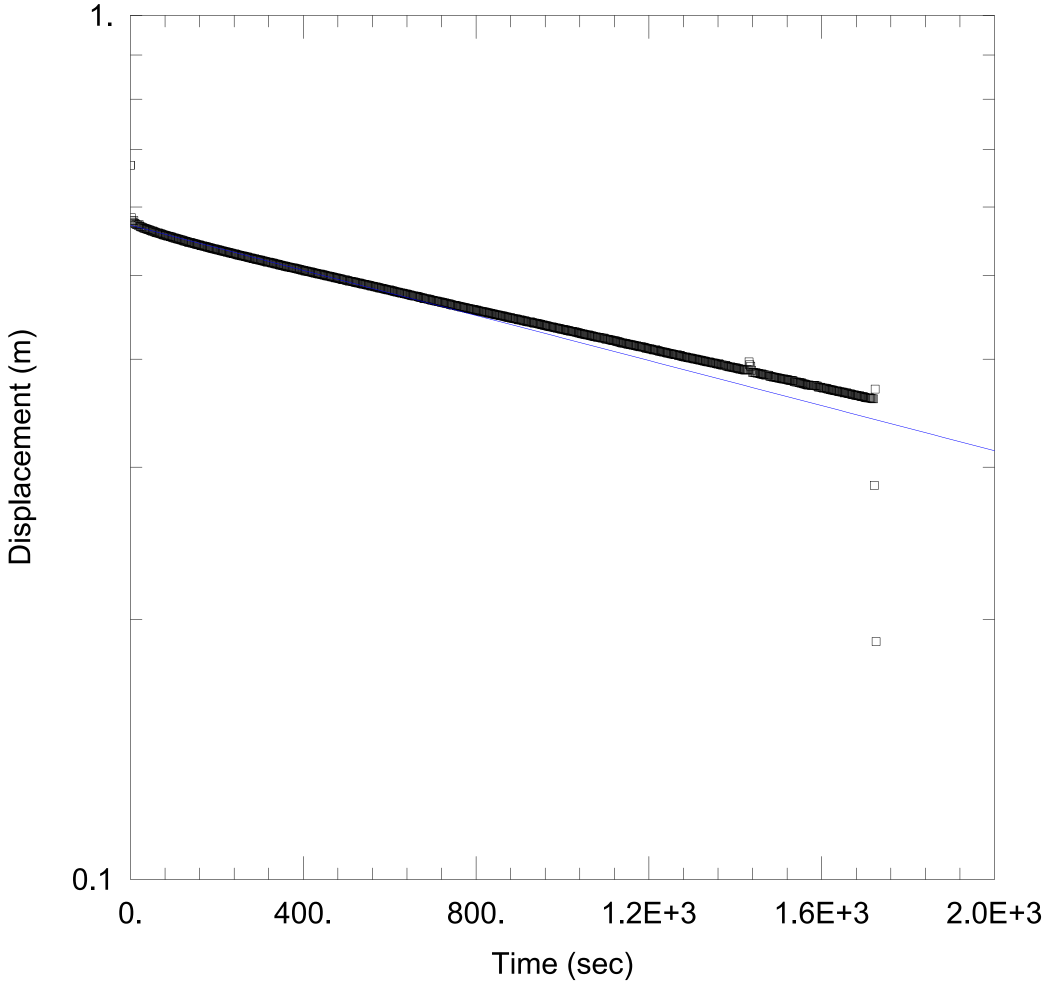
WELL DATA (MW11)

Initial Displacement: 0.62 m
Total Well Penetration Depth: 2.75 m
Casing Radius: 0.0254 m
Static Water Column Height: 5.975 m
Screen Length: 1.5 m
Well Radius: 0.0254 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev

K = 3.026E-7 m/sec
y0 = 0.214 m



WELL TEST ANALYSIS

Data Set: C:\...\180041MW12F.aqt
Date: 02/12/19 Time: 15:53:05

PROJECT INFORMATION

Company: PECG
Client: Orlando Corp.
Project: 180041
Location: Milton
Test Well: MW12
Test Date: April 09, 2018

AQUIFER DATA

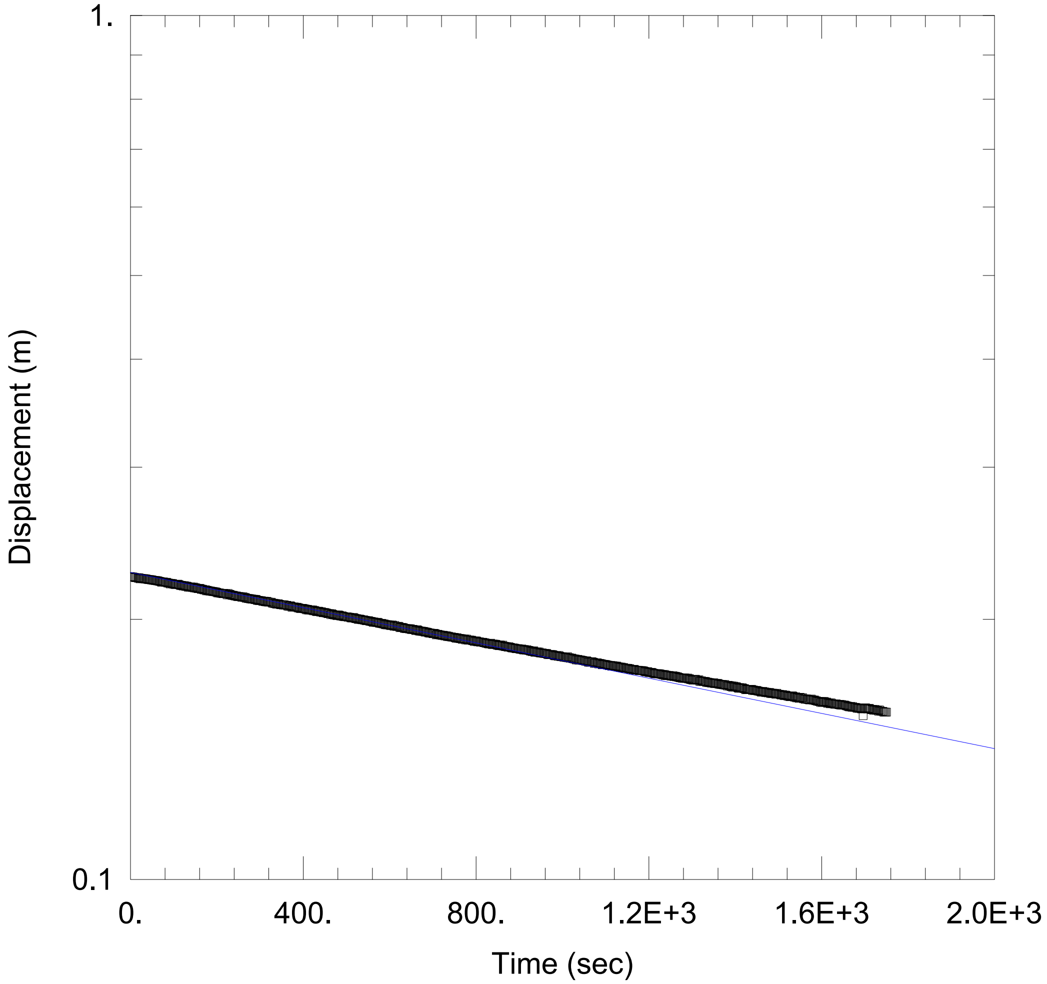
Saturated Thickness: 2.1 m
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (MW12)

Initial Displacement: 0.6709 m
Static Water Column Height: 6.8 m
Total Well Penetration Depth: 2.1 m
Screen Length: 1.5 m
Casing Radius: 0.0254 m
Well Radius: 0.0254 m

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 3.826E-7 m/sec
y0 = 0.5716 m



WELL TEST ANALYSIS

Data Set: C:\...\180041MW12R.aqt
Date: 02/12/19 Time: 15:52:44

PROJECT INFORMATION

Company: PECG
Client: Orlando Corp.
Project: 180041
Location: Milton
Test Well: MW12
Test Date: April 09, 2018

AQUIFER DATA

Saturated Thickness: 2.1 m
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (MW12)

Initial Displacement: 0.2241 m
Static Water Column Height: 6.8 m
Total Well Penetration Depth: 2.1 m
Screen Length: 1.5 m
Casing Radius: 0.0254 m
Well Radius: 0.0254 m

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 2.99E-7 m/sec
y0 = 0.2266 m

Appendix D

Certificate of Analysis (ALS, 2015)

Appendix D

Certificate of Analysis (ALS, 2015)

PALMER ENVIRONMENTAL CONSULTING
GROUP INC. TORONTO
ATTN: JASON COLE
357 BAY STREET
SUITE 800
TORONTO ON M5H 2T7

Date Received: 14-AUG-15
Report Date: 21-AUG-15 09:46 (MT)
Version: FINAL

Client Phone: 647-795-8153

Certificate of Analysis

Lab Work Order #: L1657723

Project P.O. #: NOT SUBMITTED
Job Reference: 13113 MILTON
C of C Numbers:
Legal Site Desc:

Mathy Ganeshakumar, M.Sc.
Account Manager

Sample Details/Parameters	Result	Qualifier	D.L.	Units	Criteria Specific Limits		Analyzed	Batch
L1657723-1 MW1 Sampled By: K.G./J.C. on 13-AUG-15 @ 11:40 Matrix: WATER					STANDARDS	GUIDELINES		
General Chemistry Package 3								
Ammonia, Total (as N)	<0.050		0.050	mg/L			18-AUG-15	R3249146
Bromide (Br)	<0.10		0.10	mg/L			17-AUG-15	R3248331
Nitrate and Nitrite as N	2.16		0.022	mg/L	10		18-AUG-15	
Silica	19.3		0.11	mg/L			18-AUG-15	
Chloride (Cl)	48.7		0.50	mg/L		250	17-AUG-15	R3248331
Color, Apparent	46.8		1.0	C.U.		** 5	14-AUG-15	R3247994
Conductivity	739		3.0	umhos/cm			17-AUG-15	R3248386
Detailed Ion Balance Calculation								
Ion Balance	107			%			21-AUG-15	
Cation - Anion Balance	3.3			%			21-AUG-15	
Computed Conductivity	696			uS/cm			21-AUG-15	
Conductivity % Difference	-5.9			%			21-AUG-15	
TDS (Calculated)	427			mg/L			21-AUG-15	
Anion Sum	7.45			me/L			21-AUG-15	
Cation Sum	7.96			me/L			21-AUG-15	
Saturation pH	6.97			pH			21-AUG-15	
Langelier Index	1.0			No Unit			21-AUG-15	
Hardness (as CaCO3)	373			mg/L		** 80-100	21-AUG-15	
Phosphate-P (ortho)	<0.0030		0.0030	mg/L			14-AUG-15	R3247995
Dissolved Metals in Water by CRC ICPMS								
Aluminum (Al)-Dissolved	<0.0050		0.0050	mg/L		0.1	17-AUG-15	R3248207
Dissolved Metals Filtration Location	FIELD			No Unit			17-AUG-15	R3247472
Antimony (Sb)-Dissolved	<0.00010		0.00010	mg/L	0.006		17-AUG-15	R3248207
Arsenic (As)-Dissolved	<0.00010		0.00010	mg/L	0.025		17-AUG-15	R3248207
Barium (Ba)-Dissolved	0.151		0.00010	mg/L	1		17-AUG-15	R3248207
Beryllium (Be)-Dissolved	<0.00010		0.00010	mg/L			17-AUG-15	R3248207
Bismuth (Bi)-Dissolved	<0.000050		0.000050	mg/L			17-AUG-15	R3248207
Boron (B)-Dissolved	0.045		0.010	mg/L	5		17-AUG-15	R3248207
Cadmium (Cd)-Dissolved	<0.000010		0.000010	mg/L	0.005		17-AUG-15	R3248207
Calcium (Ca)-Dissolved	103		0.050	mg/L			17-AUG-15	R3248207
Chromium (Cr)-Dissolved	0.00098		0.00050	mg/L	0.05		17-AUG-15	R3248207
Cobalt (Co)-Dissolved	<0.00010		0.00010	mg/L			17-AUG-15	R3248207
Copper (Cu)-Dissolved	0.00074		0.00020	mg/L		1	17-AUG-15	R3248207
Iron (Fe)-Dissolved	<0.010		0.010	mg/L		0.3	17-AUG-15	R3248207
Lead (Pb)-Dissolved	<0.000050		0.000050	mg/L	0.01		17-AUG-15	R3248207
Magnesium (Mg)-Dissolved	28.2		0.050	mg/L			17-AUG-15	R3248207
Manganese (Mn)-Dissolved	0.00943		0.00050	mg/L		0.05	17-AUG-15	R3248207
Molybdenum (Mo)-Dissolved	0.00137		0.000050	mg/L			17-AUG-15	R3248207
Nickel (Ni)-Dissolved	<0.00050		0.00050	mg/L			17-AUG-15	R3248207
Phosphorus (P)-Dissolved	<0.050		0.050	mg/L			17-AUG-15	R3248207
Potassium (K)-Dissolved	2.50		0.050	mg/L			17-AUG-15	R3248207
Selenium (Se)-Dissolved	<0.000050		0.000050	mg/L	0.01		17-AUG-15	R3248207
Silicon (Si)-Dissolved	9.01		0.050	mg/L			17-AUG-15	R3248207
Silver (Ag)-Dissolved	<0.000050		0.000050	mg/L			17-AUG-15	R3248207
Sodium (Na)-Dissolved	10.2		0.50	mg/L	20	200	17-AUG-15	R3248207

Sample Details/Parameters	Result	Qualifier	D.L.	Units	Criteria Specific Limits		Analyzed	Batch
L1657723-1 MW1								
Sampled By: K.G./J.C. on 13-AUG-15 @ 11:40								
Matrix: WATER					STANDARDS	GUIDELINES		
General Chemistry Package 3								
Dissolved Metals in Water by CRC ICPMS								
Strontium (Sr)-Dissolved	0.512		0.0010	mg/L			17-AUG-15	R3248207
Sulfur (S)-Dissolved	14.9		5.0	mg/L			17-AUG-15	R3248207
Thallium (Tl)-Dissolved	0.000011		0.000010	mg/L			17-AUG-15	R3248207
Tin (Sn)-Dissolved	<0.00010		0.00010	mg/L			17-AUG-15	R3248207
Titanium (Ti)-Dissolved	<0.00030		0.00030	mg/L			17-AUG-15	R3248207
Tungsten (W)-Dissolved	<0.00010		0.00010	mg/L			17-AUG-15	R3248207
Uranium (U)-Dissolved	0.000591		0.000010	mg/L	0.02		17-AUG-15	R3248207
Vanadium (V)-Dissolved	<0.00050		0.00050	mg/L			17-AUG-15	R3248207
Zinc (Zn)-Dissolved	0.0026		0.0010	mg/L		5	17-AUG-15	R3248207
Zirconium (Zr)-Dissolved	<0.00030		0.00030	mg/L			17-AUG-15	R3248207
Dissolved Organic Carbon	1.2		1.0	mg/L		5	19-AUG-15	R3249944
Fluoride (F)	0.124		0.020	mg/L	1.5		17-AUG-15	R3248331
Nitrate (as N)	2.16		0.020	mg/L	10		17-AUG-15	R3248331
Nitrite (as N)	<0.010		0.010	mg/L	1		17-AUG-15	R3248331
Sulfate (SO4)	41.5		0.30	mg/L		500	17-AUG-15	R3248331
Total Dissolved Solids	403	DLA	20	mg/L		500	20-AUG-15	R3249904
Turbidity	2.32		0.10	NTU		5	15-AUG-15	R3247491
pH	8.01		0.10	pH units		6.5-8.5	17-AUG-15	R3248383
Individual Analytes								
Speciated Alkalinity								
Alkalinity, Total (as CaCO3)	305		10	mg/L		30-500	19-AUG-15	R3250668
Alkalinity, Bicarbonate (as CaCO3)	305		10	mg/L			19-AUG-15	R3250668
Alkalinity, Carbonate (as CaCO3)	<10		10	mg/L			19-AUG-15	R3250668
Alkalinity, Hydroxide (as CaCO3)	<10		10	mg/L			19-AUG-15	R3250668
L1657723-2 MW5								
Sampled By: K.G./J.C. on 13-AUG-15 @ 17:10								
Matrix: WATER					STANDARDS	GUIDELINES		
General Chemistry Package 3								
Ammonia, Total (as N)	0.628		0.050	mg/L			18-AUG-15	R3249146
Bromide (Br)	<0.10		0.10	mg/L			17-AUG-15	R3248331
Nitrate and Nitrite as N	5.47		0.022	mg/L	10		18-AUG-15	
Silica	10.7		0.11	mg/L			18-AUG-15	
Chloride (Cl)	27.2		0.50	mg/L		250	17-AUG-15	R3248331
Color, Apparent	207		1.0	C.U.		** 5	14-AUG-15	R3247994
Conductivity	967		3.0	umhos/cm			17-AUG-15	R3248386
Detailed Ion Balance Calculation								
Ion Balance	101			%			20-AUG-15	
Cation - Anion Balance	0.3			%			20-AUG-15	
Computed Conductivity	845			uS/cm			20-AUG-15	
Conductivity % Difference	-13.5			%			20-AUG-15	
TDS (Calculated)	584			mg/L			20-AUG-15	

* Detection Limit for result exceeds Criteria Specific Limit. Assessment against Criteria Limit cannot be made.

** Analytical result for this parameter exceeds Criteria Specific Limit listed on this report.

CRITERIA REPORT

13113 MILTON

Sample Details/Parameters	Result	Qualifier	D.L.	Units	Criteria Specific Limits		Analyzed	Batch
					STANDARDS	GUIDELINES		
L1657723-2 MW5								
Sampled By: K.G./J.C. on 13-AUG-15 @ 17:10								
Matrix: WATER								
General Chemistry Package 3								
Detailed Ion Balance Calculation								
Anion Sum	9.20			me/L			20-AUG-15	
Cation Sum	9.25			me/L			20-AUG-15	
Saturation pH	7.77			pH			20-AUG-15	
Langelier Index	0.7			No Unit			20-AUG-15	
Hardness (as CaCO3)	84.9			mg/L		80-100	20-AUG-15	
Phosphate-P (ortho)	0.0078		0.0030	mg/L			14-AUG-15	R3247995
Dissolved Metals in Water by CRC ICPMS								
Aluminum (Al)-Dissolved	0.0176		0.0050	mg/L		0.1	17-AUG-15	R3248207
Dissolved Metals Filtration Location	FIELD			No Unit			17-AUG-15	R3247472
Antimony (Sb)-Dissolved	0.00218		0.00010	mg/L	0.006		17-AUG-15	R3248207
Arsenic (As)-Dissolved	0.0123		0.00010	mg/L	0.025		17-AUG-15	R3248207
Barium (Ba)-Dissolved	0.0380		0.00010	mg/L	1		17-AUG-15	R3248207
Beryllium (Be)-Dissolved	<0.00010		0.00010	mg/L			17-AUG-15	R3248207
Bismuth (Bi)-Dissolved	<0.000050		0.000050	mg/L			17-AUG-15	R3248207
Boron (B)-Dissolved	0.152		0.010	mg/L	5		17-AUG-15	R3248207
Cadmium (Cd)-Dissolved	0.000033		0.000010	mg/L	0.005		17-AUG-15	R3248207
Calcium (Ca)-Dissolved	18.0		0.050	mg/L			17-AUG-15	R3248207
Chromium (Cr)-Dissolved	0.00061		0.00050	mg/L	0.05		17-AUG-15	R3248207
Cobalt (Co)-Dissolved	0.00016		0.00010	mg/L			17-AUG-15	R3248207
Copper (Cu)-Dissolved	0.00241		0.00020	mg/L		1	17-AUG-15	R3248207
Iron (Fe)-Dissolved	<0.010		0.010	mg/L		0.3	17-AUG-15	R3248207
Lead (Pb)-Dissolved	<0.000050		0.000050	mg/L	0.01		17-AUG-15	R3248207
Magnesium (Mg)-Dissolved	9.67		0.050	mg/L			17-AUG-15	R3248207
Manganese (Mn)-Dissolved	0.0166		0.00050	mg/L		0.05	17-AUG-15	R3248207
Molybdenum (Mo)-Dissolved	0.124		0.000050	mg/L			17-AUG-15	R3248207
Nickel (Ni)-Dissolved	0.00167		0.00050	mg/L			17-AUG-15	R3248207
Phosphorus (P)-Dissolved	<0.050		0.050	mg/L			17-AUG-15	R3248207
Potassium (K)-Dissolved	10.4		0.050	mg/L			17-AUG-15	R3248207
Selenium (Se)-Dissolved	0.00517		0.000050	mg/L	0.01		17-AUG-15	R3248207
Silicon (Si)-Dissolved	4.99		0.050	mg/L			17-AUG-15	R3248207
Silver (Ag)-Dissolved	<0.000050		0.000050	mg/L			17-AUG-15	R3248207
Sodium (Na)-Dissolved	167	DLM	5.0	mg/L	** 20	200	17-AUG-15	R3248207
Strontium (Sr)-Dissolved	0.146		0.0010	mg/L			17-AUG-15	R3248207
Sulfur (S)-Dissolved	52.6		5.0	mg/L			17-AUG-15	R3248207
Thallium (Tl)-Dissolved	0.000018		0.000010	mg/L			17-AUG-15	R3248207
Tin (Sn)-Dissolved	<0.00010		0.00010	mg/L			17-AUG-15	R3248207
Titanium (Ti)-Dissolved	<0.00030		0.00030	mg/L			17-AUG-15	R3248207
Tungsten (W)-Dissolved	0.00119		0.00010	mg/L			17-AUG-15	R3248207
Uranium (U)-Dissolved	0.0149		0.000010	mg/L	0.02		17-AUG-15	R3248207
Vanadium (V)-Dissolved	0.00241		0.00050	mg/L			17-AUG-15	R3248207
Zinc (Zn)-Dissolved	0.0030		0.0010	mg/L		5	17-AUG-15	R3248207
Zirconium (Zr)-Dissolved	<0.00030		0.00030	mg/L			17-AUG-15	R3248207
Dissolved Organic Carbon	3.1		1.0	mg/L		5	17-AUG-15	R3248228
Fluoride (F)	1.06		0.020	mg/L	1.5		17-AUG-15	R3248331
Nitrate (as N)	4.79		0.020	mg/L	10		17-AUG-15	R3248331

* Detection Limit for result exceeds Criteria Specific Limit. Assessment against Criteria Limit cannot be made.

** Analytical result for this parameter exceeds Criteria Specific Limit listed on this report.

Ontario DW Std O.Reg 169/03 JUNE 2007

CRITERIA REPORT

13113 MILTON

Sample Details/Parameters	Result	Qualifier	D.L.	Units	Criteria Specific Limits STANDARDS	Criteria Specific Limits GUIDELINES	Analyzed	Batch
L1657723-2 MW5 Sampled By: K.G./J.C. on 13-AUG-15 @ 17:10 Matrix: WATER								
General Chemistry Package 3								
Nitrite (as N)	0.680		0.010	mg/L	1		17-AUG-15	R3248331
Sulfate (SO4)	162		0.30	mg/L		500	17-AUG-15	R3248331
Total Dissolved Solids	629	DLA	20	mg/L		** 500	20-AUG-15	R3249904
Turbidity	34.2		0.10	NTU		** 5	15-AUG-15	R3247491
pH	8.47		0.10	pH units		6.5-8.5	17-AUG-15	R3248383
Individual Analytes								
Speciated Alkalinity								
Alkalinity, Total (as CaCO3)	276		10	mg/L		30-500	19-AUG-15	R3249131
Alkalinity, Bicarbonate (as CaCO3)	276		10	mg/L			19-AUG-15	R3249131
Alkalinity, Carbonate (as CaCO3)	<10		10	mg/L			19-AUG-15	R3249131
Alkalinity, Hydroxide (as CaCO3)	<10		10	mg/L			19-AUG-15	R3249131

* Detection Limit for result exceeds Criteria Specific Limit. Assessment against Criteria Limit cannot be made.

** Analytical result for this parameter exceeds Criteria Specific Limit listed on this report.

Ontario DW Std O.Reg 169/03 JUNE 2007

Sample Parameter Qualifier key listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects.
DLA	Detection Limit adjusted for required dilution

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Preparation Method Reference(Based On)	Analytical Method Reference(Based On)
ALK-SPEC-MANUAL-WT	Water	Speciated Alkalinity		APHA 2320B
ALK-SPEC-WT	Water	Speciated Alkalinity		EPA 310.2
BR-IC-N-WT	Water	Bromide in Water by IC		EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

ALS Test Code	Matrix	Test Description	Preparation Method Reference(Based On)	Analytical Method Reference(Based On)
C-DIS-ORG-WT	Water	Dissolved Organic Carbon		APHA 5310 B-INSTRUMENTAL

Sample is filtered through a 0.45um filter, sample is then injected into a heated reaction chamber which is packed with an oxidative catalyst. The water is vaporized and the organic cabon is oxidized to carbon dioxide. The carbon dioxide is transported in a carrier gas and is measured by a non-dispersive infrared detector.

ALS Test Code	Matrix	Test Description	Preparation Method Reference(Based On)	Analytical Method Reference(Based On)
CL-IC-WT	Water	Chloride by IC		EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

ALS Test Code	Matrix	Test Description	Preparation Method Reference(Based On)	Analytical Method Reference(Based On)
COLOUR-WT	Water	Colour		APHA 2120

Apparent colour is determined by analysis of the decanted sample using the platinum-cobalt colourimetric method.

ALS Test Code	Matrix	Test Description	Preparation Method Reference(Based On)	Analytical Method Reference(Based On)
EC-WT	Water	Conductivity		APHA 2510 B

Water samples can be measured directly by immersing the conductivity cell into the sample.

ALS Test Code	Matrix	Test Description	Preparation Method Reference(Based On)	Analytical Method Reference(Based On)
ETL-N2N3-WT	Water	Calculate from NO2 + NO3		APHA 4110 B
ETL-SILICA-CALC-WT	Water	Calculate from SI-TOT-WT		EPA 200.8
F-IC-N-WT	Water	Fluoride in Water by IC		EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

ALS Test Code	Matrix	Test Description	Preparation Method Reference(Based On)	Analytical Method Reference(Based On)
IONBALANCE-OP03-WT	Water	Detailed Ion Balance Calculation		APHA 1030E, 2330B, 2510A
MET-D-CCMS-WT	Water	Dissolved Metals in Water by CRC ICPMS		APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

ALS Test Code	Matrix	Test Description	Preparation Method Reference(Based On)	Analytical Method Reference(Based On)
NH3-WT	Water	Ammonia, Total as N		EPA 350.1

Sample is measured colorimetrically. When sample is turbid a distillation step is required, sample is distilled into a solution of boric acid and measured colorimetrically.

ALS Test Code	Matrix	Test Description	Preparation Method Reference(Based On)	Analytical Method Reference(Based On)
NO2-IC-WT	Water	Nitrite in Water by IC		EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

ALS Test Code	Matrix	Test Description	Preparation Method Reference(Based On)	Analytical Method Reference(Based On)
NO3-IC-WT	Water	Nitrate in Water by IC		EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

ALS Test Code	Matrix	Test Description	Preparation Method Reference(Based On)	Analytical Method Reference(Based On)
PH-ALK-WT	Water	pH		APHA 4500 H-Electrode

Water samples are analyzed directly by a calibrated pH meter.

ALS Test Code	Matrix	Test Description	Preparation Method Reference(Based On)	Analytical Method Reference(Based On)
PO4-DO-COL-WT	Water	Diss. Orthophosphate in Water by Colour		APHA 4500-P PHOSPHORUS

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

ALS Test Code	Matrix	Test Description	Preparation Method Reference(Based On)	Analytical Method Reference(Based On)
SO4-IC-N-WT	Water	Sulfate in Water by IC		EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

ALS Test Code	Matrix	Test Description	Preparation Method Reference(Based On)	Analytical Method Reference(Based On)
SOLIDS-TDS-WT	Water	Total Dissolved Solids		APHA 2540C

A well-mixed sample is filtered though glass fibres filter. A known volume of the filtrate is evaporated and dried at 105–5°C overnight and then 180–10°C for 1hr.

ALS Test Code	Matrix	Test Description	Preparation Method Reference(Based On)	Analytical Method Reference(Based On)
TURBIDITY-WT	Water	Turbidity		APHA 2130 B

Sample result is based on a comparison of the intensity of the light scattered by the sample under defined conditions with the intensity of light scattered by a standard reference suspension under the same conditions. Sample readings are obtained from a Nephelometer.

Reference Information

13113 MILTON

Laboratory Methods employed follow in-house procedures, which are generally based on nationally or internationally accepted methodologies.

Chain of Custody numbers:

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location	Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA		

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Workorder: L1657723 Report Date: 21-AUG-15

Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. TORONTO
357 BAY STREET SUITE 800
TORONTO ON M5H 2T7
Contact: JASON COLE

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-SPEC-MANUAL-WT	**Water**							
Batch R3249131								
WG2152526-4 DUP		**L1657723-2**						
Alkalinity, Total (as CaCO3)		276	276		mg/L	0.0	20	19-AUG-15
Alkalinity, Bicarbonate (as CaCO3)		276	276		mg/L	0.0	25	19-AUG-15
Alkalinity, Carbonate (as CaCO3)		<10	<10	RPD-NA	mg/L	N/A	25	19-AUG-15
Alkalinity, Hydroxide (as CaCO3)		<10	<10	RPD-NA	mg/L	N/A	25	19-AUG-15
WG2152526-2 LCS								
Alkalinity, Total (as CaCO3)			98.0		%		70-130	19-AUG-15
WG2152526-1 MB								
Alkalinity, Total (as CaCO3)			<10		mg/L		10	19-AUG-15
Alkalinity, Bicarbonate (as CaCO3)			<10		mg/L		10	19-AUG-15
Alkalinity, Carbonate (as CaCO3)			<10		mg/L		10	19-AUG-15
Alkalinity, Hydroxide (as CaCO3)			<10		mg/L		10	19-AUG-15
ALK-SPEC-WT	**Water**							
Batch R3250668								
WG2152527-3 CRM		**WT-ALK-CRM**						
Alkalinity, Total (as CaCO3)			102.9		%		80-120	19-AUG-15
WG2152527-4 DUP		**L1657723-1**						
Alkalinity, Total (as CaCO3)		305	300		mg/L	1.7	20	19-AUG-15
WG2152527-2 LCS								
Alkalinity, Total (as CaCO3)			106.6		%		85-115	19-AUG-15
WG2152527-1 MB								
Alkalinity, Total (as CaCO3)			<10		mg/L		10	19-AUG-15
BR-IC-N-WT	**Water**							
Batch R3248331								
WG2150915-4 DUP		**WG2150915-3**						
Bromide (Br)		<0.10	<0.10	RPD-NA	mg/L	N/A	20	17-AUG-15
WG2150915-2 LCS								
Bromide (Br)			96.9		%		85-115	17-AUG-15
WG2150915-1 MB								
Bromide (Br)			<0.10		mg/L		0.1	17-AUG-15
WG2150915-5 MS		**WG2150915-3**						
Bromide (Br)			100.4		%		75-125	17-AUG-15
C-DIS-ORG-WT	**Water**							
Batch R3248228								
WG2150919-3 DUP		**L1657682-1**						
Dissolved Organic Carbon		4.4	4.2		mg/L	5.0	20	17-AUG-15
WG2150919-2 LCS								

Quality Control Report

Workorder: L1657723 Report Date: 21-AUG-15

Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. TORONTO
357 BAY STREET SUITE 800
TORONTO ON M5H 2T7
Contact: JASON COLE

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
C-DIS-ORG-WT	**Water**							
Batch R3248228								
WG2150919-2 LCS								
Dissolved Organic Carbon			109.3		%		80-120	17-AUG-15
WG2150919-1 MB								
Dissolved Organic Carbon			<1.0		mg/L		1	17-AUG-15
WG2150919-4 MS		**L1657682-1**						
Dissolved Organic Carbon			96.2		%		70-130	17-AUG-15
Batch R3249944								
WG2152553-3 DUP		**L1658967-1**						
Dissolved Organic Carbon		14.4	15.6		mg/L	8.4	20	19-AUG-15
WG2152553-2 LCS								
Dissolved Organic Carbon			110.5		%		80-120	19-AUG-15
WG2152553-1 MB								
Dissolved Organic Carbon			<1.0		mg/L		1	19-AUG-15
WG2152553-4 MS		**L1658967-1**						
Dissolved Organic Carbon			99.6		%		70-130	19-AUG-15
CL-IC-WT	**Water**							
Batch R3248331								
WG2150915-4 DUP		**WG2150915-3**						
Chloride (Cl)		<0.50	<0.50	RPD-NA	mg/L	N/A	25	17-AUG-15
WG2150915-2 LCS								
Chloride (Cl)			101.1		%		70-130	17-AUG-15
WG2150915-1 MB								
Chloride (Cl)			<0.50		mg/L		0.5	17-AUG-15
WG2150915-5 MS		**WG2150915-3**						
Chloride (Cl)			99.8		%		70-130	17-AUG-15
COLOUR-WT	**Water**							
Batch R3247994								
WG2150061-3 CRM		**WT-COLOUR-CRM**						
Color, Apparent			97.2		%		80-120	14-AUG-15
WG2150061-4 DUP		**L1657655-1**						
Color, Apparent		86.6	86.1		C.U.	0.5	20	14-AUG-15
WG2150061-1 MB								
Color, Apparent			<1.0		C.U.		1	14-AUG-15
EC-WT	**Water**							

Quality Control Report

Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. TORONTO
357 BAY STREET SUITE 800
TORONTO ON M5H 2T7
Contact: JASON COLE

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
EC-WT	**Water**							
Batch R3248386								
WG2151139-4 DUP		**WG2151139-3**						
Conductivity		733	734		umhos/cm	0.1	10	17-AUG-15
WG2151139-2 LCS								
Conductivity			101.1		%		90-110	17-AUG-15
WG2151139-1 MB								
Conductivity			<3.0		umhos/cm		3	17-AUG-15
F-IC-N-WT	**Water**							
Batch R3248331								
WG2150915-4 DUP		**WG2150915-3**						
Fluoride (F)		<0.020	<0.020	RPD-NA	mg/L	N/A	20	17-AUG-15
WG2150915-2 LCS								
Fluoride (F)			101.3		%		90-110	17-AUG-15
WG2150915-1 MB								
Fluoride (F)			<0.020		mg/L		0.02	17-AUG-15
WG2150915-5 MS		**WG2150915-3**						
Fluoride (F)			103.3		%		75-125	17-AUG-15
MET-D-CCMS-WT	**Water**							
Batch R3248207								
WG2150661-4 DUP		**WG2150661-3**						
Aluminum (Al)-Dissolved		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	17-AUG-15
Antimony (Sb)-Dissolved		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	17-AUG-15
Arsenic (As)-Dissolved		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	17-AUG-15
Barium (Ba)-Dissolved		0.151	0.150		mg/L	0.8	20	17-AUG-15
Beryllium (Be)-Dissolved		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	17-AUG-15
Bismuth (Bi)-Dissolved		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	17-AUG-15
Boron (B)-Dissolved		0.045	0.047		mg/L	4.1	20	17-AUG-15
Cadmium (Cd)-Dissolved		<0.000010	<0.000010	RPD-NA	mg/L	N/A	20	17-AUG-15
Calcium (Ca)-Dissolved		103	106		mg/L	2.8	20	17-AUG-15
Chromium (Cr)-Dissolved		0.00098	0.00086		mg/L	13	20	17-AUG-15
Cobalt (Co)-Dissolved		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	17-AUG-15
Copper (Cu)-Dissolved		0.00074	0.00074		mg/L	0.3	20	17-AUG-15
Iron (Fe)-Dissolved		<0.010	<0.010	RPD-NA	mg/L	N/A	20	17-AUG-15
Lead (Pb)-Dissolved		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	17-AUG-15
Magnesium (Mg)-Dissolved		28.2	28.0		mg/L	0.9	20	17-AUG-15
Manganese (Mn)-Dissolved		0.00943	0.00951		mg/L	0.8	20	17-AUG-15

Quality Control Report

Workorder: L1657723 Report Date: 21-AUG-15

Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. TORONTO
357 BAY STREET SUITE 800
TORONTO ON M5H 2T7
Contact: JASON COLE

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-WT	**Water**							
Batch R3248207								
WG2150661-4 DUP		**WG2150661-3**						
Molybdenum (Mo)-Dissolved		0.00137	0.00141		mg/L	3.0	20	17-AUG-15
Nickel (Ni)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	17-AUG-15
Phosphorus (P)-Dissolved		<0.050	<0.050	RPD-NA	mg/L	N/A	20	17-AUG-15
Potassium (K)-Dissolved		2.50	2.44		mg/L	2.4	20	17-AUG-15
Selenium (Se)-Dissolved		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	17-AUG-15
Silicon (Si)-Dissolved		9.01	8.63		mg/L	4.3	20	17-AUG-15
Silver (Ag)-Dissolved		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	17-AUG-15
Sodium (Na)-Dissolved		10.2	10.5		mg/L	2.6	20	17-AUG-15
Strontium (Sr)-Dissolved		0.512	0.527		mg/L	3.0	20	17-AUG-15
Sulfur (S)-Dissolved		14.9	15.1		mg/L	1.1	20	17-AUG-15
Thallium (Tl)-Dissolved		0.000011	0.000011		mg/L	2.8	20	17-AUG-15
Tin (Sn)-Dissolved		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	17-AUG-15
Titanium (Ti)-Dissolved		<0.00030	<0.00030	RPD-NA	mg/L	N/A	20	17-AUG-15
Tungsten (W)-Dissolved		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	17-AUG-15
Uranium (U)-Dissolved		0.000591	0.000590		mg/L	0.2	20	17-AUG-15
Vanadium (V)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	17-AUG-15
Zinc (Zn)-Dissolved		0.0026	0.0018	J	mg/L	0.0008	0.002	17-AUG-15
Zirconium (Zr)-Dissolved		<0.00030	<0.00030	RPD-NA	mg/L	N/A	20	17-AUG-15
WG2150661-2 LCS								
Aluminum (Al)-Dissolved			103.2		%		80-120	17-AUG-15
Antimony (Sb)-Dissolved			102.2		%		80-120	17-AUG-15
Arsenic (As)-Dissolved			96.6		%		80-120	17-AUG-15
Barium (Ba)-Dissolved			95.4		%		80-120	17-AUG-15
Beryllium (Be)-Dissolved			94.9		%		80-120	17-AUG-15
Bismuth (Bi)-Dissolved			95.3		%		80-120	17-AUG-15
Boron (B)-Dissolved			93.0		%		80-120	17-AUG-15
Cadmium (Cd)-Dissolved			93.4		%		80-120	17-AUG-15
Calcium (Ca)-Dissolved			97.2		%		80-120	17-AUG-15
Chromium (Cr)-Dissolved			96.5		%		80-120	17-AUG-15
Cobalt (Co)-Dissolved			93.8		%		80-120	17-AUG-15
Copper (Cu)-Dissolved			95.2		%		80-120	17-AUG-15
Iron (Fe)-Dissolved			97.9		%		80-120	17-AUG-15
Lead (Pb)-Dissolved			98.0		%		80-120	17-AUG-15

Quality Control Report

Workorder: L1657723 Report Date: 21-AUG-15

Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. TORONTO
357 BAY STREET SUITE 800
TORONTO ON M5H 2T7
Contact: JASON COLE

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-WT	**Water**							
Batch R3248207								
WG2150661-2 LCS								
Magnesium (Mg)-Dissolved			99.9		%		80-120	17-AUG-15
Manganese (Mn)-Dissolved			98.0		%		80-120	17-AUG-15
Molybdenum (Mo)-Dissolved			96.9		%		80-120	17-AUG-15
Nickel (Ni)-Dissolved			96.6		%		80-120	17-AUG-15
Phosphorus (P)-Dissolved			103.8		%		80-120	17-AUG-15
Potassium (K)-Dissolved			100.5		%		80-120	17-AUG-15
Selenium (Se)-Dissolved			98.3		%		80-120	17-AUG-15
Silicon (Si)-Dissolved			99.98		%		80-120	17-AUG-15
Silver (Ag)-Dissolved			97.6		%		80-120	17-AUG-15
Sodium (Na)-Dissolved			101.6		%		80-120	17-AUG-15
Strontium (Sr)-Dissolved			96.3		%		80-120	17-AUG-15
Sulfur (S)-Dissolved			104.9		%		80-120	17-AUG-15
Thallium (Tl)-Dissolved			97.4		%		80-120	17-AUG-15
Tin (Sn)-Dissolved			95.5		%		80-120	17-AUG-15
Titanium (Ti)-Dissolved			98.3		%		80-120	17-AUG-15
Tungsten (W)-Dissolved			101.3		%		80-120	17-AUG-15
Uranium (U)-Dissolved			98.4		%		80-120	17-AUG-15
Vanadium (V)-Dissolved			98.9		%		80-120	17-AUG-15
Zinc (Zn)-Dissolved			93.1		%		80-120	17-AUG-15
Zirconium (Zr)-Dissolved			93.4		%		80-120	17-AUG-15
WG2150661-1 MB								
Aluminum (Al)-Dissolved			<0.0050		mg/L		0.005	17-AUG-15
Antimony (Sb)-Dissolved			<0.00010		mg/L		0.0001	17-AUG-15
Arsenic (As)-Dissolved			<0.00010		mg/L		0.0001	17-AUG-15
Barium (Ba)-Dissolved			<0.00010		mg/L		0.0001	17-AUG-15
Beryllium (Be)-Dissolved			<0.00010		mg/L		0.0001	17-AUG-15
Bismuth (Bi)-Dissolved			<0.000050		mg/L		0.00005	17-AUG-15
Boron (B)-Dissolved			<0.010		mg/L		0.01	17-AUG-15
Cadmium (Cd)-Dissolved			<0.000010		mg/L		0.00001	17-AUG-15
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	17-AUG-15
Chromium (Cr)-Dissolved			<0.00050		mg/L		0.0005	17-AUG-15
Cobalt (Co)-Dissolved			<0.00010		mg/L		0.0001	17-AUG-15
Copper (Cu)-Dissolved			<0.00020		mg/L		0.0002	17-AUG-15
Iron (Fe)-Dissolved			<0.010		mg/L		0.01	17-AUG-15

Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. TORONTO
357 BAY STREET SUITE 800
TORONTO ON M5H 2T7
Contact: JASON COLE

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-WT	**Water**							
Batch R3248207								
WG2150661-1 MB								
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	17-AUG-15
Magnesium (Mg)-Dissolved			<0.050		mg/L		0.05	17-AUG-15
Manganese (Mn)-Dissolved			<0.00050		mg/L		0.0005	17-AUG-15
Molybdenum (Mo)-Dissolved			<0.000050		mg/L		0.00005	17-AUG-15
Nickel (Ni)-Dissolved			<0.00050		mg/L		0.0005	17-AUG-15
Phosphorus (P)-Dissolved			<0.050		mg/L		0.05	17-AUG-15
Potassium (K)-Dissolved			<0.050		mg/L		0.05	17-AUG-15
Selenium (Se)-Dissolved			<0.000050		mg/L		0.00005	17-AUG-15
Silicon (Si)-Dissolved			<0.050		mg/L		0.05	17-AUG-15
Silver (Ag)-Dissolved			<0.000050		mg/L		0.00005	17-AUG-15
Sodium (Na)-Dissolved			<0.50		mg/L		0.5	17-AUG-15
Strontium (Sr)-Dissolved			<0.0010		mg/L		0.001	17-AUG-15
Sulfur (S)-Dissolved			<0.50		mg/L		0.5	17-AUG-15
Thallium (Tl)-Dissolved			<0.000010		mg/L		0.00001	17-AUG-15
Tin (Sn)-Dissolved			<0.00010		mg/L		0.0001	17-AUG-15
Titanium (Ti)-Dissolved			<0.00030		mg/L		0.0003	17-AUG-15
Tungsten (W)-Dissolved			<0.00010		mg/L		0.0001	17-AUG-15
Uranium (U)-Dissolved			<0.000010		mg/L		0.00001	17-AUG-15
Vanadium (V)-Dissolved			<0.00050		mg/L		0.0005	17-AUG-15
Zinc (Zn)-Dissolved			<0.0010		mg/L		0.001	17-AUG-15
Zirconium (Zr)-Dissolved			<0.00030		mg/L		0.0003	17-AUG-15
WG2150661-5 MS		**WG2150661-3**						
Aluminum (Al)-Dissolved			101.6		%		70-130	17-AUG-15
Antimony (Sb)-Dissolved			97.9		%		70-130	17-AUG-15
Arsenic (As)-Dissolved			100.3		%		70-130	17-AUG-15
Barium (Ba)-Dissolved			N/A	MS-B	%		-	17-AUG-15
Beryllium (Be)-Dissolved			97.4		%		70-130	17-AUG-15
Bismuth (Bi)-Dissolved			89.8		%		70-130	17-AUG-15
Boron (B)-Dissolved			93.3		%		70-130	17-AUG-15
Cadmium (Cd)-Dissolved			95.5		%		70-130	17-AUG-15
Calcium (Ca)-Dissolved			N/A	MS-B	%		-	17-AUG-15
Chromium (Cr)-Dissolved			94.2		%		70-130	17-AUG-15
Cobalt (Co)-Dissolved			89.8		%		70-130	17-AUG-15
Copper (Cu)-Dissolved			89.2		%		70-130	17-AUG-15

Quality Control Report

Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. TORONTO
357 BAY STREET SUITE 800
TORONTO ON M5H 2T7
Contact: JASON COLE

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-WT	**Water**							
Batch R3248207								
WG2150661-5 MS		**WG2150661-3**						
Iron (Fe)-Dissolved			96.4		%		70-130	17-AUG-15
Lead (Pb)-Dissolved			94.9		%		70-130	17-AUG-15
Magnesium (Mg)-Dissolved			N/A	MS-B	%		-	17-AUG-15
Manganese (Mn)-Dissolved			91.2		%		70-130	17-AUG-15
Molybdenum (Mo)-Dissolved			98.4		%		70-130	17-AUG-15
Nickel (Ni)-Dissolved			91.6		%		70-130	17-AUG-15
Phosphorus (P)-Dissolved			113.4		%		70-130	17-AUG-15
Potassium (K)-Dissolved			99.98		%		70-130	17-AUG-15
Selenium (Se)-Dissolved			103.0		%		70-130	17-AUG-15
Silicon (Si)-Dissolved			N/A	MS-B	%		-	17-AUG-15
Silver (Ag)-Dissolved			93.2		%		70-130	17-AUG-15
Sodium (Na)-Dissolved			N/A	MS-B	%		-	17-AUG-15
Strontium (Sr)-Dissolved			N/A	MS-B	%		-	17-AUG-15
Sulfur (S)-Dissolved			N/A	MS-B	%		-	17-AUG-15
Thallium (Tl)-Dissolved			96.8		%		70-130	17-AUG-15
Tin (Sn)-Dissolved			98.0		%		70-130	17-AUG-15
Titanium (Ti)-Dissolved			96.3		%		70-130	17-AUG-15
Tungsten (W)-Dissolved			101.3		%		70-130	17-AUG-15
Uranium (U)-Dissolved			N/A	MS-B	%		-	17-AUG-15
Vanadium (V)-Dissolved			99.4		%		70-130	17-AUG-15
Zinc (Zn)-Dissolved			88.2		%		70-130	17-AUG-15
Zirconium (Zr)-Dissolved			95.3		%		70-130	17-AUG-15
NH3-WT	**Water**							
Batch R3249146								
WG2151581-8 DUP		**L1657723-2**						
Ammonia, Total (as N)		0.628	0.631		mg/L	0.4	20	18-AUG-15
WG2151581-6 LCS								
Ammonia, Total (as N)			103.6		%		85-115	18-AUG-15
WG2151581-5 MB								
Ammonia, Total (as N)			<0.050		mg/L		0.05	18-AUG-15
WG2151581-7 MS		**L1657723-2**						
Ammonia, Total (as N)			101.5		%		75-125	18-AUG-15
NO2-IC-WT	**Water**							

Quality Control Report

Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. TORONTO
357 BAY STREET SUITE 800
TORONTO ON M5H 2T7
Contact: JASON COLE

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NO2-IC-WT	**Water**							
Batch R3248331								
WG2150915-4 DUP		**WG2150915-3**						
Nitrite (as N)		<0.010	<0.010	RPD-NA	mg/L	N/A	25	17-AUG-15
WG2150915-2 LCS								
Nitrite (as N)			105.4		%		70-130	17-AUG-15
WG2150915-1 MB								
Nitrite (as N)			<0.010		mg/L		0.01	17-AUG-15
WG2150915-5 MS		**WG2150915-3**						
Nitrite (as N)			104.1		%		70-130	17-AUG-15
NO3-IC-WT	**Water**							
Batch R3248331								
WG2150915-4 DUP		**WG2150915-3**						
Nitrate (as N)		<0.020	<0.020	RPD-NA	mg/L	N/A	25	17-AUG-15
WG2150915-2 LCS								
Nitrate (as N)			99.5		%		70-130	17-AUG-15
WG2150915-1 MB								
Nitrate (as N)			<0.020		mg/L		0.02	17-AUG-15
WG2150915-5 MS		**WG2150915-3**						
Nitrate (as N)			98.5		%		70-130	17-AUG-15
PH-ALK-WT	**Water**							
Batch R3248383								
WG2151124-3 DUP		**WG2151124-2**						
pH		8.03	8.04	J	pH units	0.01	0.2	17-AUG-15
WG2151124-1 LCS								
pH			7.00		pH units		6.9-7.1	17-AUG-15
PO4-DO-COL-WT	**Water**							
Batch R3247995								
WG2150062-7 DUP		**L1657723-1**						
Phosphate-P (ortho)		<0.0030	<0.0030	RPD-NA	mg/L	N/A	20	14-AUG-15
WG2150062-6 LCS								
Phosphate-P (ortho)			98.0		%		80-120	14-AUG-15
WG2150062-5 MB								
Phosphate-P (ortho)			<0.0030		mg/L		0.003	14-AUG-15
WG2150062-8 MS		**L1657723-1**						
Phosphate-P (ortho)			102.0		%		70-130	14-AUG-15
SO4-IC-N-WT	**Water**							

Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. TORONTO
357 BAY STREET SUITE 800
TORONTO ON M5H 2T7
Contact: JASON COLE

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SO4-IC-N-WT	**Water**							
Batch R3248331								
WG2150915-4 DUP		**WG2150915-3**						
Sulfate (SO4)		<0.30	<0.30	RPD-NA	mg/L	N/A	20	17-AUG-15
WG2150915-2 LCS								
Sulfate (SO4)			101.1		%		90-110	17-AUG-15
WG2150915-1 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	17-AUG-15
WG2150915-5 MS		**WG2150915-3**						
Sulfate (SO4)			99.7		%		75-125	17-AUG-15
SOLIDS-TDS-WT	**Water**							
Batch R3249904								
WG2152542-3 DUP		**L1657330-11**						
Total Dissolved Solids		447	440		mg/L	1.5	20	20-AUG-15
WG2152542-2 LCS								
Total Dissolved Solids			92.8		%		85-115	20-AUG-15
WG2152542-1 MB								
Total Dissolved Solids			<10		mg/L		10	20-AUG-15
TURBIDITY-WT	**Water**							
Batch R3247491								
WG2150148-3 DUP		**L1658137-3**						
Turbidity		0.13	0.12		NTU	8.0	15	15-AUG-15
WG2150148-2 LCS								
Turbidity			105.0		%		85-115	15-AUG-15
WG2150148-1 MB								
Turbidity			<0.10		NTU		0.1	15-AUG-15

Quality Control Report

Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. TORONTO
357 BAY STREET SUITE 800
TORONTO ON M5H 2T7
Contact: JASON COLE

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

Affix ALS barcode label here
(lab use only)

COC Number: 14 -

Page 1 of 1

Report To

Company: Palmer Environmental
Contact: Jason Cole
Address: 357 Bay Street, Suite 800
Toronto, ON, M5H 2T7
Phone: 416-795-8153

Report Format / Distribution

Select Report Format: ☒ PDF ☒ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report ☒ Yes ☐ No
☒ Criteria on Report - provide details below if box checked
Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax jason@pecg.ca
Email 2 kathleen@pecg.ca

Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)

- R ☒ Regular (Standard TAT if received by 3 pm - business days)
- P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
- E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT
- E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge

Specify Date Required for E2,E or P:

Invoice To

Same as Report To ☒ Yes ☐ No
Copy of Invoice with Report ☒ Yes ☐ No
Company: Palmer Environmental
Contact: Jason Cole

Invoice Distribution

Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax jason@pecg.ca
Email 2

Project Information

ALS Quote #: Q48134
Job #: 13113 MILTON
PO / AFE:
LSD:

Oil and Gas Required Fields (client use)

Approver ID:
Cost Center:
GL Account:
Routing Code:
Activity Code:
Location:

ALS Lab Work Order # (lab use only) L1657723 NC 14-Aug-15

ALS Contact: Mathy G.

Sampler: KG/JC

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	GENCHEM3-GW-P-WT		Number of Containers
-1	MW1	13-AUG-15	11:40	GW	✓		5
-2	MW5	13-AUG-15	17:10	GW	✓		5
	Metals have been field-filtered						

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System?
☐ Yes ☒ No
Are samples for human drinking water use?
☐ Yes ☒ No

Special Instructions / Specify Criteria to add on report (client Use)

Criteria: PLEASE specify below:
ODWS
PWQO

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐
SIF Observations Yes ☐ No ☒
Ice packs Yes ☒ No ☐
Custody seal intact Yes ☐ No ☒
Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C	FINAL COOLER TEMPERATURES °C
3.3	

SHIPMENT RELEASE (client use)

Released by: JASON COLE
Date: AUG 13, 2015
Time: 8.18:11

INITIAL SHIPMENT RECEPTION (lab use only)

Received by:
Date: 14-Aug-15
Time: 0900

FINAL SHIPMENT RECEPTION (lab use only)

Received by:
Date:
Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form

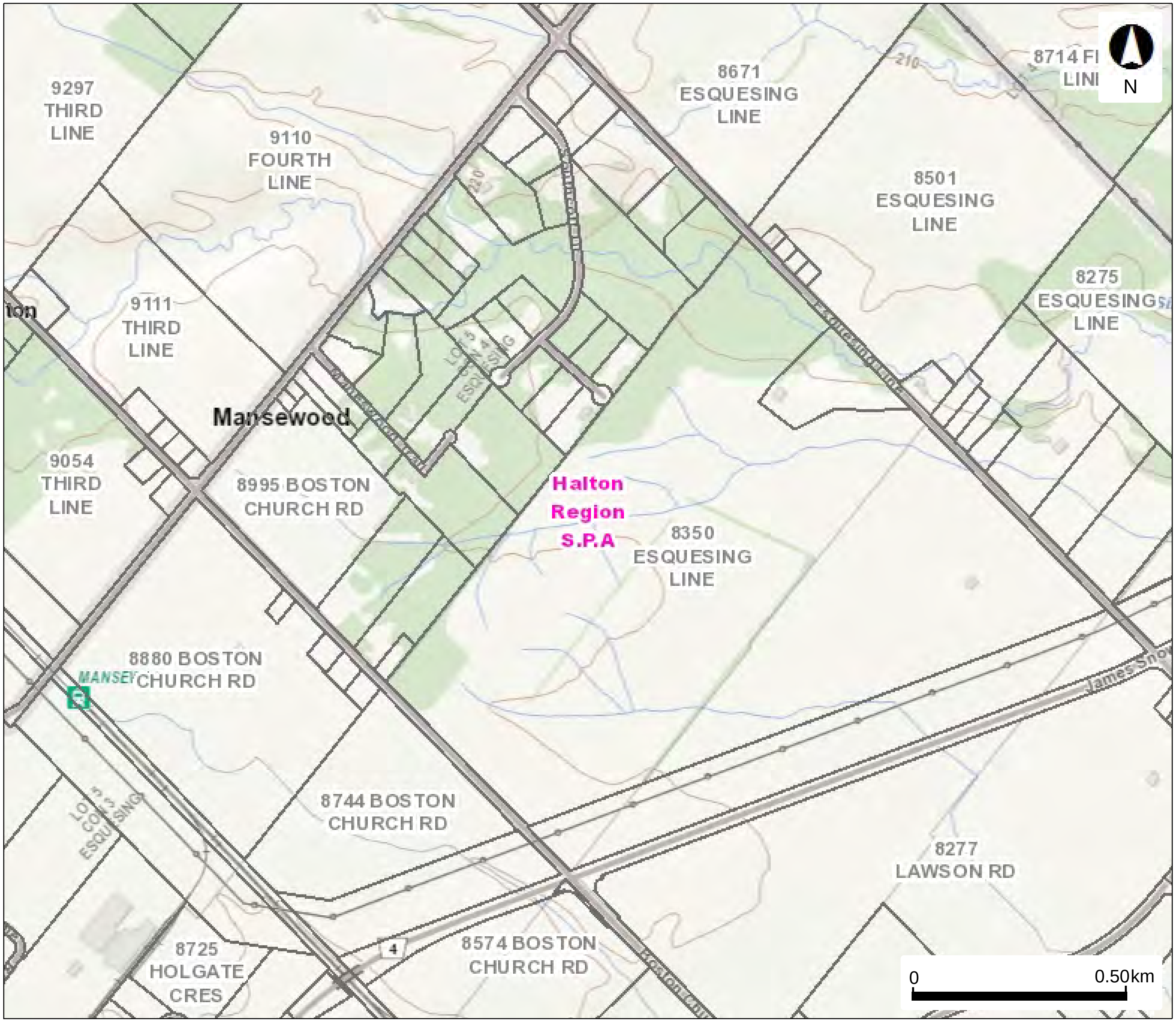
Appendix E

Source Water Protection Mapping

Appendix E

Source Water Protection Mapping

Source Water Protection



Legend

☐ Source Protection Areas

▨ WHPA Groundwater Under Direct Influence (WHPA-E)

Wellhead Protection Area

- 🟫 A
- 🟧 B
- 🟧 C
- 🟫 C1
- 🟨 D
- ☐ F

☐ Assessment Parcel

This map should not be relied on as a precise indicator of routes or locations, nor as a guide to navigation. The Ontario Ministry of Environment, Conservation and Parks (MECP) shall not be liable in any way for the use or any information on this map. of, or reliance upon, this map.

Ontario

Map Created: 6/14/2020

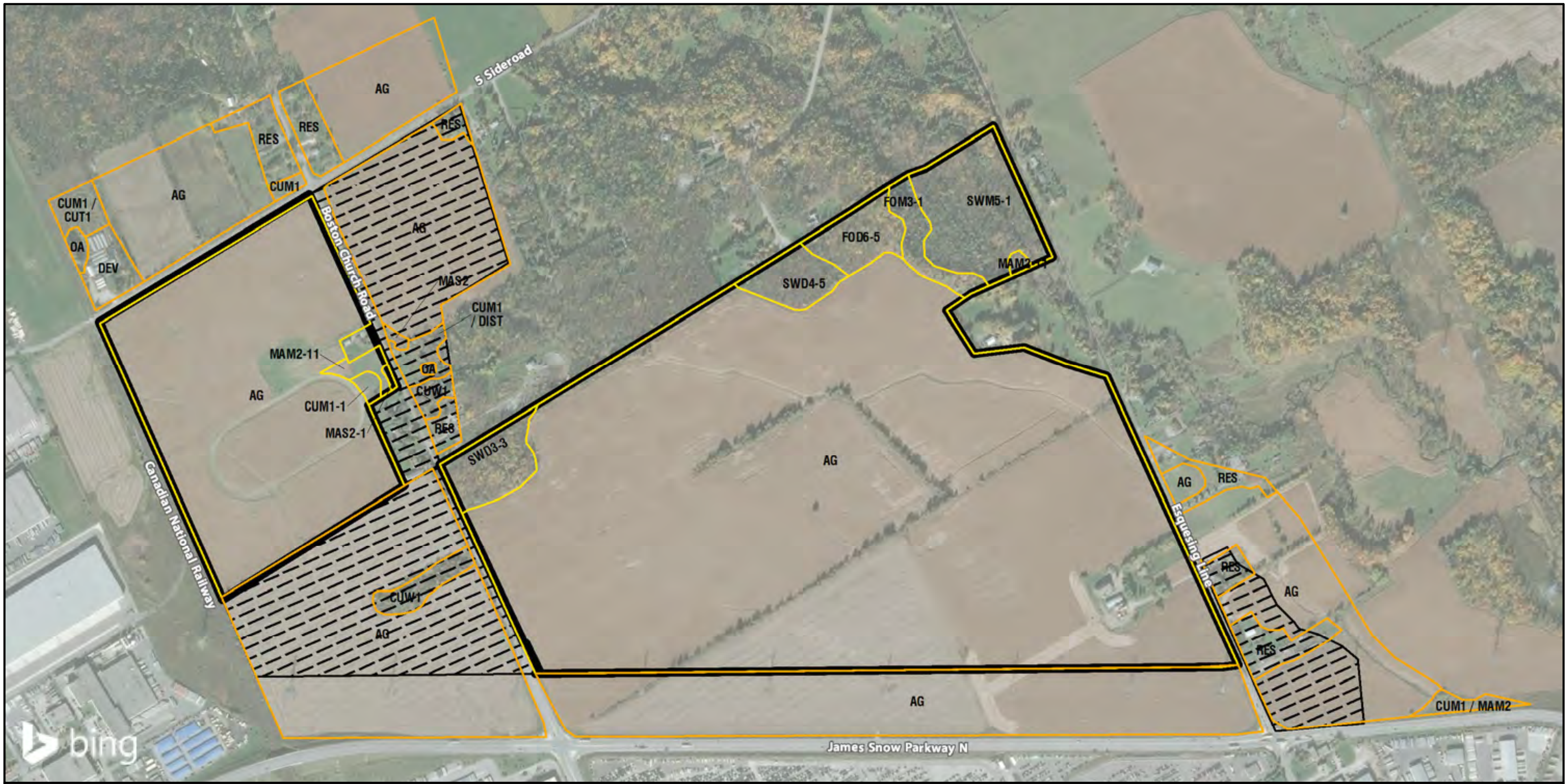
Map Center: 43.54943 N, -79.8995 W

Appendix F

Ecological Land Classification (Savanta)

Appendix F

Ecological Land Classification (Savanta)



Milton North Environmental Impact Study

Figure 5
Ecological Land Classification

▬ Subject Lands
▨ Non-participating Lands
▭ Ecological Land Classification (Confirmed)
▭ Ecological Land Classification (Interpreted)

SAVANTA
A GEI Company

0 200 m
1:12,500

N

Any information shown on Parcels 2, 3 and 5 should be considered preliminary and is subject to further investigations.

ELC Legend

CUM1	Mineral Cultural Meadow
CUM1-1	Dry-Moist Cultural Meadow
CUT1	Mineral Cultural Thicket
CUW1	Mineral Cultural Woodland
FOD6-5	Fresh-Moist Sugar Maple-Hardwood Deciduous Forest
FOM3-1	Dry- Fresh HardWood-Hemlock Mixed Forest
MAM2-11*	Mixed Mineral Meadow Marsh
MAS2	Bedrock Shallow Marsh
MAS2-1	Cattail Mineral Shallow Marsh
SWD3-3	Swamp Maple Mineral Deciduous Swamp
SWD4-5*	Hickory Mineral Deciduous Swamp
SWM5-1	Red Maple- Conifer Organic Mixed Swamp
AG	Agricultural
DEV	Development
DIST	Disturbed
OA	Open Aquatic
RES	Residential

Not listed in Southern Ontario ELC Guide

Path: C:\Savanta\8753 - SAV 7537 Milton North\gis\mxd\2020 04 21 updates\Figure 5 Ecological Land Classification.mxd Date Saved: April 21, 2020