Hydrogeological Investigation and Design Report

Harris River Rest Area

Highway 69 Four Laning

Prepared For: Ministry of Transportation

Geocres Number: 41H-117

COMMUNITIES

TRANSPORTATION

BUILDINGS

INFRASTRUCTURE

MMM GROUP

May 2013

GWP 5076-06-00 / 16-07198-001-EN4

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PART I FACTUAL INFORMATION

1.0 INTRODUCTION

MMM Group Limited (MMM) was retained by the Ministry of Transportation (MTO) to carry out a hydrogeological investigation for the upgrading of the Harris River Rest Area. This program was carried out under the MTO Agreement Number 5006-E-0030.

The redeveloped rest area will be a year-round facility and will have a building housing two men's and two women's washrooms and a viewing platform. Each men's washroom will have a stall, urinal and sink; a stall and a sink will be installed in each women's washroom. Water from an on-site source will be provided to service these washrooms once they become operational. There is potential that treatment systems for the water supply will be installed at the rest area though the water will be posted as non-potable, since ongoing water quality monitoring is not expected. Sewage will be discharged to a septic tank for simple treatment and the tank effluent will be disposed of in an on-site tile bed system.

The purpose of this hydrogeological investigation is to evaluate the potential for an on-site water supply source for the rest area and to assess the site conditions for the design of the septic system. The scope of work included drilling and installation of a test well at the rest area and testing the well for yield and water quality parameters. The water well, if suitable, would provide the non-potable water supply to the proposed washrooms. With regard to the evaluation of sewage servicing options for the rest area, soil sampling was carried out by MMM, while borehole drilling, test pitting and percolation testing were carried out by Thurber Engineering at the time of their foundations investigation for the rest-room structures. Both the hydrogeological and septic system investigations were initiated by MMM once the initial design concept for the rest area was accepted by the MTO in the fall of 2010.

2.0 SITE DESCRIPTION

The Harris River Rest Area (the "Site") is located to the west of the existing intersection of Harris Lake Road and Highway 69, approximately 50 km northwest of Parry Sound, ON (See Figures 1 and 2). The surrounding lands are uninhabited, with the closest identifiable land-use being a sand pit located approximately 2 km to the southeast, along Highway 69. The existing rest area consists of open gravel parking, picnic areas, two outhouses with no running water, and is seasonally operated.

The site is located within a mixed deciduous-coniferous bush (e.g., birch, pine, fir, etc.) to the north, west, south and east. Some clearing of this bush along a proposed access road to the site was observed to permit earlier geotechnical soil investigations to be carried out.

The Harris River is located south of the rest area and flows in a westerly direction. The rest area is on the order of 10 to 15 m higher in elevation than the Harris River (surface water level elevations recorded to range from 177.9 metres above sea level (masl) (on Aug.15, 2011) to 179.2 masl (on Sept.29, 2008)). The river valley is defined by a steep slope/ bluff (approximately 1.5:1 slope) at the southwest part of site. Grade towards the Harris River at the east end of the site is less steep (approximately 2:1 slope) (See Figure 3).

The existing rest area is primarily used as a picnic area. A gravel parking area is located along the south boundary of the site with two privies located at the south-west corner of the rest area. There are also several picnic tables and garbage bins placed across the site. Photographs showing the general nature of the surrounding land and the site are included in Appendix A.

The site is situated in an area that is mapped as underlain by coarse-textured glacio-lacustrine surficial deposits (See Figure 2). Based on the elevation contours and the proximity of the site to Harris River, along with observed water levels measured at test holes, local groundwater is flowing towards the south/southwest. Regional groundwater flow is expected to flow westerly towards Georgian Bay.

Based on a review of the Ontario Geological Survey Maps, the bedrock deposits in the area are mapped as felsic intrusive rocks and clastic metasediments. The Felsic Rocks include granite, granophyre, granodiorite, quartz diorite, quartz mononize, syenite, trondhjemite and derived gneisses. Clastic metasediments are described as conglomerate, greywacke, calcareous sandstone and siltstone, shale and derived metamorphic rocks (Freeman, 1978).

A search of the Ministry of Environment (MOE) records for wells returned the following two records:

- One 152 mm diameter well installed to a depth of 43 m in June 1997 and located approximately 6 km to the southeast of the site. The soils were characterized as loose black topsoil to 1.5 m overlying red granite bedrock with static water level measured at 1.83 m; and,
- One 76 mm diameter well installed to a depth of 30 m in May 1976 and located approximately 3 km to the southwest of the site. The soils were characterized as sand and clay topsoil to 6.1 m overlying black granite bedrock with static water level measured at 1.83 m.

The MOE well record search results are provided in Appendix B. The scarcity of well records reflects the observed land use in the vicinity of the site, and further indicates that bedrock is shallow, with generally high water levels observed, albeit from a small dataset.

3.0 SITE INVESTIGATION AND FIELD TESTING

3.1 Water Supply Work Program

3.1.1 Water Well Installation

A preliminary site visit was conducted on October 25, 2010 with representatives from MMM and the water well drilling contractor to review the proposed work plan and to identify the test well location. The test well is located approximately 12 m southwest of the proposed washroom building facility[1]. The general location of the test well was chosen to allow for future ease of access to the well for maintenance vehicles (see Figure 3). The test well is located a minimum of 80 m to the west of the proposed septic bed, and approximately 30 m to the north of the Harris River.

[1] Based on the initial rest area design concept provided in the fall of 2010, the test well was originally located approximately 3 to 6 metres from the washroom building facility.

Drilling commenced on November 5, 2010 and the test well installation was completed on November 8, 2010. The drilling was carried out using a Schramm T450WS Air Rotary Rig with a 900/350 Sullair compressor. Fluid and air was pumped through the rotating drill steel and ultimately brought cuttings to the surface.

Bedrock was encountered directly below the topsoil at a depth of approximately 0.6 metres below ground surface (mbgs). The drilling progressed to the maximum scoped depth of 60 mbgs (approximately 197 feet bgs), outlined in the original work plan. No groundwater yield was found to that depth, and MTO provided authorization to continue drilling up to a maximum depth of 106.7 mbgs (350 feet bgs). On November 8, 2010, the drilling advanced until the well drilling contractor encountered a water-bearing fractured zone within the granite bedrock at a depth of 91.4 mbgs (300 feet bgs). Steel well casing was set into the bedrock and sealed with bentonite to a depth of 6.1mbgs.

The well was developed and a preliminary 1-hour duration pumping test was performed by the well drilling contractor at a rate of 75 litres/min (20 US gal/min) as a part of the well development program. The well was chlorinated by the well drilling contractor as required by Regulation 903.

A follow-up visit by the well drilling contractor on November 10, 2010 revealed that the groundwater level inside the test well had risen to the top of the well casing (elevation of 191.5 masl, or 0.7 metres above ground surface (mags)), and was overflowing, indicating the well was artesian. The water was estimated by the well driller to be flowing at a rate of approximately 7.6 litres/min (approximately 2 US gal/min). The static water level inside the test well was therefore on the order of 12 m higher in elevation than the surface of Harris River.

A copy of the MOE water well record completed by the well drilling contractor is attached in Appendix C.

3.1.2 Pumping Test

A 6-hour duration pumping test was carried out on the test well by the well drilling contractor under the direct supervision of a MMM field technician on November 18, 2010. The pumping test started at 9:45 AM and was shut-down at 3:45 PM. During the test, air temperature varied between 0C and +4.2C and an average barometric pressure of 99.5 kPa was recorded at the Parry Sound weather station (Environment Canada website, 2010).

A submersible pump was installed within the well with a rated capacity of 75 litres/min (20 US gal/min) and the pump intake was set to a depth of approximately 73 mbgs. Pumping at the well was maintained at a steady rate of 75 litres/min (20 US gal/min) during the entire testing period, with no variation noted. The pump rate was monitored by using a F452 manual flow meter supplied by the well drilling contractor. The accuracy of the pumping rate was verified by the MMM field technician by measuring the flow at the discharge end of the hose, using a graduated bucket and timer. Water was discharged to the ground surface in the forest, at a point located approximately 20 m to the northwest of the test well. The area was monitored throughout the test to ensure there was no erosion caused by the discharge. In total, 27,000 litres of water was pumped from the well during the test.

During the pumping and recovery stages of the testing, the water levels at the well were regularly monitored by the well drilling contractor, using a Testwell water level meter. The manual water level was monitored at 0.5 minute intervals for the first 5 minutes, with monitoring frequency decreasing to 1 minute, 2 minute and then 5 minute intervals as the test progressed, and finally at 15 minute intervals beyond the first hour of pumping. A maximum drawdown of

8.8 m below the top of the well (water level at 182.7 masl) was recorded at the end of the testing, placing the water in the well at an estimated elevation of 3.5 m higher than the levels of the Harris River[2].

Following shut-down of the pump, recovery monitoring at the water well was carried out until at least 90% recovery of the static water level was recorded. The well recovered to 90% of the top of casing within 45 minutes of the pump shut-down. The recovery was measured at intervals of 0.25 minutes for the first 4 minutes and then at progressively longer intervals ranging from 0.5 minutes up to 5 minutes after 20 minutes of recovery and to the end of the monitoring (45 minutes duration).

The pumping test and recovery data was analyzed using AquiferTest Pro (version 4.2). Drawdown during pumping was analyzed using the Moench solution for fracture flow and the Double Porosity fracture flow model developed by Warren and Root. Recovery data was analyzed using the Theis Recovery Method. As drawdown and recovery data were obtained from the pumping well only, aquifer Storativity coefficients cannot be estimated. Transmissivity of the bedrock aquifer as calculated by the three approaches was 4.0 m^2/day, which is a modest value. Drawdown and recovery data for the pumping test are presented in Appendix D.

During the pumping test the discharged water was monitored for pH, temperature, electrical conductivity (EC), and total dissolved solids (TDS) using a hand-held Hanna 98130 waterproof pH, EC/TDS and temperature probe (see Table 1). In addition to this, two groundwater samples were collected during the test from a water discharge valve, included by the well drilling contractor as part of the pumping system. Sample 1 was collected at 10:00 AM, 15 minutes following the start of pumping; and, Sample 2 was collected at 3:30 PM, 15 minutes prior to the pump being shut off. The groundwater samples were placed directly into laboratory-prepared sample containers, packed on ice in coolers and delivered to the laboratory within 48 hours of sampling.

Table 1: Discharge Point Monitoring Results

Time Elapsed from the Test Start (minutes)	pH	Temperature (°C)	Conductivity (mS)	Concentration of Total Dissolved Solids (ppm)
20	7.65	8.2	0.88	440
60	7.59	7.6	0.66	348
120	7.67	7.7	0.73	350
150	7.53	7.8	0.68	401
210	7.43	9.5	0.45	228
270	7.34	8.6	0.42	212
345	7.44	7.8	0.44	224

[2] Based on an assumed river elevation of 179.2 masl (September 29, 2008). The water level at the Harris River was not surveyed at the time of testing. The higher surface water elevation from 2008 is considered more representative of the water levels in the river at the time of testing based on a comparison of photographs taken in October 2010 where the river level was on the order of 1 to 1.5 m higher than seen in a photograph taken by MMM surveyor on August 15, 2011 when the river level was surveyed at 177.9 masl.

3.2 Sewage Disposal System and Environmental Work Program

3.2.1 2010 Field Investigations

A borehole (BH 10-06) and three hand excavated test pits (TP-1 to TP-3) were advanced within the proposed septic tile field area on October 28 and November 30, 2010 by Thurber Engineering in conjunction with a geotechnical foundation investigation for the proposed rest-room facility and the viewing platform. The geotechnical investigation included five boreholes (BH 10-01 to BH 10-05). Full details of the 2010 geotechnical investigation are reported separately in the geotechnical report prepared by Thurber Engineering Limited. The borehole and test pit locations are shown on Figure 3. Copies of the Borehole and Test Pit logs and grain size analyses results are presented in Appendix C.

Boreholes BH 10-01 through to BH 10-04 were drilled by Walker Drilling under the supervision of a Thurber field technician on October 28, 2010, using a D50 tracked drill rig equipped with spilt-spoon samplers, solid stem augers and NQ2-sized diamond coring equipment. Test Pits TP-1 through TP-3 were hand excavated by the Thurber field technician on October 28, 2010 and percolation tests carried out on that date. Thurber Engineering returned to the site on November 30, 2010 with Ohlmann Geotechnical Services Limited and drilled boreholes BH 10-05 and BH 10-06 in the wooded areas using a portable tripod drill. Soil samples were obtained using continuous split-spoon sampling.

Earlier investigations had been conducted on-site by Applied Research Associates, Inc. (ARA) for the purposes of roadway design and included a number of boreholes which indicated possible depth to rock. This information is beneficial as it provides relevant data for preliminary layout of servicing. ARA's borehole logs for the roadway evaluation work at the Rest Area are included with Appendix C.

Percolation tests were carried out by Thurber Engineering at the three test pits hand-excavated in the proposed tile field bed location. At each percolation test location the field technician removed all the topsoil and excavated a 0.3 m deep straight-sided hole (0.3 m x 0.3 m square). Each hole was twice filled to the top with water and allowed to infiltrate. Each hole was then filled with water a third time and the falling water was measured against time. The tabulated measurements of the percolation tests are presented in Appendix D.

The calculated T-Times and estimated hydraulic conductivities from the percolation tests are presented on Table 2 below. Also included on this table are estimates of hydraulic conductivities of soils from the grain size analyses along with estimates of T-times based on the hydraulic conductivities.

Table 2: T-Time Estimates

Location/ Sample	Soil	Estimation Method	T-Time (minute/cm)	Hydraulic Conductivity (m/sec)
TP-1	F SAND, trace silt	Percolation Test	6.3 min/cm	-
TP-2	F SAND, trace silt	Percolation Test	2.7 min/cm	-
TP-3	SILT, some sand, trace clay	Percolation Test	10.0 min/cm	-

Location/ Sample	Soil	Estimation Method	T-Time (minute/cm)	Hydraulic Conductivity (m/sec)
TP-1	F-M SAND, trace silt	Grain Size/Hazen Approximation	*4.6 min/cm†*	$4.9x10^{-5}$ m/sec
TP-2	F-M SAND, trace silt	Grain Size/Hazen Approximation	*4.9 min/cm†*	$3.6x10^{-5}$ m/sec
TP-3	SANDY SILT, trace clay	Grain Size/Hazen Approximation	*21.9 min/cm†*	$9.0x10^{-8}$ m/sec
BH 10-05 SS-2	SILT and SAND	Grain Size/Hazen Approximation	*9.8 min/cm†*	$2.3x10^{-6}$ m/sec
BH 10-05 SS-3	SILT, some clay and sand	Grain Size/Hazen Approximation	*N/A*	$<1.0x10^{-8}$ m/sec
BH 10-05 SS-4	F-M SAND, trace silt	Grain Size/Hazen Approximation	*5.4 min/cm†*	$\sim2.5x10^{-5}$ m/sec
BH 10-06 SS-2	SILTY F-M SAND	Grain Size/Hazen Approximation	*11.0 min/cm†*	$1.4x10^{-6}$ m/sec
BH 10-06 SS-3	SILTY F-M SAND	Grain Size/Hazen Approximation	*12.0 min/cm†*	$1.0x10^{-6}$ m/sec
BH 10-06 SS-4	F-M SAND	Grain Size/Hazen Approximation	*2.9 min/cm†*	$2.9x10^{-4}$ m/sec

Note †: The T-Times shown in the table above for soil samples where grain size analyses were used to estimate hydraulic conductivity using the Hazen method, are not field verified. These estimates are based upon a relationship using information presented within the MOE Sewage Design Manual (1984) – See chart in Appendix D

3.2.2 2011 Field Investigations

The advancement of additional sampled boreholes and hand augered holes to determine the physical, hydraulic, and chemical properties of the surficial materials and bedrock for the design of the septic system was undertaken on November 2, 2011 under the supervision of an MMM field technician. Assistance was provided from Applied Research Associates who were doing bedrock probing in the area for MTO, and who coordinated and scheduled their drilling contractor to perform the borehole drilling.

The 2011 investigation consisted of the drilling or manual augering, and sampling eight test holes within the proposed footprint of the septic bed and servicing corridor (labeled as PZ-1 to PZ-3, and MMM11-01 to MMM11-05) as shown in Figure 3.

The drilling contractor (Malone's Drilling) advanced six boreholes (MMM11-02 to MMM 11-05, PZ-2, and PZ-3) using a track mounted CME 75 drill rig equipped with solid-stem augers to depths ranging from 3.05 mbgs to 7.67 mbgs. Soil samples were collected continuously using a stainless steel split-spoon sampler. The recovered soil samples were visually inspected and logged by an MMM field technician who supervised the drilling program.

Due to equipment inaccessibility, test hole PZ-1 was advanced by the MMM field technician using a 10 cm diameter stainless steel hand auger. As well, to assist in the environmental sampling and to prevent possible cross-contamination, MMM11-01 was advanced using the stainless steel hand auger to recover a soil sample for chemical analysis. A soil sample from MMM11-01 was selected for submission of chemical analysis to characterize soils within the existing parking lot structure which was considered the most likely area of potential environmental concern. The hand augered holes were advanced to a depths of 1.19 mbgs with soil conditions visually inspected and logged by the MMM field technician. Soil samples were collected and the hand augered holes were backfilled with the excavated material followed by nominal compaction.

Soil samples collected at the boreholes and hand augered holes were placed into labelled polyethylene bags. The headspace above the soil samples was monitored using a RKI Eagle Combustible Gas Indicator (RKI) and a photoionization detector (PID) once the samples stabilised within the bags to approximately room temperature to quantify the concentration of organic vapours. Following RKI and PID screening, the soil samples were temporarily stored in a cooler and maintained at a temperature between 1 and 10 degrees Celsius. The soil sample recovered at MMM11-01 and submitted for F1/BTEX petroleum hydrocarbon compound (PHC) analysis, was sampled directly from the hand auger using a laboratory supplied syringe and transferred immediately into laboratory pre-weighed vials containing methanol. The remaining part of the sample was placed into a laboratory prepared bottle for chemical analysis and in a polyethylene bag and placed into the cooler. The prepared bottles and vials were delivered to the laboratory within 48 hours of sampling.

Three standpipe piezometers consisting of 31.8 mm diameter PVC pipe with slotted screens were installed at PZ-1, PZ-2, and PZ-3. The annulus of the holes were backfilled with filter sand to 0.3 m above the screen and hole plug (bentonite) placed around the solid riser from above the sand-pack to bring the hole to grade. The borehole completion details are presented on Table 3 below. Borehole logs for the 2011 field investigation are provided in Appendix C.

Table 3: Borehole Completion Details

Borehole	Drilling Method	Piezometer Tip Depth/ Screen length	End of borehole details
PZ-1	Hand Auger	1.02 mbgs / 0.61 m	1.2 mbgs in brown fine sand due to borehole caving.
PZ-2	Solid Stem Auger	2.58 mbgs / 1.52 m	3.1 mbgs in dark grey medium to coarse sand due to borehole caving.
PZ-3	Solid Stem Auger	2.74 mbgs / 1.52 m	3.1 mbgs in grey fine sand due to borehole caving.
MMM11-01	Hand Auger	None Installed	1.2 mbgs in brown fine sand due to borehole caving.
MMM11-02	Solid Stem Auger	None Installed	7.7 mbgs due to auger refusal on assumed bedrock.
MMM11-03	Solid Stem Auger	None Installed	3.5 mbgs due to auger refusal on assumed bedrock.

Borehole	Drilling Method	Piezometer Tip Depth/ Screen length	End of borehole details
MMM11-04	Solid Stem Auger	None Installed	4.6 mbgs due to auger refusal on assumed bedrock.
MMM11-05	Solid Stem Auger	None Installed	5.0 mbgs due to auger refusal on assumed bedrock.
BH 10-01	Solid Stem Auger	None Installed	0.7 mbgs due to auger refusal on assumed bedrock.
BH 10-02	Solid Stem Auger/NQ Coring	None Installed	3.4 mbgs, cored into granite bedrock
BH 10-03	Solid Stem Auger/NQ Coring	None Installed	5.1 mbgs, cored into granite bedrock
BH 10-04	Solid Stem Auger	None Installed	0.7 mbgs due to auger refusal on assumed bedrock.
BH 10-05	Solid Stem Auger	None Installed	2.4 mbgs due to auger refusal on assumed bedrock.
BH 10-06	Solid Stem Auger	None Installed	2.4 mbgs due to 1.2 m of heaving sands. Borehole caved therefore to 1.2 mbgs
Harris River Test Well	Solid Stem Auger/NQ Coring	91.4 mbgs/ no screen installed	91.4 mbgs, cored into granite bedrock

3.3 Site Geology and Subsurface Conditions

The site investigations confirmed the published geological mapping which indicates the site is in an area with coarse textured (sand) deposits overlying bedrock. The drilling, augering and excavations generally encountered sandy deposits overlying granite bedrock.

3.3.1 Geology

3.3.1.1 Topsoil

Topsoil was identified at ground surface at nine of the test holes (PZ-1, BH10-01, BH10-02, BH10-03, BH10-05, BH10-06, TP-1, TP-2 and TP-3). The topsoil ranged in thickness from between 0.05 to 0.3 m. Topsoil was also logged at the test well site, to a depth of 0.6 mbgs, and immediately overlying the bedrock.

3.3.1.2 Asphalt

Paving material described as asphalt or compacted gravel was identified at surface at two test holes (MMM11-01 and BH10-04). It was measured between 0.05 to 0.1 m thickness.

3.3.1.3 Sandy Fill

Sandy fill was logged at two test holes. At BH10-03, it was encountered below the topsoil, was described as Sand with some silt, and extended to the bedrock to a depth of 1.2 m. At BH10-04 the fill was logged as Sand, some gravel, and also extended to the bedrock, to 0.7 m depth. The fill was moist and brown in colour.

3.3.1.4 Fine to Medium Sand

Fine to medium grained sand was encountered at ground surface or below topsoil at eleven test hole locations (MMM11-01 to MMM11-05, PZ-1 to PZ-3, BH10-01, TP-1 and TP-2) and below 1.7 m of overlying deposits at BH10-05. The sand was brown and moist near surface becoming greyish brown to grey at depth below the water table. At five locations the test holes were terminated before the base of this sand deposit was confirmed (MMM11-01, PZ-1, PZ-3, TP-1 and TP-2) at depths from 0.6 to 3.1 mbgs (PZ-3). At the remaining seven locations, the sand deposit extends to between 0.7 mbgs (to shallow bedrock) up to about 3.1 m depth (MMM11-05).

3.3.1.5 Silty Sand

Brown and moist Silty Sand was found at BH10-06 below the topsoil, from 0.2 to 2.4 m depth where the hole was terminated due to heaving sands. At MMM11-02, Silty Sand was logged between 2.3 t 3.1 m depth, and was brown in colour and saturated.

3.3.1.6 Sand and Silt

Sand and Silt to Silt some sand was reported at two test holes, below the topsoil and to depths between 0.6 mbgs (TP-3 end of hole) to 1.1 mbgs (BH10-05). The deposit at both locations was brown in colour and moist.

3.3.1.7 Silty Clay

A deposit of Silty Clay was logged below the fine to medium-grained Sand at test hole MMM11-02, between 2.0 and 2.3 m depth, and below the Sand and Silt at BH10-05 from 1.1 to 1.7 mbgs. Organic matter was noted in this soil at both locations, and at MMM11-02, it was further described as dark brown in colour and wet.

3.3.1.8 Medium to Coarse Sand

Medium to coarse grained sand was identified at depth at five of the test hole locations (MMM11-02 to MMM11-05, and PZ-2) at depths between 1.5 to 3.1 mbgs. At four of the borehole locations the sand extended to the inferred top of bedrock (auger refusal) to depths of between 3.5 to 7.7 mbgs. The base of this sand was not proven at PZ-2 which was terminated at a depth of 3.1 mbgs. The sand varied in colour from brown to grey, and was described in moist to saturated condition.

3.3.1.9 Granite Bedrock

Granite bedrock was identified at the two cored boreholes (BH 10-02 and 10-03) and at the test well site, and presumed at seven borehole locations based on auger refusal at the time of drilling. At the west part of the site, in the vicinity of the proposed washroom facilities and the test well, bedrock was encountered at shallow depth, from between 0.2 to 1.2 mbgs and is potentially associated with the rock outcropping mapped along the northern edge of the existing parking area.

At the two cored boreholes the Granite was cored to depths of 3.5 and 5.1 mbgs. The bedrock is competent and RQD of the rock ranged between 87 to 100% (average 96%). Occasional vertical to sub-vertical jointing was noted at 0.3 mbgs and 1.3 mbgs at BH 10-02 and at 2.2 mbgs and 4.2 mbgs at BH 10-03.

At the borehole locations east of the proposed washroom facility and in the area of the proposed septic field, the bedrock surface is inferred by reports of auger refusal. Auger refusal was reported at five of these borehole locations (BH 10-04 and MMM11-02 through to MMM11-05), ranging in depth from 2.4 mbgs to 7.7 mbgs. Bedrock is exposed to the northwest of the preliminary tile field location (see Figure 3) and is interpreted to fall to the south towards the river from 188.3 masl at MMM11-03 to 183.8 masl at MMM11-02.

3.3.2 Groundwater Conditions

Groundwater was encountered at seven of the test holes at the time of drilling. Standpipe piezometers were installed at three test holes on November 2, 2011. The water levels at these three piezometers were measured at the end of the day on November 2, 2011 and on December 6, 2011 and the recorded measurements are summarized in Table 4. The measurements of December 6, 2011 are considered more representative of static water levels as the monitors had approximately one month to stabilize. The overburden (shallow) groundwater is interpreted to flow in the overburden to the south southeast towards the Harris River. It also should be recognized that groundwater levels are subject to seasonal fluctuations.

At the time of the site visit on December 6, 2011, minor water flow was noted at one the two swales located downslope of the proposed septic area, and at the time of the visit on April 11, 2012, the areas was observed in moist/wet condition with pockets of standing water. These swales are situated at topographic elevations that may seasonally intercept the shallow water table.

Table 4: Groundwater Conditions

Test Hole/ Date of Work	Water Observed at Time of Excavation/ Drilling	Measured Water Levels (Nov. 2, 2011)	Measured Water Levels (Dec. 6, 2011)	Measured Water Levels (Apr. 11, 2012)	Notes
Test Well November 8, 2011	> 0.7 mags/ > 191.5 masl	N/A	N/A	N/A	Well is artesian, top of well casing surveyed at 191.5 masl
PZ-1 November 2, 2011	Dry to 1.2 mbgs/ < 185.8 masl	Dry to 1.0 mbgs/ <186.0 masl	Dry to 1.0 mbgs/ <186.0 masl	Dry to 1.0 mbgs/ <186.0 masl	
PZ-2 November 2, 2011	1.7 mbgs/190.1 masl	1.7 mbgs/ 190.1 masl	0.8 mbgs/ 191.0 masl	1.0 mbgs/ 190.8 masl	
PZ-3 November 2, 2011	1.6 mbgs/ 189.4 masl	1.6 mbgs/ 189.4 masl	1.2 mbgs/ 189.9 masl	1.2 mbgs/ 189.9 masl	
MMM11-01 November 2, 2011	Dry to 1.2 mbgs/ < 190.2 masl	N/A	N/A	N/A	No Monitor installed
MMM11-02 November 2, 2011	2.0 mbgs/189.5 masl	N/A	N/A	N/A	No Monitor installed
MMM11-03 November 2, 2011	2.1 mbgs/189.8 masl	N/A	N/A	N/A	No Monitor installed
MMM11-04 November 2, 2011	1.2 mbgs/190.8 masl	N/A	N/A	N/A	No Monitor installed
MMM11-05	2.3 mbgs/189.6 masl	N/A	N/A	N/A	No Monitor installed

Test Hole/ Date of Work	Water Observed at Time of Excavation/ Drilling	Measured Water Levels (Nov. 2, 2011)	Measured Water Levels (Dec. 6, 2011)	Measured Water Levels (Apr. 11, 2012)	Notes
November 2, 2011					
BH 10-01 October 28, 2010	Dry to 0.7 mbgs/ < 190.7 masl	N/A	N/A	N/A	No Monitor installed
BH 10-02 October 28, 2010	Not recorded	N/A	N/A	N/A	No Monitor installed
BH 10-03 October 28, 2010	Not recorded	N/A	N/A	N/A	No Monitor installed
BH 10-04 October 28, 2010	Not recorded	N/A	N/A	N/A	No Monitor installed
BH 10-05 November 30, 2010	Not recorded	N/A	N/A	N/A	No Monitor installed
BH 10-06 November 30, 2010	1.2 mbgs/189.0 masl see note to the right	N/A	N/A	N/A	Borehole log indicates 1.2 m of heaving sand – interpreted to be due to water No Monitor installed
TP-1 October 28, 2010	Dry to 0.6 mbgs/ < 191.2 masl	N/A	N/A	N/A	No Monitor installed
TP-2 October 28, 2010	Dry to 0.6 mbgs/ < 189.9 masl	N/A	N/A	N/A	No Monitor installed
TP-3 October 28, 2010	Dry to 0.6 mbgs/ < 190.7 masl	N/A	N/A	N/A	No Monitor installed

Notes: All water levels rounded to the nearest 0.1 m and "Measured Water Levels" refer to measurements taken at the completed monitoring well installation, not open hole.

3.4 Analytical Testing

Soil and groundwater samples were analyzed by Maxxam Analytics Incorporated (Maxxam Analytics) in Mississauga, Ontario, a laboratory accredited with the Canadian Association for Laboratory Accreditation (CALA).

3.4.1 Groundwater General Chemistry Results

The two groundwater samples recovered from the test well were submitted for chemical analysis for metals and general water quality characteristics through the rapid chemical analysis package for drinking water (RCAP-DW) and microbiological parameters specified in Ontario Regulation (O.Reg.) 170/03 Schedule 23. Sample 2 was also tested for a more comprehensive suite of organic parameters, outlined in O.Reg. 170/03, Schedule 24. The laboratory results were compared against the Ontario Drinking Water Standards (ODWS).

A summary of groundwater quality results are provided below. The complete groundwater analytical tables, laboratory certificates of analysis, and chain of custody are attached in Appendix D.

3.4.1.1 General Chemistry

The general chemistry results indicate that groundwater is hard (hardness of 130-140 mg/L), with an average alkalinity (140 mg/L), and with a pH of 8.1. Concentrations of dissolved sodium (15.6-16.7 mg/L) and dissolved chloride (20 mg/L) are below the ODWS. These concentrations meet the ODWS Aesthetic Objectives of 200 mg/L for sodium[3] and 250 mg/L for chloride.

3.4.1.2 Metals

The results of metal analysis show that the concentration of manganese exceeds the ODWS in both samples, while the concentrations of the remaining metal parameters were reported to meet the ODWS. The concentrations of manganese were consistent between samples, reported as 0.08 and 0.085 mg/L. These results exceed the ODWS Aesthetic Objective (AO) of 0.05 mg/L for manganese. Iron concentrations declined during the testing from 0.26 mg/L (Sample 1) to 0.14 mg/L (Sample 2) and these concentrations fall below the ODWS AO for iron of 0.3 mg/L. Manganese and Iron are aesthetic objectives under the ODWS, and concentrations in excess of these objectives can lead to staining of porcelain fixtures.

3.4.1.3 Bacteria

The microbiological results indicate that health-related parameters such as Total Coliform and E. Coli were absent in the sampled groundwater. Both samples collected during the pumping test had concentrations of 0 CFU/100 mL for both Total Coliform and E. Coli.

The groundwater samples were also analyzed for the presence of non-health related parameters such as Heterotrophic Plate Count (HPC) and Background bacteria count. The results showed that concentrations of both parameters increased from the time of collecting Sample 1 to Sample 2. The concentrations of HPC were 5 CFU/mL (Sample 1) and 41 CFU/mL (Sample 2); the concentrations of background were 25 CFU/100 mL (Sample 1) and 52 CFU/100 mL (Sample 2). There are no objectives for HPC in the current Drinking Water Standards (previous standards had flagged HPC greater than 500 CFU/100 mL as a trigger to resample).

3.4.1.4 Volatile Organic Compounds (VOCs), Semi-volatile Organics, Pesticides and Herbicides

As per O.Reg. 170/03 Schedule 24, Sample 2 was analyzed for the presence of Volatile Organic Compounds (VOCs), Semi-volatile Organics, and Pesticides and Herbicides. All parameters were found to be non-detectable and below the ODWS.

3.4.2 Soil Quality

The soil samples were submitted to Maxxam Analytics and analytical work was conducted in accordance with O.Reg. 153/04, as amended. To evaluate the soil quality at the site, data were compared to the standards established in the MOE *Soil, Groundwater and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act*, dated July 1, 2011. Since the site is located within 30 m of Harris River and does not have municipal service for water and sewage, the soil analytical results in this report have been compared to the MOE Table 8

[3] Sodium concentrations also meet the ODWS guideline of 20 mg/L for persons on sodium-restricted diets, although it is recognized that the water supply will be posted as non-potable to the general public.

generic site condition standards for use within 30 m of a water body in a potable ground water condition for all property uses. To support soil management options, soil quality data was also compared to the more stringent standards outlined in MOE Table 1 Full Depth Background Site Condition Standards.

The soil sample recovered from MMM11-01 at a depth of 0 to 1.2 mbgs was characterized as fine brown sand and submitted for chemical analysis of O.Reg. 153/04 metals and inorganics and PHCs. In summary, comparison of analytical results to the MOE 2011 Table 8 Standards did not identify any concentrations exceeding the applicable standard for metals and inorganics or PHCs.

The complete soil analytical tables, laboratory certificates of analysis, and chain of custody are attached in Appendix D.

3.4.3 Quality Assurance and Quality Control Results

Quality assurance and quality control of the soil and groundwater samples was monitored and maintained in a number of ways:

- Samples were given unique identifications as they were collected, typically identifying the project number, date, sample location, and depth. The sample numbers were recorded in field notes for each location;
- A chain-of-custody form was filled out for the samples prior to submitting the samples to the laboratory. The chain-of-custody documented sample movement from collection to receipt at the laboratory and provided sample identification, requested analysis and conditions of samples upon arrival at the laboratory (e.g., temperature, container status, etc.);
- A duplicate soil sample, labelled as DUP1, was submitted from the sample recovered at MMM11-01 for each requested analysis; and
- The laboratory performed Quality Assurance checks on the submitted samples. For each parameter, there is an acceptable upper and lower limit for the measured concentration of the parameter. Measured concentrations of analysed samples must fall within the upper and lower acceptable limits in order for the sample to be valid. If a result exceeds the upper or lower acceptable limits, the sample must be re-analysed.

The results from the duplicate soil sample (DUP 1) were used to assess the accuracy and reliability of the laboratory procedures and instruments.

A calculation of the Relative Percent Difference (RPD) between the sample (MMM11-01) and its duplicate (DUP 1) was performed and compared to acceptance limits outlined by Maxxam Analytics. The results are presented in Appendix D. The RPD acceptance limit for metals and PHCs in soil is 35% and 50% respectively. Agreement between the results between the parent and duplicate samples is considered acceptable for most parameters with the exception of chromium, cobalt, lead, nickel, zinc, conductivity and SAR. The variability was associated with low concentrations where a small actual variation results in a large percent difference. Based on the small actual variability, the results are considered to be representative of site conditions.

Analytical and quality control data were reviewed and have been validated by Maxxam Analytics. Copies of the Quality Assurance Reports and analytical methods are included with the Certificates of Analysis in Appendix D.

4.0 HYDROGEOLOGICAL SETTING

Figures 5 to 7 present the cross-sections A-A', B-B', and C-'C' respectively, which are shown on Figures 3 and 8. Figure 8 presents the measured groundwater elevations at the monitors and the inferred bedrock surface at the rest area. The investigations at the site indicate that the granite bedrock is overlain by sands. Bedrock is exposed at surface along the northwest side of the existing parking area and proposed septic bed area, and is encountered at shallow depth (0.2 to 1.2 mbgs) where the proposed washroom facilities and existing test well are located at the west end of the site.

Across the remainder of the site, and particularly the proposed septic bed area, the bedrock surface drops to the southeast towards the Harris River. At test holes constructed near the proposed septic bed area, rock is inferred by auger refusal at depths ranging from 3.1 to 7.7 mbgs, or at elevations declining from approximately 188.3 masl northwest of the proposed tile field (MMM11-03) to about 183.8 masl at MMM11-02 located within the septic bed area. We note that bedrock surfaces are irregular and so that the depth to rock can vary significantly from what was encountered or inferred at the test hole locations.

The overburden soils are sandy in nature, and near surface have been characterized as fine to medium grained sand, and with depth, become medium to coarse grained. Occasional deposits of less permeable deposits of Silt and Sand and Silty Clay have been logged at some boreholes so there is potential that these soils may be encountered at the time of septic field installation.

Recorded groundwater levels at the proposed septic area have been measured within 0.77 m of grade, and the shallow groundwater flow in the overburden is interpreted from the field data to be to the southeast towards the Harris River, as would be expected. Two swales located downslope of the proposed tile field location are at topographic elevations that could intercept the shallow water table, and their presence suggests that they are there because they are fed by seeps and springs. The easternmost of these two swales was observed with minor flow at the December 6, 2011 site visit.

The test well, constructed at the west end of the site was found to be flowing artesian (November 2010), with a groundwater elevation of at least 191.5 masl (the surveyed top of well casing). This places the water level at the test well between 12.3 to 13.6 m above the recorded water elevations of the Harris River, and above shallow groundwater elevations recorded at monitors to the east in the vicinity of the proposed septic bed area. Groundwater flow from the bedrock aquifer beneath the site is therefore vertically upward from the rock towards the Harris River and not from the river into the rock.

5.0 MISCELLANEOUS

- Geotechnical borehole locations were selected by Thurber Engineering Ltd. Thurber obtained utility clearances for the borehole locations prior to drilling. Eastern Ontario Diamond Drilling Ltd. from Hawkesbury, Ontario supplied a track mounted CME 55 drill rig and conducted the drilling, sampling, and in-situ testing operations.
- The water well installation was completed by Marshall Well Drilling (MWD) of Emsdale, Ontario. MMM coordinated the drilling progress with MWD.
- Environmental borehole locations were selected by MMM. MMM coordinated with ARA Consultants who retained Malone's Drilling to perform the drilling.

- Surveyors from MMM Group Limited staked these locations in the field, confirmed the co-ordinates and obtained the ground surface elevations.
- Routine laboratory testing was carried out by Thurber.
- Soil and groundwater chemical analysis was carried out by Maxxam Analytics Inc.
- Overall supervision of the field program was conducted by Natalia Codoban, P.Eng. and Andy Lee, P.Eng.
- The report was prepared by Andy Lee, P.Eng., Environmental Engineer; Andrew Kulin, P.Eng., Senior Hydrogeologist; and Pete Sladen, P.Eng., Senior Environmental Engineer.
- The report was reviewed by Murray Gomer, P.Geo., Senior Hydrogeologist and Designated Principal Contact for MTO Foundation Engineering – Hydrogeology Projects.

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PART II DISCUSSION AND RECOMMENDATIONS

6.0 GENERAL

This report presents interpretation of the hydrogeological data in the factual report and presents hydrogeological assessment and recommendations for the planning, design, and operation of a water well supply and proposed septic system and associated facilities at the Harris River Rest Area.

A separate investigation was completed by Thurber Engineering Limited which details the geotechnical assessment for the site. Borehole logs and percolation test results from Thurber's investigation have been included in Appendix C and Appendix D respectively.

The discussion and recommendations presented in this report are based on our understanding of the project and on the factual data obtained in the course of the investigations.

7.0 HYDROGEOLOGICAL REGIME

Groundwater levels monitored in the test well during the pumping test and recovery are presented on Figure 4. The schematic of the well is shown on the right-hand side of the graph. As can be seen on the graph, the water levels declined steadily during the testing, consistent with the pumping rate remaining constant during the pumping phase of the test. The maximum drawdown of 8.8 m in the well below the casing (approximately 182 masl) occurred at the end of the test, which is approximately 3.5 m above the elevation of the Harris River. It is noted that during normal use, infrequent, short term pumping of the well at a lower rate will occur and drawdown at the well will be considerably less than 8.8 m of drawdown recorded during the testing of the well.

The pumping test results indicate that the test well is able to provide water volume to washroom facilities far beyond the maximum projected water daily demand of 1,780 litres/day. During the test, approximately 27,000 litres was pumped out of the well during the 6-hour test.

It should also be noted that the test well is able to supply water to the washrooms at the rate higher than the anticipated maximum pumping rate. The anticipated pumping rate to supply water to the washrooms is in the order of 24 litres/min. As can be seen from Figure 4, after 6 hours of continuous pumping at the rate of 75 litres/min, the total drawdown in the well was approximately 8.8 m below the top of the well casing. Since the bottom of the well is 92.1 m below the top of the well casing, there was still over 80 m of the water column available in the well at the end of the test. This confirms that the well is able to provide the maximum water daily volume of 1,780 litres/day at the anticipated pump rate.

7.1.1 Groundwater Monitoring Results

A summary of groundwater monitoring results during the pump test is provided in Table 1. Results indicate that the measured pH declined slightly over the pumping test period. A gradual decline in conductivity and concentration of total dissolved solids (TDS) in the groundwater was also recorded as fresher groundwater entered the well following removal of water from storage within the well.

8.0 SOIL AND GROUNDWATER CHARACTERIZATION

8.1 Groundwater

8.1.1 General Chemistry

The analytical results for cations, anions, metals and other general chemistry parameters indicates that the groundwater from the bedrock is hard and that the concentration of manganese is above the Aesthetic Objective of the ODWS (> 0.05 mg/L). The concentrations for iron were found to be slightly below the Aesthetic Objective of the ODWS (< 0.3 mg/L). Both elements are naturally occurring and do not pose any health risk to users of the proposed washroom facilities. The elevated concentrations of iron and manganese are not unexpected given that groundwater from bedrock tends to be mineralized.

Elevated concentrations of manganese and/or iron above the aesthetic objectives will likely result in staining of plumbing fixtures over time if the water is not treated for iron/manganese removal. Various methods for removal of iron/manganese from water may be employed, the most commonly used being oxidization and removal by filtration.

8.1.2 Bacteria

The microbiological results indicate the absence of health-related bacteria such as *E.coli* and Total Coliform in the groundwater samples. Zero (0) CFUs (Colony Forming Units) were reported for both parameters for both sets of samples.

The groundwater samples were also analyzed for the presence of non-health related bacteriological parameters such as Heterotrophic Plate Count (HPC) and Background bacteria. The counts of both parameters were reported to increase from the time of collecting Sample 1 to that of Sample 2. The concentrations of HPC were 5 CFU/mL (Sample 1) and 41 CFU/mL (Sample 2) and the counts of background bacteria rose from 25 CFU/100 mL (Sample 1) to 52 CFU/100 mL (Sample 2). There are no objectives for HPC in the current version of the Ontario Drinking Water Standards (previous standards had flagged HPC greater than 500 CFU/100 mL as a trigger to resample). HPC results are now considered a tool in monitoring bacterial re-growth in a distribution system or the plumbing. The increased concentrations of these parameters over time are not considered to be a concern for the rest area, since the measured values are low, and the groundwater is planned to be used for washroom uses and not for drinking water purposes (MOE, 2006). It is possible over the long term there could be a gradual reduction in yield if bacterial growth clogs up fractures. Should this occur the well may need to be redeveloped and rehabilitated and sterilized.

8.1.3 Organics and Pesticides

The analytical results of the water from the test well indicated that the bedrock is not contaminated with man-made chemicals. No measurable concentrations of Volatile Organic Compounds, Semi-volatile Organics, or Pesticides and Herbicides were found to be present in the groundwater water. All results were reported as non-detectible (below the laboratory detection limits). This is not unexpected given the remoteness of the site and well depth.

8.1.4 Groundwater Under the Direct Influence of Surface Water (GUDI)

Ontario Regulation (O.Reg.) 170/03 specifies that a **drinking** water system that obtains raw water from a groundwater supply under the direct influence of surface water is to be treated as a raw water supply from a surface water source. This requirement applies to large and small municipal and non-municipal drinking water supply systems, and designated facilities (e.g., health care facilities, child care facilities, senior care facilities, educational facilities).

The Regulation defines a "small non-municipal non-residential system" as a non-municipal drinking water system that is not capable of supplying drinking water at a rate of more than 2.9 L/sec (174 L/min) and that serves a designated facility or **public facility** (any place where the general public has access to a **washroom**, drinking water fountain or shower). While the proposed redevelopment of the Harris River Rest Area will meet most of the requirements under the definition of a "small non-municipal non-residential system" it will **not** meet the requirement relating to flow rate (174 L/min), as it is proposed to install a pump capable of providing only 24 L/min of flow, nor is it being proposed for use as a drinking water system (the facility will be posted as supplied with non-potable water).

Nonetheless, for purposes of completeness and potential future use, we examined the requirements that define a GUDI well:

1) A drinking water system that obtains water from a well that is not a drilled well or from a well that does not have a watertight casing that extends to a depth of six m below ground level:
    - Not applicable - The test well is drilled and is finished with steel casing and a bentonite seal to 6.1 m depth;
2) A drinking water system that obtains water from an infiltration gallery:
    - Not applicable;
3) A drinking water system that is not capable of supplying water at a rate greater than 0.58 litres per second and that obtains water from a well, any part of which is within 15 m of surface water:
    - Not applicable – The test well will supply water at 0.40 L/sec (24 L/min) and is located approximately 30 m from the Harris River;
4) A drinking water system that is capable of supplying water at a rate greater than 0.58 L/sec and that obtains water from an overburden well, any part of which is within 100 m of surface water:
    - Not applicable – The test well will supply water at 0.40 L/sec (24 L/min) and is not an overburden well;
5) A drinking water system that is capable of supplying water at a rate greater than 0.58 litres per second and that obtains water from a bedrock well, any part of which is within 500 m of surface water:
    - Not applicable – The test well will supply water at 0.40 L/sec (24 L/min), is completed in bedrock, is located less than 500 m (approximately 30 m distance) from the Harris River. However the system does not meet the requirement for flow rate;
6) A drinking water system that exhibits evidence of contamination by surface water:

- Not applicable – No bacteria present in the water samples tested;

7) A drinking water system in respect of which a written report has been prepared by a licensed engineering practitioner or professional hydrogeologist that concludes that the system's raw water supply is groundwater under the direct influence of surface water and that includes a statement of his or her reasons for reaching that conclusion:

   - The test well is in artesian condition with respect to the Harris River, with well heads in excess of 12 m above the river elevation. The natural gradient for flow is therefore from the bedrock aquifer into the river and not from the river into the bedrock. This measure of protection held up even after 6 hours of continuous pumping at a rate of 75 L/min (three times the proposed system pump rating), as the water level in the well had only declined by 8.8 m and was therefore still above the levels of the river. Furthermore, water at the well is obtained from a fracture zone approximately 90 m below well grade (or approximately 75 m below the river level).

Based upon our review above, the test well is not classified as a GUDI well, in particular due to the protection being afforded to it from its artesian condition with respect to the adjacent river levels. We understand that the Ministry intends to post the water supply as non-potable, and a further redundancy, intends to install a water treatment system to disinfect the water.

This being said, the recommendation to post the water as "not potable" remains.

8.2 Soils

The analytical soil results indicated no metal, inorganic or PHC parameters exceeded the applicable MOE standards. As well comparison to the more stringent standards outlined in MOE Table 1 Background Property use indicates the soil meets these standards. No detectable organic vapours were measured during the RKI and PID field screening and no visual or olfactory observations were made during soil sampling that would indicate potential environmental concerns in soil at the site.

Should excess soil be encountered during site development, it can either be managed onsite or be disposed of at a site requiring fill materials. As the soil meets MOE Table 1 Standards, there are no restrictions on the reuse of the soil from an environmental perspective. In the event that suspected contaminated soil is encountered during construction works, it is recommended that confirmatory soil sampling be undertaken as per O.Reg. 153/04 (as amended) to determine concentrations of suspected contaminants.

9.0 DESIGN RECOMMENDATIONS

9.1 Appropriate Design Criteria

As per discussions with the MTO, the test well at the Harris River Rest Area will not be used immediately. It may be a few years before the washrooms are built and fully operational. Therefore, since the well was installed under artesian conditions and flowing shortly after the stabilization of the static water level, MTO agreed to MMM's recommendation to install a temporary plug inside the well below the ground surface and freeze depth. The plug will prevent water from flowing out of the well and from freezing in winter conditions. When the well is to be connected to the system, the well casing should be extended as required to be above finished grades but it may still be necessary to install a well seal and pit-less adapter to shut in the head at the final grade to avoid water leakage. The raised stick-up is recommended to be covered to insulate the well in winter conditions. Future access to the well for vehicular maintenance equipment should be also incorporated into the final grading and landscape designs.

9.2 Water and Sewage Flow Estimates

The rest area is expected to serve passenger cars, buses, and truck/trailers. We have estimated the usage of the Harris Area Rest Area, by initially assuming that the Design Flow would mirror the busiest day anticipated to be the August long weekend. We have used MMM's August 2008 rest stop survey, augmented with a November 2009 commercial traffic survey at a surrogate site (lay-by area) located about 50 km away. While it is understood that peak usage of car and truck/trailer use would not overlap, this potential has been considered to provide a conservative design.

Therefore, our assumptions are:

- The August data is indicative of future rest area use;
- Truck usage along Hwy 69 would continue unabated on the long weekend and Rest Area use would mirror the average lay-by data collected;
- Washroom use would be similar to the surveyed data - say 50% of vehicle passengers use the washrooms; and,
- Two passengers per car on average, and one passenger per truck.

Table 5 summarizes the anticipated maximum water consumption for the peak usage day over the August long weekend.

Table 5: Estimated Washroom Use, Harris River Rest Area

	Number	Passengers	Washroom Use
Passenger Vehicle	41	82	41
Motorcycle	1	1	.5
Truck	1	1	.5
Truck/Trailer & PV (lay-by)	26	33.5	17
Contingency (50%)			30
Total Estimated Use			**89**

Relating this to flow, the Ontario Building Code (OBC) does not have a "Rest Area" recommended flow. Metcalf & Eddy (Metcalf & Eddy: Wastewater Engineering Treatment and Reuse, 4th Edition, 2003) suggests 15 L/d per visitor as a design number. To add an additional level of conservatism, we have considered 20 L/person/d, carried in OBC for "Public Parks" as an estimate, for a design flow of:

89 users x 20 L/user/day = 1,780 L/day

9.3 Sanitary System

Sewage from the Rest Area washrooms will be collected and disposed through a conventional in-ground tile bed. The system will be sized for the design flow of 1,780 L/day, as calculated above, and consist of a gravity collection pipe, septic tank, dosing pump and raised tile bed. For the preliminary layout of the sanitary system, refer to Figure 9.

A description of the system and its sizing is discussed in the following sections.

9.3.1 Septic Tank

According to the OBC, the working capacity of the septic tank in non-residential occupancies should be three times the daily sanitary sewage flow. The recommended Septic Tank Volume is therefore equivalent to:

$$V_{Tank} = 1{,}780 \text{ L/day} \times 3 \text{ days} = 5{,}340 \text{ L}$$

A septic tank in excess of 5,400 L capacity will be selected from standard sizes available.

9.3.2 Treatment Facilities

No secondary or tertiary treatment facilities are required.

9.3.2.1 Pump Chamber

The OBC does not require that the effluent be dosed for this size of bed. However, the site's topography will require that the effluent is pumped to the tile bed. An 1800 mm diameter precast concrete pumping chamber will be constructed. The chamber be insulated and provided with frost straps for protection from riser separation.

The station will have a duplex pumping system, with quick-disconnect couplings for easy retrieval during maintenance, and isolation valves accessible from the surface. Pump control will be by timer with high level and low level float override.

The pumps will be capable of maintaining scouring velocities in the 50 mm diameter station piping and forcemain. Minimum pump capacity is therefore:

$$Q_{min} = (1.5 \text{ m/s}) \times (0.05 \text{ m})^2 \times (\pi/4) = 2.95 \text{ L/s}$$

The pump should fill 75 to 80% of the tile bed's bed volume within 15 minutes. The pump must be sized to discharge:

$$80\% \times 0.43 \text{ m}^3 \text{ (from Section 9.3.2.2 below)} = 0.34 \text{ m}^3$$

Assuming pump capacity of 3.0 L/s, the pump timer will be set to operate for:

Minutes of operation per dose is therefore:

$$T_{dose} = \frac{0.34 \text{ m}^3 \times 1{,}000 \text{ L/m}^3}{3.0 \text{ L/s} \times 60 \text{ s/minute}} = 1.9 \text{ minutes}$$

Pump timer settings will be recalculated and set in the field, using the supplied pump flow data.

9.3.2.2 Disposal Bed Sizing

As indicated in the Factual Information above, the site's percolation "T" times varies from 3.1 min/cm to 10 min/cm at the test pits. The tile bed area will be exposed by the contractor prior to construction and the soil conditions will be confirmed.

A piezometer installed at the proposed tile bed site indicated a relatively high groundwater table (0.77 m below grade, on December 6, 2011). The bed will therefore need to be raised slightly to ensure that the absorption stone trench will be is at least 900 mm above the seasonal high groundwater table.

A traditional disposal bed is proposed. The total length of bed piping shall be:

$$L = \frac{Q \times T}{200} = \frac{1{,}780 \times 10}{200} = say...90m$$

The bed will be raised, consisting of four runs of perforated pipe, at 1.6 m centreline spacings. The disposal bed size will be approximately 24 m long by 7 m wide.

The bed volume, assuming 75 mm diameter PVC pipes, is:

$$V_{bed} = (0.075\ m)^2 \times (\pi/4) \times 24\ m \times 4 = 0.43\ m^3$$

The bed's distribution headers will be insulated for frost protection.

9.3.2.3 Mantle Sizing

For the estimated percolation "T" time of 10 min/cm, the recommended loading rate (per the OBC) is 10 L/m^2/day. The minimum required mantle area is therefore:

$$A = \frac{Q}{10} = \frac{1{,}780}{10} = say...180m^2$$

To promote proper distribution of effluent, a three metre mantle is proposed downgradient from the tile bed.

9.3.2.4 Collection and Forcemain Piping

A 100 mm PVC sewer pipe will connect the Rest Area building to the septic tank, and from the tank to the pump chamber. The pipe will be laid with a 2% slope. Because shallow bedrock is common throughout the site, care will be taken to locate the piping to minimize the need for rock blasting and excavation. The subsurface investigation, discussed in the Factual Information section, suggests the presence of a depression in the rock. This apparent depression will be used for the routing of the collection piping. It is anticipated that portions of the piping will be within the 1.8 m deep frost zone, and insulation will be required.

The pressurized 50 mm diameter forcemain from the pumping station will be shallow and, therefore, will be insulated and heat traced.

9.4 Water Supply System

The water requirements for washroom and general maintenance use is estimated to be 1,780 L/day as derived in the preceding section. The peak instantaneous flow demand, based on all toilets being in use at the same time is calculated to be 24 L/minute.

A 150mm diameter well was drilled on-site, and was tested on November 18th, 2010 to determine available yield and water quality. The results of the well testing are described in detail in Section 3.1 of this report. The test results indicate the well will be easily capable of supplying the calculated daily and instantaneous peak demands for the facility.

9.4.1 Well Pump Capacity

The well pump shall be capable of providing the peak instantaneous flow, or to fill on-site storage in one minute, which ever flow rate is less. For this application, the well pump will be sized to provide 24 L/min.

The well, when tested, was under an artesian condition. During the 6 hour pumping test, carried out at a rate of 75 L/min, the measured water level drawdown at the well was 8.8 m from the top of the casing. Based on this result, a reasonable well setting would be 30 m below the top of the casing. The minimum required pump head is calculated as follows:

Static head loss, assuming recorded drawdown:	8.8 m
Delivery pipe head losses, 32 mm piping, 0.8 m per 100 m piping, over a 50 m length of pipe:	0.4 m
Building pipe losses, say:	1.0 m
Building target pressure, 40 psi:	28.2 m
Safety Factor of 20%:	7.7 m
Minimum Pump Pressure Required:	**46.1 m**

The well pump selected will have a minimum capacity of 24 L/min with a minimum total dynamic head of 46.1 m.

9.4.2 Delivery Pipe

Given the proximity of bedrock to ground surface at the well site, we propose that the 32 mm delivery pipe be located at grade, enclosed with a heavily insulated utilidor between the well and the Rest Area building. The utilidor will be open at the building to allow building heat to maintain temperatures above freezing in the utilidor and the upper part of the well casing.

9.4.3 System Storage

A hydropneumatic tank will be installed in the Rest Area building to provide equalization storage and pump control. A properly sized hydropneumatic tank increases the pump cycle time (time between pump starts) and extends the life of the pump. Using a minimum cycle time of 10 minutes, the required active storage volume is:

$$V_t = \quad 24 \text{ L/min} / 2 \times 5 \text{ minute fill} \quad = 60 \text{ L}$$

The hydropneumatic tank will operate between 140 kPA and 275 kPa (20 to 40 psi).

9.4.4 Water Treatment

The well water analyses show that the well water can be categorized as hard, with medium alkalinity and pH. The water may be potable with only manganese exceeding the Ontario Drinking Water Standards Aesthetic Objective. Iron was below, but close to the Aesthetic Objective. The presence of elevated concentration of manganese and iron is not a health-related concern. The concentrations in excess of these objectives can lead to staining of porcelain fixtures.

Although this water may be considered potable at the time of sampling, it is recommended that the MTO not treat it as such. The water should be posted as non-potable. The reason for this recommendation is two-fold:

- The responsibility for the supply of potable water requires that disinfection equipment be installed and monitored as prescribed in O.Reg. 170/03 (as amended). The need for frequent monitoring and equipment maintenance would be very expensive for this remote site.
- By posting the water as non-potable, this can reduce the liability for MTO.

Provision will be made in the system to install, at a later date, ultraviolet disinfection equipment. This equipment would be installed downstream of the hydropneumatic tank, and be sized for the peak flow rate of the facility.

10.0 CLOSURE

Engineering analysis and preparation of the report were carried out by:

- Mr. Andy Lee, P.Eng., Environmental Engineer;
- Mr. Andrew Kulin, P.Eng., Senior Hydrogeologist; and
- Mr. Pete Sladen, P.Eng., Senior Environmental Engineer.

The report was reviewed by Murray Gomer, P.Geo., Senior Hydrogeologist and Designated Principal Contact for MTO Foundation Engineering - Hydrogeology Projects.

Andrew Kulin, P.Eng.
Senior Hydrogeologist
MMM Group Limited

Pete Sladen, P.Eng.
Senior Environmental Engineer
MMM Group Limited

Murray Gomer, P.Geo.
Senior Hydrogeologist, Designated Principal
MMM Group Limited

11.0 STANDARD LIMITATIONS

Standard limitations relating to the soil and groundwater investigations are presented in Appendix E as they apply to this report.

12.0 REFERENCES

Environment Canada, 2010. Hourly Data Report for Parry Sound CCG for November 18, 2010.

Freeman, E.B., 1978, *Geological Highway Map, Southern Ontario*. Ontario Ministry of Northern Development and Mines, Ontario Geological Survey. Map M2418, scale 1:800,000.

Metcalf and Eddy, 2003. Wastewater Engineering: Treatment and Reuse, 4th Edition.

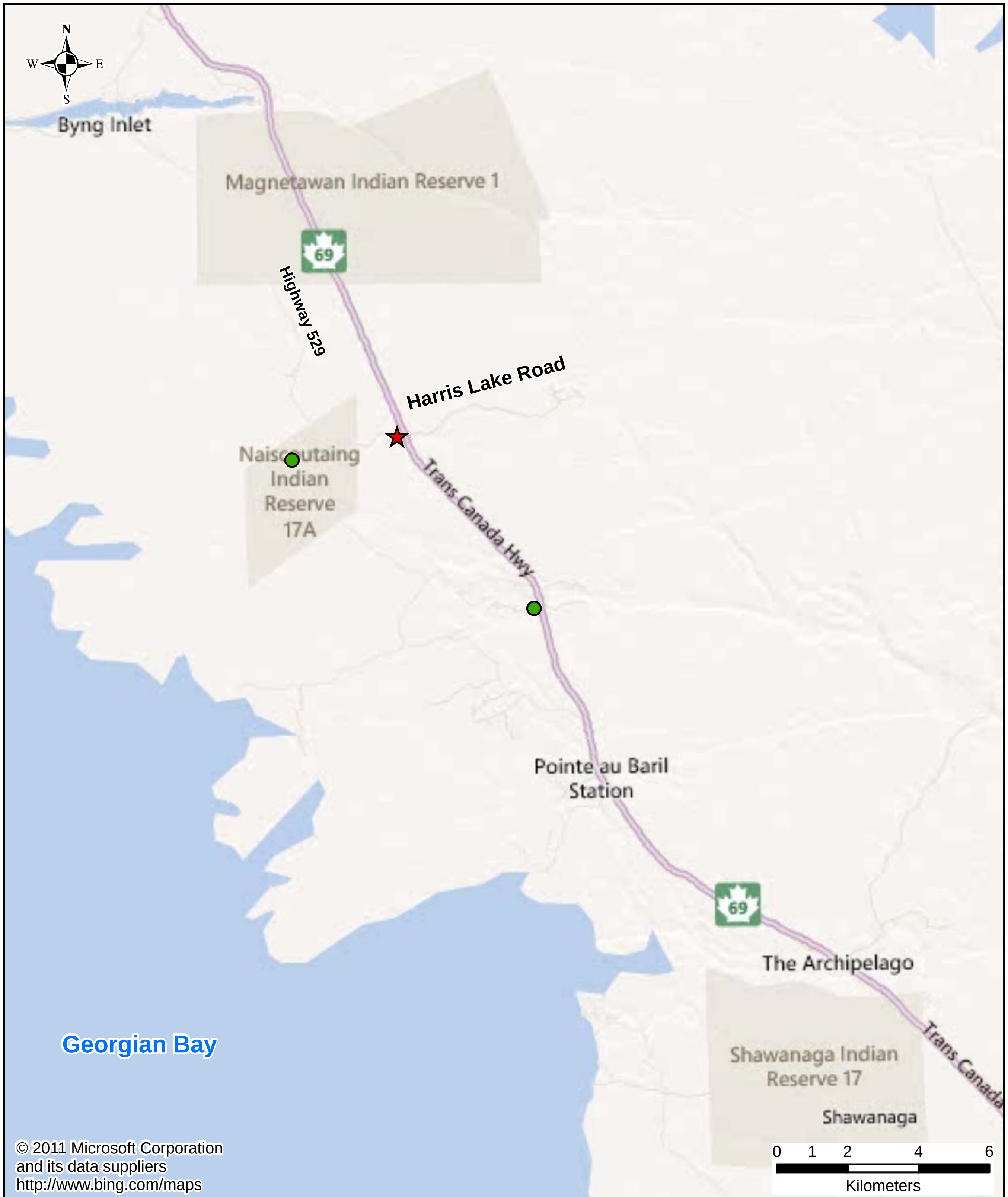
Mountain View, CA: Google Inc, 2009. Google Earth (Version 5.0.11733.9347) [Software]. Available from http://earth.google.com/intl/en_US/download-earth.html

Ontario Ministry of Environment, 2003 (Revised 2006). Ontario Drinking Water Standards.

Ontario Ministry of Environment, November 2010. Water well records obtained within 5 km radius of UTM coordinates (NAD 83, Zone 17) 542721E, 5059468N.

Ontario Ministry of the Environment, 2011. *Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act*.

FIGURES

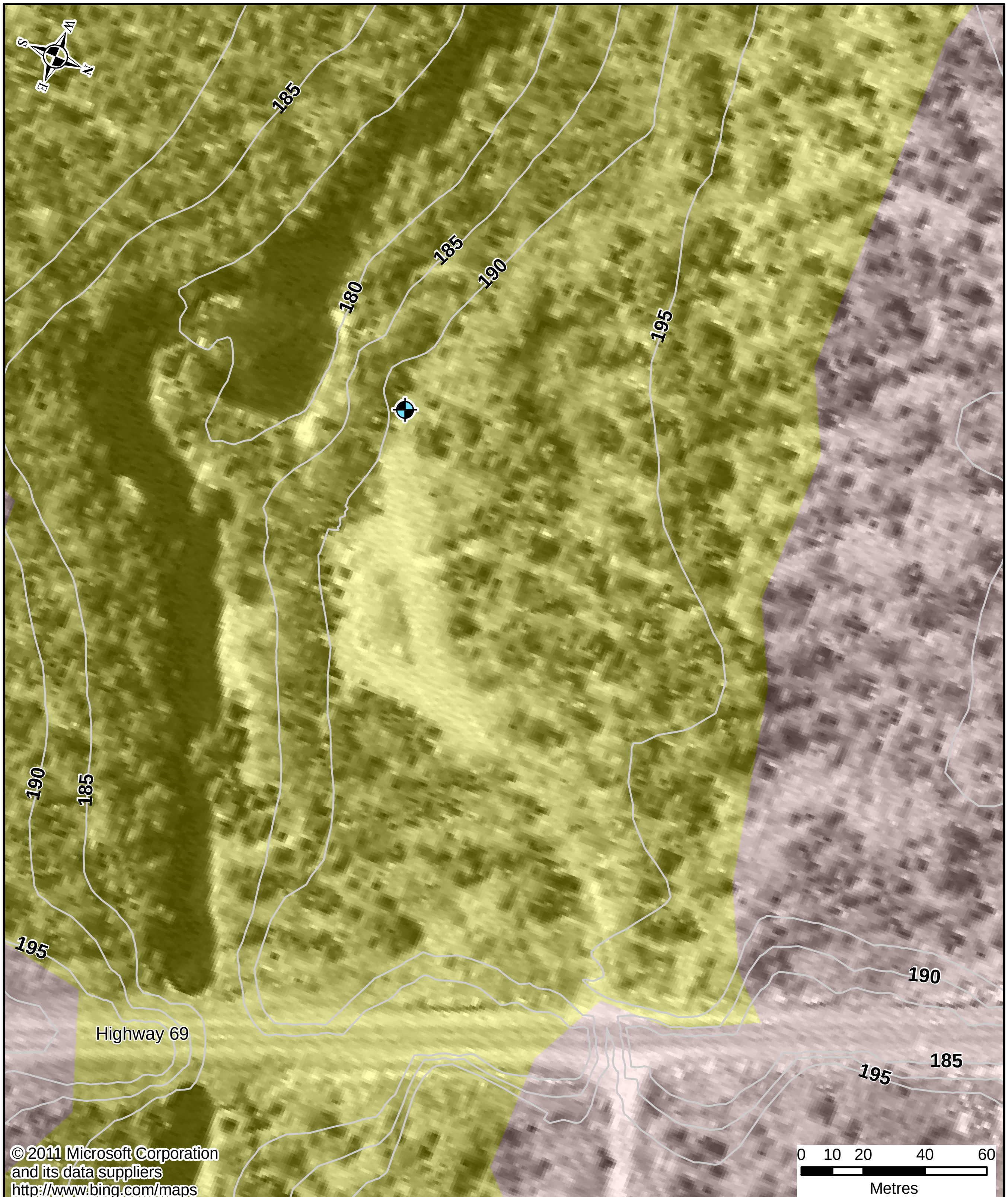


J:\1442 Projects by Job Number\2007 Jobs\16-07198 Hwy 69-529 N (Harris R)\50 Mapping\MXD\Figure 1 Site Location.mxd

Legend

- ★ Site Location
- ● MOE Well Records

Client: **Ministry of Transportation**	
Title: **Highway 69 Harris River Rest Area: Site Location**	
Prepared by: MMM GROUP	
16-07198-001-EN4	Scale as Shown / Review: AL
Date: December 2011	**Figure: 1**
© Queen's Printer for Ontario	



J:\1442 Projects by Job Number\2007 Jobs\16-07198 Hwy 69-529 N (Harris R)\50 Mapping\MXD\Figure 2 Surficial Geology.mxd

Legend

- Test Well Location (MMM 2010)
- Topographic Contour (5m Interval)

Surficial Geology

- Precambrian bedrock
- Coarse-textured glaciolacustrine deposits

Client:	**Ministry of Transportation**
Title:	**Highway 69 Harris River Rest Area: Surficial Geology**
Prepared by:	MMM GROUP
16-07198-001-EN4	Scale as Shown / Review: AL
Date: December 2011	**Figure: 2**
© Queen's Printer for Ontario	

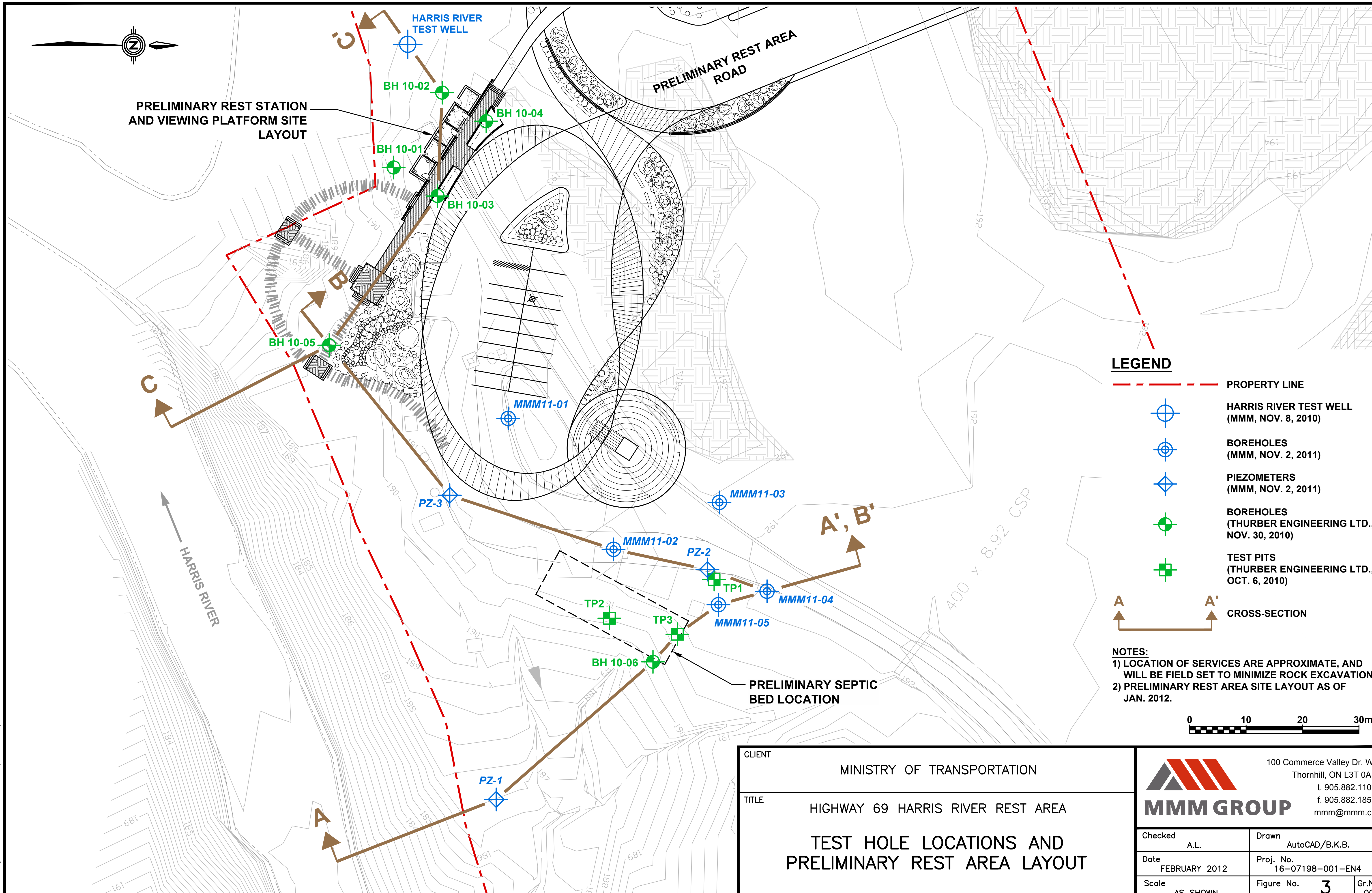
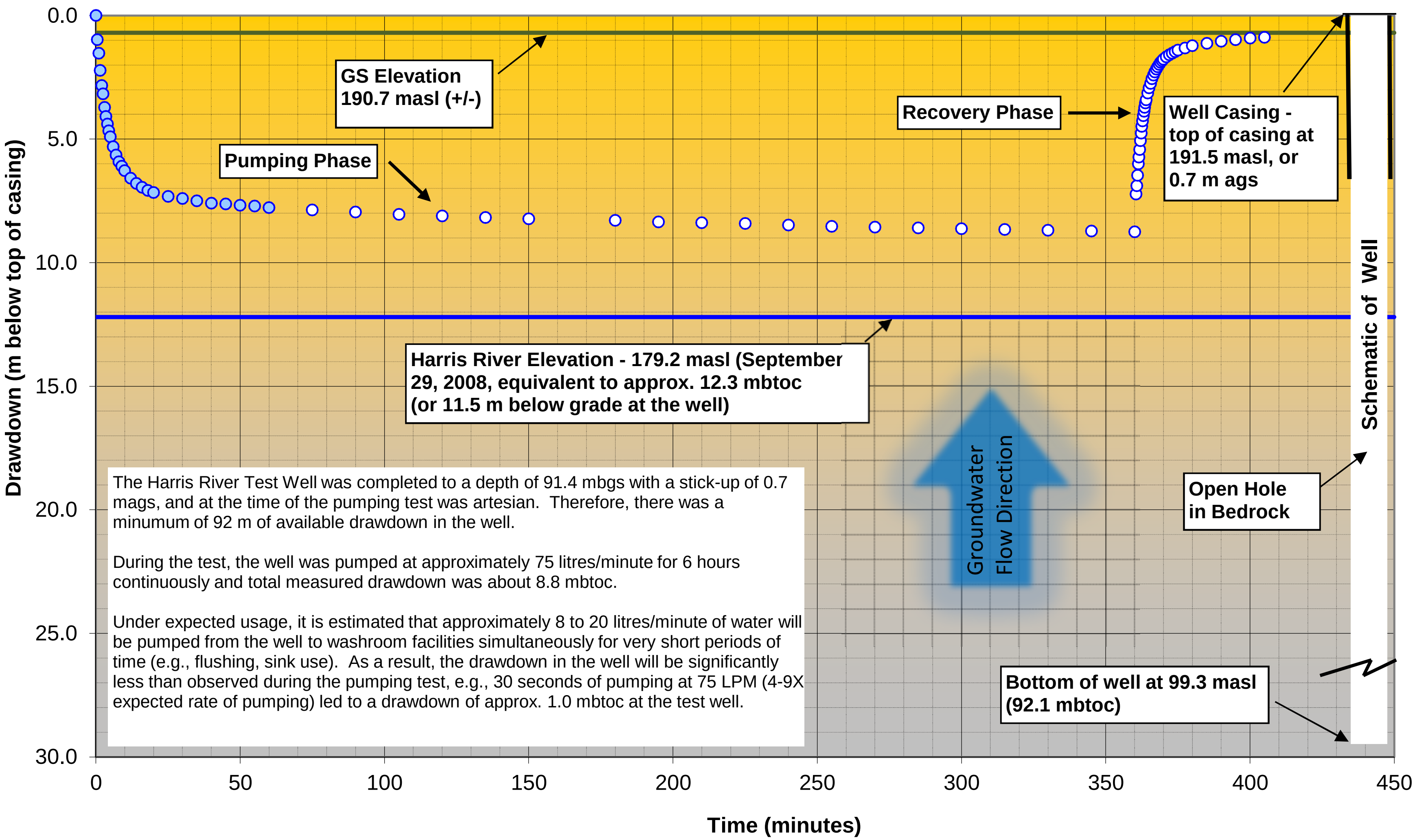
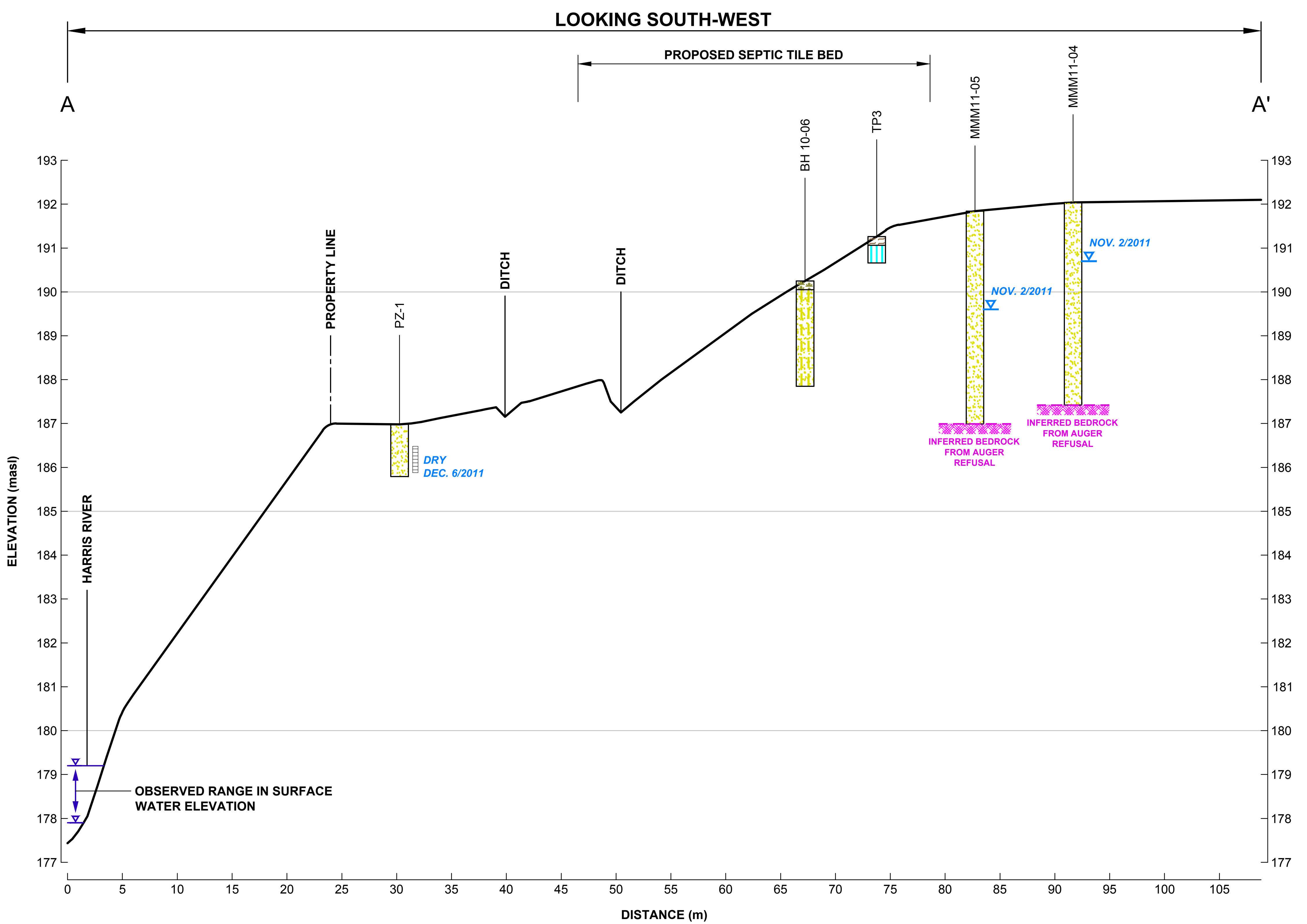


FIGURE 3.dwg Test Hole Locations And Preliminary Rest Area Layout S:\14-421\16\07198-001-EN41 Mar 16, 2012 - 9:29am

Figure 4: Groundwater Levels in a Test Well during Pumping Test and Recovery

Harris River Rest Area Pumping Test - November 18, 2010





LEGEND

- TOPSOIL
- SILT
- SAND
- GRANITE BEDROCK
- SILTY CLAY
- SAND AND SILT TO SILTY SAND
- ORGANICS
- STATIC GROUNDWATER LEVEL
- WATER FOUND
- WELL SCREEN
- GROUNDWATER LEVEL IN OPEN HOLE

CLIENT	MINISTRY OF TRANSPORTATION
TITLE	HIGHWAY 69 HARRIS RIVER REST AREA HYDROGEOLOGIC CROSS–SECTION A–A'

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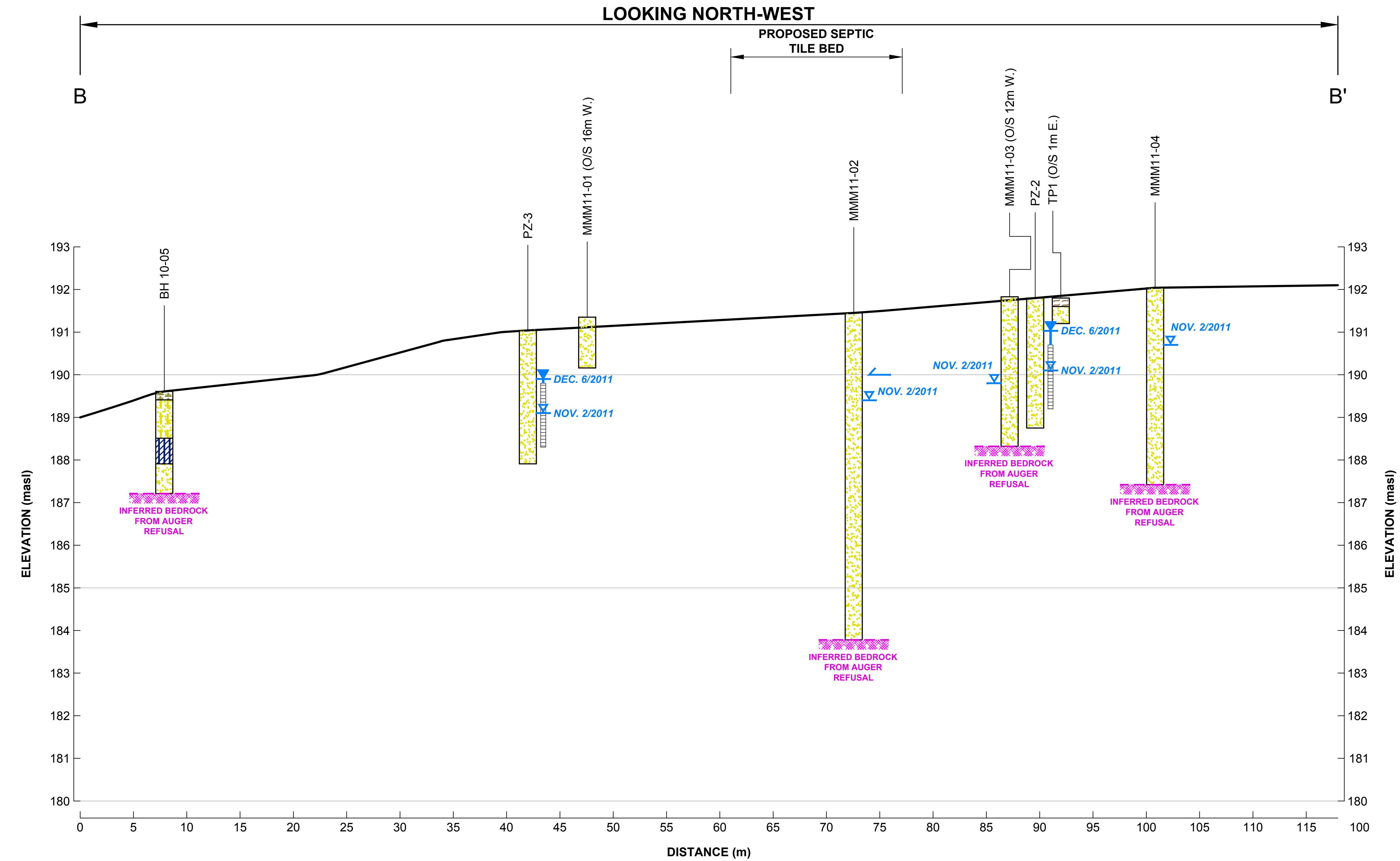
Checked A.L.		Drawn AutoCAD/B.K.B.	
Date APRIL 2012		Proj. No. 16–07198–001–EN4	
Scale	VERT: 1:100 HORIZ: 1:400	Figure No. 5	Gr.No. 001



LEGEND

- TOPSOIL
- SILT
- SAND
- GRANITE BEDROCK
- SILTY CLAY
- SAND AND SILT TO SILTY SAND
- ORGANICS
- STATIC GROUNDWATER LEVEL
- WATER FOUND
- WELL SCREEN
- GROUNDWATER LEVEL IN OPEN HOLE

CLIENT	MINISTRY OF TRANSPORTATION
TITLE	HIGHWAY 69 HARRIS RIVER REST AREA HYDROGEOLOGIC CROSS–SECTION B–B'

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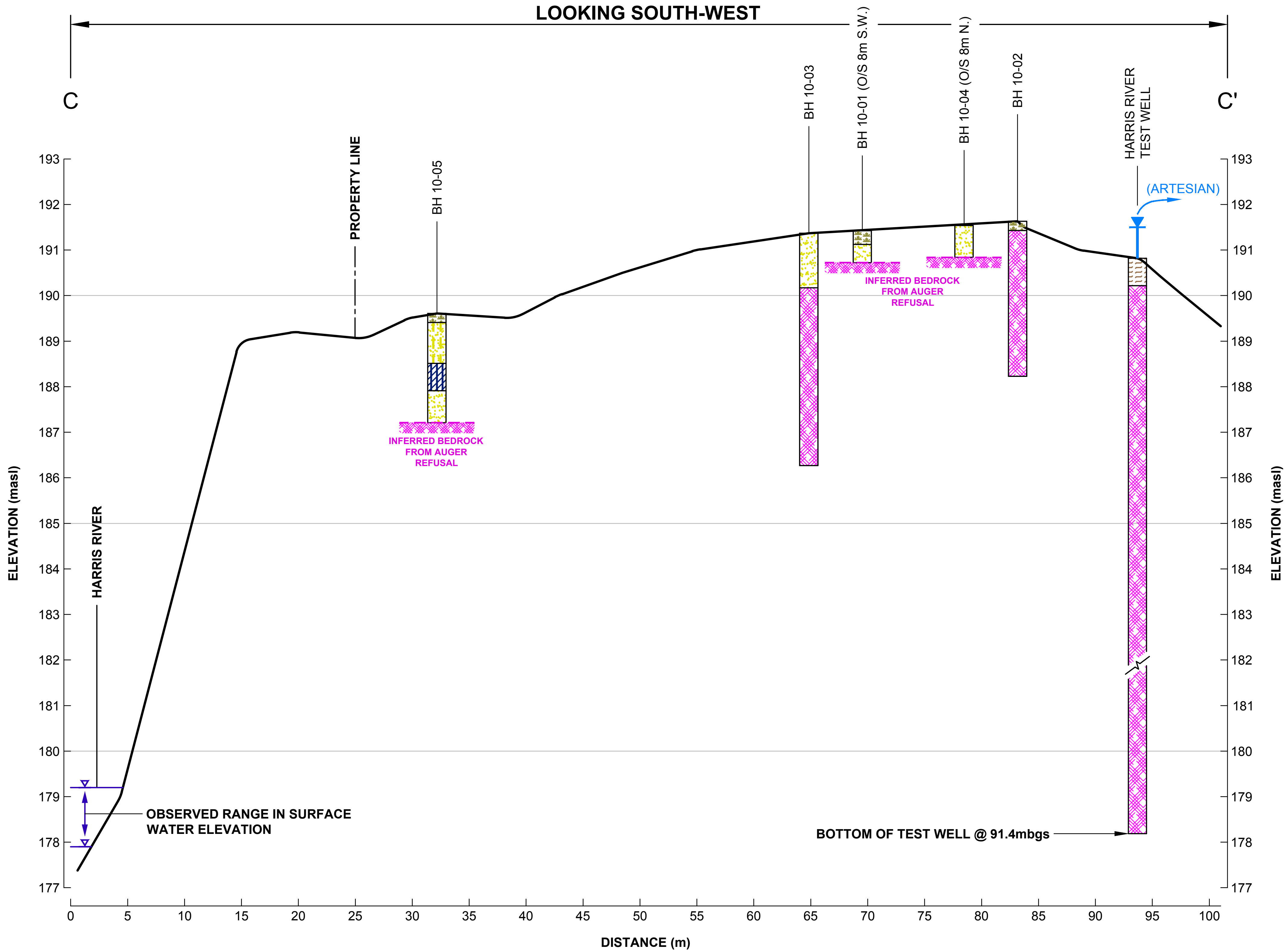
Checked: A.L.	Drawn: AutoCAD/B.K.B.
Date: FEBRUARY 2012	Proj. No.: 16–07198–001–EN4
Scale: VERT: 1:100 HORIZ: 1:400	Figure No.: 6 — Gr.No.: 001

FIGURE 5_FIGURE 6_FIGURE 7.dwg Hydrogeologic Cross-Section B-B' S:\14-42\16\07198-001-EN4\ Mar 15, 2012 - 8:02am



LEGEND

- TOPSOIL
- SILT
- SAND
- GRANITE BEDROCK
- SILTY CLAY
- SAND AND SILT TO SILTY SAND
- ORGANICS
- STATIC GROUNDWATER LEVEL
- WATER FOUND
- WELL SCREEN
- GROUNDWATER LEVEL IN OPEN HOLE

CLIENT	MINISTRY OF TRANSPORTATION
TITLE	HIGHWAY 69 HARRIS RIVER REST AREA HYDROGEOLOGIC CROSS–SECTION C–C'

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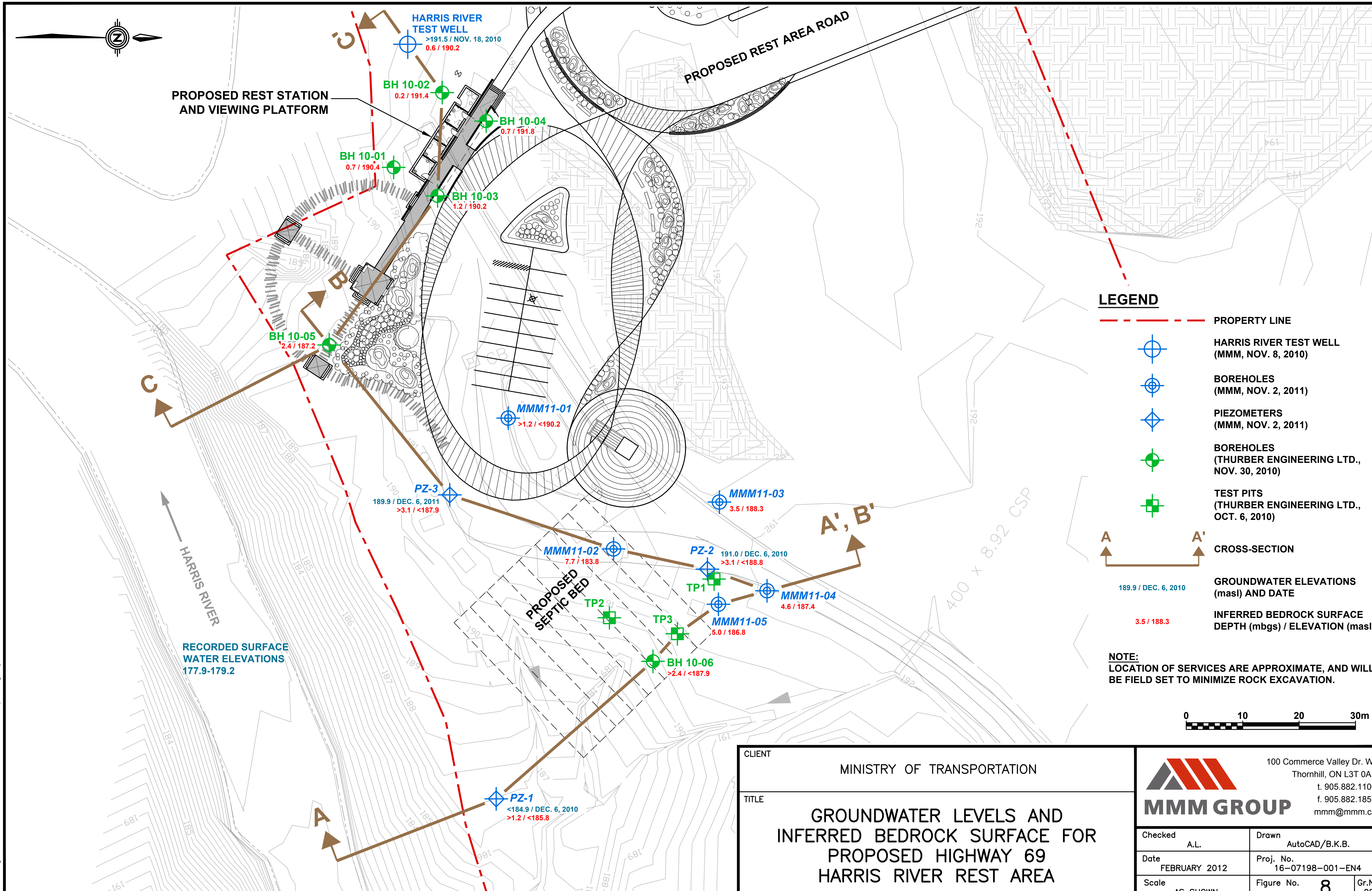
Checked: A.L.	Drawn: AutoCAD/B.K.B.		
Date: APRIL 2012	Proj. No. 16–07198–001–EN4		
Scale: VERT: 1:100 HORIZ: 1:400	Figure No.	7	Gr.No. 001



CLIENT
MINISTRY OF TRANSPORTATION

TITLE
GROUNDWATER LEVELS AND INFERRED BEDROCK SURFACE FOR PROPOSED HIGHWAY 69 HARRIS RIVER REST AREA

MMM GROUP
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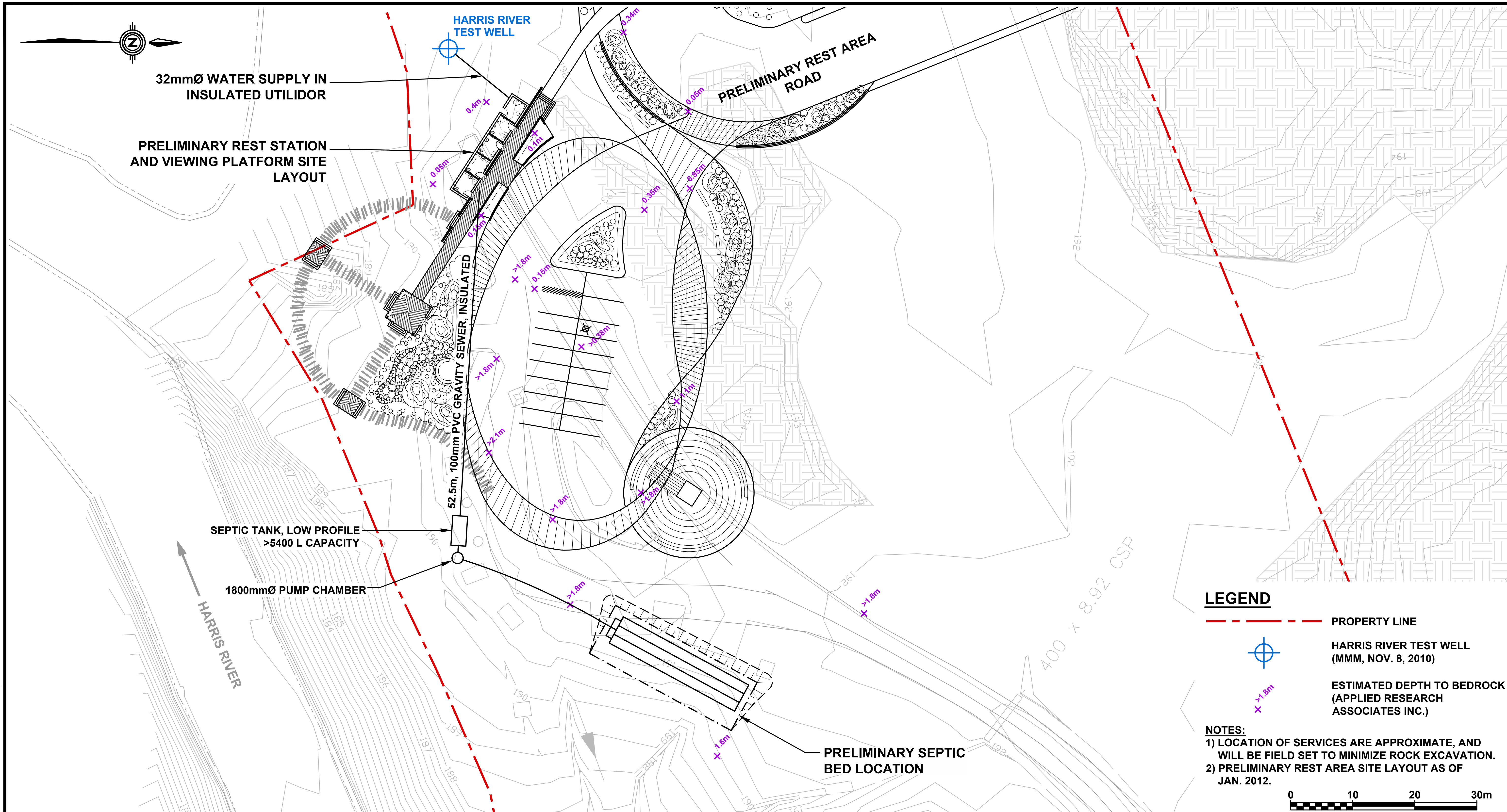
Checked A.L.	Drawn AutoCAD/B.K.B.	
Date FEBRUARY 2012	Proj. No. 16-07198-001-EN4	
Scale AS SHOWN	Figure No. 8	Gr.No. 001



CLIENT	MINISTRY OF TRANSPORTATION
TITLE	HIGHWAY 69 HARRIS RIVER REST AREA PRELIMINARY LAYOUT OF WATER AND SANITARY SERVICES

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f. 905.882.1857
mmm@mmm.ca

Checked P.S.	Drawn AutoCAD/B.K.B.	
Date FEBRUARY 2012	Proj. No. 16-07198-001-EN4	
Scale AS SHOWN	Figure No. 9	Gr.No. 001

FIGURE 9.dwg Preliminary Layout Of Water And Sanitary Services S:\14-42\16\07198-001-EN4\ Mar 16, 2012 - 9:32am

APPENDIX A – Photographs

Photograph 1: View looking north towards rest area from north embankment of Harris River (Oct.25, 2010).

Photograph 2: View from centre of rest area parking lot looking east towards Hwy 69 entrance (Oct.25, 2010).


Photograph 3: View of rest area looking southwest (Aug.30, 2007).


Photograph 4: View of rest area looking northeast (Oct.25, 2010).

Photograph 5: View of rock outcrop looking north from centre of rest area (Oct.25, 2010).

Photograph 6: Pump test on Harris River test well (Nov.18, 2010).

Photograph 7: MMM11-02 borehole drilling (Nov.2, 2011).

Photograph 8: View of split spoon soil sample from MMM11-04 (Nov.2, 2011).

Photograph 9: View of piezometer stickup at PZ-2 looking west (Nov.2, 2011).

Photograph 10: View of test well looking northwest (Dec.6, 2011).


Photograph 11: Close-up view of the south embankment of the Harris River, looking southwest (Aug.16, 2011).


Photograph 12: View of the south embankment of the Harris River, looking southwest (Dec.6, 2011).

Photograph 13: View of minor wet channel near PZ-1, looking west (Apr.11, 2012).

APPENDIX B – MOE Well Records

TOWNSHIP CONCESSION (LOT)	UTM[1]	DATE[2] CNTR[3]	CASING DIA[4]	WATER[5,6] DETAIL	STAT LVL/PUMP LVL[7] RATE[8]/TIME HR:MIN	WATER USE[9]	SCREEN INFO[10]	WELL # (AUDIT#) WELL TAG # DEPTHS TO WHICH FORMATIONS EXTEND[5,11]
HARRISON TOWNSHIP CON 10(026)	17 546640 5054593[L]	1997/06 2550	06	UK 0130	006 / 138 008 / 1:0	DO		4807598 (168216) BLCK LOAM LOOS 0005 RED GRNT SOFT 0140
INDIAN RESERVE NAISC ()	17 539806 5058774[W]	1976/05 1920	03 03	FR 0090	006 / 006 020 / 1:0	DO		4802159 () SAND LOAM CLAY 0020 BLCK GRNT 0100

Notes:
1. UTM in Zone, Easting, Northing and Datum is NAD83; L: UTM estimated from Centroid of Lot; W: UTM not from Lot Centroid
2. Date Work Completed
3. Well Contractor Licence Number
4. Casing diameter in inches
5. Unit of Depth in Feet
6. See Table 4 for Meaning of Code
7. STAT LVL: Static Water Level in Feet ; PUMP LVL: Water Level After Pumping in Feet
8. Pump Test Rate in GPM, Pump Test Duration in Hour : Minutes
9. See Table 3 for Meaning of Code
10. Screen Depth and Length in feet
11. See Table 1 and 2 for Meaning of Code

1. Core Material and Descriptive terms

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

2. Core Color

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

3. Water Use

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

4. Water Detail

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

APPENDIX C – Borehole Logs and Grain Size Analysis

Ontario Ministry of the Environment

Well Tag No. A110525 A110525

Well Record

Regulation 903 Ontario Water Resources Act

Page ____ of ____

Measurements recorded in: ☒ Metric ☐ Imperial

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
MTO Northeastern Region			

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
301-477 McKeown Ave	North Bay	Ont	P1B9S9	705 472 7900

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
Harris River Rest Station	Wallbridge	36	2

County/District/Municipality	City/Town/Village	Province	Postal Code
Parry Sound		Ontario	

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	17	0582746	5059459		

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

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	To
Brown	Top Soil			0	0.6
Grey	Granite			0.6	91.4

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0	6.1	Bentonite	

Method of Construction

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

Well Use

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

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	To
16	Steel	.5	40cm	6.1
16	Open Hole		6.1	91.4

Construction Record - Screen

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

Status of Well

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

Water Details

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

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
0	6.1	22.23
6.1	91.4	16

Results of Well Yield Testing

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

If pumping discontinued, give reason:

Pump intake set at (m/ft): 73.2

Pumping rate (l/min / GPM): 75

Duration of pumping: 6 hrs + 0 min

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

If flowing give rate (l/min / GPM): 7.5

Recommended pump depth (m/ft): 73.2

Recommended pump rate (l/min / GPM): 75

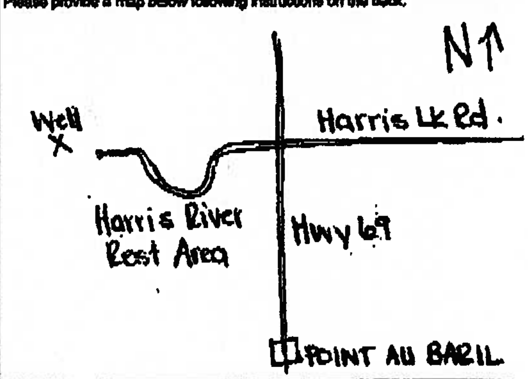
Well production (l/min / GPM): 75

Disinfected? ☒ Yes ☐ No

Draw Down Time (min)	Water Level (m/ft)	Recovery Time (min)	Water Level (m/ft)
Static Level	0		8.78
1	0.97	1	7.25
2	2.85	2	5.46
3	3.72	3	4.27
4	4.41	4	3.57
5	4.91	5	3.38
10	6.10	10	3.19
15	7.80	15	2.21
20	7.80	20	1.22
25	7.80	25	1.17
30	7.80	30	1.06
40	7.80	40	0.9
50	7.80	50	
60	7.80	60	

Map of Well Location

Please provide a map below following instructions on the back.



Comments:

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
Marshall Well Drilling	3 6 7 8

Business Address (Street Number/Name)	Municipality
33 Star Lk Rd	Emsdale

Province	Postal Code	Business E-mail Address
Ont	P0A 1J0	

Bus. Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name)
7056367216	MacInnis Mike

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
3 3 6 0	[signature]	2010 02 07

Well owner's information package delivered	Date Package Delivered	Ministry Use Only
☒ Yes ☐ No	2010 01 08	Audit No. Z124788
	Date Work Completed: 2010 01 08	Received

Ministry of Transportation Ontario

THURBER

RECORD OF BOREHOLE No 10-01

METRIC

W.P.	5076-06-00	LOCATION	HWY 69 Rest Area	ORIGINATED BY	SLL
HWY	69	BOREHOLE TYPE	Soild Stem Augers	COMPILED BY	AN
DATUM	Geodetic	DATE	2010.10.28 - 2010.10.28	CHECKED BY	TH

ELEV DEPTH (191.14 masl)	SOIL PROFILE: DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE; 20 40 60 80 100)	PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	**ORGANICS**, with roots and rootlets										
0.3	**SAND**, trace gravel, rootlets Loose Brown Moist		1	SS	2				○ (approx. 20)		
0.7	END OF BOREHOLE AT 0.68m UPON AUGER REFUSAL. BOREHOLE OPEN AND DRY. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.										

+ ³, × ³: Numbers refer to Sensitivity

20 / 15 ⌖ 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 10-02

METRIC

W.P. 5076-06-00 LOCATION HWY 69 Rest Area ORIGINATED BY SLL

HWY 69 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2010.10.28 - 2010.10.28 CHECKED BY TH

ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa	WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
191.63 masl											
0.0	**ORGANICS**, with roots and rootlets										
0.2	**GRANITE**, strong to very strong, dark grey with quartz and mica seams at 3.1m Sub-vertical joints at 0.3m and 1.3m		1	RUN						FI 2 2 1 2 1	RUN 1# TCR=100%, SCR=100%, RQD=87%
			2	RUN						1 2 0 0 0	RUN 2# TCR=100%, SCR=100%, RQD=100%
3.4	END OF BOREHOLE AT 3.4m.										

Legend: DCPT scale 20 40 60 80 100; ○ UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE; shear strength 20 40 60 80 100. PLASTIC LIMIT w_P, NATURAL MOISTURE CONTENT w, LIQUID LIMIT w_L; water content 20 40 60.

+³, ×³: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 10-03

METRIC

W.P. 5076-06-00 | LOCATION HWY 69 Rest Area | ORIGINATED BY SLL

HWY 69 | BOREHOLE TYPE Solid Stem Augers | COMPILED BY AN

DATUM Geodetic | DATE 2010.10.28 - 2010.10.28 | CHECKED BY TH

Legend: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20, 40, 60, 80, 100); SHEAR STRENGTH kPa: ○ UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE (20, 40, 60, 80, 100); PLASTIC LIMIT w_P, NATURAL MOISTURE CONTENT w, LIQUID LIMIT w_L; WATER CONTENT (%) (20, 40, 60); UNIT WEIGHT γ kN/m³; REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

191.37 masl

ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	UNIT WEIGHT / FI	REMARKS
0.0	**ORGANICS**, with roots and rootles								
	SAND, some silt, rootlets, occasional cobble Loose Brown Moist (FILL)		1	SS	2				
			2	SS	50/ 0.100				
1.2	**GRANITE**, strong to very strong, grey		1	RUN				FI 2 0	RUN 1# TCR=100%, SCR=100%, RQD=95%
	Quartz and mica seams from 2.3m to 4.2m Mechanical breaks at 2.8m, 2.9m, 3.0m, 3.1m and 3.2m 75mm sub-vertical joints at 2.2m		2	RUN				0 1 2 0	RUN 2# TCR=100%, SCR=100%, RQD=100%
			3	RUN				2 1 0	RUN 3# TCR=100%, SCR=100%, RQD=100%
	Vertical joints at 4.2m Mechanical breaks at 4.6m		4	RUN				1 0 0	RUN 4# TCR=100%, SCR=100%, RQD=96%
5.1	END OF BOREHOLE AT 5.1m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.								

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

20 / 15 – 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 10-04

METRIC

W.P. 5076-06-00 LOCATION HWY 69 Rest Area ORIGINATED BY SLL

HWY 69 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2010.10.28 - 2010.10.28 CHECKED BY TH

192.51 masl

ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P, NATURAL MOISTURE CONTENT w, LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	**ASPHALT:**(50mm)										
0.7	**SAND**, some gravel Compact Brown Moist (FILL)		1	SS	15				○		

END OF BOREHOLE AT 0.7m UPON AUGER REFUSAL.
BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.

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

20 / 15 / 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation Ontario

THURBER

RECORD OF BOREHOLE No 10-05

METRIC

W.P. 5076-06-00 LOCATION HWY 69 Rest Area ORIGINATED BY SLL

HWY 69 BOREHOLE TYPE Continuous Split Spoon COMPILED BY AN

DATUM Geodetic DATE 2010.11.30 - 2010.11.30 CHECKED BY TJH

ELEV DEPTH (189.61 masl)	DESCRIPTION	NUMBER	TYPE	"N" VALUES	WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	**ORGANICS**, with roots Black					
0.2	**SAND** and **SILT** Compact Dark Brown Moist	1	SS	12	o	
		2	SS	22	o	0 41 56 3
1.1	Silty **CLAY**, some sand, some organics matter, roots and rootets Very Stiff	3	SS	28	o	0 16 67 17
1.7	**SAND**, some silt Very Dense Brown Moist	4	SS	90	o	1 86 13 (SI+CL)
		5	SS	100/ 0.075	o	
2.4	END OF BOREHOLE AT 2.4m ON POSSIBLE BEDROCK.					

Column headings: SOIL PROFILE; SAMPLES; STRAT PLOT; GROUND WATER CONDITIONS; ELEVATION SCALE; DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100; SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100; PLASTIC LIMIT w_P, NATURAL MOISTURE CONTENT w, LIQUID LIMIT w_L; WATER CONTENT (%) 20 40 60; UNIT WEIGHT γ kN/m³

+³, ×³: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 6121.GPJ 1/20/11

Ministry of Transportation Ontario

THURBER

RECORD OF BOREHOLE No 10-06

METRIC

W.P. 5076-06-00 | LOCATION HWY 69 Rest Area | ORIGINATED BY SLL

HWY 69 | BOREHOLE TYPE Continuous Split Spoon | COMPILED BY AN

DATUM Geodetic | DATE 2010.11.30 - 2010.11.30 | CHECKED BY TJH

ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
190.25 masl											
0.0	**ORGANICS** with roots and rootlets Black										
0.2	Silty **SAND** Loose to Very Dense Brown Moist		1	SS	7				o		
			2	SS	27				o		0 66 31 3
			3	SS	80				o		0 64 32 4
			4	SS	83				o		2 95 3 (SI+CL)
2.4	END OF BOREHOLE AT 2.4m DUE TO 1.2m OF HEAVING SAND.										

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

20 / 15 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 6121.GPJ 1/20/11

Ministry of Transportation Ontario

THURBER

RECORD OF BOREHOLE No TP-01

METRIC

W.P. 5076-06-00 LOCATION Harris River Rest Area ORIGINATED BY ES

HWY 69 BOREHOLE TYPE Visual Assessment / Hand Shovel COMPILED BY MFA

DATUM Geodetic DATE 2010.10.06 - 2010.10.06 CHECKED BY RPR

ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
191.80 masl											
0.0	**TOPSOIL**, roots and rootlets, black										
0.2	**SAND**, trace to some silt and clay Brown Moist								○		0 87 13 (SI+CL)
0.6	END OF TEST PIT AT 0.6m.										

+ ³, × ³: Numbers refer to Sensitivity

15 20 5 10 (%) STRAIN AT FAILURE

ONTMT4S 6121.GPJ 7/20/11

Ministry of Transportation Ontario

RECORD OF BOREHOLE No TP-02

METRIC

W.P.	5076-06-00	LOCATION	Harris River Rest Area	ORIGINATED BY	ES
HWY	69	BOREHOLE TYPE	Visual Assessment / Hand Shovel	COMPILED BY	MFA
DATUM	Geodetic	DATE	2010.10.06 - 2010.10.06	CHECKED BY	RPR

190.54 masl

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, X LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L / WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
0.0	**TOPSOIL**, roots and rootlets, black										
0.2	**SAND**, trace to some silt and clay Brown Moist								o		0 84 16 (SI+CL)
0.6	END OF TEST PIT AT 0.6m.										

ONTMT4S 6121.GPJ 7/20/11

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

20 / 15 – 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation Ontario

THURBER

RECORD OF BOREHOLE No TP-03

METRIC

W.P. 5076-06-00 LOCATION Harris River Rest Area ORIGINATED BY ES

HWY 69 BOREHOLE TYPE Visual Assessment / Hand Shovel COMPILED BY MFA

DATUM Geodetic DATE 2010.10.06 - 2010.10.06 CHECKED BY RPR

ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, X LAB VANE) 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m3	GR	SA	SI	CL
191.26 masl														
0.0	**TOPSOIL**, roots and rootlets, black													
0.2	**SILT**, some sand, trace gravel, trace clay Brown Moist								o		1	22	68	9
0.6	END OF TEST PIT AT 0.6m.													

REMARKS & GRAIN SIZE DISTRIBUTION (%)

ONTMT4S 6121.GPJ 7/20/11

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

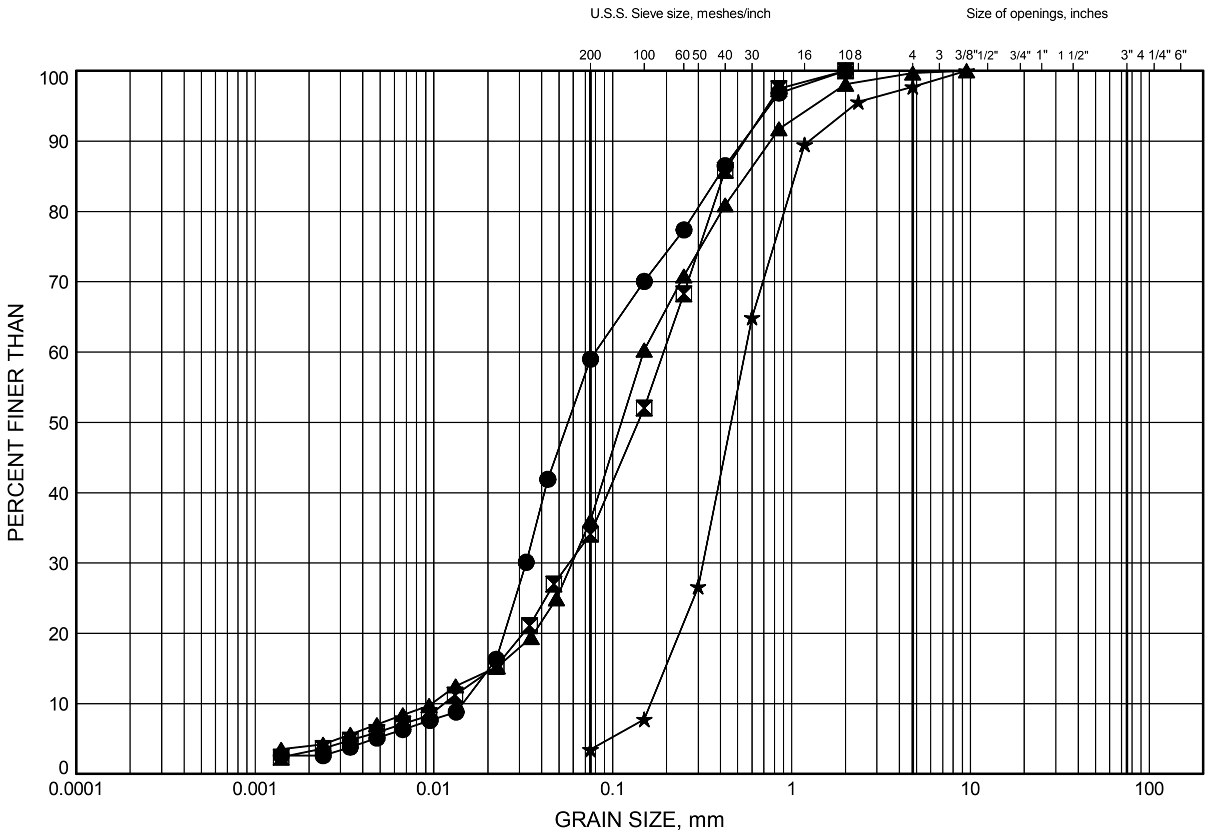
15-⊕-5 (20 / 10) (%) STRAIN AT FAILURE

Hwy 69 Four-Laning North of Hwy 529

GRAIN SIZE DISTRIBUTION

FIGURE B1

SAND & SILT/SILTY SAND



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	10-05	0.91	
⊠	10-06	0.91	
▲	10-06	1.52	
★	10-06	2.13	

W.P.# 5076-06-00

Prepared By AN

Checked By TJH

THURBER

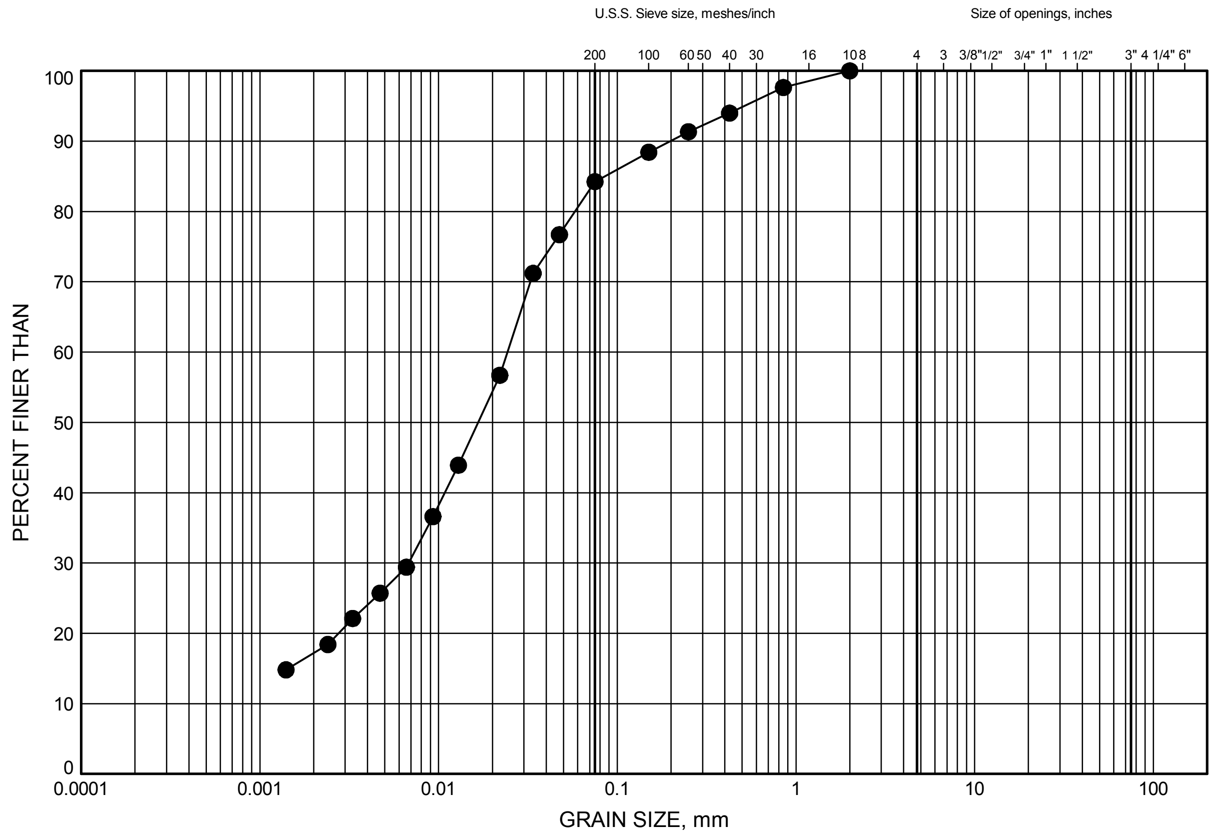
GRAIN SIZE DISTRIBUTION - THURBER 6121.GPJ 12/1/11

Hwy 69 Four-Laning North of Hwy 529

GRAIN SIZE DISTRIBUTION

FIGURE B2

SILTY CLAY



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	10-05	1.52	

W.P.# 5076-06-00

Prepared By AN

Checked By TJH

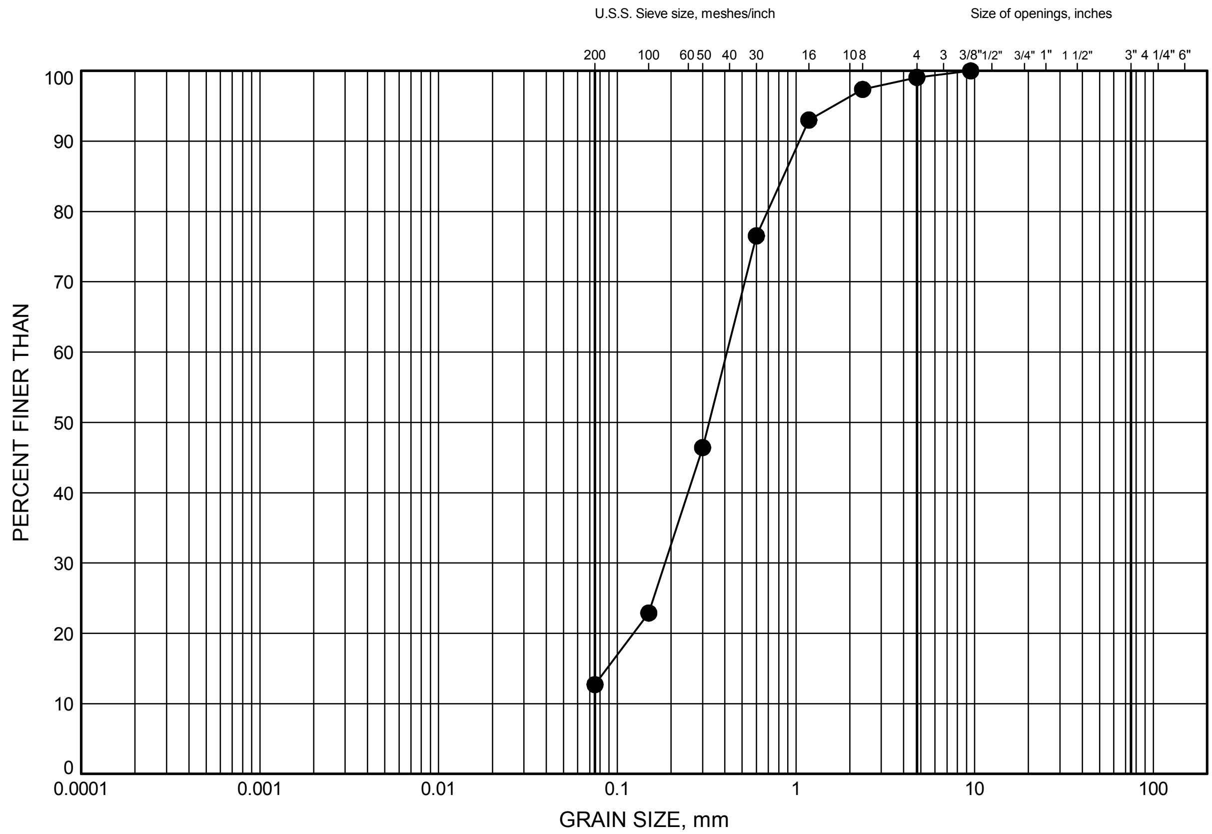
THURBER

Hwy 69 Four-Laning North of Hwy 529

GRAIN SIZE DISTRIBUTION

FIGURE B3

SAND



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	10-05	2.06	

W.P.# 5076-06-00

Prepared By AN

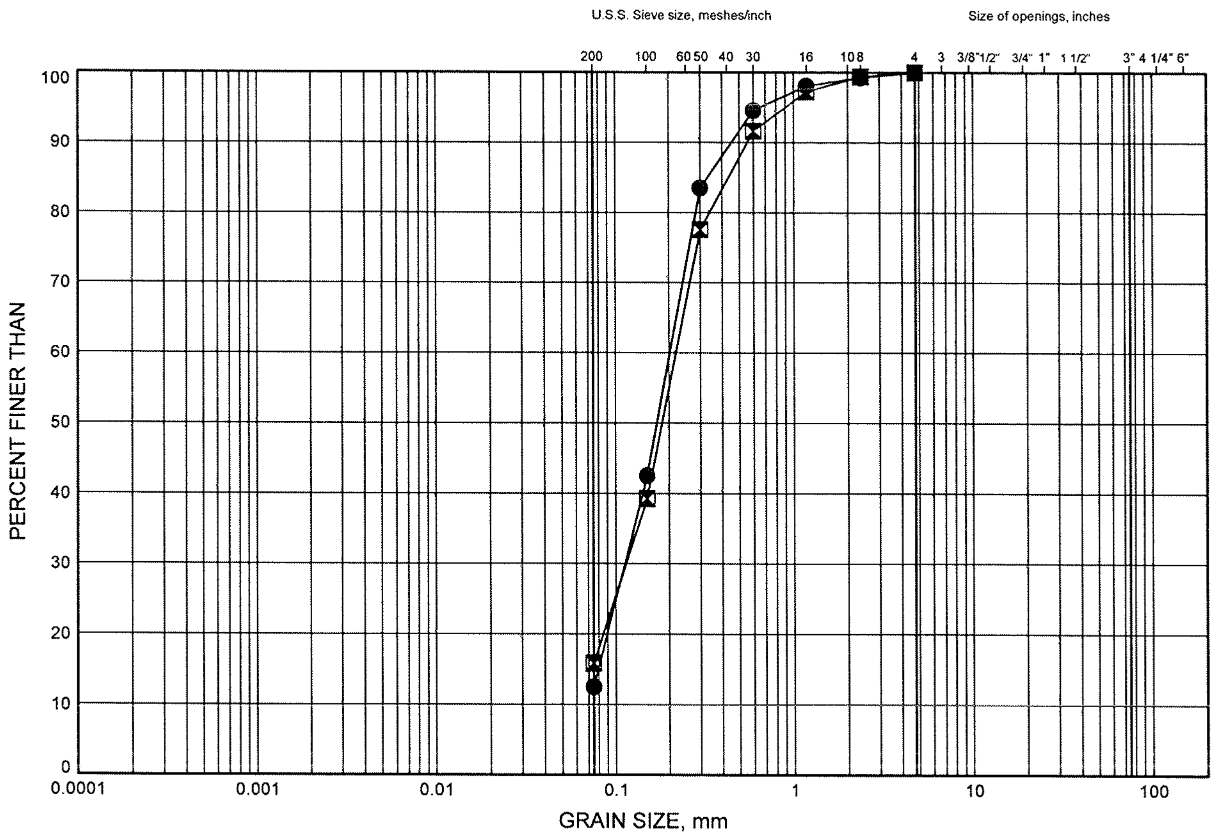
Checked By TJH

Hwy 69 Four-Laning North of Hwy 529

GRAIN SIZE DISTRIBUTION

FIGURE 1

Sand



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	TP-01	0.30	
⧗	TP-02	0.30	

W.P.# 5076-06-00

Prepared By MFA

Checked By RPR

THURBER

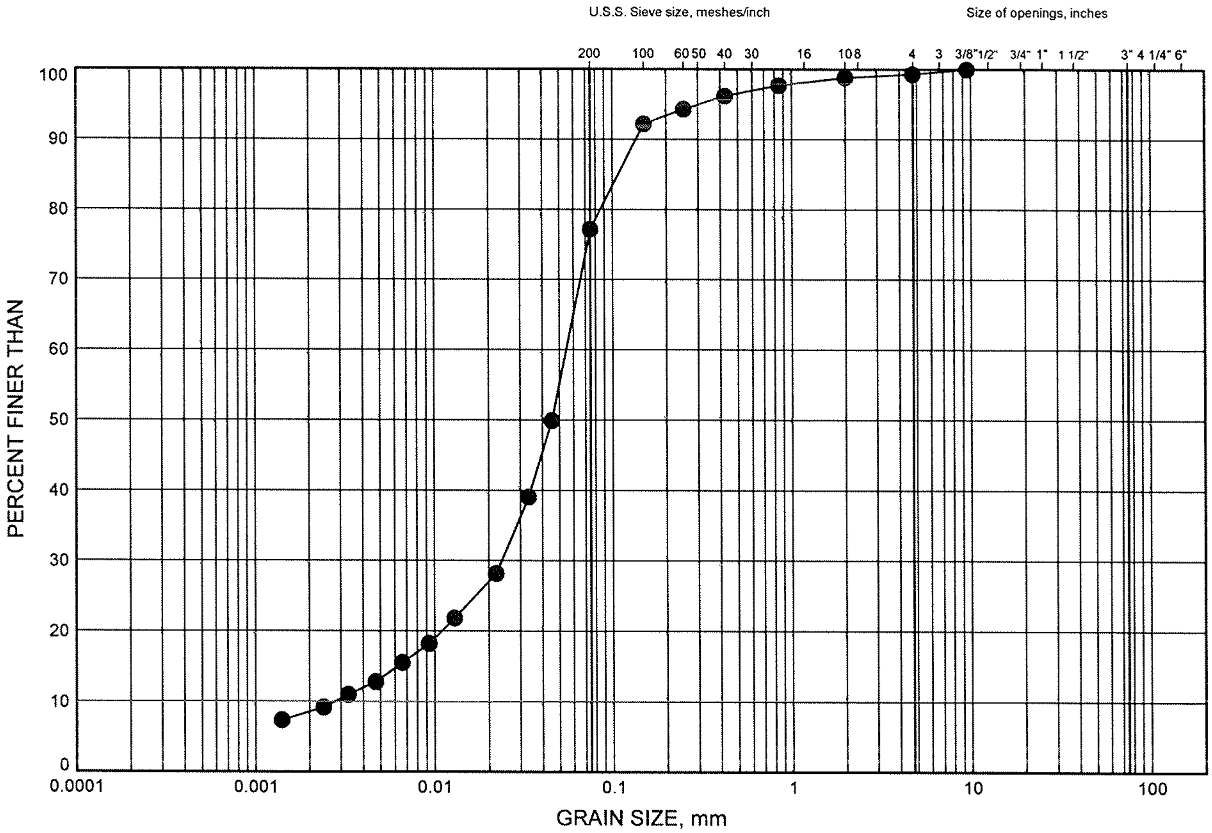
GRAIN SIZE DISTRIBUTION - THURBER 6121.GPJ 7/20/11

Hwy 69 Four-Laning North of Hwy 529

GRAIN SIZE DISTRIBUTION

FIGURE 2

Silt, some sand



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	TP-03	0.30	

W.P.# 5076-06-00

Prepared By MFA

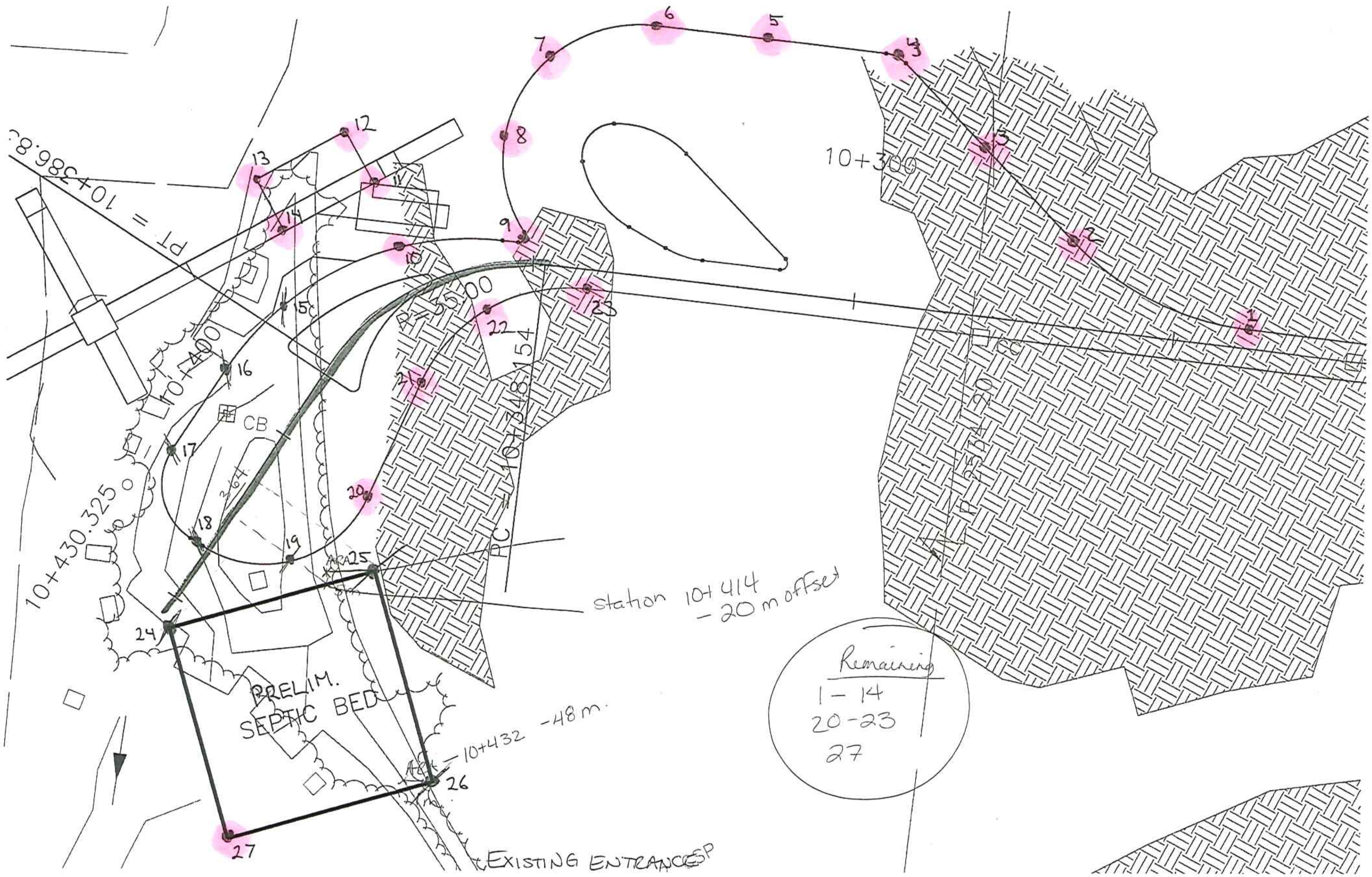
Checked By RPR

THURBER

GRAIN SIZE DISTRIBUTION - THURBER 6121.GPJ 7/20/11

HARRIS LAKE ROAD REST AREA

ARA BOREHOLE LOGS



PT = 10+386.8
10+300
R=35.00
PC = 10+348.154
10+400
10+430.325
CB
PRELIM.
SEPTIC BED
station 10+414
-20 m offset
10+432 -48 m.
EXISTING ENTRANCE
Remaining
1 – 14
20 – 23
27

BOREHOLE LOGS
Highway 69- Pointe Au Baril
Rest Area Road

0+000 D 0

0+000 D 0

0+000 D 0

10+000 SB 10 m Rt D 0

0 - 400 Br F Sa moist
400 - 1500 Br Med Sa moist
1500 NFP (Blds)

10+000 NB 10 m Lt D 0

0 - 1500 Br F Sa moist
1500 NFP (Blds)

10+000 SB 0 CL D 0

0 - 800 Br F Sa moist
800 - 1400 Br Med Sa moist
1400 - 3000 Br Co Sa moist
3000 NFP (Blds)

10+025 SB 15 m Rt D 0

0 - 100 Tps
100 - 400 Br F Sa moist
400 - 1500 Br Med Sa wet
Light Pole 9

10+050 SB 10 m Rt D 0

0 - 0 Exposed BR

10+050 NB 10 m Lt D 0

0 - 0 Exposed BR

10+050 SB 0 CL D 0

0 - 0 Exposed BR

10+075 SB 9 m Lt D 0

0 - 0 Exposed BR
Light Pole 8

10+105 NB 5 m Lt CL D 1.4

0 - 0 Exposed BR
N 5061537.6 E 230665.7 EL 190.6

10+107 SB 3.6 m Rt CL D 1.5

0 - 0 Exposed BR
N 5061532.9 E 230658.4 EL 190.5

10+108 SB 0 CL D 0

0 - 200 Surf Water
200 - 500 Br Co Sa wet
500 NFP BR

10+108 NB 10 m Lt D 0

0 - 400 Br Co Sa w Tps wet
400 NFP BR
Culvert 209 Lt Invert

10+108 SB 10 m Rt D 0

0 - 300 Surf Water
300 - 600 Br Co Sa wet
600 NFP BR
Culvert 209 Rt Invert

10+120 NB 1.9 m Lt CL D 0.1

0 - 100 Tps
100 - 375 Br Gr(y) Sa W Blds moist
375 NFP (BR)
N 5061522.8 E 230668.3 EL 192.1

10+144 NB 8.3 m Lt CL D 0.1

0 - 200 Tps
200 - 500 Gry Sa(y) Si moist
500 NFP (BR)
N 5061503.1 E 230683.2 EL 192.1

10+145 NB 8.3 m Lt CL D 0.1

0 - 200 Tps
200 NFP (BR)
N 5061501.8 E 230683.7 EL 192.2

BOREHOLE LOGS
Highway 69- Pointe Au Baril
Rest Area Road

10+147 NB 8.2 m Lt CL D 0

0 - 200 Tps
200 NFP (BR)
N 5061499.9 E 230684.4 EL 192.3

10+150 SB 1.2 m Rt CL D 0.2

0 - 200 Tps
200 - 800 Gry Sa(y) Si moist
w @ 500 mm = 15%
4.75 mm = 99%
75 µm = 60%
800 NFP (BR)
N 5061493.6 E 230676.7 EL 192.1

10+152 SB 8.7 m Rt CL D 0

0 - 150 Tps
150 - 300 Br Sa moist
300 NFP (BR)
N 5061489.4 E 230670.4 EL 192.3

10+199 NB 0.9 m Lt CL D 0.6

0 - 50 Tps
50 - 150 Br Sa moist
150 NFP (BR)
N 5061448.8 E 230697.1 EL 192.5

10+200 SB 5.7 m Rt CL D -1.4

0 - 25 Co Fib Org M moist
25 NFP (BR)
N 5061445.8 E 230691.2 EL 194.5

10+202 NB 10.4 m Lt CL D -0.6

0 - 25 Co Fib Org M moist
25 NFP (BR)
N 5061450.3 E 230706.8 EL 193.9

10+208 NB 10.3 m Lt CL D -0.7

0 - 25 Co Fib Org M moist
25 NFP (BR)
N 5061444.5 E 230709.1 EL 194.8

10+209 NB 0.4 m Lt CL D -0.8

0 - 25 Co Fib Org M moist
25 NFP (BR)
N 5061440.1 E 230700.1 EL 195.0

10+209 SB 7.9 m Rt CL D -1.4

0 - 25 Co Fib Org M moist
25 NFP (BR)
N 5061436.6 E 230692.6 EL 195.6

10+218 SB 10.9 m Rt CL D 0.5

0 - 0 Exposed BR
N 5061426.8 E 230693.3 EL 194.9

10+219 NB 0.1 m Lt CL D 0.3

0 - 0 Exposed BR
N 5061430.4 E 230703.7 EL 195.1

10+220 NB 10.6 m Lt CL D 0.2

0 - 400 Tps and Blds
400 NFP (BR)
N 5061433.2 E 230713.9 EL 195.3

10+220 NB 10.6 m Lt CL D 0.2

0 - 0 Exposed BR
N 5061433.2 E 230713.9 EL 195.3

10+227 NB 5.3 m Lt CL D 0.7

0 - 200 Tps
200 - 450 Br Gr(y) Sa W Blds moist
450 NFP (BR)
N 5061424.6 E 230711.7 EL 195.5

10+227 NB 0.2 m Lt CL D 0.4

0 - 500 Exposed Blds
500 NFP (BR)
N 5061423.3 E 230706.7 EL 195.8

10+238 NB 3.3 m Rt CL D 0

0 - 0 Exposed BR
Stake 1
N 5061411.5 E 230707.6 EL 197.3

BOREHOLE LOGS
Highway 69- Pointe Au Baril
Rest Area Road

10+239 SB 9.8 m Rt CL D -0.8

0 - 25 Co Fib Org M moist
25 NFP (BR)
N 5061408.5 E 230701.9 EL 197.6

10+241 SB 1.5 m Rt CL D -0.8

0 - 25 Co Fib Org M moist
25 NFP (BR)
N 5061409.0 E 230710.6 EL 197.6

10+243 NB 8 m Lt CL D -0.6

0 - 300 Tps and Blds
300 NFP (BR)
N 5061411.3 E 230719.9 EL 197.5

10+260 NB 8.5 m Lt CL D 0

0 - 200 Tps and Blds
200 NFP (BR)
N 5061395.8 E 230726.8 EL 196.4

10+261 SB 8.1 m Rt CL D 0.8

0 - 0 Exposed BR
N 5061388.1 E 230711.9 EL 195.6

10+261 SB 0.5 m Rt CL D 0.6

0 - 350 Tps and Blds
350 NFP (BR)
N 5061391.3 E 230718.8 EL 195.8

10+268 SB 13.4 m Rt CL D 0

0 - 50 Tps
50 NFP (BR)
Stake 2
N 5061380.3 E 230709.4 EL 194.9

10+279 SB 15.5 m Rt CL D -0.1

0 - 450 Tps W Blds
450 NFP (BR)
N 5061369.3 E 230711.6 EL 195.0

10+281 SB 25 m Rt CL D 0

0 - 30 Tps
30 NFP (BR)
Stake 3
N 5061363.3 E 230703.8 EL 193.8

10+283 NB 1.6 m Lt CL D -0.7

0 - 350 Tps W Blds
350 NFP (BR)
N 5061371.2 E 230729.2 EL 194.9

10+284 NB 15.1 m Lt CL D -2

0 - 350 Tps W Blds
350 NFP (BR)
N 5061375.3 E 230742.2 EL 196.0

10+284 NB 10.5 m Lt CL D -1.8

0 - 200 Tps and Blds
200 NFP (BR)
N 5061374.4 E 230737.5 EL 195.9

10+297 SB 38.4 m Rt CL D 0

0 - 50 Tps
50 NFP (BR)
Stake 4
N 5061343.6 E 230697.3 EL 192.3

10+300 NB 6.4 m Lt CL D -0.2

0 - 200 Tps
200 - 1300 Gry Br Sa moist
1300 NFP (BR)
N 5061357.7 E 230739.9 EL 192.1

10+301 SB 1.8 m Rt CL D -0.1

0 - 200 Tps
200 - 2100 Br Sa moist
2100 NFP (BR)
N 5061353.8 E 230732.7 EL 192.0

10+303 SB 10.1 m Rt CL D -0.1

0 - 75 Tps
75 - 2200 Gry Br Sa moist
2200 NFP (BR)
N 5061348.8 E 230725.7 EL 191.9

BOREHOLE LOGS
Highway 69- Pointe Au Baril
Rest Area Road

10+305 SB 13.8 m Rt D 0

0 - 150 Tps
150 NFP (BR)
50 N of 8
N 5061345.5 E 230723.0 EL 191.6

10+316 SB 8.5 m Rt CL D 0.2

0 - 50 Tps
50 - 1600 Gry Br Sa moist
1600 NFP (BR)
N 5061337.6 E 230731.9 EL 191.3

10+316 NB 9.4 m Lt CL D -0.2

0 - 400 Tps
400 - 3400 Gry Br Sa moist
3400 NFP (BR)
N 5061343.8 E 230748.7 EL 191.6

10+317 SB 39 m Rt CL D 0

0 - 120 Tps
120 - 1700 Br Si(y) F Sa wet
1700 NFP (Blds)
Stake 5
N 5061324.6 E 230704.3 EL 191.4

10+317 SB 0.4 m Rt CL D -0.1

0 - 150 Tps
150 - 2400 Gry Br Sa moist
2400 NFP (BR)
N 5061339.7 E 230739.8 EL 191.5

10+319 SB 0.4 m Rt CL D -0.1

0 - 150 Tps
150 - 1800 Gry Br Sa moist
1800 NFP (BR)
N 5061337.5 E 230740.7 EL 191.4

10+327 SB 24.4 m Rt D 0

0 - 100 Tps
100 - 850 Br F Sa wet
850 - 850 NFP (Blds)
25 N of 8
N 5061321.1 E 230721.4 EL 191.0

10+333 NB 0.2 m Lt CL D 0.4

0 - 150 Tps
150 - 500 Br Sa moist
500 NFP (BR)
N 5061324.5 E 230746.6 EL 191.0

10+334 NB 8.3 m Lt CL D 0.3

0 - 50 Tps
50 NFP (BR)
N 5061326.7 E 230754.4 EL 191.2

10+336 SB 9.2 m Rt CL D 0.6

0 - 500 Co Fib Org M moist
500 - 1700 Br Sa moist
1700 NFP (BR)
N 5061318.4 E 230738.9 EL 191.0

10+336 SB 39 m Rt CL D 0

0 - 150 Tps
150 - 950 Br Si(y) F Sa wet
950 NFP (Blds)
Stake 6
N 5061307.4 E 230711.2 EL 191.2

10+340 SB 1.7 m Lt CL D 0

0 - 120 Tps
120 NFP (BR)
Stake 23
N 5061319.1 E 230750.4 EL 192.0

10+349 SB 34.5 m Rt CL D 0

0 - 250 Co Fib Org M
250 - 850 Br Si(y) F Sa wet
850 NFP (Blds)
Stake 7
N 5061297.0 E 230720.3 EL 191.1

10+351 NB 2.8 m Rt CL D 0

0 - 50 Tps
50 NFP (BR)
Stake 9
N 5061306.4 E 230750.6 EL 191.7

BOREHOLE LOGS
Highway 69- Pointe Au Baril
Rest Area Road

10+353 NB 7.3 m Lt CL D 0.7

0 - 300 Tps
300 - 1800 Br Sa moist
1800 NFP (BR)
N 5061309.2 E 230760.4 EL 191.4

10+354 NB 8.2 m Lt CL D 0.7

0 - 300 Tps
300 - 2500 Br Sa moist
N 5061308.1 E 230761.9 EL 191.3

10+355 SB 6.4 m Lt CL D 0

0 - 30 Tps
30 - 950 Br F Sa wet
950 NFP (Blds)
Stake 22
N 5061307.0 E 230760.3 EL 191.3

10+355 SB 19.9 m Rt CL D 0

0 - 340 Tps
340 NFP (Blds)
Stake 8
N 5061297.1 E 230736.0 EL 191.1

10+361 SB 9.3 m Rt CL D 1.2

0 - 325 Tps
325 NFP (BR)
N 5061295.5 E 230748.1 EL 191.4

10+362 NB 10.8 m Lt D 0

0 - 900 Br F Sa Tr Si moist
900 NFP (Blds)
Blds on Surface
N 5061301.5 E 230767.3 EL 192.5

10+362 SB 8.9 m Rt CL D 1.2

0 - 300 Tps
300 - 2500 Br Sa moist
N 5061294.4 E 230749.0 EL 191.1

10+364 NB 1.1 m Lt CL D 0.2

0 - 350 Br Sa moist
350 NFP (BR)
N 5061296.1 E 230759.1 EL 192.0

10+365 NB 1.4 m Lt CL D 0.2

0 - 150 Tps
150 - 350 Br Co Sa moist
350 - 900 Br Sa and Blds moist
900 NFP (BR)
N 5061295.6 E 230759.6 EL 192.1

10+365 NB 1.4 m Lt CL D 0.2

0 - 150 Tps
150 - 300 Br Co Sa moist
300 NFP (BR)
N 5061295.6 E 230759.6 EL 192.1

10+365 NB 1.4 m Lt CL D 0.2

0 - 150 Tps
150 - 200 Br Co Sa moist
200 NFP (Poss BR)
N 5061295.6 E 230759.6 EL 192.1

10+365 NB 21.7 m Lt CL D 0

0 - 25 Tps
25 - 510 Br F Sa dry
510 NFP (Blds)
Stake 21
N 5061303.0 E 230778.5 EL 192.6

10+368 NB 1.3 m Rt CL D 0

0 - 0 Exposed BR
Stake 10
N 5061292.0 E 230758.1 EL 192.5

10+373 SB 11.1 m Rt CL D 0

0 - 100 Tps
100 NFP (BR)
Stake 11
N 5061281.4 E 230752.8 EL 192.6

10+376 SB 26.1 m Rt CL D 0

0 - 50 Tps
50 - 400 Br F Sa dry
400 NFP (Blds)
Stake 12
N 5061266.5 E 230746.1 EL 190.8

BOREHOLE LOGS
Highway 69- Pointe Au Baril
Rest Area Road

10+382 SB 18.1 m Rt CL D 0

0 - 50 Tps
50 NFP (BR)
Stake 13
N 5061265.6 E 230761.0 EL 191.2

10+383 SB 8.6 m Rt CL D 0

0 - 150 Tps
150 NFP (BR)
Stake 14
N 5061273.7 E 230766.1 EL 191.4

10+384 SB 11 m Rt CL D 0

0 - 50 Asph
50 - 300 Br Sa and Gr
300 - 450 Br Sa
450 - 890 Rd Br Sa
890 - 1800 Br Co Sa
N 5061278.9 E 230776.2 EL 191.4

10+390 SB 0 CL CL D 0

0 - 50 ST
50 - 380 Br Cr Sa and Gr moist
380 NFP (Blds/Poss BR)
Tie-in Exist Rest Area
N 5061289.3 E 230786.3 EL 190.1

10+396 SB 13 m Rt CL D 0

0 - 25 Asph
25 - 200 Br Sa and Gr
200 - 1500 Br Sa
1500 - 1800 Gry Br Sa
4.75 mm = 100%
75 µm = 32%
N 5061276.9 E 230789.2 EL 191.5

10+401 NB 16.4 m Lt CL D 0

0 - 25 Tps
25 - 900 Br F Sa dry
900 - 1000 Tps
1000 - 1100 Br F Sa dry
1100 NFP (Blds)
Stake 20
N 5061290.3 E 230793.1 EL 192.2

10+411 SB 13 m Rt CL D 0

0 - 25 Asph
25 - 350 Br Sa and Gr
350 - 500 Br Sa
500 - 900 Rd Br Sa
900 - 1200 Br Co Sa
1200 - 1800 Gry Br Sa Tr Si
1800 - 2100 Gry Br Sa Tr Si
SPT N = 5 for 300 mm
N 5061274.5 E 230804.4 EL 191.5

10+414 NB 20 m Lt CL D 0

0 - 25 ST
25 - 225 Br Sa Tr Gr
225 - 450 Br Sa
450 - 1000 Rd Br Sa
1000 - 1800 Br Co Sa
N 5061307.3 E 230812.3 EL 191.2

10+415 NB 12.5 m Lt CL D 0

0 - 50 Asph
50 - 250 Br Sa and Gr
250 - 1200 Br Sa
1200 - 1800 Br Co Sa
N 5061299.6 E 230810.7 EL 191.2

10+421 SB 2 m Rt CL D 0

0 - 50 Asph
50 - 250 Br Sa and Gr
250 - 1000 Br Sa
1000 - 1800 Gry Br Sa
N 5061284.8 E 230814.9 EL 191.6

10+432 NB 48 m Lt CL D 0

0 - 25 ST
25 - 650 Br Sa
650 - 1800 Br Co Sa
N 5061334.4 E 230832.1 EL 192.2

BOREHOLE LOGS
Highway 69- Pointe Au Baril
Rest Area Road

10+434 NB 2 m Lt CL D 0

0	-	40	Asph	
40	-	230	Br Sa and Gr	
230	-	1100	Br Sa	
1100	-	1800	Rd Br Sa	

N 5061286.9 E 230826.8 EL 191.7

10+457 NB 27.5 m Lt CL D 0

0	-	30	Tps	
30	-	1600	Br F Sa	wet
			4.75 mm =	100%
			75 µm =	21%
1600				NFP (Blds)
				Stake 27

N 5061311.8 E 230853.6 EL 191.3

Log of Borehole MMM11-01

MMM GROUP

Project No: 16-07198-001-EN4

Project: Harris River Rest Area

Client: Ministry of Transportation

Location: Harris River Rest Area, Hwy 69, Ontario

Easting: 542829 **Zone** 17T

Northing: 5059475 **Datum:** NAD 83

SUBSURFACE PROFILE										
Depth (ft / m)	Symbol	Description	Depth/Elev	Well Data	Type	Sample Number	Recovery (%)	Vapour Conc. (PID/CGI) (ppm)	N-Value (10 30 50 70 90) / Moisture Content % (10 20 30 40)	Remarks
		Ground Surface	191.35							
0 ft / 0 m		***Pavement***	0.00							
		Sand Brown with some orange oxidation, damp to moist, fine grained.	190.16 / 1.19		SS	1	100%	0/0		Soil Sample: Metals and Inorganics, Petroleum Hydrocarbon Compounds
		End of Borehole								Vapour readings in ppm using MiniRae 2000 (PID) and RKI Eagle (CGI).

Depth scale: ft 0–28; m 0–8.

Drilled By: MMM

Drill Method: Hand Auger

Drill Date: November 2, 2011

MMM Group Limited
100 Commerce Valley Drive West
Thornhill, Ontario L3T 0A1

Borehole Log is for Environmental Purposes Only

Logged By: A.B.

Checked By: A.L.

Hole Size: 100 mm

Log of Borehole MMM11-02

MMM GROUP

Project No: 16-07198-001-EN4

Project: Harris River Rest Area

Client: Ministry of Transportation

Location: Harris River Rest Area, Hwy 69, Ontario

Easting: 542850 **Zone** 17T

Northing: 5059508 **Datum:** NAD 83

SUBSURFACE PROFILE

Description	Depth/Elev	Type	Sample Number	Recovery (%)	Vapour Conc. (PID/CGI) (ppm)	N-Value
Ground Surface	191.45					
Sand Dark brown with some orange oxidation, moist, fine to medium grained.	0.00	SS	1	83%	0/0	
		SS	2	83%	0/0	5
Becoming grey in colour, some silt and clay, wet.		SS	3	79%	0/0	5
		SS	4	33%	0/0	
Silty Clay, dark brown, trace sand, wet, trace organics.	189.45 / 2.00	SS	5	33%	0/0	1
Silty Sand, compact, saturated.	189.16 / 2.29	SS	6	63%	0/0	23
Sand, greyish-brown, medium to coarse grained, wet.	188.40 / 3.05	SS	7	33%	-/-	3
		SS	-	50%	-/-	
		SS	-	63%	-/-	
		SS	-	88%	-/-	
		SS	-	67%	-/-	
End of Borehole. Auger Refusal on assumed bedrock.	183.78 / 7.67					

N-Value scale: 10 30 50 70 90; Moisture Content %: 10 20 30 40

Remarks:

Water observed between 1.52 to 2.13 mbgs. Groundwater measured at approx. 1.93 mbgs in open hole.

Borehole cave to 2.1 mbgs.

Vapour readings in ppm using MiniRae 2000 (PID) and RKI Eagle (CGI).

Notes: mbgs = meters below ground surface.

Drilled By: MMM

Drill Method: Solid Stem Augers

Drill Date: November 2, 2011

MMM Group Limited
100 Commerce Valley Drive West
Thornhill, Ontario L3T 0A1

Borehole Log is for Environmental Purposes Only

Logged By: A.B.

Checked By: A.L.

Hole Size: 152 mm

Sheet: 1 of 1

Log of Borehole MMM11-03

MMM GROUP

Project No: 16-07198-001-EN4

Project: Harris River Rest Area

Client: Ministry of Transportation

Location: Harris River Rest Area, Hwy 69, Ontario

Easting: 542843	**Zone** 17T	**Northing:** 5059513	**Datum:** NAD 83

SUBSURFACE PROFILE

Depth (m)	Symbol	Description	Depth/Elev	Well Data	Type	Sample Number	Recovery (%)	Vapour Conc. (PID/CGI) (ppm)	N-Value	Remarks
		Ground Surface	191.83							
0	Sand	***Sand*** Brown, trace orange oxidation, trace organics, moist, fine grained.	0.00		SS	1	79%	0/0	7	
					SS	2	75%	0/0	7	
		Becoming greyish-brown in colour, compact, trace clay and gravel. Change in texture to fine to medium grain.			SS	3	50%	0/0		Groundwater measured at approximately 2.03 mbgs in open hole. Borehole cave to 2.10 mgbs.
2.29	Sand	Sand, becoming saturated with depth. Change in texture to medium to coarse grain, moist to wet. Becomes wet.	189.54 / 2.29		SS	4	88%	0/0	9	
3.51		End of Borehole. Auger Refusal on assumed bedrock.	188.32 / 3.51							Vapour readings in ppm using MiniRae 2000 (PID) and RKI Eagle (CGI). Notes: mbgs = meters below ground surface

Depth scale: ft 0–28; m 0–8.

N-Value scale: 10 30 50 70 90. Moisture Content %: 10 20 30 40.

Drilled By: Malone's Drilling

Drill Method: Solid Stem Augers

Drill Date: November 2, 2011

MMM Group Limited
100 Commerce Valley Drive West
Thornhill, Ontario L3T 0A1

Borehole Log is for Environmental Purposes Only

Logged By: A.B.

Checked By: A.L.

Hole Size: 152 mm

Sheet: 1 of 1

Log of Borehole MMM11-04

MMM GROUP

Project No: 16-07198-001-EN4

Project: Harris River Rest Area

Client: Ministry of Transportation

Location: Harris River Rest Area, Hwy 69, Ontario

Easting: 542830 **Zone** 17T

Northing: 5059521 **Datum:** NAD 83

SUBSURFACE PROFILE

Depth (ft / m)	Symbol	Description	Depth/Elev	Well Data	Type	Sample Number	Recovery (%)	Vapour Conc. (PID/CGI) (ppm)	N-Value	Remarks
		Ground Surface	192.04							
0 ft / 0 m	Sand	***Sand*** Brown, moist, fine to medium grained, trace gravel.	0.00		SS	1	63%	0/0	18	
3.5 ft / 1.06 m		Becoming light brown in colour with some orange oxidation. Moist to wet.	190.98 / 1.06		SS	2	67%	0/0	10	Groundwater measured at approx. 1.22 mbgs in open hole. Borehole cave to 1.35 mbgs.
5 ft / 1.52 m		Change in texture to medium to coarse grain. Moist to wet.	190.52 / 1.52		SS	3	100%	0/0	13	
		Brown to grey, medium grained. Becomes wet to saturated.			SS	-	-	0/0	9	
					SS	-	-	0/0		
15 ft / 4.62 m		End of Borehole Auger refusal on assumed bedrock.	187.42 / 4.62							Vapour readings in ppm using MiniRae 2000 (PID) and RKI Eagle (CGI). Notes: mbgs = meters below ground surface

N-Value scale: 10, 30, 50, 70, 90. Moisture Content (%) scale: 10, 20, 30, 40.

Depth scale: 0–28 ft; 0–8 m.

Drilled By: Malone's Drilling

Drill Method: Solid Stem Augers

Drill Date: November 2, 2011

MMM Group Limited
100 Commerce Valley Drive West
Thornhill, Ontario L3T 0A1

Borehole Log is for Environmental Purposes Only

Logged By: A.B.

Checked By: A.L.

Hole Size: 152 mm

Sheet: 1 of 1

Log of Borehole MMM11-05

MMM GROUP

Project No: 16-07198-001-EN4

Project: Harris River Rest Area

Client: Ministry of Transportation

Location: Harris River Rest Area, Hwy 69, Ontario

Easting: 542861 **Zone** 17T

Northing: 5059513 **Datum:** NAD 83

SUBSURFACE PROFILE

Depth (m)	Description	Depth/Elev	Type	Sample Number	Recovery (%)	Vapour Conc. (PID/CGI) (ppm)	N-Value	Remarks
	Ground Surface	191.84						
0	***Sand*** Brown, moist, fine grained.	0.00	SS	1	79%	0/0	6	
1.07	Becoming light brown in colour with some orange oxidation. Becomes fine to medium grained.	190.77 / 1.07	SS	2	71%	0/0	11	
	Becomes greyish-brown and saturated.		SS	3	75%	0/0	19	Groundwater measured at approx. 2.25 mbgs in open hole. Borehole cave to 2.55 mbgs.
	Becomes moist to wet.		SS	-	83%	0/0	15	
3.05	Becomes medium to coarse grained and wet.	188.79 / 3.05	SS	4	100%	0/0	5	
4.85	Trace silt. Becomes wet to saturated.	186.99 / 4.85	SS	5	-	0/0	8	
	End of Borehole. Auger refusal on assumed bedrock at 5.03 mbgs.							

Remarks: Vapour readings in ppm using MiniRae 2000 (PID) and RKI Eagle (CGI).

Notes: mbgs = meters below ground surface

Drilled By: Malone's Drilling

Drill Method: Solid Stem Augers

Drill Date: November 2, 2011

MMM Group Limited
100 Commerce Valley Drive West
Thornhill, Ontario L3T 0A1

Borehole Log is for Environmental Purposes Only

Logged By: A.B.

Checked By: A.L.

Hole Size: 152 mm

Sheet: 1 of 1

Log of Borehole PZ-1

MMM GROUP

Project No: 16-07198-001-EN4

Project: Harris River Rest Area

Client: Ministry of Transportation

Location: Harris River Rest Area, Hwy 69, Ontario

Easting: 542896	**Zone** 17 T	**Northing:** 5059474	**Datum:** NAD 83

SUBSURFACE PROFILE

Depth (ft/m)	Description	Depth/Elev	Type	Sample Number	Recovery (%)	Vapour Conc. (PID/CGI) (ppm)	N-Value / Moisture Content %	Remarks
	Ground Surface	186.98						
0 ft / 0 m	***Topsoil*** Organic material with leaves and twigs	0.00	HA	1	100%	0/0		Measured water level = dry on Nov. 2/11 and Dec. 6/11. Stick-up = 1.08 mags. Depth to bottom = 2.10 mbtop
	Sand Brown, moist, fine grained. Becoming grey in colour with depth.	185.79 / 1.19	HA	2	100%	0/0		
~4 ft / 1.19 m	End of Borehole							

N-Value scale: 10, 30, 50, 70, 90. Moisture Content % scale: 10, 20, 30, 40.

Depth scale: 0–28 ft; 0–8 m.

Remarks:

Vapour readings in ppm using MiniRae 2000 (PID) and RKI Eagle (CGI).

Well Details: Riser = 31.75 mm Sch 40 PVC, Screen = 10 slot with #1 silica sand.

Notes: mags = meters above ground surface, mbtop = meters below top of pipe

Drilled By: MMM	MMM Group Limited 100 Commerce Valley Drive West Thornhill, Ontario L3T 0A1	Logged By: A.B.
Drill Method: Hand Auger		Checked By: A.L.
Drill Date: November 2, 2011	Borehole Log is for Environmental Purposes Only	Hole Size: 100 mm
		Sheet: 1 of 1

Log of Borehole PZ-2

Project No: 16-07198-001-EN4

Project: Harris River Rest Area

Client: Ministry of Transporation

Location: Harris River Rest Area, Hwy 69, Ontario

Easting: 542855 **Zone** 17T

Northing: 5059511 **Datum:** NAD 83

MOE ID#: N/A

SUBSURFACE PROFILE

Depth (m)	Description	Depth/Elev	Type	Sample Number	Recovery (%)	Vapour Conc. (PID/CGI) (ppm)	N-Value	Remarks
	Ground Surface	191.80						
0	***Sand*** Light brown, moist, fine grained.	0.00	SS	1	67%	0/0	5	
	Becoming grey in colour with some oxidation (orange) inclusions.	191.04 / 0.76	SS	2	83%	0/0	6	Measured water level = 0.8 mbgs on Dec 6/11 Measured water level = 1.68 mbgs on Nov. 2/11 Stick-up = 0.40 mags Depth to bottom = 2.98 mbtop
			SS	-	13%	-/-	2	Borehole cave to 2.15 mbgs.
			SS	-	79%	-/-	8	
	Becomes dark grey, medium to coarse grained, saturated.	189.11 / 2.69	SS	3	79%	0/0		
	End of Borehole	188.75 / 3.05						

N-Value: 10 30 50 70 90

Moisture Content %: 10 20 30 40

Depth scale: ft 0–28; m 0–8

Vapour readings in ppm using MiniRae 2000 (PID) and RKI Eagle (CGI).

Well Details: Riser = 31.75 mm Sch 40 PVC, Screen = 10 slot with #1 silica sand.

Notes: mags = meters above ground surface, mbtop = meters below top of pipe

Drilled By: Malone's Drilling

Drill Method: Solid Stem Augers

Drill Date: November 2, 2011

MMM Group Limited
100 Commerce Valley Drive West
Thornhill, Ontario L3T 0A1

Borehole Log is for Environmental Purposes Only

Logged By: A.B.

Checked By: A.L.

Hole Size: 152 mm

Sheet: 1 of 1

Log of Borehole PZ-3

MMM GROUP

Project No: 16-07198-001-EN4
Project: Harris River Rest Area
Client: Ministry of Transportation
Location: Harris River Rest Area, Hwy 69, Ontario

Easting: 542843 **Zone** 17T
Northing: 5059464 **Datum:** NAD83

SUBSURFACE PROFILE

Depth (m)	Symbol	Description	Depth/Elev	Well Data	Type	Sample Number	Recovery (%)	Vapour Conc. (PID/CGI) (ppm)	N-Value / Moisture Content %	Remarks
		Ground Surface	191.04							
0		***Sand*** Light brown, moist, fine grained.	0.00		SS	-	-	0/0		
					SS	1	100%	0/0		
0.61		Becoming dark brown with some silt.	190.43 / 0.61		SS	-	-	0/0		Measured water level - 1.2 mbgs on Dec. 6/11 Measured water level = 1.91 mbgs on Nov. 2/11 Stick-up = 0.30 mags Depth to bottom = 2.92 mbtop
2.74		Becoming grey in colour with trace gravel. Saturated.	188.30 / 2.74		SS	2	100%	0/0		
3.13		End of Borehole	187.91 / 3.13							Vapour readings in ppm using MiniRae 2000 (PID) and RKI Eagle (CGI). Well Details: Riser= 31.75 mm Sch 40 PVC, Screen = 10 slot with #1 silica sand. Notes: mags = meters above ground surface, mbtop = meters below top of pipe

Drilled By: Malone`s Drilling
Drill Method: Solid Stem Augers
Drill Date: November 2, 2011

MMM Group Limited
100 Commerce Valley Drive West
Thornhill, Ontario L3T 0A1

Borehole Log is for Environmental Purposes Only

Logged By: A.B.
Checked By: A.L.
Hole Size: 152 mm
Sheet: 1 of 1

APPENDIX D – Pumping Test, Analytical Results, and Certificates of Analysis

MMM GROUP
MMM Group Limited
100 Commerce Valley Drive West, Thornhill,
Ontario, Canada L3T 0A1. t: 905.882.4211 | f: 905.882.1857

Pumping Test - Water Level Data

Project: Harris River Rest Station

Number: 16-07198-001-EN4

Client: MTO

Location: Highway 69	Pumping Test: Pumping Test	Pumping Well: Test Well
Test Conducted by: MMM Group Limited	Test Date: 11/18/2010	Discharge: variable, average rate 0.075 [m³/min]
Observation Well: Test Well	Static Water Level [m]: 0.00	Radial Distance to PW [m]: -

	Time [min]	Water Level [m]	Drawdown [m]
1	0.5	0.98	0.98
2	1	1.52	1.52
3	1.5	2.23	2.23
4	2	2.83	2.83
5	2.5	3.17	3.17
6	3	3.72	3.72
7	3.5	4.08	4.08
8	4	4.39	4.39
9	4.5	4.66	4.66
10	5	4.91	4.91
11	6	5.30	5.30
12	7	5.64	5.64
13	8	5.91	5.91
14	9	6.10	6.10
15	10	6.28	6.28
16	12	6.58	6.58
17	14	6.80	6.80
18	16	6.95	6.95
19	18	7.07	7.07
20	20	7.16	7.16
21	25	7.32	7.32
22	30	7.41	7.41
23	35	7.50	7.50
24	40	7.59	7.59
25	45	7.62	7.62
26	50	7.68	7.68
27	55	7.71	7.71
28	60	7.77	7.77
29	75	7.86	7.86
30	90	7.96	7.96
31	105	8.05	8.05
32	120	8.11	8.11
33	135	8.17	8.17
34	150	8.23	8.23
35	180	8.29	8.29
36	195	8.35	8.35
37	210	8.38	8.38
38	225	8.41	8.41
39	240	8.47	8.47
40	255	8.53	8.53
41	270	8.56	8.56
42	285	8.60	8.60
43	300	8.63	8.63
44	315	8.66	8.66
45	330	8.69	8.69
46	345	8.72	8.72
47	360	8.75	8.75
48	360.5	7.22	7.22
49	360.8	6.89	6.89
50	361	6.46	6.46
51	361.3	6.00	6.00

MMM GROUP
MMM Group Limited
100 Commerce Valley Drive West, Thornhill,
Ontario, Canada L3T 0A1. t: 905.882.4211 | f: 905.882.1857

Pumping Test - Water Level Data

Project: Harris River Rest Station

Number: 16-07198-001-EN4

Client: MTO

	Time [min]	Water Level [m]	Drawdown [m]
52	361.5	5.73	5.73
53	361.8	5.43	5.43
54	362	5.06	5.06
55	362.3	4.75	4.75
56	362.5	4.48	4.48
57	362.8	4.27	4.27
58	363	4.05	4.05
59	363.3	3.87	3.87
60	363.5	3.72	3.72
61	363.8	3.54	3.54
62	364	3.41	3.41
63	364.5	3.14	3.14
64	365	2.93	2.93
65	365.5	2.74	2.74
66	366	2.56	2.56
67	366.5	2.41	2.41
68	367	2.29	2.29
69	367.5	2.16	2.16
70	368	2.07	2.07
71	368.5	1.98	1.98
72	369	1.89	1.89
73	369.5	1.83	1.83
74	370	1.77	1.77
75	371	1.68	1.68
76	372	1.58	1.58
77	373	1.52	1.52
78	374	1.46	1.46
79	375	1.40	1.40
80	377.5	1.31	1.31
81	380	1.22	1.22
82	385	1.13	1.13
83	390	1.04	1.04
84	395	0.98	0.98
85	400	0.91	0.91

MMM GROUP

MMM Group Limited

100 Commerce Valley Drive West, Thornhill,
Ontario, Canada L3T 0A1. t: 905.882.4211 | f: 905.882.1857

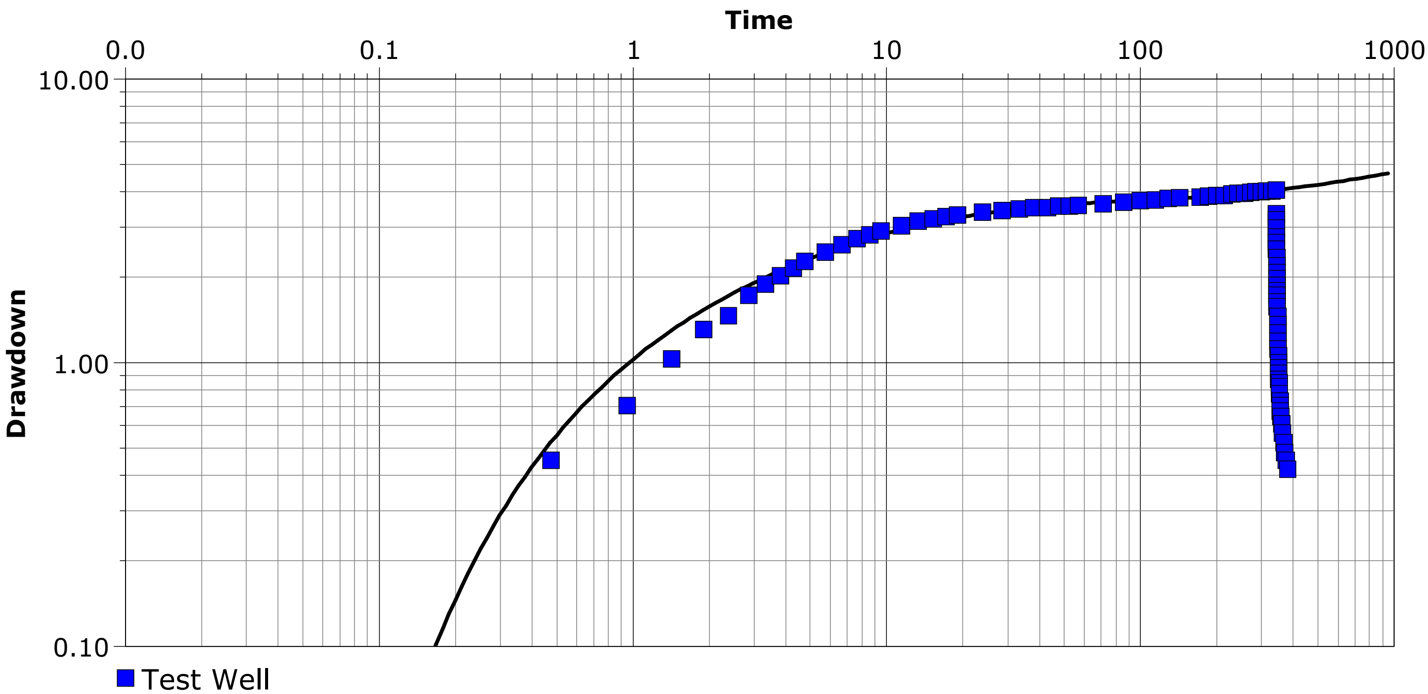
Pumping Test Analysis Report

Project: Harris River Rest Station

Number: 16-07198-001-EN4

Client: MTO

Location: Highway 69	Pumping Test: Pumping Test	Pumping Well: Test Well
Test Conducted by: MMM Group Limited		Test Date: 11/18/2010
Analysis Performed by: ANK	Moench Fracture Flow	Analysis Date: 12/1/2011
Aquifer Thickness: 90.00 m	Discharge: variable, average rate 0.075 [m³/min]	



Calculation after Moench Fracture Flow

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Storage coefficient	Sigma	Gamma	SF	Radial Distance to PW [m]
Test Well	3.98×10^{0}	4.42×10^{-2}	5.00×10^{-1}	2.18×10^{1}	9.95×10^{-1}	2.81×10^{1}	0.08

MMM GROUP

MMM Group Limited

100 Commerce Valley Drive West, Thornhill,
Ontario, Canada L3T 0A1. t: 905.882.4211 | f: 905.882.1857

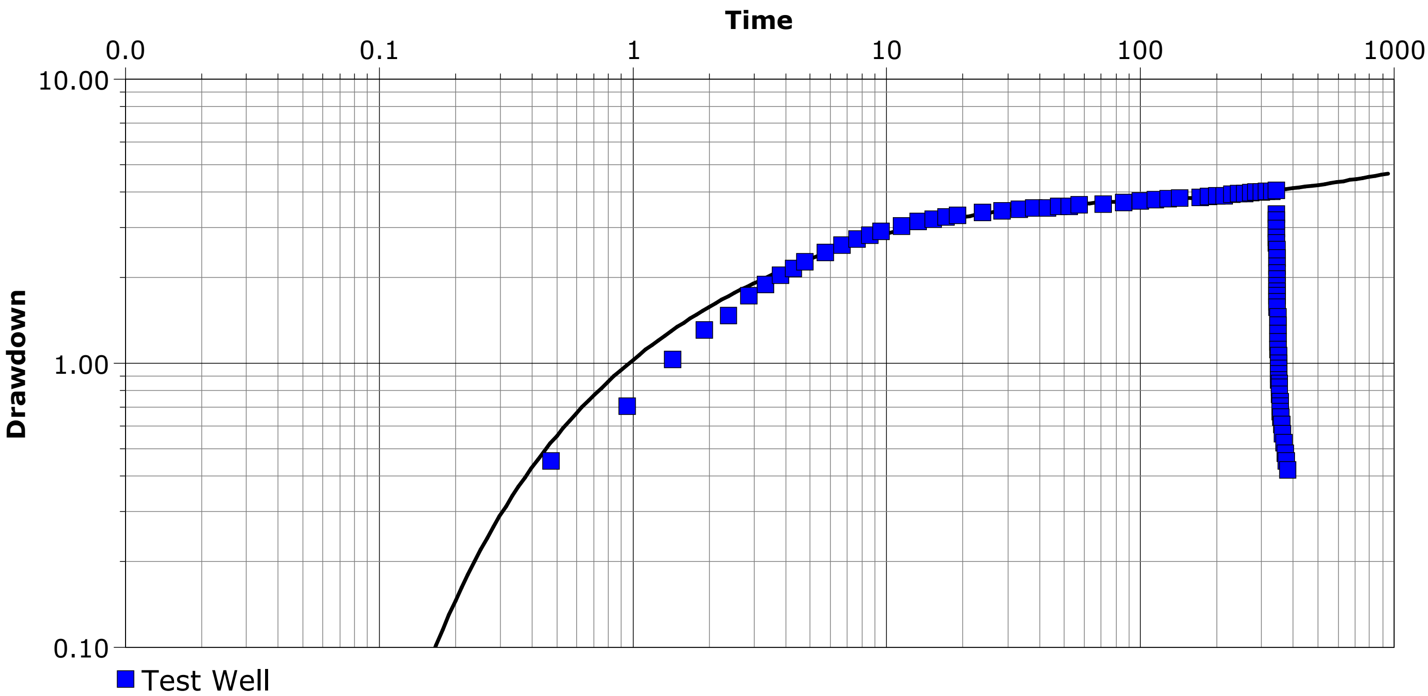
Pumping Test Analysis Report

Project: Harris River Rest Station

Number: 16-07198-001-EN4

Client: MTO

Location: Highway 69	Pumping Test: Pumping Test	Pumping Well: Test Well
Test Conducted by: MMM Group Limited		Test Date: 11/18/2010
Analysis Performed by: ANK	Double Porosity	Analysis Date: 12/1/2011
Aquifer Thickness: 90.00 m	Discharge: variable, average rate 0.075 [m³/min]	



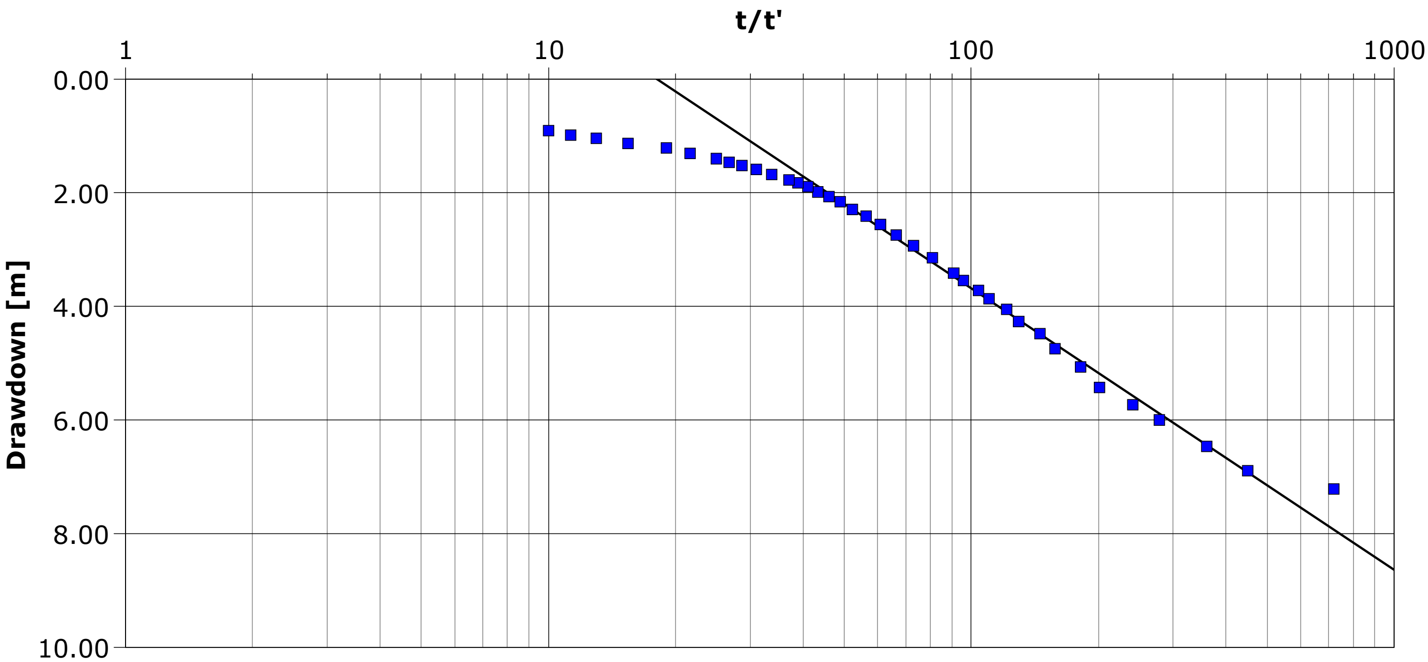
Calculation after Double Porosity

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Specific storage	Sigma	Lambda	Radial Distance to PW [m]
Test Well	3.98×10^{0}	4.42×10^{-2}	5.00×10^{-1}	2.17×10^{1}	3.47×10^{-2}	0.08

MMM GROUP
MMM Group Limited
100 Commerce Valley Drive West, Thornhill, Ontario, Canada L3T 0A1. t: 905.882.4211 | f: 905.882.1857

Pumping Test Analysis Report
Project: Harris River Rest Station
Number: 16-07198-001-EN4
Client: MTO

Location: Highway 69	Pumping Test: Pumping Test	Pumping Well: Test Well
Test Conducted by: MMM Group Limited		Test Date: 11/18/2010
Analysis Performed by: ANK	Theis Recovery	Analysis Date: 12/1/2011
Aquifer Thickness: 90.00 m	Discharge: variable, average rate 0.075 [m³/min]	



Calculation after Theis & Jacob

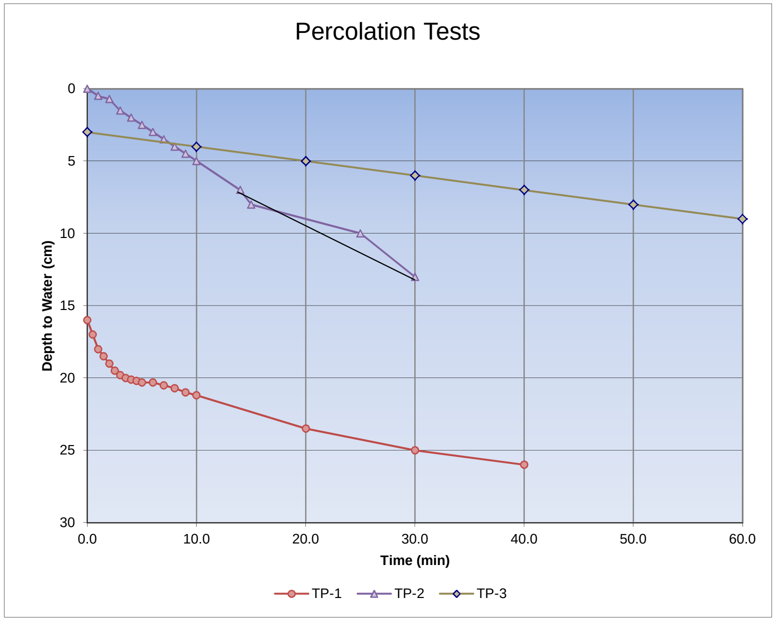
Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Radial Distance to PW [m]	
Test Well	3.99×10^{0}	4.43×10^{-2}	0.08	

Harris River Rest Station Bed Percolation Test Field Data

Tests carried out by Thurber Engineering Staff - October 28 2010

Time (min)	Depth to Water (cm)	Avg. T-Time (min/cm)	T-Time (min/cm)
TEST PIT 1 PERCOLATION TEST			
0.0	16.0		
0.5	17.0	0.5	
1.0	18.0	0.5	
1.5	18.5	0.6	
2.0	19.0	0.7	
2.5	19.5	0.7	
3.0	19.8	0.8	
3.5	20.0	0.9	
4.0	20.1	1.0	
4.5	20.2	1.1	
5	20.3	1.2	
6	20.3	1.4	
7	20.5	1.6	
8	20.7	1.7	
9	21.0	1.8	
10	21.2	1.9	
20	23.5	2.7	4.3
30	25.0	3.3	5.3
40	26.0	4.0	**6.3**

Time (min)	Depth to Water (cm)	Avg. T-Time (min/cm)	T-Time (min/cm)
TEST PIT 2 PERCOLATION TEST			
0	0.0		
1	0.5	2.0	
2	0.7	2.9	
3	1.5	2.0	
4	2.0	2.0	
5	2.5	2.0	
6	3.0	2.0	
7	3.5	2.0	
8	4.0	2.0	
9	4.5	2.0	
10	5.0	2.0	
14	7.0	2.0	
15	8.0	1.9	1.0
25	10.0	2.5	3.7
30	13.0	2.3	**2.7**
TEST PIT 3 PERCOLATION TEST			
0	3.0		
10	4.0	10.0	
20	5.0	10.0	
30	6.0	10.0	
40	7.0	10.0	10.0
50	8.0	10.0	10.0
60	9.0	10.0	**10.0**



Notes:

At TP-1, T-Time is calculated based on comparison of later water levels beginning at time = 10 minutes
At TP-2, T-Time is calculated based on comparison of later water levels beginning at time = 14 minutes
At TP-3, T-Time is calculated based on comparison of later water levels beginning at time = 30 minutes
Highlighted T-times are used for reporting and analysis.

Relationships between T-Time and Hydrauic Conductivity

based upon MOE On-Site Sewage Manual - 1984

Hydraulic Conductivity (m/sec)	T-Time (min/cm)	converted to mm/hr equivalent (used by SWMP Manual)
1.00E-03	2.0	300
1.00E-05	8.0	75
1.00E-06	12.0	50
1.00E-07	20.0	30
If K ~	**Then T-Time ~**	
2.9E-04	2.9	204
4.9E-05	4.6	131
2.5E-05	5.4	111
3.6E-05	4.9	122
2.3E-06	9.8	61
1.4E-06	11.0	55
1.0E-06	12.0	50
9.0E-08	21.9	27
<1.0E-08	>40	
Geometric Mean	8.1	
Mean	9.7	

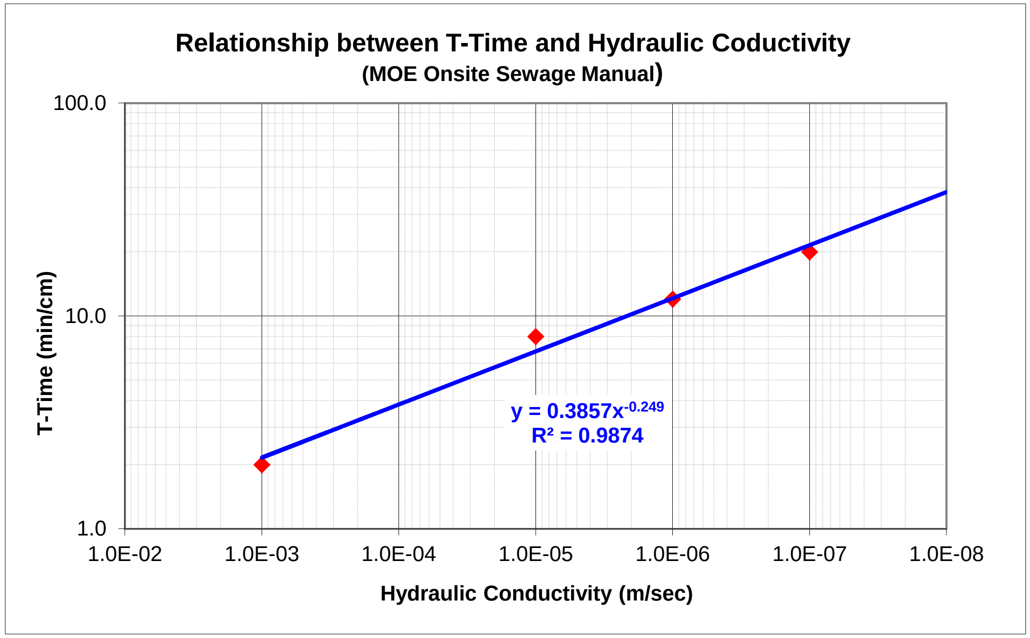


Table D-1: Groundwater Quality Results - Dissolved & Total Metals
Harris River Rest Area, Highway 69, ON

Parameter	ODWS	RDL	SAMPLE 1 11/18/2010 10:00	SAMPLE 2 11/18/2010 16:00
Aluminum (Al)	0.1	0.005	0.06	0.017
Antimony (Sb)	0.006	0.0005	<0.0005	<0.0005
Arsenic (As)	0.025	0.001	<0.001	<0.001
Barium (Ba)	1	0.005	0.11	0.11
Beryllium (Be)	NV	0.0005	<0.0005	<0.0005
Boron (B)	5	0.01	0.23	0.25
Cadmium (Cd)	0.005	0.0001	<0.0001	<0.0001
Dissolved Calcium (Ca)	NV	0.05	42.4	43.7
Calcium (Ca)	NV	0.2	47	45
Chromium (Cr)	0.05	0.005	<0.005	<0.005
Cobalt (Co)	NV	0.0005	<0.0005	<0.0005
Copper (Cu)	1	0.001	0.072	0.007
Iron (Fe)	0.3	0.1	0.26	0.14
Lead (Pb)	0.01	0.0005	0.0069	<0.0005
Dissolved Magnesium (Mg)	NV	0.05	6.76	7.00
Magnesium (Mg)	NV	0.05	7.6	7.8
Manganese (Mn)	0.05	0.002	**0.085**	**0.08**
Mercury (Hg)	0.001	0.0001	<0.0001	<0.0001
Molybdenum (Mo)	NV	0.001	0.001	0.001
Nickel (Ni)	NV	0.001	0.003	<0.001
Phosphorus (P)	NV	0.1	<0.1	<0.1
Dissolved Potassium (K)	NV	1	1	1
Potassium (K)	NV	0.2	1.8	1.8
Selenium (Se)	0.01	0.002	<0.002	<0.002
Silicon (Si)	NV	0.05	6.8	6.7
Silver (Ag)	NV	0.0001	<0.0001	<0.0001
Dissolved Sodium (Na)	200	0.5	15.6	16.7
Sodium (Na)	200	0.1	17	17
Strontium (Sr)	NV	0.001	3.6	3.5
Thallium (Tl)	NV	0.00005	<0.00005	<0.00005
Titanium (Ti)	NV	0.005	0.006	<0.005
Uranium (U)	0.02	0.0001	0.001	0.001
Vanadium (V)	NV	0.001	<0.001	<0.001
Zinc (Zn)	5	0.005	0.055	0.007

Notes:
All units in mg/L, unless otherwise stated

NV: No Value

ODWS: Technical Support Document for Ontario Drinking Water; Standards, Objectives and Guidelines, June 2003, Table 2 - Chemical Standards and Table 4 - Chemical/Physical Objectives and Guidelines

100 Exceeds ODWS

Table D-2: Groundwater Quality Results - Anions and Other Parameters
Harris River Rest Area, Highway 69, ON

Parameter	ODWS	RDL	SAMPLE 1 11/18/2010 10:00	SAMPLE 2 11/18/2010 16:00
Anion Sum	NV	N/A	3.76	3.80
Bicarb. Alkalinity (as $CaCO_3$)	NV	1	138	138
Calculated TDS	500	1	204	209
Carb. Alkalinity (as $CaCO_3$)	NV	1	2	2
Cation Sum	NV	N/A	3.40	3.53
Hardness (as $CaCO_3$)	80-100	1	**130**	**140**
Ion Balance (% Difference)	NV	N/A	5.05	3.67
Langelier Index (@ 20C)	NV		0.497	0.480
Langelier Index (@ 4C)	NV		0.247	0.231
Saturation pH (@ 20C)	NV		7.62	7.60
Saturation pH (@ 4C)	NV		7.87	7.85
Total Ammonia-N	NV	0.05	<0.05	0.06
Conductivity	NV	1	376	378
Dissolved Organic Carbon	5	0.2	1.2	1.3
Orthophosphate (P)	NV	0.01	<0.01	<0.01
pH	6.5-8.5		8.11	8.08
Dissolved Sulphate (SO4)	500	1	19	21
Alkalinity (Total as $CaCO_3$)	30-500	1	140	140
Dissolved Chloride (Cl)	250	1	20	20
Nitrite (N)	1	0.01	<0.01	<0.01
Nitrate (N)	10	0.1	<0.1	<0.1

Notes:

All units in mg/L, unless otherwise stated; cation sim is measured in me/L, conductivity is measured in umho/cm

NV: No Value

ODWS: Technical Support Document for Ontario Drinking Water; Standards, Objectives and Guidelines, June 2003, Table 2 - Chemical Standards and Table 4 - Chemical/Physical Objectives and Guidelines

100 Exceeds ODWS

Table D-3: Groundwater Quality Results - Microbiology
Harris River Rest Area, Highway 69, ON

Parameter	ODWS	RDL	SAMPLE 1	SAMPLE 2
			11/18/2010 10:00	11/18/2010 16:00
Heterotrophic plate count	NV	N/A	5	41
Background	NV	N/A	25	52
Total Coliforms	0	N/A	0	0
Escherichia coli	0	N/A	0	0

Notes:

All units in CFU/100mL, unless otherwise stated; heterotrophic plate count is measured in CFU/mL

NV: No Value

ODWS: Technical Support Document for Ontario Drinking Water; Standards, Objectives and Guidelines, June 2003, Table 1 - Microbiological Standards

100	Exceeds ODWS

Table D-4: Groundwater Quality Results - Volatile Organic Compounds
Harris River Rest Area, Highway 69, ON

Parameter	ODWS	RDL	SAMPLE 2
			11/18/2010 16:00
1,1-Dichloroethylene	0.014	0.0001	<0.0001
1,2-Dichlorobenzene	0.2	0.0002	<0.0002
1,2-Dichloroethane	0.005	0.0002	<0.0002
1,4-Dichlorobenzene	0.005	0.0002	<0.0002
Benzene	0.005	0.0001	<0.0001
Carbon Tetrachloride	0.005	0.0001	<0.0001
Chlorobenzene	NV	0.0001	<0.0001
Dichloromethane	0.05	0.0005	<0.0005
Tetrachloroethylene	0.03	0.0001	<0.0001
Toluene	NV	0.0002	<0.0002
Trichloroethylene	0.005	0.0001	<0.0001
Vinyl Chloride	0.002	0.0002	<0.0002

Notes:

All units in mg/L, unless otherwise stated

NV: No Value

ODWS: Technical Support Document for Ontario Drinking Water; Standards, Objectives and Guidelines, June 2003, Table 2 - Chemical Standards

100 Exceeds ODWS

Table D-5: Groundwater Quality Results - Semi-volatile Organics
Harris River Rest Area, Highway 69, ON

Parameter	ODWS	RDL	SAMPLE 2
			11/18/2010 16:00
2,3,4,6-Tetrachlorophenol	0.1	0.0005	<0.0005
2,4,5-T	NV	0.001	<0.001
2,4,6-Trichlorophenol	0.005	0.0005	<0.0005
2,4-D	NV	0.001	<0.001
2,4-Dichlorophenol	0.9	0.0005	<0.0005
Alachlor	0.005	0.0005	<0.0005
Aldicarb	0.009	0.005	<0.005
Atrazine	NV	0.0005	<0.0005
Des-ethyl atrazine	NV	0.0005	<0.0005
Atrazine + Desethyl-atrazine	0.005	0.001	<0.001
Bendiocarb	0.04	0.002	<0.002
Bromoxynil	0.005	0.0005	<0.0005
Carbaryl	0.09	0.005	<0.005
Carbofuran	0.09	0.005	<0.005
Chlorpyrifos (Dursban)	0.09	0.001	<0.001
Cyanazine (Bladex)	0.01	0.001	<0.001
Diazinon	0.02	0.001	<0.001
Dicamba	0.12	0.001	<0.001
Diclofop-methyl	0.009	0.0009	<0.0009
Dimethoate	0.02	0.003	<0.003
Dinoseb	0.01	0.001	<0.001
Malathion	0.19	0.005	<0.005
Metolachlor	0.05	0.0005	<0.0005
Metribuzin (Sencor)	0.08	0.005	<0.005
Ethyl Parathion	NV	0.001	<0.001
Pentachlorophenol	0.06	0.0005	<0.0005
Phorate	0.002	0.0005	<0.0005
Picloram	0.19	0.005	<0.005
Prometryne	0.001	0.0003	<0.0003
Simazine	0.01	0.001	<0.001
Terbufos	0.001	0.0005	<0.0005
Triallate	0.23	0.001	<0.001
Trifluralin	0.045	0.001	<0.001
Benzo(a)pyrene	0.00001	0.000009	<0.000009

Notes:

All units in mg/L, unless otherwise stated

NV: No Value

ODWS: Technical Support Document for Ontario Drinking Water; Standards, Objectives and Guidelines, June 2003, Table 2 - Chemical Standards

100 Exceeds ODWS

Table D-6: Groundwater Quality Results - Pesticides and Herbicides
Harris River Rest Area, Highway 69, ON

Parameter	ODWS	RDL	SAMPLE 2
			11/18/2010 16:00
Glyphosate	0.28	0.01	<0.01
Diquat	0.07	0.007	<0.007
Diuron	0.15	0.01	<0.00001
Guthion (Azinphos-methyl)	0.02	0.002	<0.002
Paraquat	0.01	0.001	<0.001
Temephos	0.28	0.01	<0.01
Lindane	0.004	0.000006	<0.000006
Heptachlor	NV	0.000006	<0.000006
Aldrin	NV	0.000006	<0.000006
Heptachlor epoxide	NV	0.000006	<0.000006
Heptachlor + Heptachlor epoxide	0.003	0.00001	<0.00001
Oxychlordane	NV	0.000006	<0.000006
g-Chlordane	NV	0.000006	<0.000006
a-Chlordane	NV	0.000006	<0.000006
Chlordane (Total)	0.007	0.00001	<0.00001
p,p-DDE	NV	0.000006	<0.000006
Dieldrin	NV	0.000006	<0.000006
Aldrin + Dieldrin	0.0007	0.00001	<0.00001
p,p-DDD	NV	0.000006	<0.000006
o,p-DDT	NV	0.000006	<0.000006
p,p-DDT	NV	0.000006	<0.000006
DDT+ Metabolites	0.03	0.00002	<0.00002
Methoxychlor	0.9	0.00002	<0.00002
Aroclor 1016	NV	0.00005	<0.00005
Aroclor 1221	NV	0.00005	<0.00005
Aroclor 1232	NV	0.00005	<0.00005
Aroclor 1242	NV	0.00005	<0.00005
Aroclor 1248	NV	0.00005	<0.00005
Aroclor 1254	NV	0.00005	<0.00005
Aroclor 1260	NV	0.00005	<0.00005
Total PCB	0.003	0.00005	<0.00005

Notes:

All units in mg/L, unless otherwise stated

NV: No Value

ODWS: Technical Support Document for Ontario Drinking Water; Standards, Objectives and Guidelines, June 2003, Table 2 - Chemical Standards

100 Exceeds ODWS

Your Project #: 16-07198-001-HG1
Your C.O.C. #: 22149101, 221491-01-01

Attention: Natalia Codoban
MMM Group Limited
100 Commerce Valley Dr W
Thornhill, ON
CANADA L3T 0A1

Report Date: 2010/12/01
This report supersedes all previous reports with the same Maxxam job number

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B0G7223
Received: 2010/11/19, 15:23

Sample Matrix: Water
Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Method Reference
Alkalinity	2	N/A	2010/11/22	CAM SOP-00448	SM 2320B
Carbonate, Bicarbonate and Hydroxide	2	N/A	2010/11/23	CAM SOP-00102	APHA 4500-CO2 D
Chloride by Automated Colourimetry	2	N/A	2010/11/23	CAM SOP-00463	SM 4500 Cl E
Conductivity	2	N/A	2010/11/22	CAM SOP-00448	SM 2510
Diuron, Guthion, Temephos	1	2010/11/26	2010/11/26	CAM SOP-00306	HPLC/DAD
Dissolved Organic Carbon (DOC)	2	N/A	2010/11/22	CAM SOP-00446	SM 5310 B
Diquat / Paraquat	1	2010/11/22	2010/11/22	CAM SOP-00327	EPA 549.2, Rev1,1997
Glyphosate	1	2010/11/26	2010/11/26	CAM SOP-00305	HPLC/FLD
Hardness (calculated as CaCO3)	2	N/A	2010/11/23	CAM SOP 00102	SM 2340 B
Mercury in Water by CVAA	2	2010/11/22	2010/11/23	CAM SOP-00453	EPA 7470
Lab Filtered Metals Analysis by ICP	2	2010/11/22	2010/11/22	CAM SOP-00408	EPA 6010
Metals Analysis by ICPMS (as received) [1]	2	2010/11/24	2010/11/24	CAM SOP-00447	EPA 6020
Ion Balance (% Difference)	2	N/A	2010/11/23		
Anion and Cation Sum	2	N/A	2010/11/23		
Coliform/ E. coli, CFU/100mL	2	N/A	2010/11/19	CAM SOP-00551	MOE E3407
Heterotrophic plate count, (CFU/mL)	2	N/A	2010/11/19	CAM SOP-00512	SM 9215
Ammonia-N	2	N/A	2010/11/25	CAM SOP-00441	US GS I-2522-90
Nitrate (NO3) and Nitrite (NO2) in Water [2]	2	N/A	2010/11/24	CAM SOP-00440	SM 4500 NO3I/NO2B
OC Pesticides (Selected) & PCB [3]	1	2010/11/22	2010/11/22	CAM SOP-00307	SW846 8081, 8082
ODWS - Semi-Volatiles	1	2010/11/29	2010/11/29	CAM SOP-00301	EPA 8270 modified
pH	2	N/A	2010/11/22	CAM SOP-00448	SM 4500H
Orthophosphate	2	N/A	2010/11/23	CAM SOP-00461	SM 4500 P-F
Sat. pH and Langelier Index (@ 20C)	2	N/A	2010/11/23		
Sat. pH and Langelier Index (@ 4C)	2	N/A	2010/11/23		
Sulphate by Automated Colourimetry	2	N/A	2010/11/23	CAM SOP-00464	EPA 375.4
Total Dissolved Solids (TDS calc)	2	N/A	2010/11/23		
VOCs (Drinking Water)	1	N/A	2010/11/24	CAM SOP-00226	EPA 8260

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
* Results relate only to the items tested.

(1) Metals analysis was performed on the sample 'as received'.
(2) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.
(3) Chlordane (Total) = Alpha Chlordane + Gamma Chlordane

../2

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

SEAN CONACHER, Project Manager
Email: SConacher@maxxam.ca
Phone# (905) 817-5700 Ext:5806

==
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Total cover pages: 2

RCAP - COMPREHENSIVE (DRINKING WATER)

Maxxam ID		HX5123		HX5124		
Sampling Date		2010/11/18 10:00		2010/11/18 16:00		
	Units	**SAMPLE 1**	**QC Batch**	**SAMPLE 2**	**RDL**	**QC Batch**
Calculated Parameters						
Anion Sum	me/L	3.76	2335836	3.80	N/A	2335836
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	138	2335297	138	1	2335297
Calculated TDS	mg/L	204	2335301	209	1	2335301
Carb. Alkalinity (calc. as CaCO3)	mg/L	2	2335297	2	1	2335297
Cation Sum	me/L	3.40	2335836	3.53	N/A	2335836
Hardness (CaCO3)	mg/L	130	2335834	140	1	2335834
Ion Balance (% Difference)	%	5.05	2335835	3.67	N/A	2335835
Langelier Index (@ 20C)	N/A	0.497	2335299	0.480		2335299
Langelier Index (@ 4C)	N/A	0.247	2335300	0.231		2335300
Saturation pH (@ 20C)	N/A	7.62	2335299	7.60		2335299
Saturation pH (@ 4C)	N/A	7.87	2335300	7.85		2335300
Inorganics						
Total Ammonia-N	mg/L	<0.05	2339213	0.06	0.05	2339213
Conductivity	umho/cm	376	2337218	378	1	2336410
Dissolved Organic Carbon	mg/L	1.2	2336962	1.3	0.2	2336739
Orthophosphate (P)	mg/L	<0.01	2336761	<0.01	0.01	2336761
pH	pH	8.11	2337213	8.08		2336411
Dissolved Sulphate (SO4)	mg/L	19	2336760	21	1	2336760
Alkalinity (Total as CaCO3)	mg/L	140	2337182	140	1	2336409
Dissolved Chloride (Cl)	mg/L	20	2336758	20	1	2336758
Nitrite (N)	mg/L	<0.01	2336407	<0.01	0.01	2336407
Nitrate (N)	mg/L	<0.1	2336407	<0.1	0.1	2336407

N/A = Not Applicable
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Maxxam Job #: B0G7223
Report Date: 2010/12/01

MMM Group Limited
Client Project #: 16-07198-001-HG1

RCAP - COMPREHENSIVE (DRINKING WATER)

Maxxam ID		HX5123		HX5124		
Sampling Date		2010/11/18 10:00		2010/11/18 16:00		
	Units	**SAMPLE 1**	**QC Batch**	**SAMPLE 2**	**RDL**	**QC Batch**
Metals						
. Aluminum (Al)	mg/L	0.060	2339127	0.017	0.005	2339216
. Antimony (Sb)	mg/L	<0.0005	2339127	<0.0005	0.0005	2339216
. Arsenic (As)	mg/L	<0.001	2339127	<0.001	0.001	2339216
. Barium (Ba)	mg/L	0.11	2339127	0.11	0.005	2339216
. Beryllium (Be)	mg/L	<0.0005	2339127	<0.0005	0.0005	2339216
. Boron (B)	mg/L	0.23	2339127	0.25	0.01	2339216
. Cadmium (Cd)	mg/L	<0.0001	2339127	<0.0001	0.0001	2339216
Dissolved Calcium (Ca)	mg/L	42.4	2336864	43.7	0.05	2336864
. Calcium (Ca)	mg/L	47	2339127	45	0.2	2339216
. Chromium (Cr)	mg/L	<0.005	2339127	<0.005	0.005	2339216
. Cobalt (Co)	mg/L	<0.0005	2339127	<0.0005	0.0005	2339216
. Copper (Cu)	mg/L	0.072	2339127	0.007	0.001	2339216
. Iron (Fe)	mg/L	0.3	2339127	0.1	0.1	2339216
. Lead (Pb)	mg/L	0.0069	2339127	<0.0005	0.0005	2339216
Dissolved Magnesium (Mg)	mg/L	6.76	2336864	7.00	0.05	2336864
. Magnesium (Mg)	mg/L	7.6	2339127	7.8	0.05	2339216
. Manganese (Mn)	mg/L	0.085	2339127	0.080	0.002	2339216
. Molybdenum (Mo)	mg/L	0.001	2339127	0.001	0.001	2339216
. Nickel (Ni)	mg/L	0.003	2339127	<0.001	0.001	2339216
. Phosphorus (P)	mg/L	<0.1	2339127	<0.1	0.1	2339216
Dissolved Potassium (K)	mg/L	1	2336864	1	1	2336864
. Potassium (K)	mg/L	1.8	2339127	1.8	0.2	2339216
. Selenium (Se)	mg/L	<0.002	2339127	<0.002	0.002	2339216
. Silicon (Si)	mg/L	6.8	2339127	6.7	0.05	2339216
. Silver (Ag)	mg/L	<0.0001	2339127	<0.0001	0.0001	2339216
Dissolved Sodium (Na)	mg/L	15.6	2336864	16.7	0.5	2336864
. Sodium (Na)	mg/L	17	2339127	17	0.1	2339216
. Strontium (Sr)	mg/L	3.6	2339127	3.5	0.001	2339216
. Thallium (Tl)	mg/L	<0.00005	2339127	<0.00005	0.00005	2339216
. Titanium (Ti)	mg/L	0.006	2339127	<0.005	0.005	2339216
. Uranium (U)	mg/L	0.0010	2339127	0.0010	0.0001	2339216
. Vanadium (V)	mg/L	<0.001	2339127	<0.001	0.001	2339216
. Zinc (Zn)	mg/L	0.055	2339127	0.007	0.005	2339216

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

REG 170, SCHEDULE 24 (WATER)

Maxxam ID		HX5124	HX5124		
Sampling Date		2010/11/18 16:00	2010/11/18 16:00		
	Units	**SAMPLE 2**	**SAMPLE 2 Lab-Dup**	**RDL**	**QC Batch**
Semivolatile Organics					
2,3,4,6-Tetrachlorophenol	mg/L	<0.0005		0.0005	2343332
2,4,5-T	mg/L	<0.001		0.001	2343332
2,4,6-Trichlorophenol	mg/L	<0.0005		0.0005	2343332
2,4-D	mg/L	<0.001		0.001	2343332
2,4-Dichlorophenol	mg/L	<0.0005		0.0005	2343332
Alachlor	mg/L	<0.0005		0.0005	2343332
Aldicarb	mg/L	<0.005		0.005	2343332
Atrazine	mg/L	<0.0005		0.0005	2343332
Des-ethyl atrazine	mg/L	<0.0005		0.0005	2343332
Atrazine + Desethyl-atrazine	mg/L	<0.001		0.001	2343332
Bendiocarb	mg/L	<0.002		0.002	2343332
Bromoxynil	mg/L	<0.0005		0.0005	2343332
Carbaryl	mg/L	<0.005		0.005	2343332
Carbofuran	mg/L	<0.005		0.005	2343332
Chlorpyrifos (Dursban)	mg/L	<0.001		0.001	2343332
Cyanazine (Bladex)	mg/L	<0.001		0.001	2343332
Diazinon	mg/L	<0.001		0.001	2343332
Dicamba	mg/L	<0.001		0.001	2343332
Diclofop-methyl	mg/L	<0.0009		0.0009	2343332
Dimethoate	mg/L	<0.003		0.003	2343332
Dinoseb	mg/L	<0.001		0.001	2343332
Malathion	mg/L	<0.005		0.005	2343332
Metolachlor	mg/L	<0.0005		0.0005	2343332
Metribuzin (Sencor)	mg/L	<0.005		0.005	2343332
Ethyl Parathion	mg/L	<0.001		0.001	2343332
Pentachlorophenol	mg/L	<0.0005		0.0005	2343332
Phorate	mg/L	<0.0005		0.0005	2343332
Picloram	mg/L	<0.005		0.005	2343332
Prometryne	mg/L	<0.0003		0.0003	2343332
Simazine	mg/L	<0.001		0.001	2343332
Terbufos	mg/L	<0.0005		0.0005	2343332
Triallate	mg/L	<0.001		0.001	2343332
Trifluralin	mg/L	<0.001		0.001	2343332
Benzo(a)pyrene	mg/L	<0.000009		0.000009	2343332

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

MMM Group Limited
Client Project #: 16-07198-001-HG1

Maxxam Job #: B0G7223
Report Date: 2010/12/01

REG 170, SCHEDULE 24 (WATER)

Maxxam ID		HX5124	HX5124		
Sampling Date		2010/11/18 16:00	2010/11/18 16:00		
	Units	**SAMPLE 2**	**SAMPLE 2 Lab-Dup**	**RDL**	**QC Batch**
Surrogate Recovery (%)					
2,4,6-Tribromophenol	%	94			2343332
2,4-Dichlorophenyl Acetic Acid	%	111			2343332
2-Fluorobiphenyl	%	88			2343332
D14-Terphenyl (FS)	%	102			2343332
D5-Nitrobenzene	%	94			2343332
Volatile Organics					
1,1-Dichloroethylene	mg/L	<0.0001		0.0001	2335641
1,2-Dichlorobenzene	mg/L	<0.0002		0.0002	2335641
1,2-Dichloroethane	mg/L	<0.0002		0.0002	2335641
1,4-Dichlorobenzene	mg/L	<0.0002		0.0002	2335641
Benzene	mg/L	<0.0001		0.0001	2335641
Carbon Tetrachloride	mg/L	<0.0001		0.0001	2335641
Chlorobenzene	mg/L	<0.0001		0.0001	2335641
Methylene Chloride(Dichloromethane)	mg/L	<0.0005		0.0005	2335641
Tetrachloroethylene	mg/L	<0.0001		0.0001	2335641
Toluene	mg/L	<0.0002		0.0002	2335641
Trichloroethylene	mg/L	<0.0001		0.0001	2335641
Vinyl Chloride	mg/L	<0.0002		0.0002	2335641
Surrogate Recovery (%)					
4-Bromofluorobenzene	%	100			2335641
D4-1,2-Dichloroethane	%	107			2335641
D8-Toluene	%	100			2335641

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Maxxam Job #: B0G7223
Report Date: 2010/12/01

MMM Group Limited
Client Project #: 16-07198-001-HG1

REG 170, SCHEDULE 24 (WATER)

Maxxam ID		HX5124	HX5124		
Sampling Date		2010/11/18 16:00	2010/11/18 16:00		
	Units	**SAMPLE 2**	**SAMPLE 2 Lab-Dup**	**RDL**	**QC Batch**
Pesticides & Herbicides					
Glyphosate	mg/L	<0.01	<0.01	0.01	2341708
Diquat	mg/L	<0.007		0.007	2336446
Diuron	mg/L	<0.01		0.01	2341679
Guthion (Azinphos-methyl)	mg/L	<0.002		0.002	2341679
Paraquat	mg/L	<0.001		0.001	2336446
Temephos	mg/L	<0.01		0.01	2341679
Lindane	mg/L	<0.000006		0.000006	2336517
Heptachlor	mg/L	<0.000006		0.000006	2336517
Aldrin	mg/L	<0.000006		0.000006	2336517
Heptachlor epoxide	mg/L	<0.000006		0.000006	2336517
Heptachlor + Heptachlor epoxide	mg/L	<0.00001		0.00001	2336517
Oxychlordane	mg/L	<0.000006		0.000006	2336517
g-Chlordane	mg/L	<0.000006		0.000006	2336517
a-Chlordane	mg/L	<0.000006		0.000006	2336517
Chlordane (Total)	mg/L	<0.00001		0.00001	2336517
p,p-DDE	mg/L	<0.000006		0.000006	2336517
Dieldrin	mg/L	<0.000006		0.000006	2336517
Aldrin + Dieldrin	mg/L	<0.00001		0.00001	2336517
p,p-DDD	mg/L	<0.000006		0.000006	2336517
o,p-DDT	mg/L	<0.000006		0.000006	2336517
p,p-DDT	mg/L	<0.000006		0.000006	2336517
DDT+ Metabolites	mg/L	<0.00002		0.00002	2336517
Methoxychlor	mg/L	<0.00002		0.00002	2336517
Aroclor 1016	mg/L	<0.00005		0.00005	2336517
Aroclor 1221	mg/L	<0.00005		0.00005	2336517
Aroclor 1232	mg/L	<0.00005		0.00005	2336517
Aroclor 1242	mg/L	<0.00005		0.00005	2336517
Aroclor 1248	mg/L	<0.00005		0.00005	2336517
Aroclor 1254	mg/L	<0.00005		0.00005	2336517
Aroclor 1260	mg/L	<0.00005		0.00005	2336517
Total PCB	mg/L	<0.00005		0.00005	2336517
Surrogate Recovery (%)					
2,4,5,6-Tetrachloro-m-xylene	%	80			2336517
Decachlorobiphenyl	%	77			2336517

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Maxxam ID		HX5123	HX5124		
Sampling Date		2010/11/18 10:00	2010/11/18 16:00		
	Units	**SAMPLE 1**	**SAMPLE 2**	**RDL**	**QC Batch**
Metals					
Mercury (Hg)	mg/L	<0.0001	<0.0001	0.0001	2337294

MICROBIOLOGY (WATER)

Maxxam ID		HX5123	HX5124	HX5124		
Sampling Date		2010/11/18 10:00	2010/11/18 16:00	2010/11/18 16:00		
	Units	**SAMPLE 1**	**SAMPLE 2**	**SAMPLE 2 Lab-Dup**	**RDL**	**QC Batch**
Microbiological						
Heterotrophic plate count	CFU/mL	5	41		N/A	2336015
Background	CFU/100mL	25	52	50	N/A	2336014
Total Coliforms	CFU/100mL	0	0	0	N/A	2336014
Escherichia coli	CFU/100mL	0	0	0	N/A	2336014

N/A = Not Applicable
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
2335641	4-Bromofluorobenzene	2010/11/23	100	70 - 130	99	70 - 130	98	%				
2335641	D4-1,2-Dichloroethane	2010/11/23	95	70 - 130	96	70 - 130	98	%				
2335641	D8-Toluene	2010/11/23	101	70 - 130	103	70 - 130	102	%				
2335641	1,1-Dichloroethylene	2010/11/23	87	70 - 130	97	70 - 130	<0.0001	mg/L				
2335641	1,2-Dichlorobenzene	2010/11/23	94	70 - 130	103	70 - 130	<0.0002	mg/L				
2335641	1,2-Dichloroethane	2010/11/23	90	70 - 130	98	70 - 130	<0.0002	mg/L				
2335641	1,4-Dichlorobenzene	2010/11/23	94	70 - 130	103	70 - 130	<0.0002	mg/L				
2335641	Benzene	2010/11/23	92	70 - 130	101	70 - 130	<0.0001	mg/L				
2335641	Carbon Tetrachloride	2010/11/23	102	70 - 130	112	70 - 130	<0.0001	mg/L				
2335641	Chlorobenzene	2010/11/23	93	70 - 130	101	70 - 130	<0.0001	mg/L				
2335641	Methylene Chloride(Dichloromethane)	2010/11/23	94	70 - 130	102	70 - 130	<0.0005	mg/L				
2335641	Tetrachloroethylene	2010/11/23	93	70 - 130	103	70 - 130	<0.0001	mg/L				
2335641	Toluene	2010/11/23	92	70 - 130	102	70 - 130	<0.0002	mg/L				
2335641	Trichloroethylene	2010/11/23	91	70 - 130	99	70 - 130	<0.0001	mg/L				
2335641	Vinyl Chloride	2010/11/23	87	70 - 130	107	70 - 130	<0.0002	mg/L				
2336014	Background	2010/11/20							3.9	N/A		
2336014	Total Coliforms	2010/11/20							NC	N/A		
2336014	Escherichia coli	2010/11/20							NC	N/A		
2336407	Nitrite (N)	2010/11/24	NC	80 - 120	112	85 - 115	<0.01	mg/L	0.6	25		
2336407	Nitrate (N)	2010/11/24	NC	80 - 120	109	85 - 115	<0.1	mg/L	NC	25		
2336409	Alkalinity (Total as CaCO3)	2010/11/22					<1	mg/L	0.1	25	97	85 - 115
2336410	Conductivity	2010/11/22					<1	umho/cm	0.05	25	102	85 - 115
2336446	Diquat	2010/11/22	84	50 - 130	97	50 - 130	<0.007	mg/L	NC	40		
2336446	Paraquat	2010/11/22	71	50 - 130	90	50 - 130	<0.001	mg/L	NC	40		
2336517	2,4,5,6-Tetrachloro-m-xylene	2010/11/22	76	40 - 130	81	40 - 130	76	%				
2336517	Decachlorobiphenyl	2010/11/22	74	40 - 130	65	40 - 130	65	%				
2336517	Lindane	2010/11/22	90	30 - 130	96	30 - 130	<0.00000001	mg/L	2.1	40		
2336517	Heptachlor	2010/11/22	83	30 - 130	86	30 - 130	<0.00000001	mg/L	2.3	40		
2336517	Aldrin	2010/11/22	68	30 - 130	86	30 - 130	<0.00000001	mg/L	2.3	40		
2336517	Heptachlor epoxide	2010/11/22	91	30 - 130	93	30 - 130	<0.00000001	mg/L	3.2	40		
2336517	Oxychlordane	2010/11/22	84	40 - 130	86	40 - 130	<0.00000001	mg/L	2.3	40		
2336517	g-Chlordane	2010/11/22	90	30 - 130	93	30 - 130	<0.00000001	mg/L	1.1	40		
2336517	a-Chlordane	2010/11/22	90	30 - 130	93	30 - 130	<0.00000001	mg/L	1.1	40		
2336517	p,p-DDE	2010/11/22	96	30 - 130	93	30 - 130	<0.00000001	mg/L	1.1	40		
2336517	Dieldrin	2010/11/22	92	36 - 130	94	36 - 130	<0.00000001	mg/L	2.1	40		
2336517	p,p-DDD	2010/11/22	95	30 - 130	96	30 - 130	<0.00000001	mg/L	2.1	40		
2336517	o,p-DDT	2010/11/22	87	40 - 130	89	40 - 130	<0.00000001	mg/L	1.1	40		
2336517	p,p-DDT	2010/11/22	93	30 - 130	89	30 - 130	<0.00000001	mg/L	1.1	40		
2336517	Methoxychlor	2010/11/22	93	40 - 130	92	40 - 130	<0.00000002	mg/L	1.1	40		
2336517	Heptachlor + Heptachlor epoxide	2010/11/22					<0.00000001	mg/L				

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
2336517	Chlordane (Total)	2010/11/22					<0.00000001	mg/L				
2336517	Aldrin + Dieldrin	2010/11/22					<0.00000001	mg/L				
2336517	DDT+ Metabolites	2010/11/22					<0.00000002	mg/L				
2336517	Aroclor 1016	2010/11/22					<0.00000005	mg/L				
2336517	Aroclor 1221	2010/11/22					<0.00000005	mg/L				
2336517	Aroclor 1232	2010/11/22					<0.00000005	mg/L				
2336517	Aroclor 1242	2010/11/22					<0.00000005	mg/L				
2336517	Aroclor 1248	2010/11/22					<0.00000005	mg/L				
2336517	Aroclor 1254	2010/11/22					<0.00000005	mg/L				
2336517	Aroclor 1260	2010/11/22					<0.00000005	mg/L				
2336517	Total PCB	2010/11/22					<0.00000005	mg/L				
2336739	Dissolved Organic Carbon	2010/11/22	100	80 - 120	100	80 - 120	<0.2	mg/L	3.1	20		
2336758	Dissolved Chloride (Cl)	2010/11/23	NC	75 - 125	100	80 - 120	<1	mg/L	0.8	20		
2336760	Dissolved Sulphate (SO4)	2010/11/23	NC	75 - 125	99	80 - 120	<1	mg/L	0.7	25		
2336761	Orthophosphate (P)	2010/11/23	111	75 - 125	102	80 - 120	<0.01	mg/L	NC	25		
2336864	Dissolved Calcium (Ca)	2010/11/22	NC	80 - 120	102	90 - 110	<0.05	mg/L	0.1	25		
2336864	Dissolved Magnesium (Mg)	2010/11/22	95	80 - 120	102	90 - 110	<0.05	mg/L	0.3	25		
2336864	Dissolved Potassium (K)	2010/11/22	101	80 - 120	102	90 - 110	<1	mg/L	4.8	25		
2336864	Dissolved Sodium (Na)	2010/11/22	NC	80 - 120	105	90 - 110	<0.5	mg/L	0.3	25		
2336962	Dissolved Organic Carbon	2010/11/22	NC	80 - 120	93	80 - 120	<0.2	mg/L	2.3	20		
2337182	Alkalinity (Total as CaCO3)	2010/11/22					<1	mg/L	1.3	25	97	85 - 115
2337218	Conductivity	2010/11/22					<1	umho/cm	0.4	25	103	85 - 115
2337294	Mercury (Hg)	2010/11/23	105	75 - 125	103	80 - 120	<0.0001	mg/L	NC	25		
2339127	. Aluminum (Al)	2010/11/24	105	80 - 120	105	90 - 110	<0.005	mg/L	1.6	25		
2339127	. Antimony (Sb)	2010/11/24	110	80 - 120	101	90 - 110	<0.0005	mg/L	NC	25		
2339127	. Arsenic (As)	2010/11/24	102	80 - 120	99	90 - 110	<0.001	mg/L	NC	25		
2339127	. Barium (Ba)	2010/11/24	101	80 - 120	98	90 - 110	<0.005	mg/L	NC	25		
2339127	. Beryllium (Be)	2010/11/24	108	80 - 120	104	90 - 110	<0.0005	mg/L	NC	25		
2339127	. Boron (B)	2010/11/24	110	80 - 120	104	90 - 110	<0.01	mg/L	NC	25		
2339127	. Cadmium (Cd)	2010/11/24	106	80 - 120	100	90 - 110	<0.0001	mg/L	NC	25		
2339127	. Calcium (Ca)	2010/11/24	NC	80 - 120	105	90 - 110	<0.2	mg/L	0.1	25		
2339127	. Chromium (Cr)	2010/11/24	100	80 - 120	101	90 - 110	<0.005	mg/L	NC	25		
2339127	. Cobalt (Co)	2010/11/24	103	80 - 120	100	90 - 110	<0.0005	mg/L	NC	25		
2339127	. Copper (Cu)	2010/11/24	98	80 - 120	98	90 - 110	<0.001	mg/L	0.2	25		
2339127	. Iron (Fe)	2010/11/24	103	80 - 120	102	90 - 110	<0.1	mg/L	NC	25		
2339127	. Lead (Pb)	2010/11/24	98	80 - 120	100	90 - 110	<0.0005	mg/L	NC	25		
2339127	. Magnesium (Mg)	2010/11/24	101	80 - 120	101	90 - 110	<0.05	mg/L	0.9	25		
2339127	. Manganese (Mn)	2010/11/24	104	80 - 120	102	90 - 110	<0.002	mg/L	NC	25		
2339127	. Molybdenum (Mo)	2010/11/24	103	80 - 120	101	90 - 110	<0.001	mg/L	NC	25		
2339127	. Nickel (Ni)	2010/11/24	100	80 - 120	97	90 - 110	<0.001	mg/L	NC	25		

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
2339127	. Phosphorus (P)	2010/11/24	106	80 - 120	109	90 - 110	<0.1	mg/L	NC	25		
2339127	. Potassium (K)	2010/11/24	102	80 - 120	103	90 - 110	<0.2	mg/L	0.2	25		
2339127	. Selenium (Se)	2010/11/24	103	80 - 120	102	90 - 110	<0.002	mg/L	NC	25		
2339127	. Silicon (Si)	2010/11/24	102	80 - 120	104	90 - 110	<0.05	mg/L	0.9	25		
2339127	. Silver (Ag)	2010/11/24	101	80 - 120	98	90 - 110	<0.0001	mg/L	NC	25		
2339127	. Sodium (Na)	2010/11/24	NC	80 - 120	101	90 - 110	<0.1	mg/L	0.7	25		
2339127	. Strontium (Sr)	2010/11/24	100	80 - 120	104	90 - 110	<0.001	mg/L	0.2	25		
2339127	. Thallium (Tl)	2010/11/24	101	80 - 120	101	90 - 110	<0.00005	mg/L	NC	25		
2339127	. Titanium (Ti)	2010/11/24	99	80 - 120	100	90 - 110	<0.005	mg/L	NC	25		
2339127	. Uranium (U)	2010/11/24	98	80 - 120	100	90 - 110	<0.0001	mg/L	NC	25		
2339127	. Vanadium (V)	2010/11/24	101	80 - 120	101	90 - 110	<0.001	mg/L	NC	25		
2339127	. Zinc (Zn)	2010/11/24	100	80 - 120	97	90 - 110	<0.005	mg/L	NC	25		
2339213	Total Ammonia-N	2010/11/25	97	80 - 120	102	85 - 115	<0.05	mg/L	NC	25		
2339216	. Aluminum (Al)	2010/11/24	103	80 - 120	100	90 - 110	<0.005	mg/L				
2339216	. Antimony (Sb)	2010/11/24	106	80 - 120	105	90 - 110	<0.0005	mg/L				
2339216	. Arsenic (As)	2010/11/24	102	80 - 120	97	90 - 110	<0.001	mg/L				
2339216	. Barium (Ba)	2010/11/24	97	80 - 120	99	90 - 110	<0.005	mg/L				
2339216	. Beryllium (Be)	2010/11/24	103	80 - 120	102	90 - 110	<0.0005	mg/L				
2339216	. Boron (B)	2010/11/24	106	80 - 120	106	90 - 110	<0.01	mg/L				
2339216	. Cadmium (Cd)	2010/11/24	101	80 - 120	101	90 - 110	<0.0001	mg/L				
2339216	. Calcium (Ca)	2010/11/24	NC	80 - 120	100	90 - 110	<0.2	mg/L				
2339216	. Chromium (Cr)	2010/11/24	103	80 - 120	98	90 - 110	<0.005	mg/L				
2339216	. Cobalt (Co)	2010/11/24	101	80 - 120	99	90 - 110	<0.0005	mg/L				
2339216	. Copper (Cu)	2010/11/24	99	80 - 120	98	90 - 110	<0.001	mg/L				
2339216	. Iron (Fe)	2010/11/24	105	80 - 120	101	90 - 110	<0.1	mg/L				
2339216	. Lead (Pb)	2010/11/24	98	80 - 120	96	90 - 110	<0.0005	mg/L				
2339216	. Magnesium (Mg)	2010/11/24	NC	80 - 120	98	90 - 110	<0.05	mg/L				
2339216	. Manganese (Mn)	2010/11/24	103	80 - 120	101	90 - 110	<0.002	mg/L				
2339216	. Molybdenum (Mo)	2010/11/24	102	80 - 120	99	90 - 110	<0.001	mg/L				
2339216	. Nickel (Ni)	2010/11/24	98	80 - 120	97	90 - 110	<0.001	mg/L				
2339216	. Phosphorus (P)	2010/11/24	111	80 - 120	101	90 - 110	<0.1	mg/L				
2339216	. Potassium (K)	2010/11/24	106	80 - 120	98	90 - 110	<0.2	mg/L				
2339216	. Selenium (Se)	2010/11/24	104	80 - 120	101	90 - 110	<0.002	mg/L				
2339216	. Silicon (Si)	2010/11/24	104	80 - 120	97	90 - 110	<0.05	mg/L				
2339216	. Silver (Ag)	2010/11/24	99	80 - 120	99	90 - 110	<0.0001	mg/L				
2339216	. Sodium (Na)	2010/11/24	NC	80 - 120	99	90 - 110	<0.1	mg/L	1.3(1)	25		
2339216	. Strontium (Sr)	2010/11/24	NC	80 - 120	97	90 - 110	<0.001	mg/L				
2339216	. Thallium (Tl)	2010/11/24	100	80 - 120	97	90 - 110	<0.00005	mg/L				
2339216	. Titanium (Ti)	2010/11/24	104	80 - 120	98	90 - 110	<0.005	mg/L				
2339216	. Uranium (U)	2010/11/24	100	80 - 120	98	90 - 110	<0.0001	mg/L				

MMM Group Limited
Client Project #: 16-07198-001-HG1

Maxxam Job #: B0G7223
Report Date: 2010/12/01

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
2339216	. Vanadium (V)	2010/11/24	105	80 - 120	100	90 - 110	<0.001	mg/L				
2339216	. Zinc (Zn)	2010/11/24	99	80 - 120	97	90 - 110	<0.005	mg/L				
2341679	Diuron	2010/11/26	92	40 - 130	95	40 - 130	<0.01	mg/L	NC	40		
2341679	Guthion (Azinphos-methyl)	2010/11/26	104	40 - 130	99	40 - 130	<0.002	mg/L				
2341679	Temephos	2010/11/26	68	40 - 130	90	40 - 130	<0.01	mg/L				
2341708	Glyphosate	2010/11/26	68	50 - 130	104	50 - 130	<0.01	mg/L	NC	40		
2343332	2,4,6-Tribromophenol	2010/11/29	94	30 - 130	92	30 - 130	92	%				
2343332	2,4-Dichlorophenyl Acetic Acid	2010/11/29	107	30 - 130	105	30 - 130	113	%				
2343332	2-Fluorobiphenyl	2010/11/29	90	30 - 130	88	30 - 130	90	%				
2343332	D14-Terphenyl (FS)	2010/11/29	98	30 - 130	98	30 - 130	100	%				
2343332	D5-Nitrobenzene	2010/11/29	95	30 - 130	94	30 - 130	97	%				
2343332	2,3,4,6-Tetrachlorophenol	2010/11/29	93	30 - 130	91	30 - 130	<0.0005	mg/L	2.6	40		
2343332	2,4,5-T	2010/11/29	110	30 - 130	107	30 - 130	<0.001	mg/L	2.3	40		
2343332	2,4,6-Trichlorophenol	2010/11/29	96	30 - 130	96	30 - 130	<0.0005	mg/L	3.1	40		
2343332	2,4-D	2010/11/29	111	30 - 130	111	30 - 130	<0.001	mg/L	1.1	40		
2343332	2,4-Dichlorophenol	2010/11/29	90	30 - 130	89	30 - 130	<0.0005	mg/L	3.2	40		
2343332	Alachlor	2010/11/29	120	40 - 130	115	40 - 130	<0.0005	mg/L	3.2	40		
2343332	Aldicarb	2010/11/29	104	40 - 130	98	40 - 130	<0.005	mg/L	5.8	40		
2343332	Atrazine	2010/11/29	83	30 - 130	86	30 - 130	<0.0005	mg/L	1.3	40		
2343332	Des-ethyl atrazine	2010/11/29	47	30 - 130	50	30 - 130	<0.0005	mg/L	1.4	40		
2343332	Atrazine + Desethyl-atrazine	2010/11/29	65	30 - 130	68	30 - 130	<0.000001	mg/L	0.3	40		
2343332	Bendiocarb	2010/11/29	110	40 - 130	105	40 - 130	<0.002	mg/L	0.8	40		
2343332	Bromoxynil	2010/11/29	115	40 - 130	113	40 - 130	<0.0005	mg/L	0.2	40		
2343332	Carbaryl	2010/11/29	121	40 - 130	112	40 - 130	<0.005	mg/L	1.1	40		
2343332	Carbofuran	2010/11/29	111	40 - 130	103	40 - 130	<0.005	mg/L	2.0	40		
2343332	Chlorpyrifos (Dursban)	2010/11/29	121	40 - 130	116	40 - 130	<0.001	mg/L	2.2	40		
2343332	Cyanazine (Bladex)	2010/11/29	60	40 - 130	71	40 - 130	<0.001	mg/L	0.5	40		
2343332	Diazinon	2010/11/29	99	40 - 130	99	40 - 130	<0.001	mg/L	2.1	40		
2343332	Dicamba	2010/11/29	98	30 - 130	100	30 - 130	<0.001	mg/L	0.8	40		
2343332	Diclofop-methyl	2010/11/29	130	40 - 130	102	40 - 130	<0.0009	mg/L	22.8	40		
2343332	Dimethoate	2010/11/29	94	40 - 130	93	40 - 130	<0.003	mg/L	3.2	40		
2343332	Dinoseb	2010/11/29	123	40 - 130	117	40 - 130	<0.001	mg/L	0.8	40		
2343332	Malathion	2010/11/29	102	40 - 130	101	40 - 130	<0.005	mg/L	0.5	40		
2343332	Metolachlor	2010/11/29	115	40 - 130	109	40 - 130	<0.0005	mg/L	0.4	40		
2343332	Metribuzin (Sencor)	2010/11/29	80	40 - 130	71	40 - 130	<0.005	mg/L	1.7	40		
2343332	Ethyl Parathion	2010/11/29	117	40 - 130	110	40 - 130	<0.001	mg/L	0.9	40		
2343332	Pentachlorophenol	2010/11/29	105	25 - 130	101	25 - 130	<0.0005	mg/L	1.2	40		
2343332	Phorate	2010/11/29	98	40 - 130	95	40 - 130	<0.0005	mg/L	1.8	40		
2343332	Picloram	2010/11/29	64	10 - 130	67	10 - 130	<0.005	mg/L	5.0	40		
2343332	Prometryne	2010/11/29	117	30 - 130	112	30 - 130	<0.0003	mg/L	0.9	40		

Maxxam Job #: B0G7223
Report Date: 2010/12/01

MMM Group Limited
Client Project #: 16-07198-001-HG1

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
2343332	Simazine	2010/11/29	75	40 - 130	78	40 - 130	<0.001	mg/L	0.06	40		
2343332	Terbufos	2010/11/29	101	40 - 130	100	40 - 130	<0.0005	mg/L	5.5	40		
2343332	Triallate	2010/11/29	119	40 - 130	114	40 - 130	<0.001	mg/L	0.4	40		
2343332	Trifluralin	2010/11/29	114	40 - 130	111	40 - 130	<0.001	mg/L	1.8	40		
2343332	Benzo(a)pyrene	2010/11/29	91	30 - 130	86	30 - 130	<0.000009	mg/L	2.4	40		

N/A = Not Applicable
RPD = Relative Percent Difference
Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.
Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.
QC Standard: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.
Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.
Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.
Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.
NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was not sufficiently significant to permit a reliable recovery calculation.
NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.
(1) - POTENTIAL EXCEEDENCE FOR PARAMETER

Validation Signature Page

Maxxam Job #: B0G7223

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

CHARLES ANCKER, B.Sc., M.Sc., C.Chem, Senior Analyst

CRISTINA CARRIERE, Scientific Services

FLOYD MAYEDE, Senior Analyst

MAXIMA HERMANEZ, SENIOR ANALYST

Validation Signature Page

Maxxam Job #: B0G7223

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

ROBERT MACAULAY, Senior Analyst

==

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

19-Nov-10 15:23
SEAN CONACHER
B0G7223
SEL ENV-821

Maxxam — MICRO

Maxxam Analytics International Corporation o/a Maxxam Analytics
6740 Campobello Road, Mississauga, Ontario Canada L5N 2L8 Tel:(905) 817-5700 Toll-free:800-563-6266 Fax:(905) 817 5779 www.maxxam.ca

CHAIN OF CUSTODY

Page 1 of 1

INVOICE INFORMATION:		REPORT INFORMATION (if differs from invoice):		PROJECT INFORMATION:	
Company Name:	#22101 MMM Group Limited	Company Name:		Quotation #:	A94264
Contact Name:	Annette Blazeiko	Contact Name:	Natalia Codoban	P.O. #:	
Address:	100 Commerce Valley Dr W, Thornhill ON L3T 0A1	Address:		Project #:	16-07198-001-HG1
				Project Name:	
Phone:	(905)882-4211 x6237 Fax: (905)882-0055	Phone:	Fax:	Site #:	
Email:	blazeikoa@mmm.ca, FergusonJonesA@mmm.ca	Email:	codobann@mmm.ca	Sampled By:	

Laboratory Use Only: BOTTLE ORDER #: 221491 | CHAIN OF CUSTODY #: C#221491-01-01 | PROJECT MANAGER: SEAN CONACHER

REGULATORY CRITERIA:

☐ MISA Reg. 153/04: ☐ Table 1 ☐ Table 2 ☐ Table 3 ☐ Table 6; ☐ Residential/Parkland ☐ Industrial/Commercial ☐ Medium/Fine ☐ Coarse
☐ PWQO
☐ Reg. 558
Sewer Use: ☐ Sanitary ☐ Storm ☐ Combined
Municipality ______
Other (specify) ______ Report Criteria on C of A? ☐

Reg. 153 ☐ 2004 ☐ 2011

SPECIAL INSTRUCTIONS

Note: For regulated drinking water samples - please use the Drinking Water Chain of Custody Form

SAMPLES MUST BE KEPT COOL (< 10°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

ANALYSIS REQUESTED (Please be specific):

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Regulated Drinking Water ? (Y / N)	Metals Field Filtered ? (Y / N)	Coliform/ E. coli, CFU/100mL	Heterotrophic plate count, (CFU/mL)	RCAp - Comprehensive (Drinking Water)	Mercury in Water by CVAA	Reg 170, Schedule 24						# of Bottles	Comments
1		Sample 1	Nov. 18	10 am	WT			✓	✓	✓	✓								Any extra bottles
2		Sample 2	Nov. 18	4pm	WT			✓	✓	✓	✓	✓							please put on hold.
3					WT														
4					WT														
5																			
6																			
7																			
8																			
9																			
10																			

TURNAROUND TIME (TAT) REQUIRED:

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS

Regular (Standard) TAT: ☑
(will be applied if Rush TAT is not specified):
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission) ☐
Date Required: ______ Time Required: ______
Rush Confirmation Number: ______ *(call lab for #)*

*RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time:	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time:	# Jars Used and Not Submitted	Laboratory Use Only		
Annette Blazeiko [signature]	10/11/19		[signature]	2010/11/19	15:23		Time Sensitive ☒	Temperature (°C) on Receipt: 3/3/2 °C	Custody Seal Intact on Cooler? ☐ Yes ☐ No

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

White: Maxxam Yellow: Client

Table D-7: Summary of Analytical Results in Soil
Metals and Inorganics and PHCs
Harris River Rest Area, Highway 69, ON

Sample ID Depth (m) Maxxam Job # Sampling Date	MOE Table 1 Standards	MOE Table 8 Standards	REPORTING LIMIT	Units	MMM11-01 (Avg.) 0.0-1.20 m B1H4101 11/2/11
Metals and Inorganics					
Antimony	1	1.3	0.2	ug/g	0.4
Arsenic	11	18	1	ug/g	1
Barium	210	220	0.5	ug/g	9.5
Beryllium	2.5	2.5	0.2	ug/g	<0.2
Boron (Hot Water Soluble)	NV	1.5	0.05	ug/g	0.07
Cadmium	1	1.2	0.1	ug/g	<0.1
Chromium	67	70	1	ug/g	7.5
Chromium VI	0.66	0.66	0.2	ug/g	0.3
Cobalt	19	22	0.1	ug/g	1.7
Copper	62	92	0.5	ug/g	4.6
Lead	45	120	1	ug/g	11
Mercury	0.16	0.27	0.05	ug/g	<0.05
Molybdenum	2	2	0.5	ug/g	<0.5
Nickel	37	82	0.5	ug/g	3.7
Selenium	1.2	1.5	0.5	ug/g	<0.5
Silver	0.5	0.5	0.2	ug/g	<0.2
Thallium	1	1	0.05	ug/g	<0.05
Vanadium	86	86	5	ug/g	10
Zinc	290	290	5	ug/g	10
pH (pH Units)	5 to 9	5 to 9	-	pH	5.1
Conductivity (ms/cm)	0.47	0.7	0.002	mS/cm	0.05
Sodium Absorption Ratio	1	5	-	N/A	0.88
Cyanide, Free	0.051	0.051	0.01	ug/g	0.01
Boron (Total)	36	36	5	ug/g	<5
Uranium	1.9	2.5	0.05	ug/g	0.28
Petroleum Hydrocarbon Compounds (PHCs)					
Benzene	0.02	0.02	0.02	ug/g	<0.02
Toluene	0.2	0.2	0.02	ug/g	<0.02
Ethylbenzene	0.05	0.05	0.02	ug/g	<0.02
Total Xylenes	0.05	0.05	0.04	ug/g	<0.04
F1 (C6-C10)	17	25	10	ug/g	<10
F2 (C10-C16)	10	10	10	ug/g	<10
F3 (C16-C34)	240	240	10	ug/g	<10
F4 (C34-C50)	120	120	10	ug/g	<10

Notes:
'NV ' : No Standard established NA: Parameter not analyzed
Ontario Ministry of the Environment, "Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act, " March 2004, amended April 15, 2011. Table 1: Full Depth Background Site Condition Standards and Table 8: Generic Site Condition Standards for Use within 30 m of a Water Body in a Potable Ground Water Condition for Residential/Parkland/Institutional/Industrial/Commercial/Community Property Use

100	Exceeds MOE Standard Value

Table D-8: Summary of Relative Percent Difference (RPD) Results in Soil
Harris River Rest Area, Hwy 69, ON

Parameter	Sample[1]	Duplicate[1]	% Difference
	MMM11-01	DUP 1	
Metals and Inorganics			
Antimony	<0.2	0.4	-
Arsenic	<1	1	-
Barium	9.2	9.7	-5.3%
Beryllium	<0.2	<0.2	-
Boron (Hot Water Soluble)	<0.05	0.07	-
Cadmium	<0.1	<0.1	-
Chromium	6	9	-40.0%
Chromium VI	0.3	<0.2	-
Cobalt	1.2	2.1	-54.5%
Copper	4.1	5	-19.8%
Lead	<1	11	> 167 %
Mercury	<0.05	<0.05	-
Molybdenum	<0.5	<0.5	-
Nickel	2.6	4.8	-59.5%
Selenium	<0.5	<0.5	-
Silver	<0.2	<0.2	-
Thallium	<0.05	<0.05	-
Vanadium	10	10	0.0%
Zinc	7	13	-60.0%
pH (pH Units)	4.85	5.62	-14.7%
Conductivity (ms/cm)	0.068	0.03	77.6%
Sodium Absorption Ratio	0.45	1.3	-97.1%
Cyanide, Free	<0.01	0.01	-
Boron (Total)	<5	<5	-
Uranium	0.3	0.25	18.2%
Parameter	**Sample[1]**	**Duplicate[1]**	**% Difference**
	MMM11-01	**DUP 1**	
Petroleum Hydrocarbon Compounds (PHCs)			
Benzene	<0.02	<0.02	-
Toluene	<0.02	<0.02	-
Ethylbenzene	<0.02	<0.02	-
m/p xylenes	<0.04	<0.04	-
o xylene	<0.02	<0.02	-
Total Xylenes	<0.04	<0.04	-
F1 (C6-C10)	<10	<10	-
F1 (C6-C10) - BTEX	<10	<10	-
F2 (C10-C16)	<10	<10	-
F3 (C16-C34)	<10	<10	-
F4 (C34-C50)	<10	<10	-

Notes:

(1)	All results reported in micrograms per gram (µg/g) unless
<	Parameter not detected above value specified
% Difference	Relative Percent Difference = |(X-Y)/Average(X,Y)| x 100% where X is the sample and Y is the duplicate
-	RPD could not be calculated.

Maxxam

Success Through Science®

Your Project #: 16-07198-001-EN4
Your C.O.C. #: 30471901, 304719-01-01

Attention: Andy Lee
MMM Group Limited
100 Commerce Valley Dr W
Thornhill, ON
CANADA L3T 0A1

Report Date: 2011/11/21

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B1H4101
Received: 2011/11/04, 14:28

Sample Matrix: Soil
Samples Received: 3

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Method Reference
Hot Water Extractable Boron	1	2011/11/09	2011/11/10	CAM SOP-00408	R153 Ana. Prot. 2011
Hot Water Extractable Boron	1	2011/11/10	2011/11/10	CAM SOP-00408	R153 Ana. Prot. 2011
Free (WAD) Cyanide	1	N/A	2011/11/09	CAM SOP-00457	SM 4500CN-I
Free (WAD) Cyanide	1	N/A	2011/11/10	CAM SOP-00457	SM 4500CN-I
Conductivity	1	N/A	2011/11/09	CAM SOP-00414	APHA 2510
Conductivity	1	N/A	2011/11/10	CAM SOP-00414	APHA 2510
Hexavalent Chromium in Soil by IC (1)	1	N/A	2011/11/15	CAM SOP-00436	EPA SW846-3060/7199
Hexavalent Chromium in Soil by IC (1)	1	N/A	2011/11/18	CAM SOP-00436	EPA SW846-3060/7199
Petroleum Hydro. CCME F1 & BTEX in Soil	2	2011/11/05	2011/11/09	CAM SOP-00315	CCME CWS
Petroleum Hydro. CCME F1 & BTEX in Soil	1	2011/11/08	2011/11/09	CAM SOP-00315	CCME CWS
Petroleum Hydrocarbons F2-F4 in Soil	2	2011/11/10	2011/11/10	CAM SOP-00316	CCME CWS
Acid Extr. Metals (aqua regia) by ICPMS	1	2011/11/09	2011/11/09	CAM SOP-00447	EPA 6020
Acid Extr. Metals (aqua regia) by ICPMS	1	2011/11/10	2011/11/10	CAM SOP-00447	EPA 6020
Moisture	2	N/A	2011/11/08	CAM SOP-00445	McKeague 2nd ed 1978
pH CaCl2 EXTRACT	1	2011/11/09	2011/11/09	CAM SOP-00413	SM 4500 H
pH CaCl2 EXTRACT	1	2011/11/10	2011/11/10	CAM SOP-00413	SM 4500 H
Sodium Adsorption Ratio (SAR)	1	2011/11/05	2011/11/09	CAM SOP-00102	EPA 6010
Sodium Adsorption Ratio (SAR)	1	2011/11/05	2011/11/11	CAM SOP-00102	EPA 6010

Remarks:

Maxxam Analytics has performed all analytical testing herein in accordance with ISO 17025 and the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act. All methodologies comply with this document and are validated for use in the laboratory. The methods and techniques employed in this analysis conform to the performance criteria (detection limits, accuracy and precision) as outlined in the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act.

The CWS PHC methods employed by Maxxam conform to all prescribed elements of the reference method and performance based elements have been validated. All modifications have been validated and proven equivalent following the 'Alberta Environment Draft Addenda to the CWS-PHC, Appendix 6, Validation of Alternate Methods'. Documentation is available upon request. Maxxam has made the following improvements to the CWS-PHC reference benchmark method: (i) Headspace for F1; and, (ii) Mechanical extraction for F2-F4. Note: F4G cannot be added to the C6 to C50 hydrocarbons. The extraction date for samples field preserved with methanol for F1 and Volatile Organic Compounds is considered to be the date sampled.

Maxxam Analytics is accredited by SCC (Lab ID 97) for all specific parameters as required by Ontario Regulation 153/04. Maxxam Analytics is limited in liability to the actual cost of analysis unless otherwise agreed in writing. There is no other warranty expressed or implied. Samples will be retained at Maxxam Analytics for three weeks from receipt of data or as per contract.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
* Results relate only to the items tested.

(1) Soils are reported on a dry weight basis unless otherwise specified.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

JOLANTA GORALCZYK, Project Manager
Email: JGoralczyk@maxxam.ca
Phone# (905) 817-5700

==
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Total cover pages: 1

MMM Group Limited
Client Project #: 16-07198-001-EN4

Maxxam Job #: B1H4101
Report Date: 2011/11/21

O'REG 153 INORGANICS PACKAGE (SOIL)

Maxxam ID		LN2150	LN2150		LN2151	LN2151		
Sampling Date		2011/11/02	2011/11/02		2011/11/02	2011/11/02		
	Units	**MMM11-01**	**MMM11-01 Lab-Dup**	**QC Batch**	**DUP 1**	**DUP 1 Lab-Dup**	**RDL**	**QC Batch**
Calculated Parameters								
Sodium Adsorption Ratio	N/A	0.45		2672438	1.3			2672438
Inorganics								
Chromium (VI)	ug/g	0.3		2677144	<0.2		0.2	2677129
Conductivity	mS/cm	0.068		2676540	0.030	0.030	0.002	2677720
Free Cyanide	ug/g	<0.01		2674678	0.01	<0.01	0.01	2676008
Available (CaCl2) pH	pH	4.85	4.86	2677651	5.62			2676588
Metals								
Hot Water Ext. Boron (B)	ug/g	<0.05		2676374	0.07		0.05	2677508
Acid Extractable Antimony (Sb)	ug/g	<0.2		2676268	0.4		0.2	2677505
Acid Extractable Arsenic (As)	ug/g	<1		2676268	1		1	2677505
Acid Extractable Barium (Ba)	ug/g	9.2		2676268	9.7		0.5	2677505
Acid Extractable Beryllium (Be)	ug/g	<0.2		2676268	<0.2		0.2	2677505
Acid Extractable Boron (B)	ug/g	<5		2676268	<5		5	2677505
Acid Extractable Cadmium (Cd)	ug/g	<0.1		2676268	<0.1		0.1	2677505
Acid Extractable Chromium (Cr)	ug/g	6		2676268	9		1	2677505
Acid Extractable Cobalt (Co)	ug/g	1.2		2676268	2.1		0.1	2677505
Acid Extractable Copper (Cu)	ug/g	4.1		2676268	5.0		0.5	2677505
Acid Extractable Lead (Pb)	ug/g	<1		2676268	11		1	2677505
Acid Extractable Molybdenum (Mo)	ug/g	<0.5		2676268	<0.5		0.5	2677505
Acid Extractable Nickel (Ni)	ug/g	2.6		2676268	4.8		0.5	2677505
Acid Extractable Selenium (Se)	ug/g	<0.5		2676268	<0.5		0.5	2677505
Acid Extractable Silver (Ag)	ug/g	<0.2		2676268	<0.2		0.2	2677505
Acid Extractable Thallium (Tl)	ug/g	<0.05		2676268	<0.05		0.05	2677505
Acid Extractable Uranium (U)	ug/g	0.30		2676268	0.25		0.05	2677505
Acid Extractable Vanadium (V)	ug/g	10		2676268	10		5	2677505
Acid Extractable Zinc (Zn)	ug/g	7		2676268	13		5	2677505
Acid Extractable Mercury (Hg)	ug/g	<0.05		2676268	<0.05		0.05	2677505

N/A = Not Applicable
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Maxxam Job #: B1H4101
Report Date: 2011/11/21

MMM Group Limited
Client Project #: 16-07198-001-EN4

O'REG 153 PETROLEUM HYDROCARBONS (SOIL)

Maxxam ID		LN2150	LN2150	LN2151		
Sampling Date		2011/11/02	2011/11/02	2011/11/02		
	Units	**MMM11-01**	**MMM11-01 Lab-Dup**	**DUP 1**	**RDL**	**QC Batch**
Inorganics						
Moisture	%	18		24	1	2675245
BTEX & F1 Hydrocarbons						
Benzene	ug/g	<0.02	<0.02	<0.02	0.02	2675962
Toluene	ug/g	<0.02	<0.02	<0.02	0.02	2675962
Ethylbenzene	ug/g	<0.02	<0.02	<0.02	0.02	2675962
o-Xylene	ug/g	<0.02	<0.02	<0.02	0.02	2675962
p+m-Xylene	ug/g	<0.04	<0.04	<0.04	0.04	2675962
Total Xylenes	ug/g	<0.04	<0.04	<0.04	0.04	2675962
F1 (C6-C10)	ug/g	<10	<10	<10	10	2675962
F1 (C6-C10) - BTEX	ug/g	<10	<10	<10	10	2675962
F2-F4 Hydrocarbons						
F2 (C10-C16 Hydrocarbons)	ug/g	<10		<10	10	2677658
F3 (C16-C34 Hydrocarbons)	ug/g	<10		<10	10	2677658
F4 (C34-C50 Hydrocarbons)	ug/g	<10		<10	10	2677658
Reached Baseline at C50	ug/g	YES		YES		2677658
Surrogate Recovery (%)						
1,4-Difluorobenzene	%	100	100	102		2675962
4-Bromofluorobenzene	%	99	98	97		2675962
D10-Ethylbenzene	%	89	89	91		2675962
D4-1,2-Dichloroethane	%	99	98	99		2675962
o-Terphenyl	%	94		96		2677658

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Maxxam Job #: B1H4101
Report Date: 2011/11/21

MMM Group Limited
Client Project #: 16-07198-001-EN4

PETROLEUM HYDROCARBONS (CCME)

Maxxam ID		LN2152		
Sampling Date		2011/11/02		
	Units	**TRIP BLANK**	**RDL**	**QC Batch**
BTEX & F1 Hydrocarbons				
Benzene	ug/g	<0.02	0.02	2676408
Toluene	ug/g	<0.02	0.02	2676408
Ethylbenzene	ug/g	<0.02	0.02	2676408
o-Xylene	ug/g	<0.02	0.02	2676408
p+m-Xylene	ug/g	<0.04	0.04	2676408
Total Xylenes	ug/g	<0.04	0.04	2676408
F1 (C6-C10)	ug/g	<10	10	2676408
F1 (C6-C10) - BTEX	ug/g	<10	10	2676408
Surrogate Recovery (%)				
1,4-Difluorobenzene	%	103		2676408
4-Bromofluorobenzene	%	100		2676408
D10-Ethylbenzene	%	90		2676408
D4-1,2-Dichloroethane	%	100		2676408

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Maxxam Job #: B1H4101
Report Date: 2011/11/21

MMM Group Limited
Client Project #: 16-07198-001-EN4

Test Summary

Maxxam ID LN2150
Sample ID MMM11-01
Matrix Soil

Collected 2011/11/02
Shipped
Received 2011/11/04

Test Description	Instrumentation	Batch	Extracted	Analyzed	Analyst
Hot Water Extractable Boron	ICP	2676374	2011/11/09	2011/11/10	AZITA FAZAELI
Free (WAD) Cyanide	TECH	2674678	N/A	2011/11/09	LOUISE HARDING
Conductivity	COND	2676540	N/A	2011/11/09	NEIL DASSANAYAKE
Hexavalent Chromium in Soil by IC	IC/SPEC	2677144	N/A	2011/11/18	LUSINE KHACHATRYAN
Petroleum Hydro. CCME F1 & BTEX in Soil	HSGC/MSFD	2675962	2011/11/05	2011/11/09	ABDIKARIM ALI
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	2677658	2011/11/10	2011/11/10	JEEVARAJ JEEVARATRNAM
Acid Extr. Metals (aqua regia) by ICPMS	ICP/MS	2676268	2011/11/09	2011/11/09	HUA REN
Moisture	BAL	2675245	N/A	2011/11/08	LAKHVIR KALER
pH CaCl2 EXTRACT		2677651	2011/11/10	2011/11/10	XUANHONG QIU
Sodium Adsorption Ratio (SAR)	CALC/MET	2672438	2011/11/09	2011/11/09	AUTOMATED STATCHK

Maxxam ID LN2150 Dup
Sample ID MMM11-01
Matrix Soil

Collected 2011/11/02
Shipped
Received 2011/11/04

Test Description	Instrumentation	Batch	Extracted	Analyzed	Analyst
Petroleum Hydro. CCME F1 & BTEX in Soil	HSGC/MSFD	2675962	2011/11/05	2011/11/09	ABDIKARIM ALI
pH CaCl2 EXTRACT		2677651	2011/11/10	2011/11/10	XUANHONG QIU

Maxxam ID LN2151
Sample ID DUP 1
Matrix Soil

Collected 2011/11/02
Shipped
Received 2011/11/04

Test Description	Instrumentation	Batch	Extracted	Analyzed	Analyst
Hot Water Extractable Boron	ICP	2677508	2011/11/10	2011/11/10	AZITA FAZAELI
Free (WAD) Cyanide	TECH	2676008	N/A	2011/11/10	LOUISE HARDING
Conductivity	COND	2677720	N/A	2011/11/10	NEIL DASSANAYAKE
Hexavalent Chromium in Soil by IC	IC/SPEC	2677129	N/A	2011/11/15	CHRIS LI
Petroleum Hydro. CCME F1 & BTEX in Soil	HSGC/MSFD	2675962	2011/11/05	2011/11/09	ABDIKARIM ALI
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	2677658	2011/11/10	2011/11/10	JEEVARAJ JEEVARATRNAM
Acid Extr. Metals (aqua regia) by ICPMS	ICP/MS	2677505	2011/11/10	2011/11/10	HUA REN
Moisture	BAL	2675245	N/A	2011/11/08	LAKHVIR KALER

Test Summary

pH CaCl2 EXTRACT		2676588	2011/11/09	2011/11/09	XUANHONG QIU
Sodium Adsorption Ratio (SAR)	CALC/MET	2672438	2011/11/11	2011/11/11	AUTOMATED STATCHK

Maxxam ID LN2151 Dup
Sample ID DUP 1
Matrix Soil

Collected 2011/11/02
Shipped
Received 2011/11/04

Test Description	Instrumentation	Batch	Extracted	Analyzed	Analyst
Free (WAD) Cyanide	TECH	2676008	N/A	2011/11/10	LOUISE HARDING
Conductivity	COND	2677720	N/A	2011/11/10	NEIL DASSANAYAKE

Maxxam ID LN2152
Sample ID TRIP BLANK
Matrix Soil

Collected 2011/11/02
Shipped
Received 2011/11/04

Test Description	Instrumentation	Batch	Extracted	Analyzed	Analyst
Petroleum Hydro. CCME F1 & BTEX in Soil	HSGC/MSFD	2676408	2011/11/08	2011/11/09	ANCA GANEA

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GENERAL COMMENTS

Sample LN2150-01: SAR Analysis: Sodium was not detected. To report SAR the sodium detection limit was used in the calculation. This value represents a maximum ratio.

Sample LN2151-01: SAR Analysis: Sodium was not detected. To report SAR the sodium detection limit was used in the calculation. This value represents a maximum ratio.

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Maxxam Job #: B1H4101
Report Date: 2011/11/21

MMM Group Limited
Client Project #: 16-07198-001-EN4

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	**Parameter**	**Date**	**% Recovery**	**QC Limits**	**% Recovery**	**QC Limits**	**Value**	**Units**	**Value (%)**	**QC Limits**	**% Recovery**	**QC Limits**
2674678	Free Cyanide	2011/11/09	102	75 - 125	106	75 - 125	<0.01	ug/g	NC	35		
2675245	Moisture	2011/11/08							3.5	20		
2675962	1,4-Difluorobenzene	2011/11/09	99	60 - 140	100	60 - 140	100	%				
2675962	4-Bromofluorobenzene	2011/11/09	101	60 - 140	102	60 - 140	99	%				
2675962	D10-Ethylbenzene	2011/11/09	107	60 - 140	91	60 - 140	88	%				
2675962	D4-1,2-Dichloroethane	2011/11/09	103	60 - 140	98	60 - 140	99	%				
2675962	Benzene	2011/11/09	103	60 - 140	87	60 - 140	<0.02	ug/g	NC	50		
2675962	Toluene	2011/11/09	103	60 - 140	89	60 - 140	<0.02	ug/g	NC	50		
2675962	Ethylbenzene	2011/11/09	107	60 - 140	93	60 - 140	<0.02	ug/g	NC	50		
2675962	o-Xylene	2011/11/09	112	60 - 140	94	60 - 140	<0.02	ug/g	NC	50		
2675962	p+m-Xylene	2011/11/09	104	60 - 140	92	60 - 140	<0.04	ug/g	NC	50		
2675962	F1 (C6-C10)	2011/11/09	100	60 - 140	88	60 - 140	<10	ug/g	NC	50		
2675962	Total Xylenes	2011/11/09					<0.04	ug/g	NC	50		
2675962	F1 (C6-C10) - BTEX	2011/11/09					<10	ug/g	NC	50		
2676008	Free Cyanide	2011/11/10	116	75 - 125	105	75 - 125	<0.01	ug/g	NC	35		
2676268	Acid Extractable Antimony (Sb)	2011/11/09	95	75 - 125	91	75 - 125	<0.2	ug/g	7.8	30		
2676268	Acid Extractable Arsenic (As)	2011/11/09	104	75 - 125	94	75 - 125	<1	ug/g	NC	30		
2676268	Acid Extractable Barium (Ba)	2011/11/09	NC(1)	75 - 125	92	75 - 125	<0.5	ug/g	0.2	30		
2676268	Acid Extractable Beryllium (Be)	2011/11/09	99	75 - 125	91	75 - 125	<0.2	ug/g	NC	30		
2676268	Acid Extractable Boron (B)	2011/11/09	99	75 - 125	88	75 - 125	<5	ug/g	NC	30		
2676268	Acid Extractable Cadmium (Cd)	2011/11/09	101	75 - 125	92	75 - 125	<0.1	ug/g	NC	30		
2676268	Acid Extractable Chromium (Cr)	2011/11/09	116	75 - 125	102	75 - 125	<1	ug/g	2.6	30		
2676268	Acid Extractable Cobalt (Co)	2011/11/09	108	75 - 125	97	75 - 125	<0.1	ug/g	5.6	30		
2676268	Acid Extractable Copper (Cu)	2011/11/09	NC(1)	75 - 125	97	75 - 125	<0.5	ug/g	2.7	30		
2676268	Acid Extractable Lead (Pb)	2011/11/09	NC(1)	75 - 125	96	75 - 125	<1	ug/g	9.3	30		
2676268	Acid Extractable Molybdenum (Mo)	2011/11/09	102	75 - 125	93	75 - 125	<0.5	ug/g	NC	30		
2676268	Acid Extractable Nickel (Ni)	2011/11/09	109	75 - 125	99	75 - 125	<0.5	ug/g	19.4	30		
2676268	Acid Extractable Selenium (Se)	2011/11/09	101	75 - 125	93	75 - 125	<0.5	ug/g	NC	30		
2676268	Acid Extractable Silver (Ag)	2011/11/09	102	75 - 125	94	75 - 125	<0.2	ug/g	NC	30		
2676268	Acid Extractable Thallium (Tl)	2011/11/09	90	75 - 125	94	75 - 125	<0.05	ug/g	NC	30		
2676268	Acid Extractable Uranium (U)	2011/11/09	106	75 - 125	96	75 - 125	<0.05	ug/g	6.4	30		
2676268	Acid Extractable Vanadium (V)	2011/11/09	115	75 - 125	98	75 - 125	<5	ug/g	NC	30		
2676268	Acid Extractable Zinc (Zn)	2011/11/09	NC(1)	75 - 125	98	75 - 125	<5	ug/g	3.5	30		
2676268	Acid Extractable Mercury (Hg)	2011/11/09	NC(1)	75 - 125	95	75 - 125	<0.05	ug/g	10.4	30		
2676374	Hot Water Ext. Boron (B)	2011/11/10					<0.05	ug/g	7.5	35	94	85 - 115
2676408	1,4-Difluorobenzene	2011/11/09	102	60 - 140	103	60 - 140	103	%				
2676408	4-Bromofluorobenzene	2011/11/09	102	60 - 140	101	60 - 140	99	%				
2676408	D10-Ethylbenzene	2011/11/09	98	60 - 140	93	60 - 140	96	%				
2676408	D4-1,2-Dichloroethane	2011/11/09	96	60 - 140	100	60 - 140	99	%				
2676408	Benzene	2011/11/09	88	60 - 140	85	60 - 140	<0.02	ug/g				

MMM Group Limited
Client Project #: 16-07198-001-EN4

Maxxam Job #: B1H4101
Report Date: 2011/11/21

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
2676408	Toluene	2011/11/09	97	60 - 140	95	60 - 140	<0.02	ug/g				
2676408	Ethylbenzene	2011/11/09	100	60 - 140	98	60 - 140	<0.02	ug/g				
2676408	o-Xylene	2011/11/09	107	60 - 140	102	60 - 140	<0.02	ug/g				
2676408	p+m-Xylene	2011/11/09	99	60 - 140	97	60 - 140	<0.04	ug/g				
2676408	F1 (C6-C10)	2011/11/10	97	60 - 140	82	60 - 140	<10	ug/g	NC	50		
2676408	Total Xylenes	2011/11/09					<0.04	ug/g				
2676408	F1 (C6-C10) - BTEX	2011/11/10					<10	ug/g	NC	50		
2676540	Conductivity	2011/11/09					<0.002	mS/cm	1.0	35	102	75 - 125
2677129	Chromium (VI)	2011/11/15	87	75 - 125	94	75 - 125	<0.2	ug/g	NC	35	100	75 - 125
2677144	Chromium (VI)	2011/11/18	95	75 - 125	101	75 - 125	<0.2	ug/g	NC	35	115	75 - 125
2677505	Acid Extractable Antimony (Sb)	2011/11/10	96	75 - 125	105	75 - 125	<0.2	ug/g	NC	30		
2677505	Acid Extractable Arsenic (As)	2011/11/10	101	75 - 125	103	75 - 125	<1	ug/g	NC	30		
2677505	Acid Extractable Barium (Ba)	2011/11/10	NC	75 - 125	103	75 - 125	<0.5	ug/g	0.1	30		
2677505	Acid Extractable Beryllium (Be)	2011/11/10	98	75 - 125	102	75 - 125	<0.2	ug/g	NC	30		
2677505	Acid Extractable Boron (B)	2011/11/10	92	75 - 125	98	75 - 125	<5	ug/g	NC	30		
2677505	Acid Extractable Cadmium (Cd)	2011/11/10	100	75 - 125	105	75 - 125	<0.1	ug/g	NC	30		
2677505	Acid Extractable Chromium (Cr)	2011/11/10	104	75 - 125	108	75 - 125	<1	ug/g	0.3	30		
2677505	Acid Extractable Cobalt (Co)	2011/11/10	99	75 - 125	103	75 - 125	<0.1	ug/g	0.4	30		
2677505	Acid Extractable Copper (Cu)	2011/11/10	98	75 - 125	104	75 - 125	<0.5	ug/g	0.2	30		
2677505	Acid Extractable Lead (Pb)	2011/11/10	102	75 - 125	108	75 - 125	<1	ug/g	2.7	30		
2677505	Acid Extractable Molybdenum (Mo)	2011/11/10	98	75 - 125	103	75 - 125	<0.5	ug/g	NC	30		
2677505	Acid Extractable Nickel (Ni)	2011/11/10	101	75 - 125	103	75 - 125	<0.5	ug/g	2.5	30		
2677505	Acid Extractable Selenium (Se)	2011/11/10	101	75 - 125	104	75 - 125	<0.5	ug/g	NC	30		
2677505	Acid Extractable Silver (Ag)	2011/11/10	100	75 - 125	106	75 - 125	<0.2	ug/g	NC	30		
2677505	Acid Extractable Thallium (Tl)	2011/11/10	99	75 - 125	106	75 - 125	<0.05	ug/g	NC	30		
2677505	Acid Extractable Uranium (U)	2011/11/10	103	75 - 125	109	75 - 125	<0.05	ug/g	4.1	30		
2677505	Acid Extractable Vanadium (V)	2011/11/10	104	75 - 125	102	75 - 125	<5	ug/g	NC	30		
2677505	Acid Extractable Zinc (Zn)	2011/11/10	NC	75 - 125	106	75 - 125	<5	ug/g	0.3	30		
2677505	Acid Extractable Mercury (Hg)	2011/11/10	99	75 - 125	107	75 - 125	<0.05	ug/g	NC	30		
2677508	Hot Water Ext. Boron (B)	2011/11/10					<0.05	ug/g			99	85 - 115
2677658	o-Terphenyl	2011/11/10	110	50 - 130	108	50 - 130	106	%				
2677658	F2 (C10-C16 Hydrocarbons)	2011/11/10	112	50 - 130	110	70 - 130	<10	ug/g	NC	30		
2677658	F3 (C16-C34 Hydrocarbons)	2011/11/10	114	50 - 130	112	70 - 130	<10	ug/g	NC	30		

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QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
2677658	F4 (C34-C50 Hydrocarbons)	2011/11/10	111	50 - 130	109	70 - 130	<10	ug/g	NC	30		
2677720	Conductivity	2011/11/10					<0.002	mS/cm	1.3	35	102	75 - 125

N/A = Not Applicable

RPD = Relative Percent Difference

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.

Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was not sufficiently significant to permit a reliable recovery calculation.

NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.

(1) - Metal analysis:The recovery in the matrix spike was not calculated (NC). Spiked concentration was less than 2x that native to the sample.

Validation Signature Page

Maxxam Job #: B1H4101

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

BRAD NEWMAN, Scientific Specialist

CRISTINA CARRIERE, Scientific Services

MEDHAT RISKALLAH, Manager, Hydrocarbon Department

MAMDOUH SALIB, Analyst, Hydrocarbons

==

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam IMMEDIATE TEST

Maxxam Analytics International Corporation o/a Maxxam Analytics
6740 Campobello Road, Mississauga, Ontario Canada L5N 2L8 Tel:(905) 817-5700 Toll-free:800-563-6266 Fax:(905) 817-5779 www.maxxam.ca

CHAIN OF CUSTO[DY]

4-Nov-11 14:28
JOLANTA GORALCZYK
B1H4101
SEL ENV-056

Page 1 of 1

INVOICE INFORMATION:		REPORT INFORMATION (if differs from invoice):		PROJECT INFORMATION:	
Company Name:	#22101 MMM Group Limited	Company Name:		Quotation #:	A72109
Contact Name:	Andy Lee	Contact Name:	Andy Lee	P.O. #:	
Address:	100 Commerce Valley Dr W	Address:		Project #:	16-07198-001-EN4
	Thornhill ON L3T 0A1			Project Name:	
Phone:	(905)882-4211 x6287 Fax: (905)882-0055	Phone:	(905)882-4211 x6287 Fax:	Site #:	
Email:	LeeAD@mmm.ca	Email:	LeeAD@mmm.ca	Sampled By:	

[Laboratory Use O]nly:
BOTTLE ORDER #: 304719
C#304719-01-01
PROJECT MANAGER: JOLANTA GORALCZYK

Regulation 153 (2011) 2004
- [ ] Table 1 [ ] Res/Park [ ] Medium/Fine
- [ ] Table 2 [ ] Ind/Comm [ ] Coarse
- [ ] Table 3 [ ] Agri/Other
- [x] Table 6 [ ] For RSC

Other Regulations
- [ ] CCME [ ] Sanitary Sewer Bylaw
- [ ] Reg. 558 [ ] Storm Sewer Bylaw
- [ ] MISA Municipality ____
- [ ] PWQO
- [ ] Other ____

SPECIAL INSTRUCTIONS

Include Criteria on Certificate of Analysis (Y/N)? ____

Note: For MOE regulated drinking water samples - please use the Drinking Water Chain of Custody Form

SAMPLES MUST BE KEPT COOL (< 10°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

ANALYSIS REQUESTED (Please be specific):

TURNAROUND TIME (TAT) REQUIRED:
PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS

Regular (Standard) TAT: [x]
(will be applied if Rush TAT is not specified):
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)
Date Required: ____ Time Required: ____ [ ]
Rush Confirmation Number: ____ *(call lab for #)*

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Regulated Drinking Water ? (Y / N)	Metals Field Filtered ? (Y / N)	O'Reg 153 Petroleum Hydrocarbons	O'Reg 153 Inorganics Package	# of Bottles	Comments
1		mmm11-01	Nov 2		SOIL			✓	✓	6	
2		Dup 1	Nov2		SOIL			✓	✓	6	
3					SOIL						
4											
5											
6											
7											2
8											
9											
10											

*RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time:	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time:	# Jars Used and Not Submitted
A.Blazeiko A. Blazeiko	11/11/03	11:28	France Senlut / [illegible] ZOFIA ZEMLA	11/11/04 / 2011/11/04	14:28	

Laboratory Use Only				
Time Sensitive	Temperature (°C) on Receipt	Custody Seal	Yes	No
	5/5/7 °C	Present	✓	
		Intact	✓	

18/18/18°C from bottle sample for disposal

White: Maxxam Yellow: Client

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

Maxxam

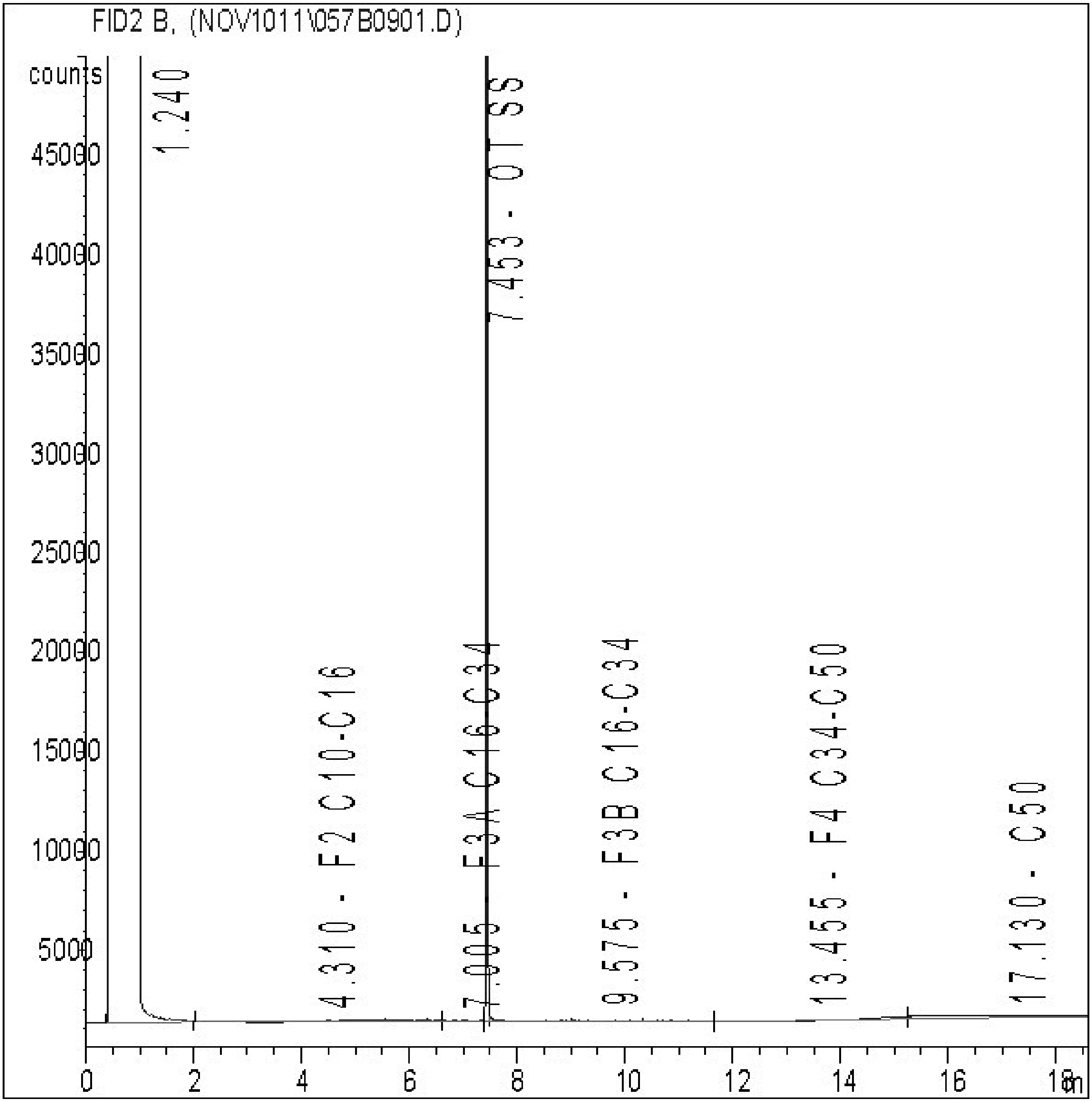
Success Through Science®

MMM Group Limited
Client Project #: 16-07198-001-EN4

Client ID: MMM11-01

Report Date: 2011/11/21
Maxxam Job #: B1H4101
Maxxam Sample: LN2150

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram



Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

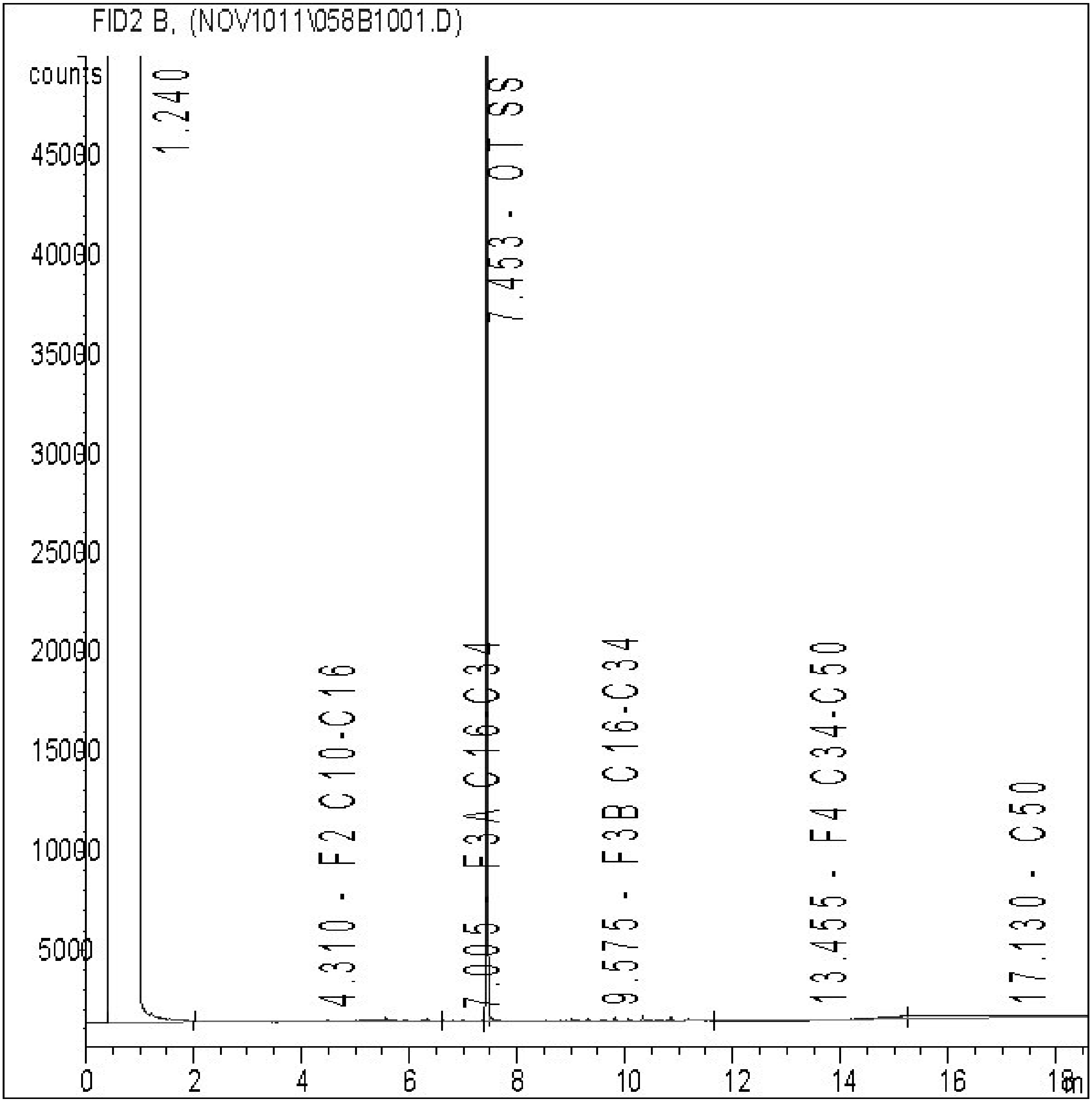
Success Through Science®

Report Date: 2011/11/21
Maxxam Job #: B1H4101
Maxxam Sample: LN2151

MMM Group Limited
Client Project #: 16-07198-001-EN4

Client ID: DUP 1

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram



Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

STANDARD LIMITATIONS
ENVIRONMENTAL INVESTIGATIONS and CHARACTERIZATION PROGRAMS

These Standard Limitations form part of the Report to which they are appended and any use of the Report is subject to them.

1. Exclusive Use By Client

This Report was prepared for the exclusive use of the client identified as the intended recipient. Any use of the Report by any other party without the written consent of MMM Group Limited is the sole responsibility of such party. MMM Group Limited accepts no responsibility for damages that may be suffered by any third party as a result of decisions made or actions taken based on the Report.

2. Scope, Terms and Conditions of Contract

The observations and investigations (hereinafter referred to as the "Work") upon which this Report is based were carried out in accordance with the scope, terms and conditions of the contract or the proposal pursuant to which the Work was commissioned. The conclusions presented in the Report are based solely upon the scope of services described in the contract or the proposal and governed by the time and budgetary constraints imposed by them.

3. Standard of Care

The principles, procedures and standards relevant to the nature of the services performed are not universally the same. The Work has been carried out in accordance with generally accepted environmental study and/or professional practices, industry standards and environmental regulations, where applicable. No other warranties are either expressed or implied with respect to the professional services provided under the terms of the contract or the proposal and represented in this Report.

4. Scope of the Work

This Report may be based in part on information obtained at discrete sampling and/or monitoring locations. The conditions reported herein were those encountered at the subject property at the time the Work was performed and as present at the discrete sampling/monitoring locations, if any. Conditions between sampling/monitoring locations may be different than those encountered at the sampling/monitoring locations and MMM Group Limited is not responsible for such differences.

5. Reasonable Conclusions

The conclusions contained in this Report are based on the Work and may also consider a review of information from other sources as identified in the Report. The accuracy of information from other sources was not verified unless specifically noted in the Report, nor was it determined if the reviewed information constituted all information that exists and pertains to the subject property.

The conclusions made are based on reasonable and professional interpretation of the information considered. If additional information concerning conditions of relevance to this Report is obtained during future work at the subject property, MMM Group Limited should be notified in order that we may determine if modifications to the conclusions presented in this Report are necessary.

6. Report as a Complete document

This Report must be read as a whole and sections taken out of context may be misleading. If discrepancies occur between the preliminary (draft) and final versions of the Report, the final version of the report shall take precedence.

7. Limits of Liability

MMM Group Limited's liability with respect to the Work is limited to re-performing, without cost, any part of the Work that is unacceptable solely as a result of failure to comply with industry standards. MMM Group Limited's maximum liability is limited to the amount of its fee received for the Work, provided that notice of claim is made within one year of the date of delivery of the Report.