MMM GROUP

INTER-OFFICE MEMO

To:	Chris Tyrrell	Date:	March 28, 2012
From:	Andrew Kulin, P.Eng.	Job No.:	14-09222
Subject:	Technical Memorandum HG#1 - Hydrogeology	CC:	Mark Cece

The information presented below provides additional technical detail in support of the responses identified in MMM's response letter addressed jointly to the Town and the Conservation Authority. We have identified the content in the same manner as the responses are presented in Attachment A of the formal response letter for ease of cross-referencing.

8 – S.4.4 – Groundwater Contributions and the Pond

The pond was identified in the EIR/FSS report to be losing water into the ground (Section 4.5, page 4-37). Additional data collected since March/July 2011 continues to support this statement.

A data logger was installed at monitoring well MMM09-02 (located to the east of the pond) in March 2011. Manual water level monitoring has also occurred at this monitor on a quarterly basis beginning in June 2009, with all the data provided in tabular and graphical format in Appendix 4-5 of the EIR/FSS report. Three new monitoring wells were constructed in mid-July 2011 at two locations along the west side of the pond and identified as MMM11-21, MMM11-22 (nested) located to the west and southwest of the pond were. A staff gauge was installed in the existing Pond in early July 2011 as were three mini-piezometers installed along the periphery of the pond (MP-21, MP-22, and MP-23).

Data loggers were installed at the staff gauge in early July 2011 and at the three new monitoring wells in late July 2011. MMM hydrogeological staff carried out water level monitoring visits and data logger uploads at the site on September 30, 2011 and January 19, 2012[1]. A manual measurement at the staff gauge was also obtained by Ecology staff when they visited the site with HRCA, MNR and DFO on October 20, 2011.

Four boreholes drilled by EXP Services Inc. along the main tributary channel for a slope stability investigation included piezometers (refer to borehole logs presented in the EXP report dated November 18, 2011 and entitled "*Slope Stability Analysis Report, 14 Mile Creek, Pigott Farm Land, Oakville, Ontario*") which accompanies the response. The groundwater elevations at these piezometers on July 27, 2011 ranged between 144.2 to 145.5 masl while the pond elevation on this date was recorded at 148.8 masl.

All data collected up to January 19, 2012 conclusively proves the pond is losing water to the ground (i.e., pond levels higher than static water levels in groundwater monitors at every measurement, downward gradients at the mini-piezometers[2] when and at the new nested well (MMM11-22) on the west side of the pond).

[1] MMM staff discovered that the pond staff gauge was missing in January 2012 (top of T-bar visible at ice surface) and that the data logger (direct read cable with interface at the shore) could not be uploaded (no connection/signal). It is suspected that the staff gauge was sheared off the T-Bar by ice-heave, and at time of a subsequent thaw event sank into the pond. An estimate of the ice level was made based on the height of the visible T-Bar above the ice. Photographs are presented on the attached plot (SWL-8). It will not be possible to look for the data logger and staff gauge until after the spring thaw and confirm if data can be retrieved from the device.

[2] At site visits when the mini-piezometer and/or pond were not dry or frozen.

Plots of the water level fluctuations at each of the above monitors are provided (SWL-8, SWL-16 to SWL-18) as is a hydrogeological cross-section plotted through the centre of the pond (see Figures HG1 and HG2). These figures clearly illustrate the conclusion that the pond is losing water into the ground.

10 – S.4.4.3 – Interpretation of Soil Classification

Clay-sized particles form a significant percentage of the soils found at the Lazy Pat Farm site (approx. 27% overall) and we add that watercourses base flows measured on-site when compared to the estimated base flows obtained using the water balance were in general agreement when using a soil infiltration factor of 0.10.

The soils mapping of the site shown on Figure 4W.6.1 of the NOCCS, identifies most of the bcIMC property as comprised of Oneida Clay Loam (Hydrologic Soil Group D, ref. Table 4W.6.2), with Chinguacousy Clay Loam (Hydrologic Soil Group C) mapped within the natural valley features at the site. These classifications, particularly the Hydrologic Soil Group "D" grouping mapped across the majority of the site support a soil infiltration factor closer to 0.1[3].

13 – S.4.4.6 – Potential Base Flow Reductions to Watercourses

We note that with the level of mitigation proposed in the EIR/FSS, the water balance calculated a net 49% overall (annual) reduction in groundwater infiltration within the confines of the subject property only. This is under post-development conditions with 90% imperviousness (given the large employment uses and associated parking areas), in a clay-rich soil environment. On the overall subwatershed basis (which includes protected lands north of Highway 407), the net reduction to groundwater infiltration was calculated on the order of 18%.

The NOCSS itself recognizes that minimizing changes (reductions) in infiltration will be difficult given the low permeability of the surficial soils found in North Oakville, estimated in the NOCCS as up to a 60% reduction in infiltration without mitigation within development limits (ref. Section 5.2.2 of the NOCCS, page 5-11).

MMM's reported post-development water balance scenario without mitigation estimates a 69.3% reduction in infiltration across the site within FM1001 (factoring infiltration contributions from both developed (with modelled 90% imperviousness) and undeveloped areas). The measures proposed in the EIR/FSS identifying best practices/opportunities for infiltration along the perimeter of the natural areas, which result in a calculated reduction in post-development infiltration in the order of 49% versus a 69% reduction without mitigation. As noted in our response *12 – S.4.4.4.2* (found within the formal response letter, Attachment A), mitigation against infiltration for interior lots will be ineffectual given the unweathered condition (cut areas) or highly compacted nature (areas of fill) of the surficial soils in the interior of the site after site grading.

Figure 4.9 of the EIR/FSS report presents the calculated monthly infiltration to the entire subwatershed area under the post-development condition, and this figure illustrates that infiltration will range from 78 to 92% of the pre-development values between November and May. While the largest infiltration reductions were calculated to occur during the spring season (February, March, April, at 78 to 79% predevelopment levels) this is also the time of the year when the area is normally fully saturated from snow melt and other runoff.

[3] It can be determined from Table 3.1 of the MOE Stormwater Management Planning and Design Manual (2003) that the soil infiltration factor applied for soils from Hydrologic Soil Group D is 0.1, and for soils from Hydrologic Soil Group CD, a soil infiltration factor of 0.15.

Attachments

J:\1442 Projects by Job Number\2009\14-09222-001-HG1 Bentall Lands\050 Mapping\MXD\Report\Figure 4 On-site Monitoring Locations.mxd

Legend

Monitoring Locations

- MMM Monitoring Well (2009/2011)
- Mini-Piezometer
- TROW Monitoring Well (2001)
- Lazy Pat Farm Well
- Flow Monitoring Points
- Staff Gauge
- Site Boundary
- Watercourse
- Cross Section

Note: FMP-3 is located offsite at the southeast corner of Tremaine Road and Number 1 Sideroad

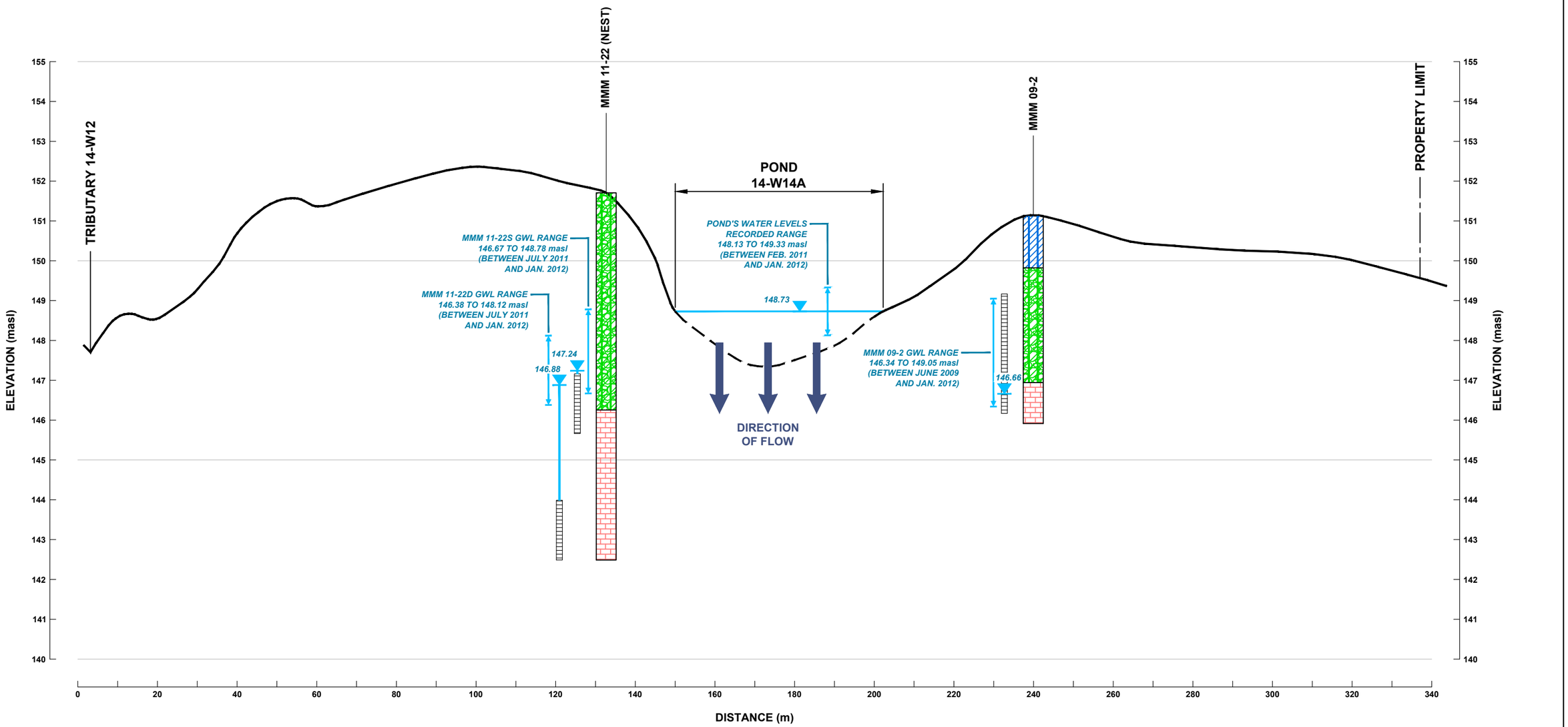
Client: **Bentall Kennedy (Canada) LP**

Title: **On-site Monitoring Locations**

Prepared by: MMM GROUP

14-09222-001-HG1	Scale as Shown	Review: AK
Date: February 2012	**Figure: HG1**	

FACING NORTH



LEGEND

- CLAYEY SILT
- CLAYEY SILT TILL
- SHALE BEDROCK

GWL RANGE — 146.88 — GWL (masl) (JULY 27, 2011)

SCREEN

NOTE:
POND BOTTOM BASED ON BATHYMETRY DATA.

Environmental Implementation Report / Functional Servicing Study for 14 Mile Creek West and the Lazy Pat Farm Property

Hydrogeological Cross-Section Through Pond

Scale: H = 1:1000 V = 1:100

Client: Bentall Kennedy

Prepared by: MMM GROUP

Date: February 2012

Project No.: 14-09222-001-HG1

Aerial Photo:

Figure HG2

FIGURE HG2.dwg Hydrogeological Cross-Section Through Pond S:\14-42\14\09222-001-HG1\00-PEER REVIEW REPORT-NOVEMBER 2011\ Feb 04, 2012 - 10:35am

Figure SWL-8: Pond Water Level and Temperature
MMM-11-Pond (2011)

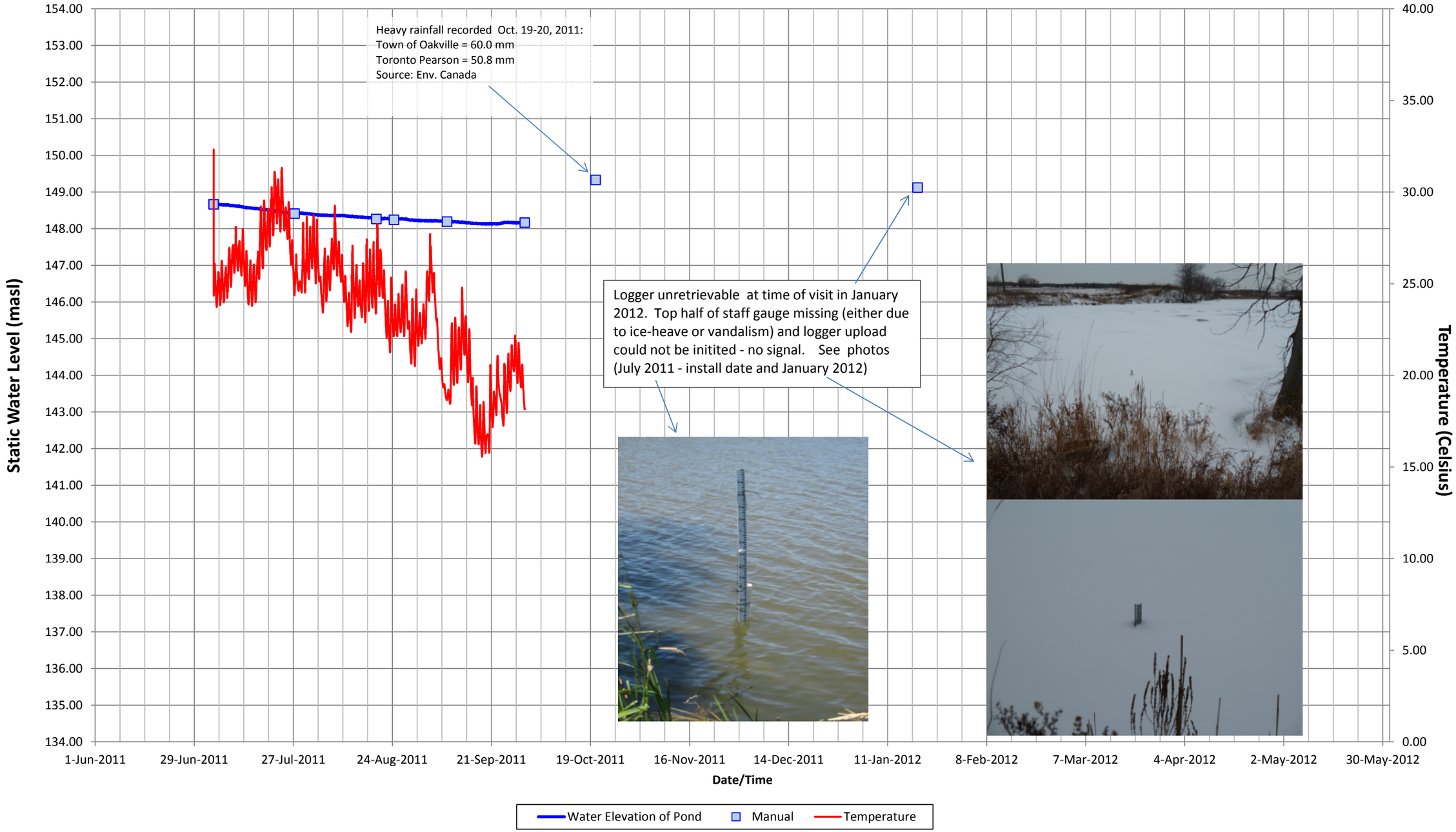


Figure SWL-16: Static Water Levels and Groundwater Temperature
MMM-09-02 (2009-2011)

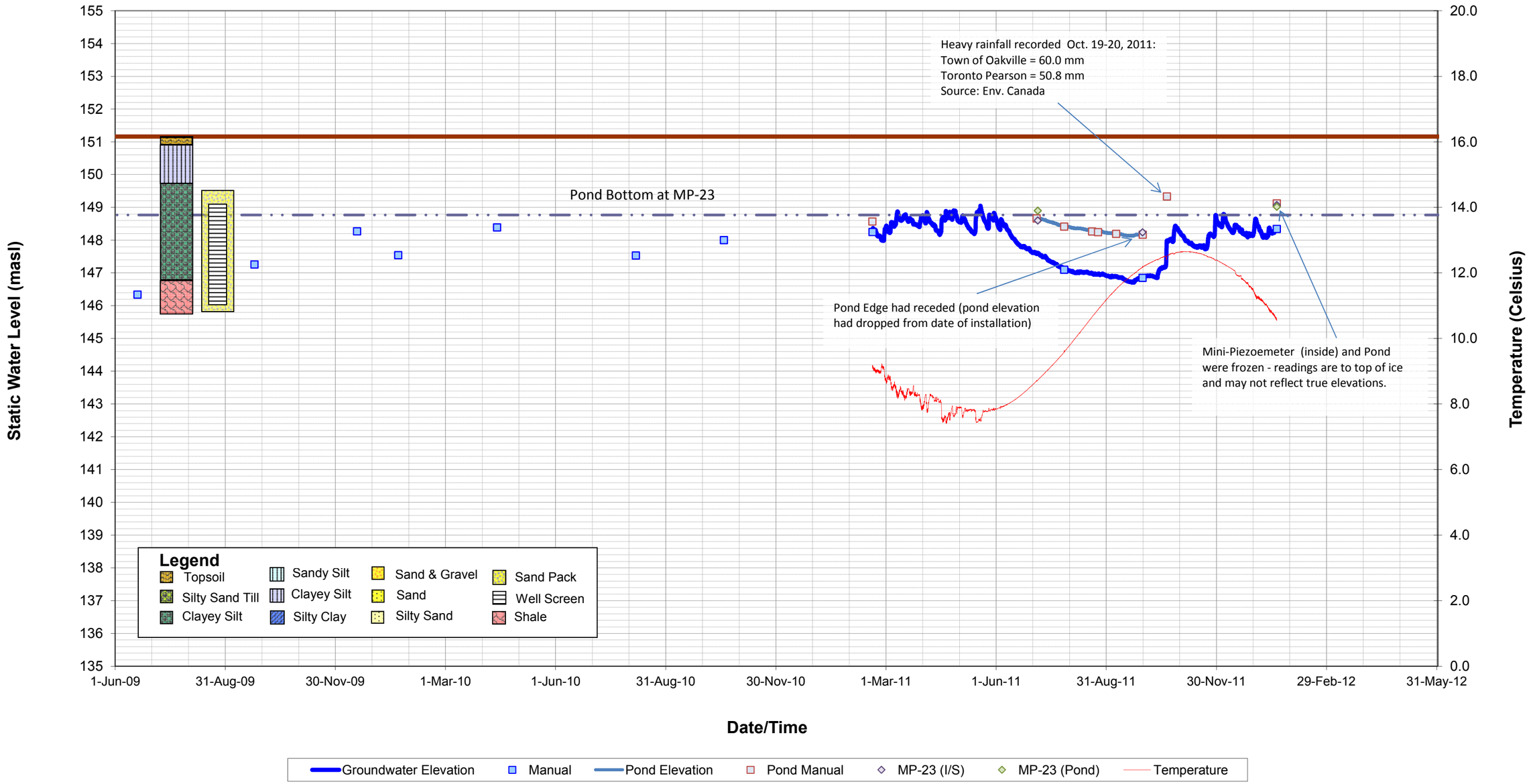


Figure SWL-17: Static Water Levels and Groundwater Temperature
MMM-11-21 (2009-2012)

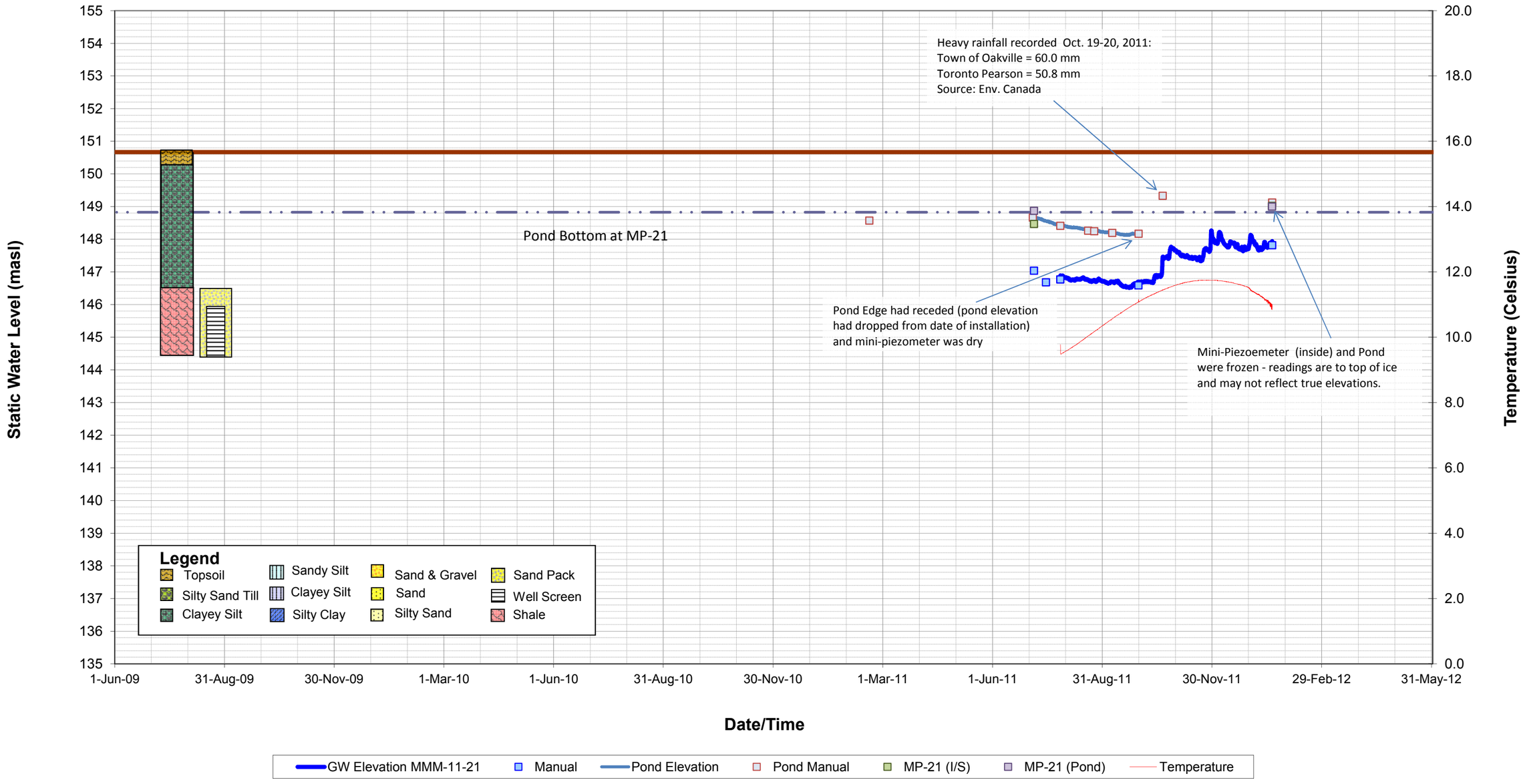


Figure SWL-18: Static Water Levels and Groundwater Temperature
MMM-11-22 Nest (2011-2012)

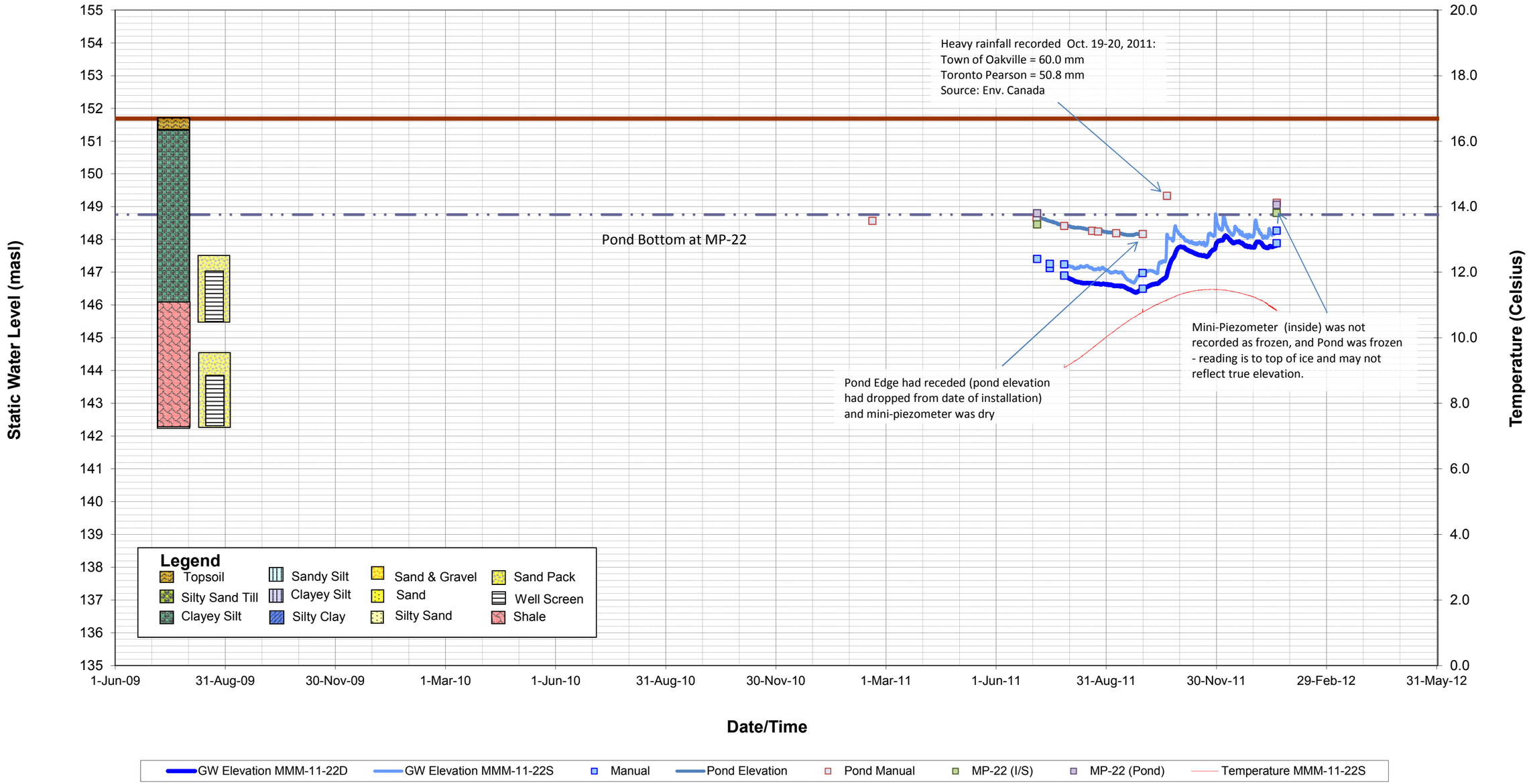


Table SWL-1: Static Water Levels at Monitoring Wells

Well ID	Location Easting m	Location Northing m	Ground Elevation masl	Stick-up mag	Top Elevation masl	Screen Bottom mbg	Screen Top mbg	Screen Length m	Install Date	Water Level 01-May-09 mbtop	Water Level 01-May-09 masl	Water Level 05-May-09 mbtop	Water Level 05-May-09 masl	Water Level 19-Jun-09 mbtop	Water Level 19-Jun-09 masl	Water Level 24-Sep-09 mbtop	Water Level 24-Sep-09 masl	Water Level 17-Nov-09 mbtop	Water Level 17-Nov-09 masl	Water Level 18-Nov-09 mbtop	Water Level 18-Nov-09 masl	Water Level 18-Dec-09 mbtop	Water Level 18-Dec-09 masl	Water Level 21-Jan-10 mbtop	Water Level 21-Jan-10 masl	Water Level 22-Jan-10 mbtop	Water Level 22-Jan-10 masl	Water Level 13-Apr-10 mbtop	Water Level 13-Apr-10 masl	Water Level 06-Aug-10 mbtop	Water Level 06-Aug-10 masl	Water Level 18-Oct-10 mbtop	Water Level 18-Oct-10 masl	Water Level 19-Oct-10 mbtop	Water Level 19-Oct-10 masl	Water Level 17-Feb-11 mbtop	Water Level 17-Feb-11 masl	Water Level 18-Feb-11 mbtop	Water Level 18-Feb-11 masl
MMM09-01-S	598300	4809022	148.48	1.00	149.48	5.18	2.18	3.00	9-Jun-09					5.77	143.71	5.99	143.49					4.60	144.88			5.45	144.03	4.22	145.25	5.47	144.01	4.75	144.73					5.19	144.29
MMM09-01-D	598301	4809024	148.27	1.05	149.32	8.89	7.39	1.50	9-Jun-09					5.65	143.67	6.21	143.11					5.15	144.18			5.59	143.73	5.05	144.28	5.47	143.85	5.23	144.09					5.02	144.30
MMM09-02	598132	4809239	151.16	1.10	152.26	5.21	2.21	3.00	1-Jun-09					5.92	146.34	5.00	147.26					3.99	148.27	4.72	147.54			3.87	148.40	4.73	147.54	4.26	148.00					4.02	148.24
MMM09-03	597983	4809410	151.40	1.13	152.53	3.07	1.57	1.50	1-Jun-09					2.68	149.85	2.77	149.76					1.50	151.03	2.12	150.41			1.39	151.15	2.38	150.16	1.99	150.54					1.83	150.71
MMM09-04	597761	4809653	152.35	1.09	153.44	6.02	3.02	3.00	8-Jun-09					4.82	148.62	2.50	150.94					2.10	151.34	2.38	151.06			2.21	151.22	2.42	151.02	2.26	151.17					2.22	151.22
MMM09-05-S	597485	4809933	159.00	1.23	160.23	8.66	5.66	3.00	5-Jun-09					6.86	153.37	2.39	157.84							2.23	158.00			1.86	158.36	2.40	157.83	2.46	157.77					2.21	158.02
MMM09-05-D	597482	4809935	159.31	1.09	160.40	16.41	14.91	1.50	5-Jun-09					5.07	155.33	12.10	148.30							11.39	149.01			11.26	149.14	11.34	149.06	11.41	149.00					11.22	149.18
MMM09-06-S	597170	4809527	155.18	1.19	156.37	5.84	3.34	2.50	4-Jun-09					4.64	151.73	1.74	154.63							1.93	154.44			1.67	154.70	1.76	154.61	1.95	154.43					1.99	154.38
MMM09-06-D	597170	4809529	155.36	1.15	156.51	10.87	9.37	1.50	4-Jun-09					1.88	154.63	1.72	154.79							1.89	154.62			2.23	154.28	1.76	154.75	1.68	154.83					2.09	154.42
MMM09-07	597526	4809600	153.82	1.06	154.88	5.84	2.84	3.00	8-Jun-09					2.19	152.69	2.34	152.54							2.59	152.29			2.44	152.44	2.31	152.58	2.58	152.31					2.54	152.34
MMM09-08	597395	4809298	158.01	0.95	158.95	7.87	4.37	3.50	2-Jun-09					3.02	155.93	3.06	155.89							2.97	155.98			2.46	156.49	2.92	156.04	2.47	156.49					2.83	156.12
MMM09-09	597550	4809184	151.64	1.08	152.72	2.26	1.76	0.50	2-Jun-09					1.95	150.77	2.11	150.61					1.63	151.09	1.73	150.99			1.66	151.06	2.08	150.64	1.67	151.05					1.40	151.32
MMM09-10-S	597811	4809270	149.69	1.07	150.75	2.13	1.63	0.50	2-Jun-09					1.50	149.25	1.75	149.00					1.14	149.62	1.37	149.38			1.18	149.57	1.59	149.17	1.36	149.39					1.14	149.61
MMM09-10-D	597813	4809270	149.65	1.07	150.72	7.67	6.17	1.50	2-Jun-09					1.41	149.31	1.59	149.13					1.08	149.64	1.28	149.44			1.05	149.68	1.40	149.32	1.19	149.53					1.06	149.66
MMM09-11	597840	4808917	153.52	1.06	154.58	5.51	2.51	3.00	8-Jun-09					2.08	152.50	2.50	152.08							2.21	152.37			1.60	152.98			1.74	152.84					2.29	152.29
MMM09-12	598015	4808712	152.71	1.09	153.80	3.38	1.88	1.50	9-Jun-09					2.71	151.09	3.20	150.60							2.47	151.33			1.97	151.83	2.91	150.89	2.17	151.63					2.22	151.58
MMM09-13	597431	4808891	157.30	1.08	158.38	3.20	1.83	1.37	9-Nov-09													1.43	156.96			2.11	156.27	1.43	156.95	2.54	155.84			1.80	156.58	2.24	156.14		
MMM09-14	597154	4809172	155.53	0.98	156.51	5.13	2.24	2.90	10-Nov-09									2.09	154.42							1.82	154.69	1.54	154.97	1.93	154.58			1.57	154.94	1.79	154.72		
MMM09-15S	597151	4808905	159.18	1.02	160.20	4.42	1.52	2.90	11-Nov-10									1.36	158.84	1.36	158.84	1.18	159.02			1.35	158.85	1.25	158.95	1.61	158.59			1.23	158.97	1.23	158.97		
MMM09-15D	597153	4808903	159.13	1.09	160.22	12.50	11.13	1.37	11-Nov-10									1.87	158.35	1.89	158.33	2.51	157.71			3.00	157.22	7.88	152.34	6.16	154.06			6.12	154.10	6.12	154.10		
MMM09-16	596526	4809514	163.75	1.15	164.90	5.94	2.97	2.97	13-Nov-09									Dry to 7.11		6.95	157.95	5.30	159.60			3.24	161.66	1.55	163.35	2.33	162.57			2.73	162.18	2.40	162.50		
MMM09-17	596202	4809823	162.72	1.00	163.72	5.92	2.97	2.95	13-Nov-09									2.51	161.21	2.29	161.43	1.25	162.47	1.40	162.32			1.21	162.51	1.10	162.63			1.23	162.49	1.17	162.55		
MMM09-18S	595803	4809213	169.36	1.11	170.47	6.10	3.20	2.90	12-Nov-09									6.13	164.34	6.01	164.46	2.28	168.19	2.31	168.16			1.70	168.77	2.48	167.99			2.27	168.20	2.26	168.21		
MMM09-18D	595805	4809215	169.38	1.06	170.43	15.37	13.94	1.42	12-Nov-09									6.21	164.22	6.25	164.18	5.74	164.69	5.90	164.53			5.01	165.42	5.83	164.61			6.02	164.42	5.91	164.52		
MMM09-19S	595387	4810334	180.22	(0.11)	180.11	5.92	3.17	2.74	17-Nov-09											Dry to 5.95		4.41	175.70	3.10	177.01			0.37	179.74	0.79	179.32			0.62	179.49	1.35	178.76		
MMM09-19D	595388	4810336	180.18	(0.08)	180.10	15.06	13.64	1.42	16-Nov-09											Dry to 15.08		13.82	166.28	8.92	171.18			5.52	174.58	4.46	175.64			4.54	175.56	4.13	175.97		
MMM09-20	594807	4809575	181.50	(0.15)	181.35	7.21	4.24	2.97	17-Nov-09											6.70	174.65	0.47	180.88	1.22	180.13			0.52	180.83	1.15	180.21			0.67	180.68			0.30	181.05
MMM11-21	598145	4809144	150.67	0.89	151.56	6.20	4.68	1.52	14-Jul-11																														
MMM11-22-S	598045	4809175	151.69	0.89	152.58	6.12	4.60	1.52	14-Jul-11																												
MMM11-22-D	598046	4809175	151.74	0.82	152.56	9.18	7.66	1.52	14-Jul-11																												
TROW MW-1	598305	4809194	149.79	(0.08)	149.72	4.60	1.60	3.00	3-Jan-01			1.47	148.25	2.32	147.40	2.75	146.97											1.38	148.34	2.27	147.45	2.01	147.71					1.84	147.88
TROW MW-2	598337	4809146	149.70	(0.08)	149.62	4.60	1.60	3.00	5-Jan-01			0.87	148.75	1.58	148.04	2.16	147.46													1.82	147.80	2.31	147.31					1.99	147.63
TROW MW-3	598131	4808935	150.94	1.00	151.94	6.10	3.10	3.00	3-Jan-01			1.77	150.17	2.70	149.24	2.80	149.14							2.44	149.50			1.98	149.96	2.66	149.28	2.08	149.86					2.17	149.77
Pond Gauge	598201	4809161	147.94	1.00	148.94				4-Jul-11																											0.40	148.57		
Lazy Pat Well	598308	4809122	149.66	0.15	149.81											3.95	145.86													CNL									

Upward Gradient (Nests Only)
Downward Gradient (Nests Only)
Static Water Level within 0.3 m of grade
Static Water Level is above grade

Table SWL-1: Static Water Levels at Monitoring Wells

Well ID	Location Easting m	Location Northing m	Ground Elevation masl	Stick-up mag	Top Elevation masl	Screen Bottom mbg	Screen Top mbg	Screen Length m	Install Date	Water Level 04-Jul-11 mbtop	Water Level 04-Jul-11 masl	Water Level 05-Jul-11 mbtop	Water Level 05-Jul-11 masl	Water Level 15-Jul-11 mbtop	Water Level 15-Jul-11 masl	Water Level 27-Jul-11 mbtop	Water Level 27-Jul-11 masl	Water Level 19-Aug-11 mbtop	Water Level 19-Aug-11 masl	Water Level 24-Aug-11 mbtop	Water Level 24-Aug-11 masl	Water Level 08-Sep-11 mbtop	Water Level 08-Sep-11 masl	Water Level 30-Sep-11 mbtop	Water Level 30-Sep-11 masl	Water Level 20-Oct-11 mbtop	Water Level 20-Oct-11 masl	Water Level 19-Jan-12 mbtop	Water Level 19-Jan-12 masl
MMM09-01-S	598300	4809022	148.48	1.00	149.48	5.18	2.18	3.00	9-Jun-09			5.42	144.06			5.89	143.59							5.89	143.59			4.60	144.88
MMM09-01-D	598301	4809024	148.27	1.05	149.32	8.89	7.39	1.50	9-Jun-09			5.62	143.70			6.29	143.03							5.75	143.57			5.15	144.17
MMM09-02	598132	4809239	151.16	1.10	152.26	5.21	2.21	3.00	1-Jun-09	4.66	147.60					5.60	146.66							5.41	146.85			3.92	148.34
MMM09-03	597983	4809410	151.40	1.13	152.53	3.07	1.57	1.50	1-Jun-09	2.24	150.29													3.50	149.03			1.65	150.88
MMM09-04	597761	4809653	152.35	1.09	153.44	6.02	3.02	3.00	8-Jun-09	2.37	151.07					2.60	150.84							2.47	150.97			2.14	151.30
MMM09-05-S	597485	4809933	159.00	1.23	160.23	8.66	5.66	3.00	5-Jun-09	1.90	158.33													2.82	157.41			1.72	158.51
MMM09-05-D	597482	4809935	159.31	1.09	160.40	16.41	14.91	1.50	5-Jun-09	11.17	149.23													11.31	149.09			11.32	149.08
MMM09-06-S	597170	4809527	155.18	1.19	156.37	5.84	3.34	2.50	4-Jun-09			1.80	154.57											2.65	153.72			1.58	154.79
MMM09-06-D	597170	4809529	155.36	1.15	156.51	10.87	9.37	1.50	4-Jun-09			1.96	154.55											2.07	154.44			1.71	154.80
MMM09-07	597526	4809600	153.82	1.06	154.88	5.84	2.84	3.00	8-Jun-09	2.12	152.76													2.84	152.04			2.21	152.67
MMM09-08	597395	4809298	158.01	0.95	158.95	7.87	4.37	3.50	2-Jun-09			2.55	156.40											3.42	155.53			2.10	156.85
MMM09-09	597550	4809184	151.64	1.08	152.72	2.26	1.76	0.50	2-Jun-09			2.01	150.71			2.31	150.41							1.99	150.73			1.58	151.14
MMM09-10-S	597811	4809270	149.69	1.07	150.75	2.13	1.63	0.50	2-Jun-09			1.43	149.32			2.01	148.74							1.93	148.82			1.10	149.65
MMM09-10-D	597813	4809270	149.65	1.07	150.72	7.67	6.17	1.50	2-Jun-09			1.62	149.10			1.82	148.90							1.84	148.88			0.99	149.73
MMM09-11	597840	4808917	153.52	1.06	154.58	5.51	2.51	3.00	8-Jun-09	2.36	152.22													3.49	151.09			1.46	153.12
MMM09-12	598015	4808712	152.71	1.09	153.80	3.38	1.88	1.50	9-Jun-09	2.84	150.96													4.30	149.50			1.91	151.89
MMM09-13	597431	4808891	157.30	1.08	158.38	3.20	1.83	1.37	9-Nov-09																				
MMM09-14	597154	4809172	155.53	0.98	156.51	5.13	2.24	2.90	10-Nov-09																				
MMM09-15S	597151	4808905	159.18	1.02	160.20	4.42	1.52	2.90	11-Nov-10																				
MMM09-15D	597153	4808903	159.13	1.09	160.22	12.50	11.13	1.37	11-Nov-10																				
MMM09-16	596526	4809514	163.75	1.15	164.90	5.94	2.97	2.97	13-Nov-09																				
MMM09-17	596202	4809823	162.72	1.00	163.72	5.92	2.97	2.95	13-Nov-09																				
MMM09-18S	595803	4809213	169.36	1.11	170.47	6.10	3.20	2.90	12-Nov-09																				
MMM09-18D	595805	4809215	169.38	1.06	170.43	15.37	13.94	1.42	12-Nov-09																				
MMM09-19S	595387	4810334	180.22	(0.11)	180.11	5.92	3.17	2.74	17-Nov-09																				
MMM09-19D	595388	4810336	180.18	(0.08)	180.10	15.06	13.64	1.42	16-Nov-09																				
MMM09-20	594807	4809575	181.50	(0.15)	181.35	7.21	4.24	2.97	17-Nov-09																				
MMM11-21	598145	4809144	150.67	0.89	151.56	6.20	4.68	1.52	14-Jul-11					4.52	147.04	4.79	146.77							4.97	146.59			3.74	147.82
MMM11-22-S	598045	4809175	151.69	0.89	152.58	6.12	4.60	1.52	14-Jul-11					5.17	147.41	5.34	147.24							5.60	146.98			4.31	148.27
MMM11-22-D	598046	4809175	151.74	0.82	152.56	9.18	7.66	1.52	14-Jul-11					5.30	147.26	5.68	146.88							6.08	146.48			4.74	147.82
TROW MW-1	598305	4809194	149.79	(0.08)	149.72	4.60	1.60	3.00	3-Jan-01			2.07	147.65											3.09	146.63				
TROW MW-2	598337	4809146	149.70	(0.08)	149.62	4.60	1.60	3.00	5-Jan-01															Dry	DRY				
TROW MW-3	598131	4808935	150.94	1.00	151.94	6.10	3.10	3.00	3-Jan-01	2.72	149.22													3.28	148.66			1.91	150.03
Pond Gauge	598201	4809161	147.94	1.00	148.94				4-Jul-11			0.71	148.65			0.47	148.41	0.32	148.26	0.30	148.24	0.25	148.19	0.23	148.17	1.39	149.33	1.18	149.12
Lazy Pat Well	598308	4809122	149.66	0.15	149.81																								

Upward Gradient (Nests Only)
Downward Gradient (Nests Only)
Static Water Level within 0.3 m of grade
Static Water Level is above grade

Table SWL-2: Static Water Levels at Mini-Piezometers, Staff Gauges, and Flow Measuring Points

ID	Location[1]		Ground Elevation[2]	Stick-up	Top Elevation	Screen Bottom	Screen Top	Screen	Install Date	Water Levels			Water Levels			Water Levels			Water Levels			Water Levels			Water Levels			Water Levels		
										05-May-09			29-May-09			19-Jun-09			24-Sep-09			09-Nov-09			18-Dec-09		
	Easting	Northing								In	Out	Delta	In	Out	Delta	In	Out	Delta	In	Out	Delta	In	Out	Delta	In	Out	Delta
	m	m	masl	mag	masl	mbg	mbg	m																				
MP-01	597409	4809840	154.59	1.22	155.81	0.64	0.39	0.25	05-May-09		1.16		1.17	1.19	(0.02)	1.18	1.02	0.16	1.20	1.14	0.06	1.17	1.20	(0.03)					
MP-02	597769	4809666	151.54	1.05	152.59	0.81	0.56	0.25	05-May-09		1.00		1.17	1.02	0.15	1.21	1.04	0.17	dry to 1.47	dry to 0.98	N/A	1.02	dry to 1.03	N/A	0.94	0.97	N/A		
MP-03	597808	4809266	149.16	1.35	150.51	0.50	0.25	0.25	05-May-09		1.27		1.27	1.29	(0.02)	1.32	1.37	(0.05)	dry to 1.47	dry to 1.34	N/A								
MP-04	597972	4809088	144.12	1.44	145.56	0.41	0.16	0.25	05-May-09		1.42		1.40	1.40	0.00	1.40	1.36	0.04	dry to 1.47	dry to 1.41	N/A								
MP-05 (pond on hill)	597514	4809671	157.61	1.27	158.88	0.59	0.34	0.25	05-May-09		1.11		1.37	dry to 1.27	N/A	1.57	dry to 1.27	N/A	dry to 1.47	dry to 1.27	N/A	1.33	dry to 1.27	N/A					
MP-06	597348	4809418	152.20	1.25	153.45	0.61	0.36	0.25	05-May-09		1.12		1.22	1.14	0.08	1.29	1.16	0.13	dry to 1.57	dry to 1.20	N/A								
MP-07	597541	4809150	150.78	1.29	152.07	0.57	0.32	0.25	05-May-09		1.08		1.08	1.08	0.00	1.29	1.05	0.24	dry to 1.56	dry to 1.26	N/A								
MP-21	598162	4809146	148.83	1.88	150.71	0.51			04-Jul-11																				
MP-22	598051	4809192	148.76	1.92	150.68	0.55			04-Jul-11																				
MP-23	598045	4809233	148.77	1.87	150.63	0.68			04-Jul-11																				
Observations at Other Locations - Not Mini-Piezometers																													
Stream Gauge #1	597677	4809113	149.61	0.95	150.57														0.14	pooled		0.18			0.19				
Stream Gauge #2	598345	4809063	142.35	0.99	143.34														0.10	pooled					0.21				
Stream Gauge #3			147.97	1.00	148.97				04-Jul-11																				
FMP-01	597622	4809128	150.16		N/A																		0.02	pooled	0.09	0.09	average		
FMP-02	597574	4809796	153.31		N/A																								
FMP-03	596266	4809815			N/A																								
FMP-04	597523	4809561																			pooled			pooled					

Notes:

Difference in heads

- Negative Value = Upward Flow (from ground into channel)
- Positive Value = Downward Flow (from channel into ground)
- indicates piezometer and/or surface water were frozen (ice)

Minipiezometers are between 1.85 to 1.86 m total length from top of pipe to tip (2009 installations)

Table SWL-2: Static Water Levels at Mini-Piezometers, Staff Gauges, and Flow Measuring Points

ID	Location[1]		Ground Elevation [2]	Stick-up	Top Elevation	Screen Bottom	Screen Top	Screen	Install Date	Water Levels			Water Levels			Water Levels			Water Levels			Water Levels			Water Levels			Water Levels			Water Levels		
	Easting	Northing								21-Jan-10			13-Apr-10			06-Aug-10			18-Oct-10			17-Feb-11			05-Jul-11			30-Sep-11			19-Jan-12		
	m	m	masl	mag	masl	mbg	mbg	m		In	Out	Delta	In	Out	Delta	In	Out	Delta	In	Out	Delta	In	Out	Delta	In	Out	Delta	In	Out	Delta	In	Out	Delta
MP-01	597409	4809840	154.59	1.22	155.81	0.64	0.39	0.25	05-May-09	1.08	1.16	N/A	1.05	1.10	(0.05)	1.22	dry to 1.22	N/A	1.12	1.00	0.12	1.03	0.92	N/A	1.12	1.18	(0.06)	1.14	1.08	0.06	Frozen at 0.97	Frozen at 1.03	N/A
MP-02	597769	4809666	151.54	1.05	152.59	0.81	0.56	0.25	05-May-09	1.04	1.02	N/A	0.97	0.92	0.06	1.42	dry to 1.03	N/A	1.02	0.92	0.10	0.90	0.91	N/A	1.39	dry to 1.06		1.02	0.97	0.05	Frozen at 0.88	Frozen at 0.88	N/A
MP-03	597808	4809266	149.16	1.35	150.51	0.50	0.25	0.25	05-May-09	1.16	1.22	N/A	Could not locate			dry to 1.35	dry to 1.35	N/A	1.18	1.14	0.04	1.14	0.80	N/A	Destroyed								
MP-04	597972	4809088	144.12	1.44	145.56	0.41	0.16	0.25	05-May-09	Destroyed by ice																							
MP-05 (pond on hill)	597514	4809671	157.61	1.27	158.88	0.59	0.34	0.25	05-May-09	1.19	1.10	N/A	1.11	1.09	0.02	dry to 1.55	dry to 1.27	N/A	1.28	dry to 1.16	N/A	1.19	dry to 1.18	N/A	dry to 1.55	dry to 1.22	N/A	1.39	dry to 1.26		Frozen at 1.05	Frozen at 1.06	N/A
MP-06	597348	4809418	152.20	1.25	153.45	0.61	0.36	0.25	05-May-09	1.05	1.08	N/A	1.11	1.08	0.03	1.43	dry to 1.20	N/A	1.14	1.04	0.10				dry to 1.54	dry to 1.13	N/A						
MP-07	597541	4809150	150.78	1.29	152.07	0.57	0.32	0.25	05-May-09	1.12	1.13	N/A	1.07	1.10	(0.03)	1.33	dry to 1.26	N/A	1.13	1.08	0.05												
MP-21	598162	4809146	148.83	1.88	150.71	0.51			04-Jul-11																2.24	1.84	0.40	dry to 2.26	dry to 1.74		Frozen at 1.69	Frozen at 1.71	N/A
MP-22	598051	4809192	148.76	1.92	150.68	0.55			04-Jul-11																2.22	1.88	0.34	dry to 2.25	dry to 1.77		1.87	Frozen at 1.62	N/A
MP-23	598045	4809233	148.77	1.87	150.63	0.68			04-Jul-11																2.03	1.73	0.30	2.39	dry to 1.71		Frozen at 1.56	Frozen at 1.61	N/A
Observations at Other Locations - Not Mini-Piezometers																																	
Stream Gauge #1	597677	4809113	149.61	0.95	150.57					Frozen	0.19			0.18		0.12	pooled		0.15			0.88			0.14	pooled		0.20			0.24		
Stream Gauge #2	598345	4809063	142.35	0.99	143.34					Frozen	0.18	Flow under ice		0.21		0.12	pooled		0.20			0.90			Destroyed								
Stream Gauge #3			147.97	1.00	148.97				04-Jul-11																	0.71							
FMP-01	597622	4809128	150.16		N/A						Frozen	No Flow		0.11	average			Dry					Frozen	No Flow									
FMP-02	597574	4809796	153.31		N/A						Frozen	No Flow		0.04	average			Dry					Frozen	No Flow			Dry						
FMP-03	596266	4809815			N/A									0.10	average			Dry					Frozen	No Flow									
FMP-04	597523	4809561									Frozen	No Flow		0.03	average			Dry					Frozen	No Flow									

Notes:

Difference in heads

- Negative Value = Upward Flow (from ground into channel)
- Positive Value = Downward Flow (from channel into ground)
- indicates piezometer and/or surface water were frozen (ice)

Minipiezometers are between 1.85 to 1.86 m total length from top of pipe to tip (2009 installations)

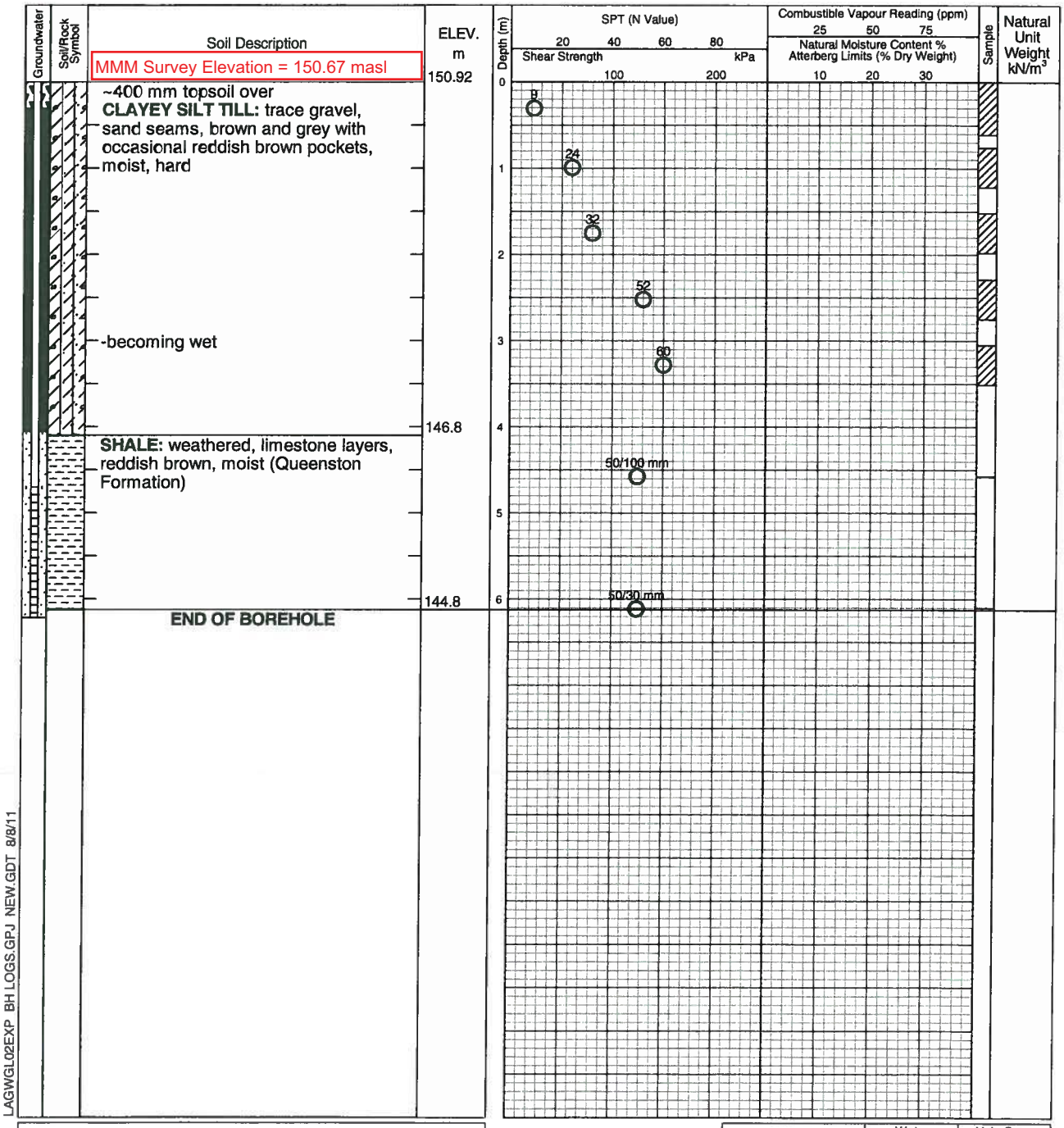
Log of Borehole MMM-11-21

Project No. BRM00059627-C0
Drawing No. 6
Project: Geotechnical Investigation
Sheet No. 1 of 1
Location: 14 Mile Creek, Oakville, Ontario

Date Drilled: July 14, 2011
Drill Type: CME 55 - Trackmount
Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer



LAGWGL02EXP BH LOGS.GPJ NEW.GDT 8/8/11

Notes:
1. Borehole advanced to completion at 6.125 m depth by conventional soil sampling methods using a specialist drilling subcontractor. For borehole definitions, see notes prior to logs.
2. This drawing forms part of and must be read in conjunction with the subject report (Ref. No.: BRM00059627-C0); borehole data requires interpretation assistance by exp professional staff before use by others.
3. Monitoring Well installed and borehole backfilled as shown on completion.

exp.
New identity of Trow Associates Inc.
Brampton

Elapsed Time	Water Level (m)	Hole Open to (m) MW = Mon. Well
On completion	6.0	6.20
July 15, 2011	3.63	
July 27, 2011	3.99	

Log of Borehole MMM-11-22-D

Project No. BRM00059627-C0 Drawing No. 7

Project: Geotechnical Investigation Sheet No. 1 of 1

Location: 14 Mile Creek, Oakville, Ontario

Date Drilled: July 14, 2011

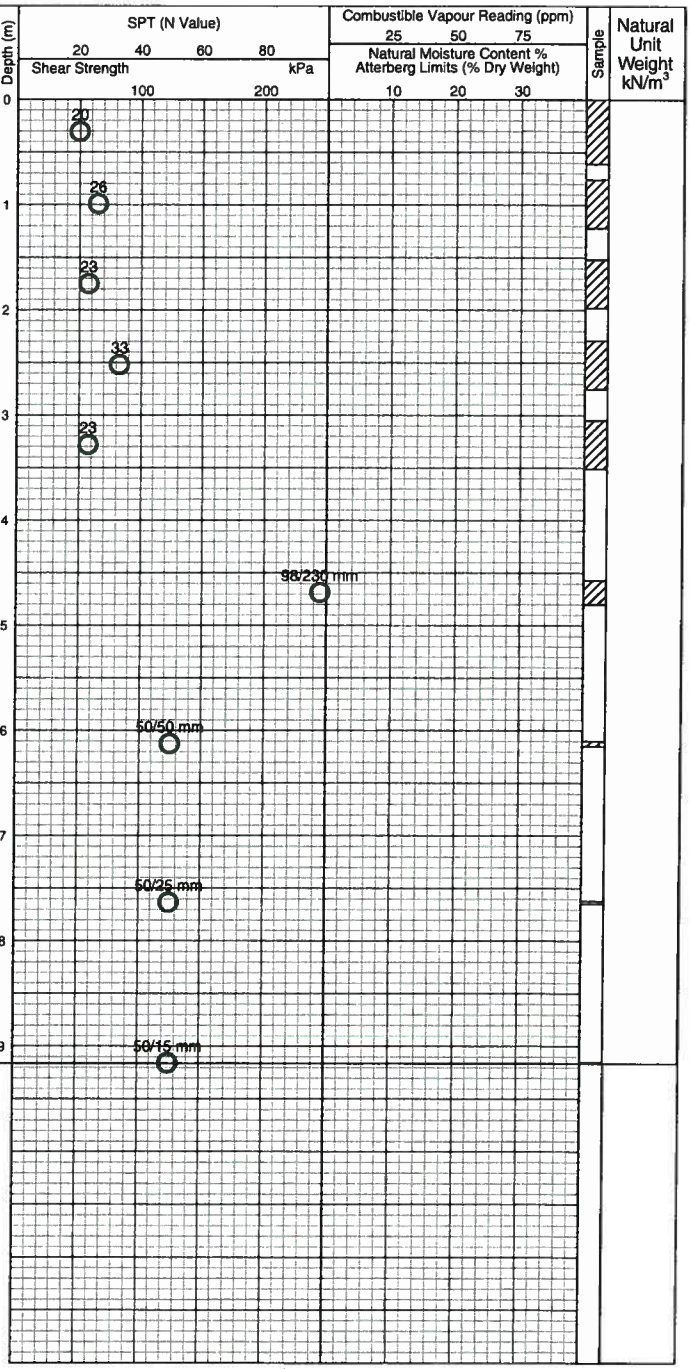
Drill Type: CME 55 - Trackmount

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer

Soil Description	ELEV. m
MMM Survey Elevation = 151.74 masl	152.00
~350 mm topsoil over **CLAYEY SILT TILL:** trace gravel, sand seams, brown, reddish brown pockets, oxidized fissures, moist, hard	
-wet, larger gravel sizes and cobbles	
-becoming wet	
-becoming reddish brown with shale fragments	
	146.5
SHALE: weathered, reddish brown, moist (Queenston Formation)	
	142.8
END OF BOREHOLE	



Notes:
1. Borehole advanced to completion at 9.165 m depth by conventional soil sampling methods using a specialist drilling subcontractor. For borehole definitions, see notes prior to logs.
2. This drawing forms part of and must be read in conjunction with the subject report (Ref. No.: BRM00059627-C0); borehole data requires interpretation assistance by exp professional staff before use by others.
3. Monitoring Well installed and borehole backfilled as shown on completion.

exp.
New identity of Trow Associates Inc.
Brampton

Elapsed Time	Water Level (m)	Hole Open to (m) MW = Mon. Well
On completion	8.54	9.15
July 15, 2011	4.48	
July 27, 2011	4.84	

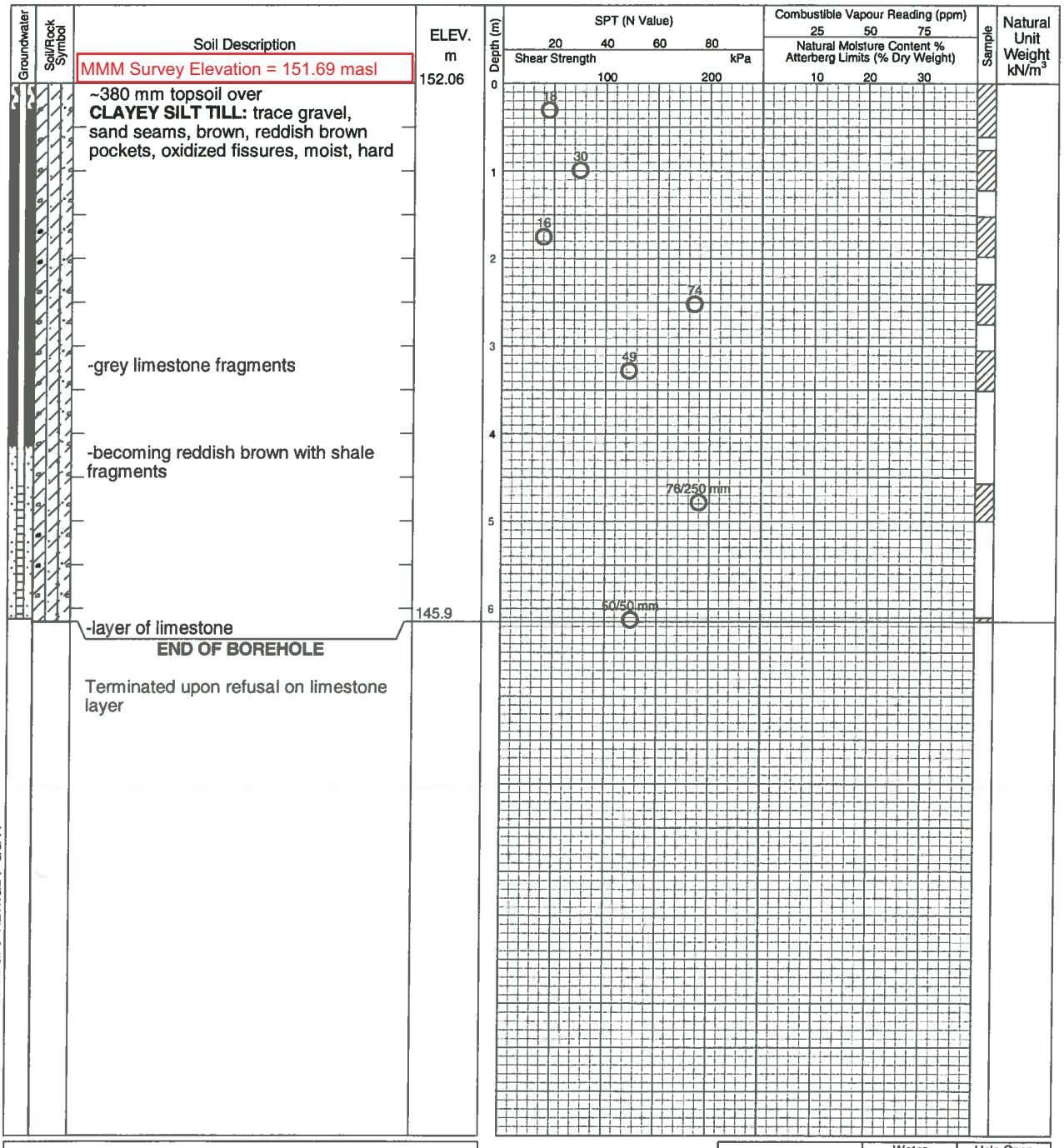
LAGWGL02EXP BH LOGS.GPJ NEW.GDT 8/8/11

Log of Borehole MMM-11-22-S

Project No. BRM00059627-C0
Drawing No. 8
Project: Geotechnical Investigation
Sheet No. 1 of 1
Location: 14 Mile Creek, Oakville, Ontario

Date Drilled: July 13, 2011
Drill Type: CME 55 - Trackmount
Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test
Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer

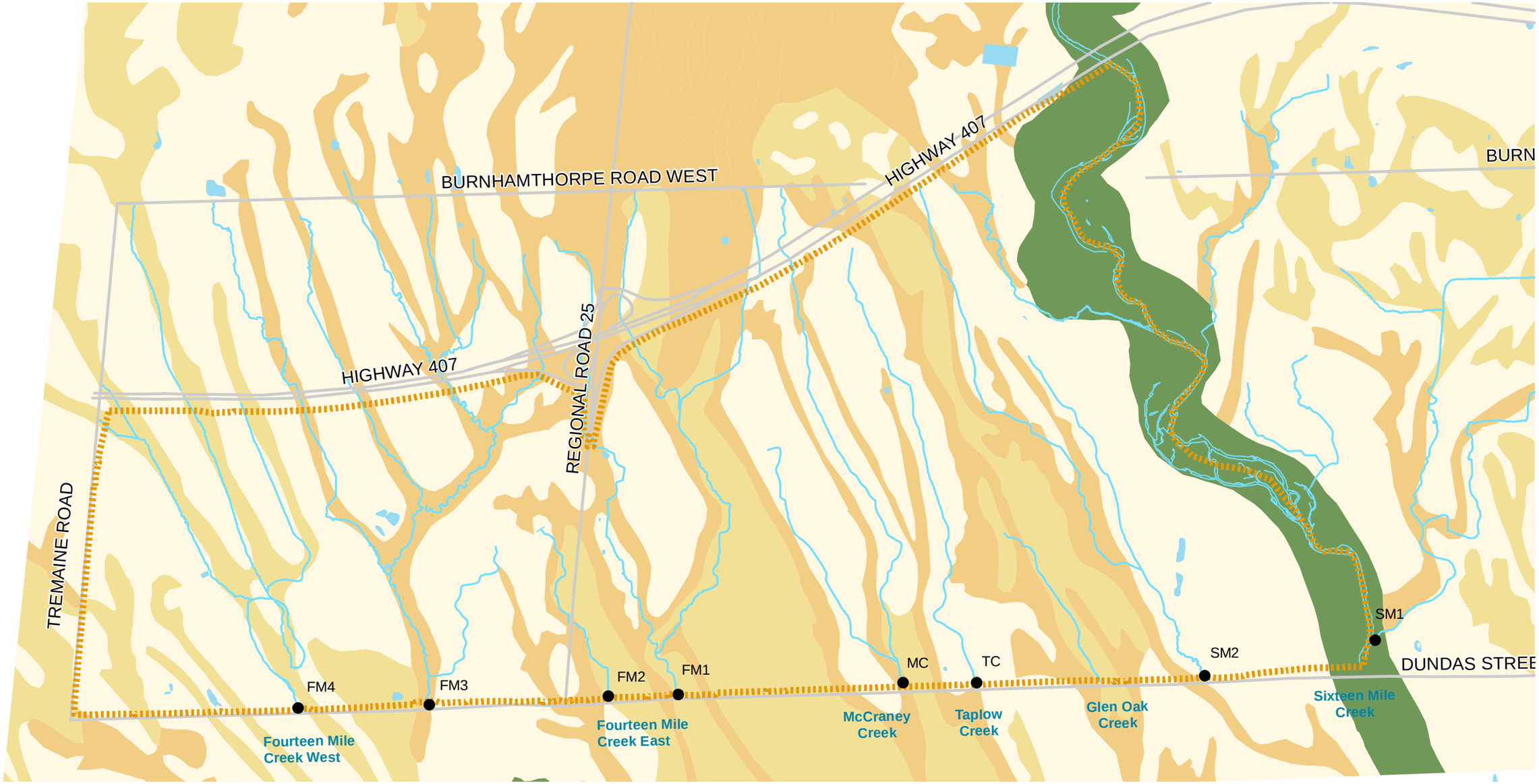


LAGWGL02EXP BH LOGS.GPJ NEW.GDT 8/8/11

Notes:
1. Borehole advanced to completion at 6.15 m depth by conventional soil sampling methods using a specialist drilling subcontractor. For borehole definitions, see notes prior to logs.
2. This drawing forms part of and must be read in conjunction with the subject report (Ref. No.: BRM00059627-C0); borehole data requires interpretation assistance by exp professional staff before use by others.
3. Monitoring Well installed and borehole backfilled as shown on completion.

exp.
New identity of Trow Associates Inc.
Brampton

Elapsed Time	Water Level (m)	Hole Open to (m) MW = Mon. Well
On completion	No free water	6.12
July 15, 2011	4.28	
July 27, 2011	4.56	



NORTH OAKVILLE CREEKS SUBWATERSHED STUDY

TSH engineers architects planners · PARISH geomorphic · Natural Resource Solutions Inc. Aquatic, Terrestrial and Wetland Biologists · Donald G. Weatherbe Associates · Morrison Environmental Limited Groundwater Consultants · EWRG Environmental Water Resources Group Ltd.

0 250 500
Meters

OAKVILLE

August 2006

Legend

- West Study Area
- Road
- Watercourse
- Pond
- Flow Monitoring Station

Soil Type

- Bottom Land
- Brady (Sandy Loam)
- Chinguacousy (Rocky Phase)
- Chinguacousy Clay Loam
- Jeddo Clay Loam
- Lockport Clay
- Oneida (Rocky Phase)
- Onieda Clay Loam
- Trafalgar Clay

West Study Area

Soils and Flow Monitoring Locations

Figure 4W.6.1