

January 30, 2019

File No. 1-18-0347-46

Brampton Office

Associated Engineering
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Attention: Mr. Mark Torrie, P.Eng., M.Eng., Manager MTO Group

**RE: HYDROGEOLOGICAL INVESTIGATION
IRONDALE RIVER CULVERT, HIGHWAY 118
MINISTRY OF TRANSPORTATION, ONTARIO
DB-2017-4000, SITE 40-063C**

Dear Sir:

Terraprobe was retained by Associated Engineering (Ont.) Ltd. (AE) on behalf of Aecon Group Inc. (Aecon) to complete a hydrogeological investigation for the proposed culvert replacement for the Irondale River crossing Highway 118, Monmouth Township, Ontario.

The purpose of the hydrogeological investigation is to review the subsurface stratigraphy and shallow ground water conditions in relation to the proposed scope of construction works for the Irondale River Culvert replacement and to provide an assessment of dewatering volumes expected during construction. An impact assessment of dewatering on surrounding private water supply wells and natural features was completed. Recommendations are provided for monitoring, mitigation and contingency measures in order to limit potential impacts of construction dewatering.

1.0 INTRODUCTION

The site is located on Highway 118 approximately 1.1 km east of Regional Road 648 in Monmouth Township, Ontario. The site location is indicated on the attached Figure 1. It is proposed to replace the

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existing triple barrel timber culvert approximately located at Sta. 23+860 and it is understood that the work area for the culvert replacement extends from Sta. 23+780 to Sta. 23+930, a distance of approximately 150 m. Highway 118 will be temporarily realigned to the south from Sta. 23+715 to Sta. 24+040 to facilitate the culvert replacement while maintaining traffic flow on Highway 118.

The Highway 118 embankment is approximately 3.5 +/- m in height at the site with a pavement centre line elevation of approximately 372.8 +/-m. Bedrock outcrops exist on both sides of the highway at the west project limit. To the east of the bedrock outcrops is the Irondale River Valley which is characterized as a lowland area featuring a meandering river channel and a swamp located north of Highway 118. The culvert conveys flows of the Irondale River from north to south below Highway 118.

2.0 SITE GEOLOGY AND HYDROGEOLOGY

Site soil conditions were investigated as part of the *Draft Foundation Investigation and Design Report, Irondale River Culvert Replacement, Highway 118, Ministry of Transportation, Ontario, DB-2017-4000, Site 40-063C Geocres No.*, dated February, 2019 completed by Terraprobe (project number 1-18-0347). This investigation consisted of drilling and sampling two borehole locations to depths of 4.3 and 5.5 m below ground surface. The approximately borehole locations are indicated on the attached Figure 2 and borehole logs are provided in Appendix A.

Ground water conditions within the open boreholes were measured immediately following completion of drilling operations and boreholes were backfilled in accordance with MTO procedures and Ontario Regulation 903.

Previous subsurface investigations were carried out at the site by Golder Associated Limited (Golder). These investigations were carried out over two stages and were used to supplement investigations carried out by Terraprobe. Four boreholes (numbers 13-231 through to 13-234) were drilled over the first stage completed in 2013, and two additional boreholes were completed during the second phase in 2016 (boreholes numbered 16-235 and 16-236). These boreholes were completed to various depths between 6.7 and 12.3 m below ground surface. The approximate locations of the Golder boreholes are indicated on the attached Figure 2 and borehole logs are provided in Appendix A.

2.1 Borehole Locations

A summary of the completed borehole locations are provided in the table below:

Summary of Borehole Locations

Borehole Location	Northing	Easting	Ground Surface Elevation (masl)	Borehole Depth	
				(mbgl)	(masl)
BH1	4983425.5	405685.8	369.7	4.3	365.4
BH2	4983405.2	405716.5	370.4	5.5	364.9
BH13-231	4983410.8	405745.4	369.7	7.7	362.0
BH13-232	4983426.6	405732.4	372.6	12.3	360.3
BH13-233	4983432.4	405723.1	371.4	10.4	361.0
BH13-234	4983417.9	405717.9	372.9	9.8	363.1
BH16-235	4983420.3	405717.0	372.8	6.7	366.1
BH16-236	4983423.9	405736.1	372.8	7.5	365.3

Based on the results of the subsurface investigations completed at the site , the soils consist of a flexible pavement structure or topsoil overlying deposits of loose to very dense sand and gravel fill. Underlying the fill deposits are native soils consisting of compact to dense organic sand, very loose to very dense silty sand to sand and loose to very dense sandy gravel to gravelly sand.

2.2 Subsurface Conditions

The stratigraphic conditions recorded on the attached borehole logs are inferred from non-continuous soil sampling and represent transitions between soil types rather than exact planes of geological change. It is expected that the subsurface conditions will vary between and beyond the borehole locations.

2.2.1 Flexible Pavement

Golder boreholes 13-232, 13-234, 16-235 and 16-236 were drilled through the pavement structure of Highway 118. A flexible pavement consisting of up to 0.1 m thick asphaltic concrete underlain by crushed stone extending to depths of 0.3 to 0.4 m below ground surface (to elevations between 372.2 and 372.5 m) was encountered.

2.2.2 Topsoil

Terraprobe boreholes 1 and 2 encountered surficial topsoil approximately 25 to 35 mm in thickness. Topsoil thickness will vary between and beyond the borehole locations.

2.2.3 Fill – Sand and Gravel to Gravelly Sand

Fill deposits ranged in composition from sand and gravel to gravelly sand to depths between 0.6 to 3.8 m

below ground surface (to elevations between 369.8 and 369.0 m) across the site.

Standard penetration tests performed within the fill deposits measure SPT-N values ranging from 8 to more than 65 blows for 0.3 m of penetration indicating a loose to very dense relative density.

Golder carried out grain size distribution tests on three samples of the sand and gravel to gravelly sand fill. The test results show a grain size distribution consisting of 35% to 49% gravel, 43% to 56% sand, 5% to 8% silt and 1% clay size particles.

2.2.4 Fill - Cobbles

Fill material consisting of cobbles with some sand were encountered within Golder borehole 13-233. The cobble layer was approximately 0.8 m in thickness and extends to an elevation of 370.6 m.

2.2.5 Organic Sand

A deposit of organic sand was encountered within Terraprobe borehole 1, approximately 1.6 m in thickness extending to a depth of 2.2 m below ground surface (elevation of 367.5 m).

The measured SPT-N values from Standard Penetration Testing carried out within the organic sand deposit ranged from 17 to 41 blows for 0.3 m of penetration indicating a compact to dense relative density.

Grain size distribution testing was carried on the organic sand layer with results showing a grain size distribution of 2% gravel, 79% sand and 3% clay size particles.

2.2.6 Silty Sand to Sand

Silty sand to sand deposits were encountered at each of the Golder and Terraprobe borehole locations. The silty sand to sand deposits varied in thickness from 0.7 to 7.7 m and were encountered to the borehole termination depth in some locations (13-231, 13-232, 13-233, 13-234 and 16-236). The silty sand and sand deposits extend to depths between 3.7 to 12.3 m below ground surface (elevations between 369.0 to 360.3 m).

The N-values of Standard Penetration Testing carried out in the silty sand to sand deposits range from 2 to more than 55 blows per 0.3 m of penetration indicating a very loose to very dense relative density.

Grain size distribution testing was carried out by Golder on the silty sand to sand deposits with grain size

distribution showing 0% to 35% gravel, 58% to 95% sand, 2% to 8% silt and 0% to 2% clay sized particles.

2.2.7 Sandy Gravel to Gravelly Sand

Sandy gravel to gravelly sand deposits were encountered at borehole locations to depths ranging from 2.9 to 10.7 m below ground surface (elevations between 367.6 to 361.9 m). The sandy gravel to gravelly sand deposits were encountered to the depth of completion in Boreholes 1, 2 and 16-235.

The N-Values of Standard Penetration tests carried out within the sandy gravel to gravelly sand deposits range from 6 to more than 100 blows for 0.3 m of penetration, indicating a loose to very dense relative density.

Grain size analysis of collected samples were evaluated and the grain size distribution consists of 25% to 55% gravel, 37% to 61% sand, 4% to 17% silt and 0% to 2% clay sized particles.

2.2.9 Bedrock

Bedrock was not investigated as part of the subsurface investigation. Auger refusal was observed at borehole locations 13-231, 13-232 and 13-233 at depths between 7.7 and 12.3 m below ground surface (elevations between 396.0 and 360.3 m). Bedrock is expected to consist of pre-Cambrian gneiss of the Central Metasedimentary Belt. Bedrock depth is anticipated at elevations lower than encountered auger refusal.

2.3 Ground Water Levels

The ground water conditions were observed in the boreholes during and upon completion of drilling activities. A piezometer was installed in Golder borehole 13-233 at the time of completion. Water levels were taken on June 3, 2013 (Golder) and on August 10 and September 5, 2018 (Terraprobe). Water levels were observed between 1.8 to 2.0 m below ground surface (elevation 369.9 to 369.4 m).

In addition to the shallow ground water elevation, surface water elevations were reported by AE's surveyors in July 2018 at an elevation of 369.4 m. It is expected that ground water levels will be under the influence of surface water and that shallow ground water flow will generally follow the topography and will be directed to surface features including wetland areas and the Irondale River. Seasonal variation in ground water levels is expected.

2.4 Hydraulic Conductivity

A single well response test was performed to assess rates of hydraulic conductivity of ground water at the piezometer installation in Borehole 13-233 (25 mm diameter installation). A rising head test was performed in which a volume of water was removed from the piezometer and the well recovery was monitored. The results of the rising head test were evaluated using Aquifer Test Pro software using both a Hvorslev and Bouwer & Rice analysis. For the piezometer which was screened within sand and gravel to sand, the resulting hydraulic conductivity of the subsurface regime within the screened strata was calculated to range between 1.0×10^{-5} to 1.3×10^{-5} m/s. The rising head test analysis is provided in Appendix B.

It is anticipated that due to the small diameter of the piezometer rising head test results will be biased low due to capillary forces acting on measured water levels. As such, further analysis was completed for the sandy to gravelly sand layers based on the grain size analysis results of representative samples obtained from the site (as detailed in Section 2.2) above using the Hazen method (Hazen, 1911) as follows:

$$K = C(D_{10})^2$$

Where: K is the hydraulic conductivity (cm/s)
C is Hazen's empirical coefficient (100 for medium sand).
 D_{10} is the diameter of the 10th percentile grain size of the material (mm)

The following table summarizes the results of the Hazen analysis for rates of hydraulic conductivity based on the measured grain size analysis curves for various sandy soils encountered at the site.

Summary of Hazen Analysis

Soil Type	Borehole Location	Sample Depth (m)	D_{10} Diameter (mm)	Hazen Conductivity (m/s)
Sand	BH2 SS6	3.8 to 4.3	0.12	1.4×10^{-2}
Sand	BH1 SS4	2.3 to 2.9	0.16	2.6×10^{-2}
Organic Sand	BH1 SS3	1.6 to 2.2	0.05	2.5×10^{-3}
Gravelly Sand	BH1 SS6	3.8 to 4.3	0.06	3.6×10^{-3}
Gravelly Sand	BH 2 SS1	0 to 0.6	0.03	9.0×10^{-4}
Gravelly Sand	BH2 SS4	2.2 to 2.9	0.05	2.5×10^{-3}

Given the proposed depth of the culvert excavations are anticipated at depths between 5.5 and 5.7 m below ground surface (elevation of 367.0 to 367.2 m), the anticipated soil type is expected to be gravelly

sand with a hydraulic conductivity estimated at 3.6×10^{-3} m/s.

2.5 Ground Water Quality Sampling Results

Ground water quality samples were obtained from the Golder piezometer 13-233 on September 5, 2018. Ground water was analyzed for metals, inorganics, polycyclic aromatic hydrocarbons (PAHs), volatile organic carbons (VOCs), petroleum hydrocarbons (PHCs) and microbiology. An analysis was completed for hydrocarbons to evaluate potential contamination of shallow ground water due to the creosote treated timber of the existing culvert.

Results of sampling were compared to the Provincial Water Quality Objectives (PWQO). Petroleum hydrocarbon parameters were not detected within the collected ground water samples. High suspended solid and turbidity readings were observed along with exceedances of many metals parameters. A summary of water quality exceedances above the PWQO are noted in the table below:

Summary of Water Quality Exceedances

Parameter	PWQO Standard	Ground Water Quality BH12-233
Total Suspended Solids (mg/L)	N/A	513
Turbidity (NTU)	N/A	515
Iron (ug/L)	300	4850
Aluminum (ug/L)	75	2580
Cobalt (ug/L)	0.9	4.08
Copper (ug/L)	5.0	20.8
Vanadium (ug/L)	6.0	9.23

The above metals exceedances are considered representative of the total metals concentration. It is anticipated that sediment loads within the sand and gravel deposits will not pose a long term issue. Dewatering will likely be completed through a series of screened well points which would preclude the movement of fine sediment from construction works. Direct discharge is not recommended to the Irondale River. It is anticipated that dewatering discharge will be directed to overland flow discharging to Irondale River. Additional measures including hay bales, rock check dams and temporary settlement basins are recommended where feasible to limit sediment loads of the dewatering discharge. Laboratory certificates of analysis are provided in the attached Appendix C.

3.0 LOCAL WATER RESOURCES

The area surrounding the site consists of natural areas including woodlots, the Irondale River and associated wetland areas, and privately serviced rural residential dwellings. A review of the Ministry of the Environment Conservation and Parks (MECP) well record data base was completed. Three private wells were identified within a 500 m radius of the site. Based on completed well logs, the soils consisted of topsoil overlying bedrock (depth of up to 1.5 m below ground surface) or bedrock underlying deposits of sand and gravel at a depth of 15.2 m. Surrounding private wells were screened within the granite bedrock at depths between 36.6 to 73.2 m below ground surface. Water levels were reported between 4.9 to 9.1 m below ground surface with flow rates of approximately 10 gallons per minute. Potable water supply is expected to be obtained at depth within the underlying bedrock. The table below summarizes the well records located within a 500 m radius of the site:

Summary of Well Records

Well ID	Easting	Northing	Well Depth	Water Level	Pumping Rate	Stratigraphy
2707192	718807	4984923	73.2 m	4.8 m	10 GPM	Sand Gravel (5.2) Sand Silt Gravel (15.2) Granite (73.2)
2702979	718937	4984490	57.0 m	9.1 m	10 GPM	Topsoil (0.9) Granite (57..0)
7274952	719587	4895000	36.6 m	6.1 m	10 GPM	Topsoil (1.5) Granite (36.6)

Well Records are provided in the attached Appendix D. A map showing locations of the surrounding wells is attached as Figure 3. Shallow ground water within the overburden deposits (i.e. sand and gravel) is expected to follow topography and be directed to surface water features including the Irondale River and associated wetland features. It is anticipated that the wetlands are primarily due to shallow bedrock and associated poor drainage conditions.

Shallow ground water baseflow to surface water features is expected. The surface water elevation at the site was measured at an elevation of 369.4 m. The shallow ground water level within Borehole 12-233 was observed at 369.6 m. Based on the observed ground water and surface water elevations it is expected that vertical hydraulic gradients at the site are positive (i.e. upward ground water flow).

4.0 REQUIREMENTS FOR GROUND WATER CONTROL

It is anticipated that excavations for the Irondale River Culvert replacement will be completed below the shallow ground water level and active temporary dewatering will be required for construction. It is anticipated that the base of excavations will be within the sand and gravel deposits. Dewatering

requirements for the culvert replacement were analyzed following a Darcy's Law approach. Detailed calculations are provided in Appendix E.

4.1 Culvert Dewatering Requirements

The following site parameters were considered in the dewatering assessment:

- Ground Surface Elevation – 372.7 m
- Surface Water Elevation – 369.4 m
- Ground Water Elevation – 369.6 m (3.1 m below ground surface)
- Hydraulic Gradient – 0.03
- Soil Type at Base of Excavations – Sand and Gravel
- Hydraulic Conductivity – 3.6×10^{-3} m/s

The hydraulic gradient was taken as the difference of the surface water elevation (369.4 m) and the ground water elevation (369.6 m) divided by the difference from the base of the river bed at the culvert crossing (367.5 m) from the depth of piezometer in Borehole 13-233 (361.0 m).

The following assumptions were made with regards to the construction requirements:

- Area of excavation for the culvert footings – 171 m² (9.0 m by 19.0 m)
- Footing excavation perimeter – 56 m
- Base elevation of excavation – 367.0 m (depth of 5.7 m below ground surface)
- Dewatering target elevation – 366.0 m (approximately 1.0 m below the base of excavations)

Base elevations within the upstream section of excavations are proposed at 367.2 m and at an elevation of 367.0 m within the downstream sections. For the purpose of the dewatering assessment excavations were uniformly assumed at an elevation of 367.0 m.

It was also assumed that lateral ground water flow to open excavations would be precluded due to the installation of impervious interlocking sheet piles. The dimensions of the sheet piling were assumed at 25 m by 25 m covering an area of 625 m². Engineering drawings for the proposed culvert replacement are provided in Appendix F.

Pumping of rainfall from within the proposed sheet pile area was considered under the dewatering assessment. Consideration was provided for pumping of the two-year storm event (25 mm daily

intensity) over an area of 625 m², for an additional pumped volume of approximately 15,600 L/day.

Based on the above parameters it is estimated that the ground water dewatering for excavations will be approximately 2,393,500 L/day. Accounting for rainfall, the total daily dewatering volume is estimated at 2,409,100 L/day for the Irondale River Culvert replacement.

Based on the above estimated dewatering volume, a Category 3 Permit to Take Water (PTTW) would be required from the MECP. A PTTW is required for temporary construction dewatering projects for dewatering rates in excess of 400,000 L/day. It is anticipated that this Hydrogeological Investigation will form the basis of the supporting documentation required for the PTTW application.

The proposed dewatering method may consist of one or more of the following:

- Installation of vacuum well points;
- Installation of educator well points; or,
- Installation of filtered sump pits at the base of open excavations.

It is recommended that the specifications and estimates outlined in this report be reviewed by a dewatering contractor to ensure that the design and specifications of the dewatering system is capable of operating at the above stated target rates, given the required excavation depths and extents.

It should be noted that dewatering considerations were not estimated for the construction of the temporary road realignment. Details concerning the dimensions, depth and construction of the temporary crossing were not available. However, it is considered that any dewatering would be completed under the PTTW obtained for the culvert replacement works.

5.0 IMPACT ASSESSMENT

The following impact assessment is based on the current design information for the Irondale River Culvert replacement provided in this report, and the results of the subsurface investigation. The purpose of the impact assessment is to determine the potential ground water flow that may be encountered during construction, along with potential impacts to surrounding features.

5.1 Radius of Influence

The potential radius of influence arising from ground water taking activities was calculated based on the anticipated drawdown and hydraulic conductivity determined for the site. The calculated radius of influence will extend to an anticipated maximum distance of 650 m surrounding the proposed excavation

areas. The radius of influence will be limited to the extents of the sand and gravel soils from which dewatering is anticipated. It is anticipated that the actual zone of influence will be less than 650 m due to shallow bedrock conditions in the vicinity of the site. Due to the impervious nature of the granite bedrock underlying the surficial soils, it is expected that the bedrock will act as a boundary condition limiting the extent of impacts due to dewatering. Calculations for the radius of influence are provided in Appendix E.

5.2 Geotechnical Impacts of Dewatering

The lowering of ground water levels has the potential to induce ground settlement within the radius of influence. The results of the geotechnical investigation indicate that the vicinity of the site is characterized by bedrock outcrops and shallow soil conditions. It is expected that surrounding buildings would be completed to the top of or within bedrock, and as such settlement due to active dewatering is not expected.

It is noted that settlement can also occur in the event of loss of ground through the pumping of fines or suspended materials through the dewatering system. The dewatering system must be properly designed to ensure that there is no pumping of fines or suspended material.

5.3 Dewatering Impacts on Local Ground Water Resource

As summarized in Section 3.0 above, private water supply wells are completed within the granite bedrock at depths greater than 36.6 m below ground surface. The maximum dewatering for the Irondale River Culvert replacement is anticipated at 6.7 m below ground surface. The extent of surficial deposits of sand and gravel is expected to be limited in extent, and private supply wells are not expected to be screened within shallow overburden deposits. Impacts to ground water supply wells are not expected.

5.4 Dewatering Impacts on Surface Water

Ground water is expected to discharge to the Irondale River and associated wetland areas. It is anticipated that dewatering will be temporary in nature and not result in long term impacts to surface water features. It is anticipated that dewatering discharge will be directed to surface water features downstream of the culvert crossing. During construction, inspection of the river channel downstream of the site is recommended for signs of erosion due to the discharge of ground water.

5.5 Discharge of Water

It is proposed to direct construction dewatering discharge from the ground water control activities

overland to the Irondale River. Regular inspection and water quality sampling at the point where discharge enters surface water is recommended to confirm compliance of discharge with the PWQO. Discharge should be clear and free of sediment, sheen or foam. Measures should be implemented including rock check dams and hay bales to prevent erosion and channelization of discharge flows. In the event that erosion is noted the discharge location should be changed.

6.0 MONITORING AND CONTINGENCY PLAN

The results of the study and impact analysis suggest there will be no significant impacts created by the ground water control activities. Nonetheless, it is important to maintain records to ensure that any unforeseen impacts are properly identified and appropriate contingency measures can be implemented.

Record keeping should be conducted over the duration of the ground water control activities. Records should include the following:

- Daily records of the current location, depth and extent of all excavations on the site;
- Daily records of water taking including time and rate of pumping;
- Inspection of discharge from the ground water control system on an hourly basis for evidence of visible suspended solids or silt; and,
- Daily inspection of excavation activities for the potential presence of deleterious materials which may result in an impact to water quality.

In the event that significant fines are noted in the ground water discharge, the pumping should be stopped immediately and proper control measures should be implemented to prevent the movement of fines.

Consideration should be given to a preconstruction survey to document the surrounding private water supply wells and building foundations. The preconstruction survey would then serve as documented baseline conditions to evaluate potential any claims that may arise due to dewatering and construction activities.

7.0 SUMMARY

Based on the results of the study, the following summary and conclusions are made:

- i. Excavations for the proposed Irondale River Culvert replacement will cover 171 m² to depths of about 5.7 m. Excavations are proposed to be completed within interlocking sheet piles that will

limit the lateral flow of ground water into open excavations. Shallow ground water levels were measured at an elevation of 369.6 m (3.1 m below ground surface). The dewatering target for construction dewatering is approximately 1.0 m below the base of excavations at an elevation of 366.0 m.

- ii. It is anticipated that excavations will be completed within the sand and gravel deposits with a hydraulic conductivity estimated at 3.6×10^{-3} m/s.
- iii. Ground water quality sampling results indicated that hydrocarbon impacts were not noted within the shallow ground water. Total metals exceedances were noted in the collected ground water sample. Metals exceedances were attributed to high suspended sediment within the collected sample. Ground water quality is expected to meet the Provincial Water Quality Objectives provided sediment control measures are implemented.
- iv. Land use in the vicinity of the site consists of rural residential properties privately serviced. There were three well records identified within a 500 m radius of the site. Private wells are typically completed to depths greater than 36.6 m within bedrock.
- v. Dewatering estimates were calculated based on a Darcy approach given the observed site conditions and construction requirements. Including removal of precipitation (25 mm rainfall event) falling within the sheet pile area of 625 m², the total dewatering volume is anticipated at 2,409,100 L/day.
- vi. The radius of influence associated with the ground water control activities is estimated at approximately 648 m. The radius of influence will be limited to the extent of sand and gravel deposits. The area is characterized by bedrock outcrops which are expected to act as a boundary condition for dewatering.
- vii. It is expected that the dewatering discharge will be directed overland to the Irondale River downstream of the site. Regular inspection and water quality sampling is recommended at the point of discharge to surface water. Discharge should be appropriately managed to limit erosion at the point of discharge and within the river channel.
- viii. Impacts of dewatering including ground settlement, impacts to private wells and surface water features are not anticipated. Consideration should be given to a preconstruction survey to document existing well and foundation conditions to serve as baseline conditions in the event of

an interference claim.

- ix. A program of monitoring during construction is recommended. The monitoring should include frequent inspection of the excavation and discharge water. Detailed records should be maintained regarding excavation progress and pumping rates and volumes.

We trust this information is sufficient for your present purposes. Should you have any questions concerning the above, please do not hesitate to contact the undersigned.

Yours truly,
Terraprobe Inc.



Paul L. Raepple, P.Geo.
Hydrogeologist



Rehman Abdul, M.S., P.Eng.
Principal, Transportation & Infrastructure

Stoney Creek Office

Enclosures

Figure 1 – Site Location Plan

Figure 2 – Borehole Location Plan

Figure 3 – Dewatering and Private Well Location Plan

Appendix A – Borehole Logs

Appendix B – Results of In-Situ Hydraulic Conductivity Testing

Appendix C – Laboratory Certificates of Analysis

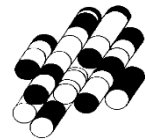
Appendix D –, Ministry of the Environment Conservation and Parks Well Records

Appendix E – Dewatering Analysis

Appendix F - Engineering Drawings

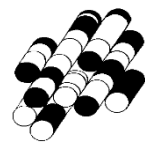
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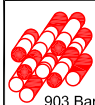
Terraprobe Inc.



FIGURES

Terraprobe Inc.





Terraprobe

903 Barton Street - Unit 22, Stoney Creek, Ontario, L8E 5R7
Tel: (905) 643-7560, Fax: (905) 643-7559

Title:

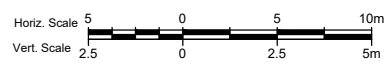
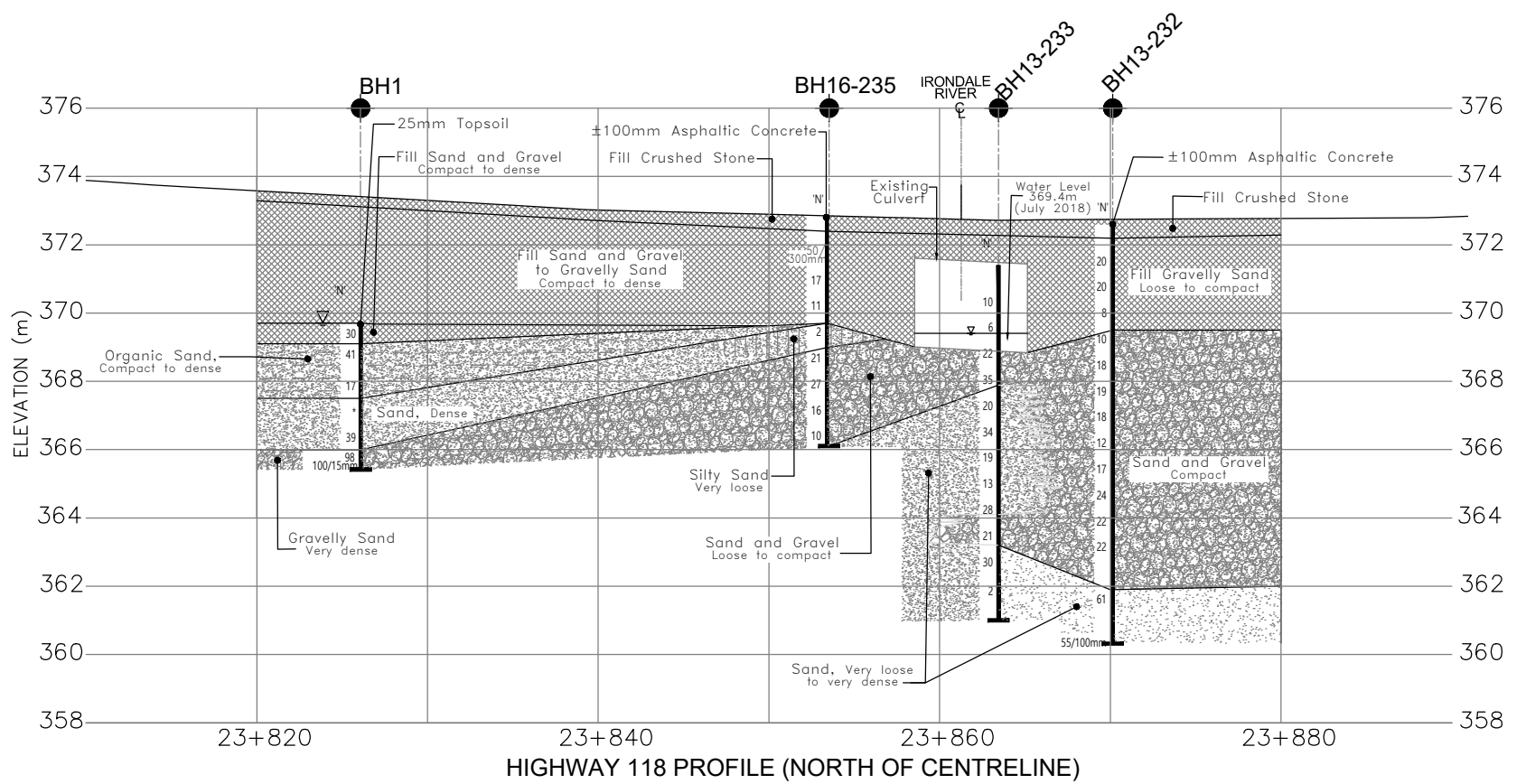
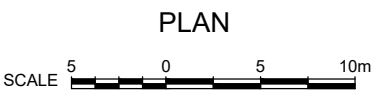
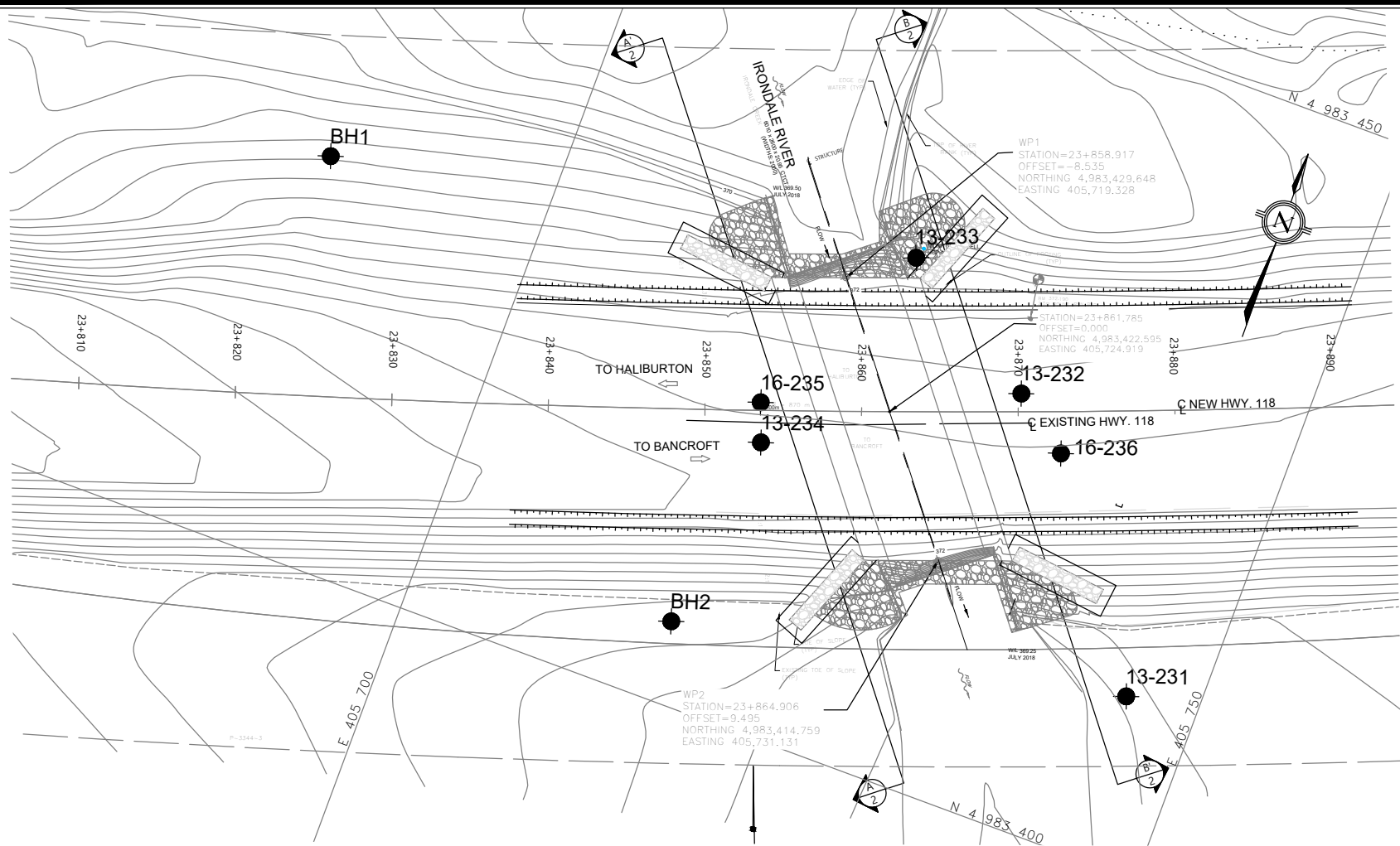
SITE LOCATION PLAN

File No.

1-18-0347-46

FIGURE :

1



METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETERS UNLESS
OTHERWISE SHOWN

GWP No. 4126-10-00
CONT DB-2017-4000

HWY 118
IRONDALE RIVER
CULVERT REPLACEMENT
BOREHOLE LOCATIONS AND SOIL STRATA
(PROFILE NORTH OF CENTRELINE)

Consulting Geotechnical & Environmental Engineering
Construction Materials Engineering, Inspection & Testing
11 Indell Lane - Brampton Ontario L6T 3Y3 (905) 796-2650

COUNTY OF HALIBURTON
GEOGRAPHIC TOWNSHIP OF
MONMOUTH

KEY PLAN NOT TO SCALE

Bore Hole

Dynamic Cone Penetration Test

Bore Hole And Cone

'N'

CONE

Blows/0.3m (Std Pen Test, 475 J/blow)

Blows/0.3m (60" Cone, 475 J/blow)

WL at Time of Investigation

WL in Piezometer

Piezometer

90% Rock Quality Designation

Auger Refusal

COORDINATES
(MTM, ZONE 10)

BH No.	ELEV. (m)	NORTHING (m)	EASTING (m)
1	369.7	4 983 425.5	405 685.8
2	370.4	4 983 405.2	405 716.5
13-231	369.7	4 983 410.8	405 745.4
13-232	372.6	4 983 426.6	405 732.4
13-233	371.4	4 983 432.4	405 723.1
13-234	372.9	4 983 417.9	405 717.9
16-235	372.8	4 983 420.3	405 717.0
16-236	372.8	4 983 423.9	405 736.1

NOTE

This drawing is for subsurface information only. The proposed structure details/works if shown are for illustration purposes only and may not be consistent with final design configuration as shown elsewhere in the contract documents.

The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

The complete foundation investigation and design report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview.

Information contained in this report and related documents are specifically excluded in accordance with Section GC 2.01 of OPS General Conditions

REFERENCE

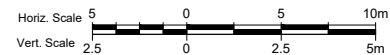
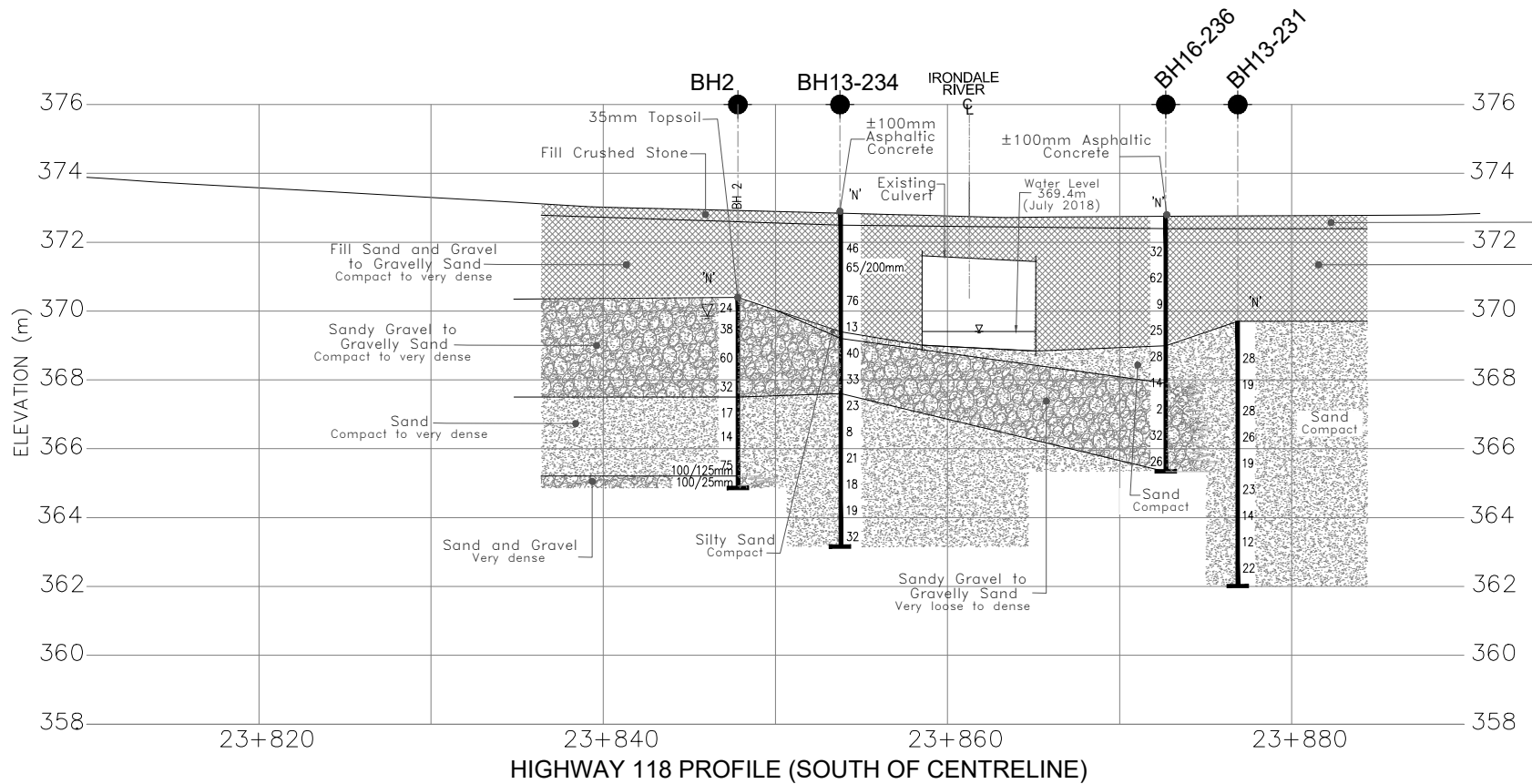
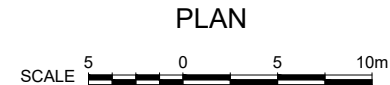
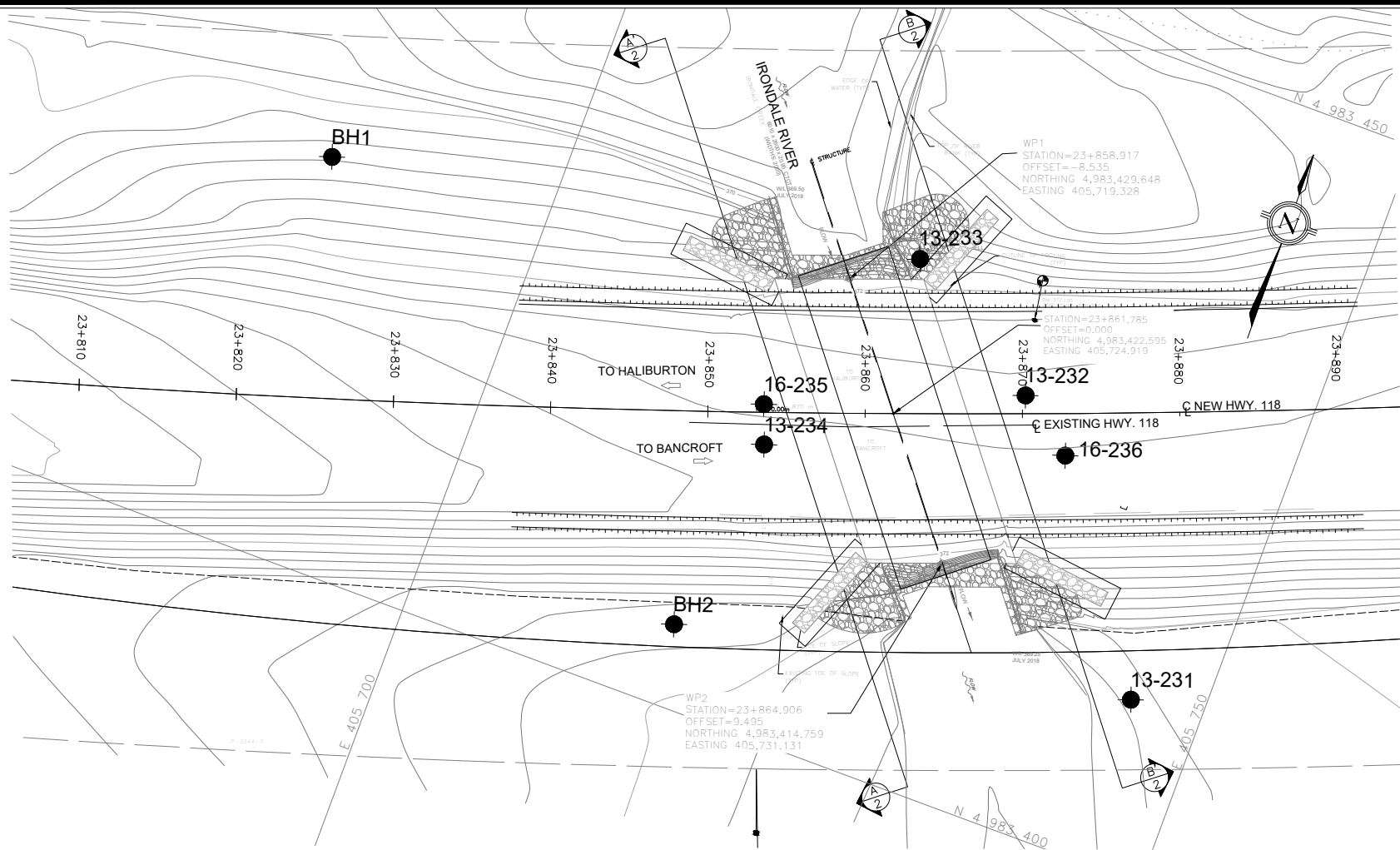
Drawings provided in digital format by Associated Engineering, drawing file "3412039-CP2-IRONDALE-XB1.dwg", received Nov. 15, 2018 and drawing file "E8201181.dwg" received Sept. 11, 2018.

REVISIONS

DATE	BY	DESCRIPTION

HWY: 118	PROJECT No. 1-18-0347	DIST.
SUBM'D: SD	CHKD: RA	DATE: Nov. 2018
DRAWN: KC	CHKD: RA	APPD: MT
		SITE: 40-063C
		DWG: 1A

T:\1-Project Files\2018\18-0347 - Elk Creek Hwy 28 Replacement\1-Three Structure Replacements (MTO)A.Dwg
Log:\Irondale\Irondale River 2018-KC\Irondale (Plan and Profile) 2018-11-19.dwg, Kama

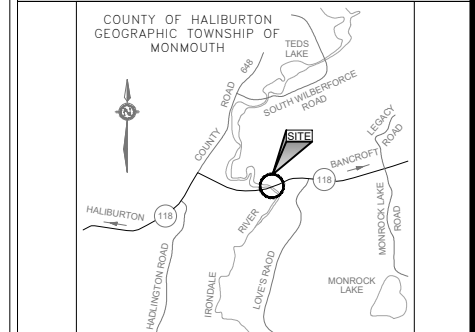


GWP No. 4126-10-00
CONT DB-2017-4000



HWY 118
IRONDALE RIVER
CULVERT REPLACEMENT
BOREHOLE LOCATIONS AND SOIL STRATA
(PROFILE SOUTH OF CENTRELINE)

SHEET



KEY PLAN NOT TO SCALE

LEGEND

- Bore Hole
- Dynamic Cone Penetration Test
- Bore Hole And Cone
- Blows/0.3m (Std Pen Test, 475 J/blow)
- Blows/0.3m (60" Cone, 475 J/blow)
- WL at Time of Investigation
- WL in Piezometer
- Piezometer
- Rock Quality Designation
- Auger Refusal

BH No.	ELEV. (m)	COORDINATES (MTM, ZONE 10)	
		NORTHING (m)	EASTING (m)
1	369.7	4 983 425.5	405 685.8
2	370.4	4 983 405.2	405 716.5
13-231	369.7	4 983 410.8	405 745.4
13-232	372.6	4 983 426.6	405 732.4
13-233	371.4	4 983 432.4	405 723.1
13-234	372.9	4 983 417.9	405 717.9
16-235	372.8	4 983 420.3	405 717.0
16-236	372.8	4 983 423.9	405 736.1

NOTE

This drawing is for subsurface information only. The proposed structure details/works if shown are for illustration purposes only and may not be consistent with final design configuration as shown elsewhere in the contract documents.

The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

The complete foundation investigation and design report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview.

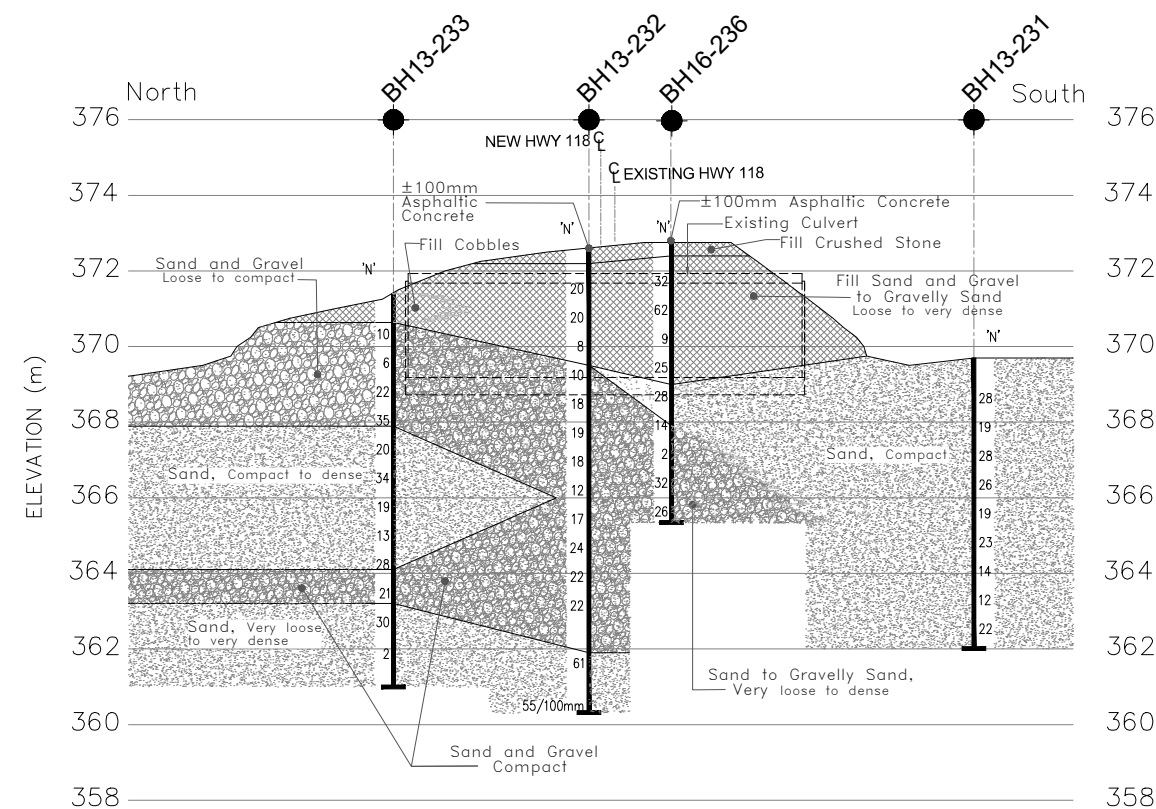
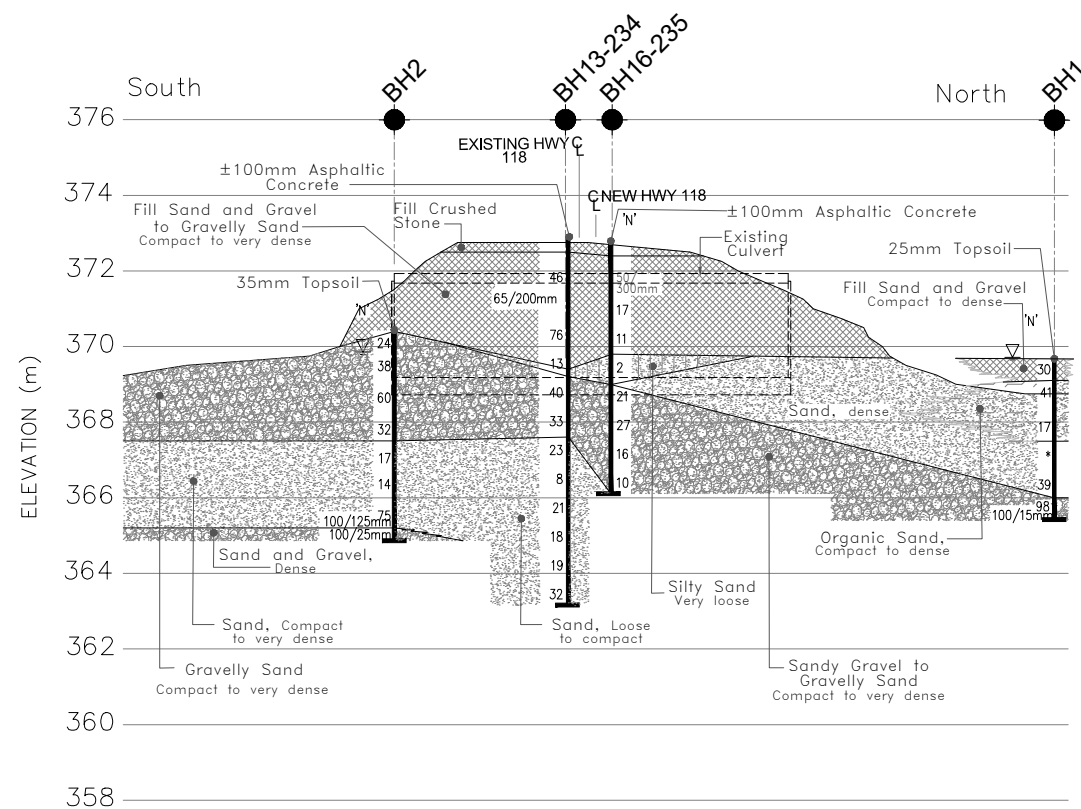
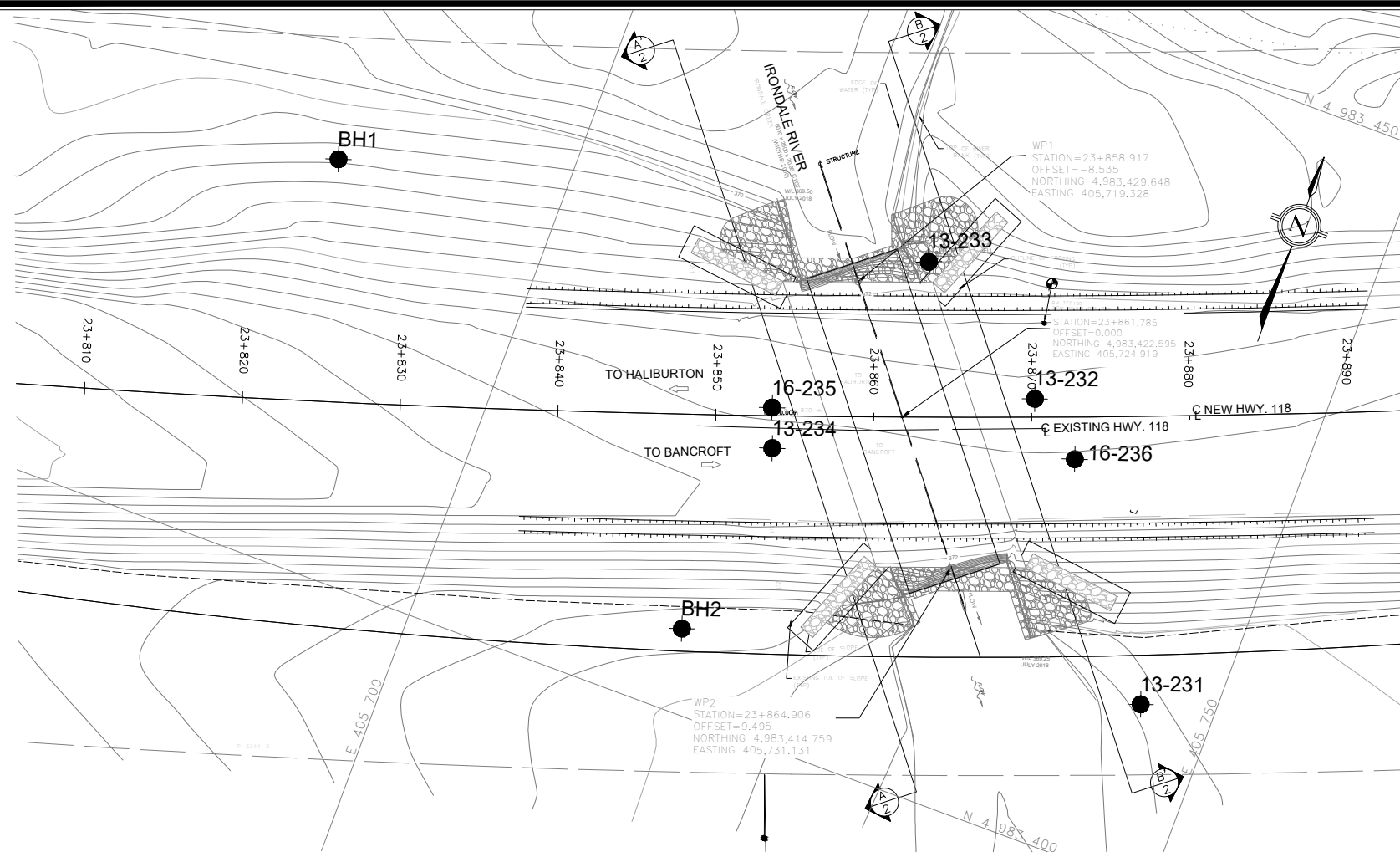
Information contained in this report and related documents are specifically excluded in accordance with Section GC 2.01 of OPS General Conditions

REFERENCE

Drawings provided in digital format by Associated Engineering, drawing file "3412039-CP2-IRONDALE-KB1.dwg" received Nov. 15, 2018 and drawing file "EB201181.dwg" received Sept. 11, 2018.

REVISIONS			
	DATE	BY	DESCRIPTION

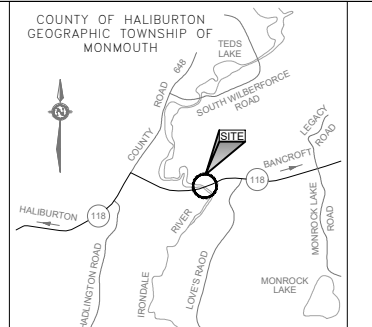
HWY.	118	PROJECT No.	1-18-0347	DIST.
SUBM'D.	SD	CHKD. RA	DATE: Nov. 2018	SITE: 40-063C
DRAWN:	KC	CHKD. RA	APPD: MT	DWG. 1B










GWP No. 4126-10-00
CONT DB-2017-4000

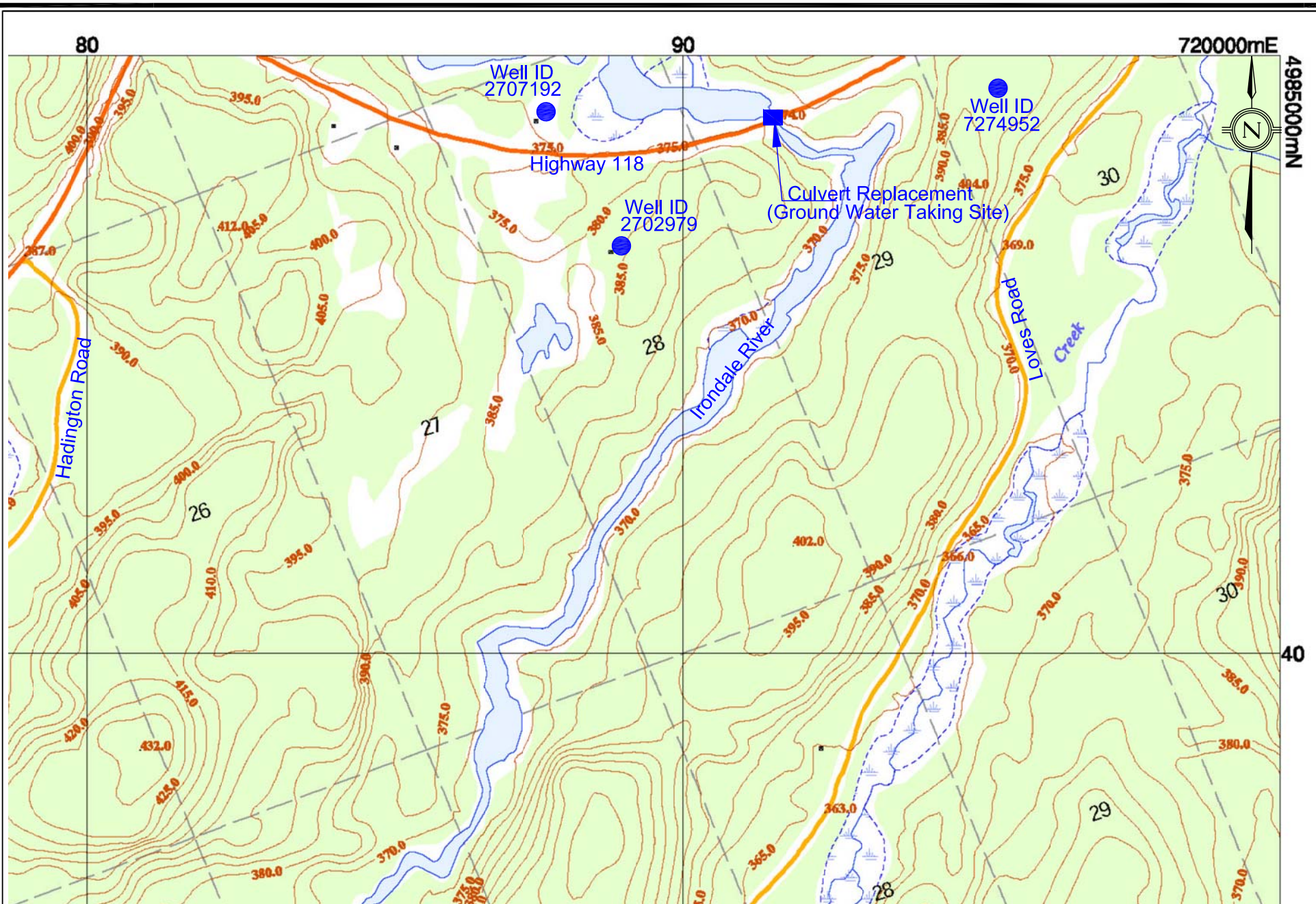


<p>HWY 118 IRONDALE RIVER CULVERT REPLACEMENT BOREHOLE LOCATIONS AND SOIL STRATA (Section A-A' and B-B')</p>	
------------------------------------------------------------------------------------------------------------------------------------------------------------------	--



KEY PLAN		NOT TO SCALE
LEGEND		
	Bore Hole	
	Dynamic Cone Penetration Test	
	Bore Hole And Cone	
	Blows/0.3m (Std Pen Test, 475 J/blow)	
CONE	Blows/0.3m (60° Cone, 475 J/blow)	
	WL at Time of Investigation	
	WL in Piezometer	
	Piezometer	
90%	Rock Quality Designation	
A/R	Auger Refusal	

BH No.	ELEV. (m)	COORDINATES (MTM, ZONE 10)	
		NORTHING (m)	EASTING (m)
1	369.7	4 983 425.5	405 685.8
2	370.4	4 983 405.2	405 716.5
13-231	369.7	4 983 410.8	405 745.4
13-232	372.6	4 983 426.6	405 732.4
13-233	371.4	4 983 432.4	405 723.1
13-234	372.9	4 983 417.9	405 717.9
16-235	372.8	4 983 420.3	405 717.0
16-236	372.8	4 983 423.9	405 736.1



LEGEND

2707192



Private Well Location



Terraprobe

903 Barton Street - Unit 22, Stoney Creek, Ontario, L8E 5R7
Tel: (905) 643-7560, Fax: (905) 643-7559

Title:

DEWATERING AND PRIVATE WELL LOCATION PLAN

File No.

1-18-0347-46

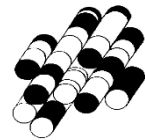
FIGURE :

3

Borehole Logs

APPENDIX A

Terraprobe Inc.



LIST OF ABBREVIATIONS

The abbreviations commonly employed on Records of Boreholes, on figures, and in the text of the report are as follows:

I. SAMPLE TYPE

AS	Auger sample
BS	Block sample
CS	Chunk sample
DO or DP	Seamless open-ended, driven or pushed tube samplers
DS	Denison type sample
FS	Foil sample
RC	Rock core
SC	Soil core
SS	Split spoon sampler
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample
DT	Dual tube sample
DD	Diamond drilling

II. PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg. (140 lb.) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) split spoon sampler for a distance of 300 mm (12 in.).

Dynamic Cone Penetration Resistance (DCPT); N_d :

The number of blows by a 63.5 kg (140 lb.) hammer dropped 760 mm (30 in.) to drive an uncased 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH:	Sampler advanced by hydraulic pressure
PM:	Sampler advanced by manual pressure
WH:	Sampler advanced by static weight of hammer
WR:	Sampler advanced by weight of sampler and rod

Cone Penetration Test (CPT):

An electronic cone penetrometer with a 60° conical tip and a projected end area of 10 cm² pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (q_t), porewater pressure (u) and friction along a sleeve are recorded electronically at 25 mm penetration intervals.

III. SOIL DESCRIPTION

(a) Cohesionless Soils

Density Index (Relative Density)	N Blows/300 mm Or Blows/ft.
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

(b) Cohesive Soils C_u or S_u

Consistency	kPa	Psf
Very soft	0 to 12	0 to 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1,000
Stiff	50 to 100	1,000 to 2,000
Very stiff	100 to 200	2,000 to 4,000
Hard	Over 200	Over 4,000

IV. SOIL TESTS

w	Water content
w_p or PL	Plastic limited
w_l or LL	Liquid limit
C	Consolidation (oedometer) test
CHEM	Chemical analysis (refer to text)
CID	Consolidated isotropically drained triaxial test ¹
CIU	Consolidated isotropically undrained triaxial test with porewater pressure measurement ¹
D_R	Relative density
DS	Direct shear test
Gs	Specific gravity
M	Sieve analysis for particle size
MH	Combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	Organic content test
SO ₄	Concentration of water-soluble sulphates
UC	Unconfined compression test
UU	Unconsolidated undrained triaxial test
V	Field vane test (LV-laboratory vane test)
γ	Unit weight

Note: ¹ Tests which are anisotropically consolidated prior shear are shown as CAD, CAU.

LIST OF SYMBOLS

Unless otherwise stated, the symbols employed in the report are as follows:

I. GENERAL

π	3.1416
$\ln x$	natural logarithm of x
$\log_{10} x$ or $\log x$	logarithm of x to base 10
g	acceleration due to gravity
t	time
FOS	factor of safety
V	volume
W	weight

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta \sigma'$
ϵ	linear strain
ϵ_v	volumetric strain
η	coefficient of viscosity
ν	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial vertical effective overburden stress
$\sigma_1 \sigma_2 \sigma_3$	principal stresses (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3) / 3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight)*
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s / \rho_w$) formerly (G_s)
e	void ratio
n	porosity
S	degree of saturation
*	Density symbol is ρ . Unit weight symbol is γ where $\gamma = \rho g$ (i.e. mass density multiplied by acceleration due to gravity)

(a) Index Properties (continued)

w	water content
w_L or LL	liquid limit
w_p or PL	plastic limit
I_p or PI	plasticity Index $= (w_L - w_p)$
w_s	shrinkage limit
I_L	liquidity index $= (w - w_p) / I_p$
I_c	consistency index $= (w_L - w) / I_p$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index $= (e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)

(b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (overconsolidated range)
C_s	swelling index
C_α	coefficient of secondary consolidation
m_v	coefficient of volume change
c_v	coefficient of consolidation (vertical direction)
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation stress
OCR	overconsolidation ratio $= \sigma'_p / \sigma'_{vo}$

(d) Shear Strength



τ_p or τ_r	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction $= \tan \delta$
c'	effective cohesion
c_u or s_u	undrained shear strength ($\phi = 0$ analysis)
p	mean total stress $(\sigma_1 + \sigma_3) / 2$
p'	mean effective stress $(\sigma'_1 + \sigma'_3) / 2$
q	$(\sigma_1 - \sigma_3) / 2$ or $(\sigma'_1 - \sigma'_3) / 2$
q_u	compressive strength $(\sigma_1 - \sigma_3)$
S_t	sensitivity

Notes:

$$^1 \tau = c' + \sigma' \tan \phi'$$

$$^2 \text{ shear strength} = (\text{compressive strength}) / 2$$

PROJECT 12-1121-0099-1230		RECORD OF BOREHOLE No 13-231		SHEET 1 OF 1	METRIC
G.W.P. 4128-10-01	LOCATION N 4983410.8 ; E 405745.4	ORIGINATED BY HEC			
DIST Eastern HWY 118	BOREHOLE TYPE Power Auger 200 mm Diam. (Hollow Stem)	COMPILED BY JM			
DATUM Geodetic	DATE May 14-15, 2013	CHECKED BY SAT			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					w _p	w	w _L			
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED										
369.7	GROUND SURFACE							20	40	60	80	100						
0.0	SAND, trace gravel Compact Brown to grey						369											
368.9							368											
0.8	SAND, some gravel, trace silt, contains cobbles Compact Grey Moist to wet		1	SS	28		367											
			2	SS	19													
			3	SS	28													
			4	SS	26													
		5	SS	19														
		6	SS	23														
		7	SS	14														
		8	SS	12														
		9	SS	22														
362.0	END OF BOREHOLE AUGER REFUSAL						362											
7.7	NOTES: 1. Water level in open borehole at a depth of 0.8 m below ground surface (Elev. 368.9 m), measured during drilling.																	

GTA-MTO 001 N:\ACTIVE\2012\1121 - GEOTECHNICAL\12-1121-0099 MRC 22 STRUCTURES EASTERN REGION\SPATIAL IMG\INT1211210099.GPJ GAL-GTA.GDT 4/27/17 JM

PROJECT 12-1121-0099-1230		RECORD OF BOREHOLE No 13-232		SHEET 1 OF 2		METRIC	
G.W.P. 4128-10-01		LOCATION N 4983426.6 ; E 405732.4		ORIGINATED BY HEC			
DIST Eastern HWY 118		BOREHOLE TYPE Power Auger 200 mm Diam. (Hollow Stem)		COMPILED BY JM			
DATUM Geodetic		DATE May 8, 2013		CHECKED BY SAT			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
								20 40 60 80 100	25 50 75					
372.6	GROUND SURFACE													
0.0	ASPHALTIC CONCRETE (0.0 m - 0.1 m)													
372.2	Crushed stone (FILL) Grey													
0.4	Gravelly sand, contains cobbles (FILL) Compact to loose Brown Moist		1	SS	20									35 56 8 1
			2	SS	20									
			3	SS	8									
369.5	SAND and GRAVEL, contains cobbles Compact Brown, grey and grey-brown Moist to wet		4	SS	10									46 49 5 0
3.1			5	SS	18									
			6	SS	19									
			7	SS	18									48 48 4 0
			8	SS	12									54 41 5 0
			9	SS	17									
			10	SS	24									
			11	SS	22									40 55 5 0
			12	SS	22									

GTA-MTO 001 N\ACTIVE\2012\1121 - GEOTECHNICAL\12-1121-0099 MRC 22 STRUCTURES EASTERN REGION\SPATIAL IMG\INT\1211210099.GPJ GAL-GTA.GDT 4/27/17 JM

Continued Next Page

+³, X³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT 12-1121-0099-1230		RECORD OF BOREHOLE No 13-232		SHEET 2 OF 2	METRIC
G.W.P. 4128-10-01	LOCATION N 4983426.6 ; E 405732.4	ORIGINATED BY HEC			
DIST Eastern HWY 118	BOREHOLE TYPE Power Auger 200 mm Diam. (Hollow Stem)	COMPILED BY JM			
DATUM Geodetic	DATE May 8, 2013	CHECKED BY SAT			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					w _p	w	w _L		GR	SA	SI	CL
	--- CONTINUED FROM PREVIOUS PAGE ---																			
361.9	SAND and GRAVEL, contains cobbles Compact Brown, grey and grey-brown Moist to wet																			
10.7	SAND, some gravel, trace silt, contains cobbles and boulders Compact to very dense Grey-brown Wet		13	SS	61												24 71 5 0			
360.3			14	SS	55/0.1															
12.3	END OF BOREHOLE AUGER REFUSAL																			

GTA-MTO 001 N:\ACTIVE\2012\1121 - GEOTECHNICAL\12-1121-0099 MRC 22 STRUCTURES EASTERN REGION\SPATIAL IMG\INT\1211210099.GPJ GAL-GTA.GDT 4/27/17 JM

PROJECT 12-1121-0099-1230

RECORD OF BOREHOLE No 13-233

SHEET 1 OF 2

METRIC

G.W.P. 4128-10-01

LOCATION N 4983432.4 :E 405723.1

ORIGINATED BY HEC

DIST Eastern HWY 118

BOREHOLE TYPE Power Auger 200 mm Diam. (Hollow Stem)

COMPILED BY JM

DATUM Geodetic

DATE May 13-14, 2013

CHECKED BY SAT

GTA-MTO 001 N:\ACTIVE\2012\1121 - GEOTECHNICAL\12-1121-0099 MRC 22 STRUCTURES EASTERN REGION\SPATIAL IMG\INT1211210099.GPJ GAL-GTA.GDT 4/27/17 JM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		W _p W W _L				
371.4	GROUND SURFACE							20 40 60 80 100						GR SA SI CL
0.0	Cobbles, some sand (FILL) Loose Brown Moist						371							
370.6														
0.8	SAND and GRAVEL, trace silt Loose to compact Brown Moist to wet		1	SS	10									
			2	SS	6									
			3	SS	22									
			4	SS	35									
367.9							368							
3.5	SAND, trace to some gravel, trace silt, contains cobbles Compact to dense Brown to grey-brown Wet		5	SS	20									
			6	SS	34									
			7	SS	19									
			8	SS	13									
364.1			9	SS	28									
7.3	SAND and GRAVEL, trace silt, contains cobbles Compact Brown Wet		10	SS	21									
363.2														
8.2	SAND, trace gravel and silt, contains cobbles and boulders Compact Brown Wet		11	SS	30									
362.3														
9.1	SAND, trace silt Very loose Brown Wet		12	SS	2									

Continued Next Page

+³, X³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT 12-1121-0099-1230		RECORD OF BOREHOLE No 13-233				SHEET 2 OF 2		METRIC					
G.W.P. 4128-10-01		LOCATION N 4983432.4 ; E 405723.1				ORIGINATED BY HEC							
DIST Eastern HWY 118		BOREHOLE TYPE Power Auger 200 mm Diam. (Hollow Stem)				COMPILED BY JM							
DATUM Geodetic		DATE May 13-14, 2013				CHECKED BY SAT							
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
	--- CONTINUED FROM PREVIOUS PAGE ---						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED	20 40 60 80 100 WATER CONTENT (%)					
361.0 10.4	END OF BOREHOLE AUGER REFUSAL NOTES: 1. Water level in well screen at a depth of 1.8 m below ground surface (Elev. 369.6 m), measured on June 3, 2013.												

GTA-MTO 001 N\ACTIVE\2012\1121 - GEO TECHNICAL\12-1121-0099 MRC 22 STRUCTURES EASTERN REGION\SPATIAL IMGINT\1211210099.GPJ GAL-GTA.GDT 4/27/17 JM

PROJECT 12-1121-0099-1230		RECORD OF BOREHOLE No 13-234		SHEET 1 OF 1		METRIC	
G.W.P. 4128-10-01		LOCATION N 4983417.9 ; E 405717.9		ORIGINATED BY HEC			
DIST Eastern HWY 118		BOREHOLE TYPE Power Auger 200 mm Diam. (Hollow Stem)		COMPILED BY JM			
DATUM Geodetic		DATE May 9, 2013		CHECKED BY SAT			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W _p W W _L	W _p W W _L	W _p W W _L		
372.9	GROUND SURFACE													
0.0	ASPHALTIC CONCRETE (0.0 m - 0.1 m)													
372.5	Crushed stone (FILL) Grey													
0.4	Sand and gravel, trace silt, contains cobbles and boulders (FILL) Compact to very dense Brown Moist to wet		1	SS	46									43 51 5 1
			2	SS	65/0.2									
							371							
			3	SS	76									49 43 7 1
							370							
			4	SS	13									
369.4	Silty SAND, trace gravel, contains organic matter Compact Brown Moist to wet						369							
3.7			5	SS	40									55 37 7 1
368.6	Sandy GRAVEL, trace silt, contains organic matter and silty sand seams Dense Grey Wet													
4.3			6	SS	33									43 49 7 1
	SAND and GRAVEL, trace silt, contains cobbles Dense Brown to grey Wet						368							
367.6			7	SS	23									
5.3	SAND, some gravel, trace silt Compact to loose Grey Wet						367							
			8	SS	8									18 77 4 1
							366							
365.7	SAND, trace to some gravel, trace silt, contains cobbles and boulders Compact Brown Wet													
7.2			9	SS	21									
			10	SS	18									
			11	SS	19									
							364							
			12	SS	32									11 84 4 1
363.2	END OF BOREHOLE													
9.8														

GTA-MTO 001 N:\ACTIVE\2012\1121 - GEOTECHNICAL\12-1121-0099 MRC 22 STRUCTURES EASTERN REGION\SPATIAL IMG\INT\1211210099.GPJ GAL-GTA.GDT 4/27/17 JM

PROJECT 12-1121-0099-1231

RECORD OF BOREHOLE No 16-235

SHEET 1 OF 1

METRIC

G.W.P. 412B-10-01

LOCATION N 4983420.3 :E 405717.0

ORIGINATED BY KM

DIST Eastern HWY 118

BOREHOLE TYPE Power Auger/200 mm Diam. (Hollow Stem)

COMPILED BY JLL

DATUM Geodetic

DATE December 23, 2016

CHECKED BY CG

GTA-MTO 001 N:\ACTIVE\2012\1121 - GEOTECHNICAL\12-1121-0099 MRC 22 STRUCTURES EASTERN REGION\SPATIAL MGMT\PHASE 1231\1211210099-1231.GPJ GAL-GTA.GDT 4/27/17 JM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			W _p W W _L					
								○ UNCONFINED + FIELD VANE								
								● QUICK TRIAXIAL x REMOULDED								
372.8	GROUND SURFACE							20	40	60	80	100	25	50	75	
0.0	ASPHALTIC CONCRETE (0.0 m - 0.1 m)															
372.5	Crushed stone (FILL) Grey		1	GRAB												
0.4	Sand and gravel to gravelly sand, contains cobbles and boulders (FILL) Compact to dense Brown Moist		2	SS	50/0.1		372									
			3	SS	17		371									
			4	SS	11		370									
369.8																
3.1	Silty SAND, some gravel, contains cobbles Very loose Brown Wet		5	SS	2		369									
369.0																
3.8	SAND and GRAVEL, some silt to silty, contains cobbles Compact Grey - brown Wet		6	SS	21		368									
			7	SS	27		367									
			8	SS	16											
			9	SS	10											
366.1																
6.7	END OF BOREHOLE															

PROJECT 12-1121-0099-1231

RECORD OF BOREHOLE No 16-236

SHEET 1 OF 1

METRIC

G.W.P. 412B-10-01

LOCATION N 4983423.9 ; E 405736.1

ORIGINATED BY KM

DIST Eastern HWY 118

BOREHOLE TYPE Power Auger/200 mm Diam. (Hollow Stem)

COMPILED BY JJL

DATUM Geodetic

DATE December 23, 2016

CHECKED BY CG










SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w_p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w_L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL						
372.8	GROUND SURFACE						20	40	60	80	100	25	50	75		
0.0	ASPHALTIC CONCRETE (0.0 m - 0.1 m)															
372.5	Crushed stone (FILL) (0.1 m - 0.3 m)		1	GRAB												
	Grey Sand and gravel to gravelly sand, contains cobbles and boulders (FILL)		2	SS	32											
	Loose to very dense															
	Brown		3	SS	62											
	Moist															
			4	SS	9											
			5	SS	25											
369.0																
3.8	SAND, some gravel and silt seams, contains cobbles		6	SS	28											
	Compact															
	Brown to grey															
	Wet															
367.9			7	SS	14											
4.9	SAND to gravelly SAND, some silt, contains cobbles															
	Very loose to dense		8	SS	2											
	Grey-brown to grey															
	Wet		9	SS	32											
			10	SS	26											
365.3																
7.5	END OF BOREHOLE															

RECORD OF BOREHOLE No 1

1 of 1

METRIC

G.W.P. 4126-10-00 LOCATION Coords: E:405685.8 N:4983425.5 ORIGINATED BY NG
 DIST HWY 118 BOREHOLE TYPE TRIPOD MOUNTED WITH CASING, WASH BORING COMPILED BY SD
 DATUM GEODETIC DATE 2018-8-13 - 2018-8-14 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	SPT 'N' VALUE			SHEAR STRENGTH (kPa)							
								20 40 60 80 100							
								O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE							
								PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			WATER CONTENT (%)				
								w _p w w _L			-----				
369.7	GROUND SURFACE							20	40	60	80	100			GR SA SI CL
369.1	25mm TOPSOIL		1	SS	30										
0.6	FILL, sand and gravel, some silt to silty, compact to dense, brown, wet		2	SS	41										
	ORGANIC SAND, some silt, trace to some gravel, trace clay, trace wood and rootlets, compact to dense, dark brown, wet		3	SS	17										
367.5															
2.2	SAND, trace gravel, trace silt, dense, brown, wet		4	SS	*										
			5	SS	39										
366.0															
3.7	GRAVELLY SAND, some silt, trace clay, very dense, brown, wet		6	SS	98										
365.4			7	SS	100 / 15mm										
4.3															

</

END OF BOREHOLE

*Unable to perform standard penetration test due to sand rising into casing.

Unable to extend the borehole deeper than 4.3m, borehole relocated 1.7m to the north, refusal encountered again at 4.3m below ground surface.

Unstabilized water level measured at 0.2 m below ground surface; borehole caved at 3.1 m below ground surface upon completion of drilling.

RECORD OF BOREHOLE No 2

1 of 1

METRIC

G.W.P. 4126-10-00 LOCATION Coords: E:405716.5 N:4983405.2 ORIGINATED BY NG
 DIST HWY 118 BOREHOLE TYPE TRIPOD MOUNTED WITH CASING, WASH BORING COMPILED BY SD
 DATUM GEODETIC DATE 2018-8-14 - 2018-8-15 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	SPT 'N' VALUE			20 40 60 80 100	W _p	W	W _L			WATER CONTENT (%)
								SHEAR STRENGTH (kPa)						
								<div><div></div><div></div><div></div><div></div><div></div></div> <div><div></div><div></div><div></div><div></div><div></div></div>						
370.4	GROUND SURFACE													
	35mm TOPSOIL		1	SS	24		370							29 52 17 2
	GRAVELLY SAND, some silt, trace clay, trace organics, compact to very dense, brown, wet		2	SS	38									sampler wet at 0.6m
			3	SS	60			369						Aug. 14, 2018
			4	SS	32			368						Aug. 15, 2018
367.5	SAND, trace silt, trace gravel, compact to 4.4m, very dense below, brown, wet	5	SS	17			367						25 61 12 2	
2.9		6	SS	14										
		7	SS	75			366							1 94 (5)
365.2	SAND AND GRAVEL, trace silt, very dense, brown, wet	8	SS	100 / 25mm			365							
5.2		9	SS	100 / 25mm										
364.9														
5.5														
END OF BOREHOLE														

END OF BOREHOLE

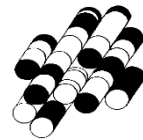
Unstabilized water level measured at 0.7 m below ground surface; borehole caved at 2.3 m below ground surface upon completion of drilling.

Unable to extend the borehole deeper than 5.5m, borehole relocated 2.7m to the east, refusal encountered again at 4.3m below ground surface.

Results of In-Situ Hydraulic Conductivity Testing

APPENDIX B

Terraprobe Inc.





Terraprobe

11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

Slug Test Analysis Report

Project: Irondale River Culvert

Number: 1-18-0347

Client: AE

Location: Hwy 118

Slug Test: BH 13-233

Test Well: BH 13-233

Test Conducted by: FY

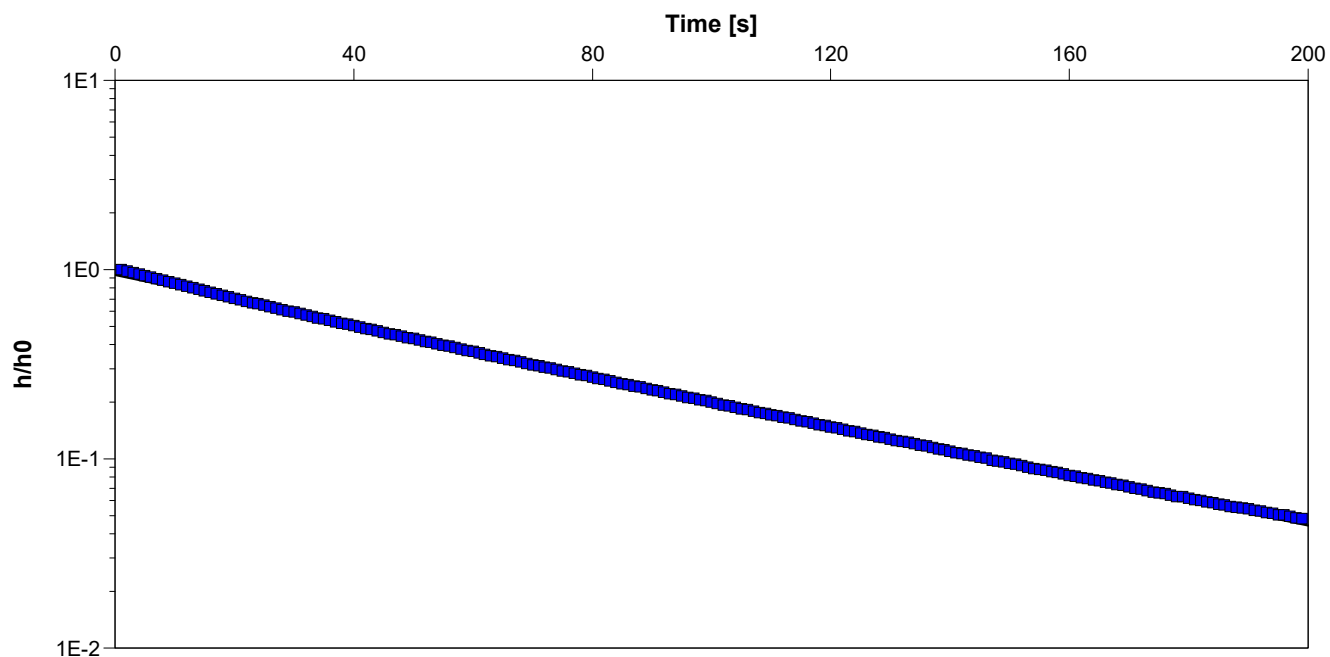
Test Date: 9/5/2018

Analysis Performed by: SD

Hvorslev

Analysis Date: 12/5/2018

Aquifer Thickness: 10.40 m



Calculation using Hvorslev

Observation Well

Hydraulic Conductivity
[m/s]

BH 13-233

1.31×10^{-5}



Terraprobe

11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

Slug Test Analysis Report

Project: Irondale River Culvert

Number: 1-18-0347

Client: AE

Location: Hwy 118

Slug Test: BH 13-233

Test Well: BH 13-233

Test Conducted by: FY

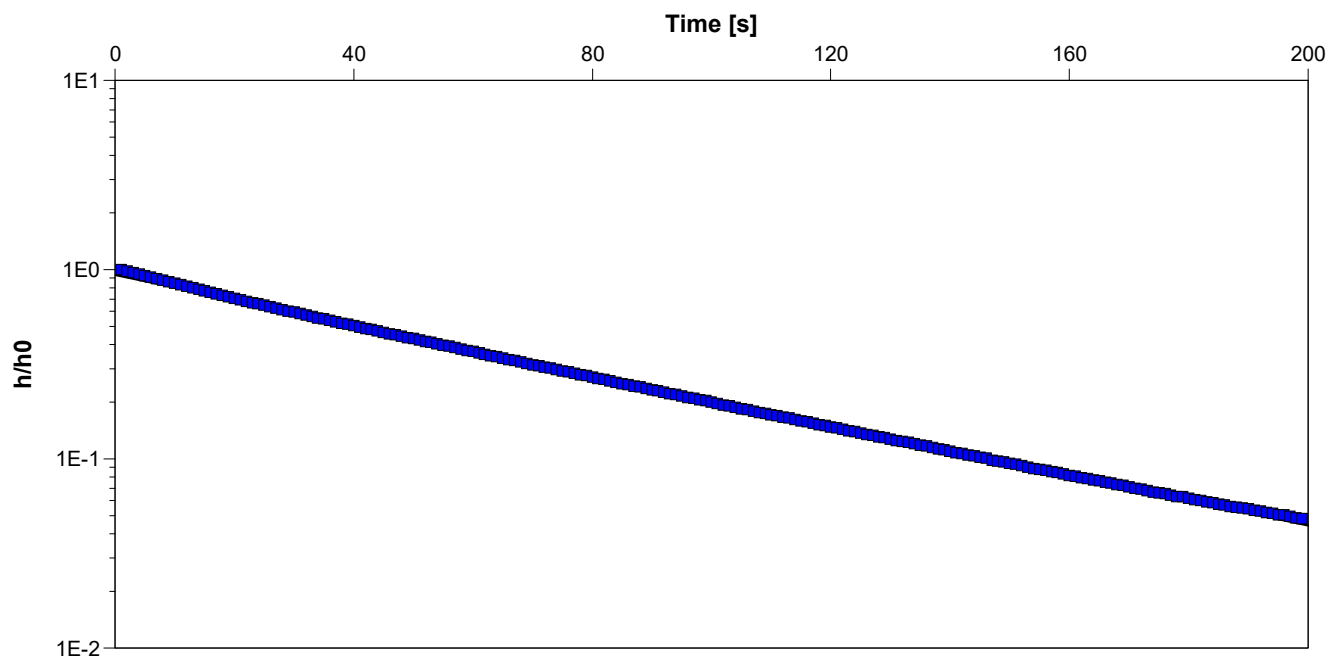
Test Date: 9/5/2018

Analysis Performed by: SD

Bouwer & Rice

Analysis Date: 12/5/2018

Aquifer Thickness: 10.40 m



Calculation using Bouwer & Rice

Observation Well

Hydraulic Conductivity
[m/s]

BH 13-233

1.00×10^{-5}



Terraprobe

11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

Slug Test - Analyses Report

Project: Irondale River Culvert

Number: 1-18-0347

Client: AE

Location: Hwy 118

Slug Test: BH 13-233

Test Well: BH 13-233

Test Conducted by: FY

Test Date: 9/5/2018

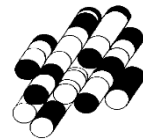
Aquifer Thickness: 10.40 m

	Analysis Name	Analysis Performed	Analysis Date	Method name	Well	T [m ² /s]	K [m/s]	S
1	Hvorslev	SD	12/5/2018	Hvorslev	BH 13-233		1.31×10^{-5}	
2	Bouwer & Rice	SD	12/5/2018	Bouwer & Rice	BH 13-233		1.00×10^{-5}	

Laboratory Certificates of Analysis

APPENDIX C

Terraprobe Inc.





FINAL REPORT

CA14128-SEP18 R1

1-18-0347, Irondale River

Prepared for

Terraprobe Inc

First Page

CLIENT DETAILS

Client Terraprobe Inc

Address 11 Indell Lane, Brampton
Canada, L6T 3Y3
Phone: (905) 796-2650. Fax:(905) 796-2250

Contact Sepideh D_Monfared

Telephone (905) 796-2650

Facsimile (905) 796-2250

Email smonfared@terraprobe.ca

Project 1-18-0347, Irondale River

Order Number

Samples Ground Water (2)

LABORATORY DETAILS

Project Specialist Deanna Edwards, B.Sc, C.Chem

Laboratory SGS Canada Inc.

Address 185 Concession St., Lakefield ON, K0L 2H0

Telephone 705-652-2000

Facsimile 705-652-6365

Email deanna.edwards@sgs.com

SGS Reference CA14128-SEP18

Received 09/06/2018

Approved 11/16/2018

Report Number CA14128-SEP18 R1

Date Reported 11/16/2018

COMMENTS

MAC - Maximum Acceptable Concentration

AO/OG - Aesthetic Objective / Operational Guideline

MDL - SGS Method Detection Limit

NR - Not regulated / reportable under applicable Provincial drinking water regulations as per client.

Temperature of Sample upon Receipt: 5 degrees C

Cooling Agent Present: Yes

Custody Seal Present: No

Chain of Custody Number: 004381

SIGNATORIES



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QC Summary..... 14-29

Legend..... 30

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FINAL REPORT

CA14128-SEP18 R1

Client: Terraprobe Inc
Project: 1-18-0347, Irondale River
Project Manager: Sepideh D_Monfared
Samplers: Fatemeh

PACKAGE: REG153 - BTEX (WATER)

Sample Number 8
Sample Name Irondale River
Sample Matrix Ground Water
Sample Date 05/09/2018

L1 = REG153 / GROUND WATER / COARSE - TABLE 1 - All Types of Property Uses - UNDEFINED

Parameter	Units	RL	L1	Result
BTEX				
Benzene	ug/L	0.5	0.5	< 0.5
Ethylbenzene	ug/L	0.5	0.5	< 0.5
Toluene	ug/L	0.5	0.8	< 0.5
Xylene (total)	ug/L	0.5	72	< 0.5
m/p-xylene	ug/L	0.5		< 0.5
o-xylene	ug/L	0.5		< 0.5

PACKAGE: REG153 - General Chemistry (WATER)

Sample Number 8
Sample Name Irondale River
Sample Matrix Ground Water
Sample Date 05/09/2018

L1 = REG153 / GROUND WATER / COARSE - TABLE 1 - All Types of Property Uses - UNDEFINED

Parameter	Units	RL	L1	Result
General Chemistry				
Dissolved Oxygen	mg/L	1		8.3
UV Transmittance	%T	-		27.2
Total Suspended Solids	mg/L	2		513
Alkalinity	mg/L as CaCO3	2		68
Bicarbonate	mg/L as CaCO3	2		68
Carbonate	mg/L as CaCO3	2		< 2
OH	mg/L as CaCO3	2		< 2



FINAL REPORT

CA14128-SEP18 R1

Client: Terraprobe Inc
Project: 1-18-0347, Irondale River
Project Manager: Sepideh D_Monfared
Samplers: Fatemeh

PACKAGE: REG153 - General Chemistry (WATER)

Sample Number 8
Sample Name Irondale River
Sample Matrix Ground Water
Sample Date 05/09/2018

L1 = REG153 / GROUND WATER / COARSE - TABLE 1 - All Types of Property Uses - UNDEFINED

Parameter	Units	RL	L1	Result
General Chemistry (continued)				
Colour	TCU	3		33
Conductivity	uS/cm	2		149
Phosphorus (total reactive)	mg/L	0.03		0.25
Turbidity	NTU	0.10		515
Total Kjeldahl Nitrogen (N)	as N mg/L	0.05		0.31
Ammonia+Ammonium (N)	as N mg/L	0.04		0.15
Sulphide	µg/L	6		27
Total Organic Carbon	mg/L	1		3
Dissolved Organic Carbon	mg/L	1		2



FINAL REPORT

CA14128-SEP18 R1

Client: Terraprobe Inc

Project: 1-18-0347, Irondale River

Project Manager: Sepideh D_Monfared

Samplers: Fatemeh

PACKAGE: **REG153 - Hydrides (WATER)**

Sample Number 9
Sample Name Irondale River
O.Reg 153
Sample Matrix Ground Water
Sample Date 05/09/2018

L1 = REG153 / GROUND WATER / COARSE - TABLE 1 - All Types of Property Uses - UNDEFINED

Parameter	Units	RL	L1	Result
Hydrides				
Antimony	µg/L	0.02	1.5	0.04
Arsenic	µg/L	0.2	13	0.6
Selenium	µg/L	0.04	5	0.11

PACKAGE: **REG153 - Metals and Inorganics (WATER)**

Sample Number 8 9
Sample Name Irondale River Irondale River
O.Reg 153
Sample Matrix Ground Water Ground Water
Sample Date 05/09/2018 05/09/2018

L1 = REG153 / GROUND WATER / COARSE - TABLE 1 - All Types of Property Uses - UNDEFINED

Parameter	Units	RL	L1	Result	Result
Metals and Inorganics					
Fluoride	mg/L	0.06		0.11	
Bromide	mg/L	0.05		0.05#<MDL	
Nitrite (as N)	as N mg/L	0.003		0.003#<MDL	
Nitrate (as N)	as N mg/L	0.006		0.006	
Sulphate	mg/L	0.04		3.9	
Hardness	mg/L as CaCO3	0.05		74.5	
Boron	µg/L	2		17	
Calcium	mg/L	0.01		21.9	
Iron	ug/L	7		4850	
Potassium	mg/L	0.003		2.26	
Magnesium	mg/L	0.001		4.79	



FINAL REPORT

CA14128-SEP18 R1

Client: Terraprobe Inc

Project: 1-18-0347, Irondale River

Project Manager: Sepideh D_Monfared

Samplers: Fatemeh

PACKAGE: REG153 - Metals and Inorganics (WATER)

Sample Number	8	9
Sample Name	Irondale River	Irondale River O.Reg 153
Sample Matrix	Ground Water	Ground Water
Sample Date	05/09/2018	05/09/2018

L1 = REG153 / GROUND WATER / COARSE - TABLE 1 - All Types of Property Uses - UNDEFINED

Parameter	Units	RL	L1	Result	Result
Metals and Inorganics (continued)					
Sodium	mg/L	0.01		3.04	
Aluminum	µg/L	0.3		2580	
Bismuth	µg/L	0.007		0.013	
Manganese	µg/L	0.01		731	
Phosphorus	mg/L	0.003		0.144	
Silicon	ug/L	20		9880	
Strontium	µg/L	0.02		73.5	
Tin	µg/L	0.01		0.20	
Titanium	ug/L	0.05		217	
Barium	µg/L	0.02	610		72.2
Beryllium	µg/L	0.007	0.5		0.218
Boron	µg/L	2	1700		12
Cadmium	µg/L	0.003	0.5		0.047
Chromium	µg/L	0.03	11		5.15
Cobalt	µg/L	0.004	3.8		4.08
Copper	µg/L	0.02	5		20.8
Lead	µg/L	0.01	1.9		3.94
Molybdenum	µg/L	0.01	23		0.33
Nickel	µg/L	0.1	14		6.6
Silver	µg/L	0.002	0.3		< 0.002
Thallium	µg/L	0.005	0.5		0.080
Uranium	µg/L	0.002	8.9		4.86
Vanadium	µg/L	0.01	3.9		9.23



FINAL REPORT

CA14128-SEP18 R1

Client: Terraprobe Inc

Project: 1-18-0347, Irondale River

Project Manager: Sepideh D_Monfared

Samplers: Fatemeh

PACKAGE: REG153 - Metals and Inorganics (WATER)

Sample Number 8 9
Sample Name Irondale River Irondale River
O.Reg 153
Sample Matrix Ground Water Ground Water
Sample Date 05/09/2018 05/09/2018

L1 = REG153 / GROUND WATER / COARSE - TABLE 1 - All Types of Property Uses - UNDEFINED

Parameter	Units	RL	L1	Result	Result
Metals and Inorganics (continued)					
Zinc	µg/L	2	160		31

PACKAGE: REG153 - Microbiology (WATER)

Sample Number 8
Sample Name Irondale River
Sample Matrix Ground Water
Sample Date 05/09/2018

L1 = REG153 / GROUND WATER / COARSE - TABLE 1 - All Types of Property Uses - UNDEFINED

Parameter	Units	RL	L1	Result
Microbiology				
Total Coliform	cfu/100mL	-		200
E. Coli	cfu/100mL	-		0
Heterotrophic Plate Count (HPC)	cfu/1mL	-		>2000

PACKAGE: REG153 - Na (WATER)

Sample Number 9
Sample Name Irondale River
O.Reg 153
Sample Matrix Ground Water
Sample Date 05/09/2018

L1 = REG153 / GROUND WATER / COARSE - TABLE 1 - All Types of Property Uses - UNDEFINED

Parameter	Units	RL	L1	Result
Na				
Sodium	µg/L	10	490000	3010



FINAL REPORT

CA14128-SEP18 R1

Client: Terraprobe Inc
Project: 1-18-0347, Irondale River
Project Manager: Sepideh D_Monfared
Samplers: Fatemeh

PACKAGE: REG153 - Other (ORP) (WATER)

Sample Number	8	9
Sample Name	Irondale River	Irondale River O.Reg 153
Sample Matrix	Ground Water	Ground Water
Sample Date	05/09/2018	05/09/2018

L1 = REG153 / GROUND WATER / COARSE - TABLE 1 - All Types of Property Uses - UNDEFINED

Parameter	Units	RL	L1	Result	Result
Other (ORP)					
pH	no unit	0.05		7.40	
Mercury (total)	µg/L	0.01	0.1		< 0.01
Chloride	µg/L	200	790000	2800	
Chromium VI	µg/L	0.2	25		< 0.2
Free Cyanide	µg/L	2	5	< 2	

PACKAGE: REG153 - PAHs (WATER)

Sample Number	8
Sample Name	Irondale River
Sample Matrix	Ground Water
Sample Date	05/09/2018

L1 = REG153 / GROUND WATER / COARSE - TABLE 1 - All Types of Property Uses - UNDEFINED

Parameter	Units	RL	L1	Result
PAHs				
Acenaphthene	µg/L	0.1	4.1	< 0.1
Acenaphthylene	µg/L	0.1	1	< 0.1
Anthracene	µg/L	0.1	0.1	< 0.1
Benzo(a)anthracene	µg/L	0.1	0.2	< 0.1
Benzo(a)pyrene	µg/L	0.01	0.01	< 0.01
Benzo(b)fluoranthene	µg/L	0.1	0.1	< 0.1
Benzo(ghi)perylene	µg/L	0.2	0.2	< 0.2
Benzo(k)fluoranthene	µg/L	0.1	0.1	< 0.1
Chrysene	µg/L	0.1	0.1	< 0.1
Dibenzo(a,h)anthracene	µg/L	0.1	0.2	< 0.1
Fluoranthene	µg/L	0.1	0.4	< 0.1



FINAL REPORT

CA14128-SEP18 R1

Client: Terraprobe Inc
Project: 1-18-0347, Irondale River
Project Manager: Sepideh D_Monfared
Samplers: Fatemeh

PACKAGE: REG153 - PAHs (WATER)

Sample Number 8
Sample Name Irondale River
Sample Matrix Ground Water
Sample Date 05/09/2018

L1 = REG153 / GROUND WATER / COARSE - TABLE 1 - All Types of Property Uses - UNDEFINED

Parameter	Units	RL	L1	Result
PAHs (continued)				
Fluorene	µg/L	0.1	120	< 0.1
Indeno(1,2,3-cd)pyrene	µg/L	0.2	0.2	< 0.2
1-Methylnaphthalene	µg/L	0.5		< 0.5
2-Methylnaphthalene	µg/L	0.5		< 0.5
Methylnaphthalene, 2-(1-)	µg/L	0.5	2	< 0.5
Naphthalene	µg/L	0.5	7	< 0.5
Phenanthrene	µg/L	0.1	0.1	< 0.1
Pyrene	µg/L	0.1	0.2	< 0.1

PACKAGE: REG153 - PHCs (WATER)

Sample Number 8
Sample Name Irondale River
Sample Matrix Ground Water
Sample Date 05/09/2018

L1 = REG153 / GROUND WATER / COARSE - TABLE 1 - All Types of Property Uses - UNDEFINED

Parameter	Units	RL	L1	Result
PHCs				
F1 (C6-C10)	µg/L	25	420	< 25
F1-BTEX (C6-C10)	µg/L	25		< 25
F2 (C10-C16)	µg/L	100	150	< 100
F3 (C16-C34)	µg/L	200	500	< 200
F4 (C34-C50)	µg/L	200	500	< 200
Chromatogram returned to baseline at nC50	Yes / No	-		YES



FINAL REPORT

CA14128-SEP18 R1

Client: Terraprobe Inc
Project: 1-18-0347, Irondale River
Project Manager: Sepideh D_Monfared
Samplers: Fatemeh

PACKAGE: REG153 - Phenols (WATER)

Sample Number 8
Sample Name Irondale River
Sample Matrix Ground Water
Sample Date 05/09/2018

L1 = REG153 / GROUND WATER / COARSE - TABLE 1 - All Types of Property Uses - UNDEFINED

Parameter	Units	RL	L1	Result
Phenols				
4AAP-Phenolics	mg/L	0.002		< 0.002

PACKAGE: REG153 - SVOC Surrogates (WATER)

Sample Number 8
Sample Name Irondale River
Sample Matrix Ground Water
Sample Date 05/09/2018

L1 = REG153 / GROUND WATER / COARSE - TABLE 1 - All Types of Property Uses - UNDEFINED

Parameter	Units	RL	L1	Result
SVOC Surrogates				
Surr Nitrobenzene-d5	Surr Rec %	-		83
Surr 2-Fluorobiphenyl	Surr Rec %	-		76
Surr 4-Terphenyl-d14	Surr Rec %	-		91
Surr 2-Fluorophenol	Surr Rec %	-		47
Surr 2,4,6-Tribromophenol	Surr Rec %	-		90

PACKAGE: REG153 - THMs (VOC) (WATER)

Sample Number 8
Sample Name Irondale River
Sample Matrix Ground Water
Sample Date 05/09/2018

L1 = REG153 / GROUND WATER / COARSE - TABLE 1 - All Types of Property Uses - UNDEFINED

Parameter	Units	RL	L1	Result
THMs (VOC)				
Bromodichloromethane	µg/L	0.5	2	< 0.5
Bromoform	µg/L	0.5	5	< 0.5
Dibromochloromethane	µg/L	0.5	2	< 0.5



FINAL REPORT

CA14128-SEP18 R1

Client: Terraprobe Inc

Project: 1-18-0347, Irondale River

Project Manager: Sepideh D_Monfared

Samplers: Fatemeh

PACKAGE: **REG153 - VOC Surrogates (WATER)**

Sample Number 8
Sample Name Irondale River
Sample Matrix Ground Water
Sample Date 05/09/2018

L1 = REG153 / GROUND WATER / COARSE - TABLE 1 - All Types of Property Uses - UNDEFINED

Parameter	Units	RL	L1	Result
VOC Surrogates				
Surr 1,2-Dichloroethane-d4	Surr Rec %	-		105
Surr 2-Bromo-1-Chloropropane	Surr Rec %	-		95
Surr 4-Bromofluorobenzene	Surr Rec %	-		87

PACKAGE: **REG153 - VOCs (WATER)**

Sample Number 8
Sample Name Irondale River
Sample Matrix Ground Water
Sample Date 05/09/2018

L1 = REG153 / GROUND WATER / COARSE - TABLE 1 - All Types of Property Uses - UNDEFINED

Parameter	Units	RL	L1	Result
VOCs				
Acetone	µg/L	30	2700	< 30
Bromomethane	µg/L	0.5	0.89	< 0.5
Carbon tetrachloride	µg/L	0.2	0.2	< 0.2
Chlorobenzene	µg/L	0.5	0.5	< 0.5
Chloroform	µg/L	0.5	2	< 0.5
1,2-Dichlorobenzene	µg/L	0.5	0.5	< 0.5
1,3-Dichlorobenzene	µg/L	0.5	0.5	< 0.5
1,4-Dichlorobenzene	µg/L	0.5	0.5	< 0.5
Dichlorodifluoromethane	µg/L	2.0	590	< 2
1,1-Dichloroethane	µg/L	0.5	0.5	< 0.5
1,2-Dichloroethane	µg/L	0.5	0.5	< 0.5
1,1-Dichloroethylene	µg/L	0.5	0.5	< 0.5
trans-1,2-Dichloroethene	µg/L	0.5	1.6	< 0.5



FINAL REPORT

CA14128-SEP18 R1

Client: Terraprobe Inc

Project: 1-18-0347, Irondale River

Project Manager: Sepideh D_Monfared

Samplers: Fatemeh

PACKAGE: **REG153 - VOCs (WATER)**

Sample Number 8

Sample Name Irondale River

Sample Matrix Ground Water

Sample Date 05/09/2018

L1 = REG153 / GROUND WATER / COARSE - TABLE 1 - All Types of Property Uses - UNDEFINED

Parameter	Units	RL	L1	Result
VOCs (continued)				
cis-1,2-Dichloroethene	µg/L	0.5	1.6	< 0.5
1,2-Dichloropropane	µg/L	0.5	0.5	< 0.5
cis-1,3-Dichloropropene	µg/L	0.5		< 0.5
trans-1,3-Dichloropropene	µg/L	0.5		< 0.5
1,3-dichloropropene (total)	µg/L	0.5	0.5	< 0.5
Ethylenedibromide	µg/L	0.2	0.2	< 0.2
n-Hexane	µg/L	1.0	5	< 1
Methyl ethyl ketone	µg/L	1	400	< 20 †
Methyl Isobutyl Ketone	µg/L	20	640	< 20
Methyl-t-butyl Ether	µg/L	2.0	15	< 2
Methylene Chloride	µg/L	0.5	5	< 0.5
Styrene	µg/L	0.5	0.5	< 0.5
Tetrachloroethylene	µg/L	0.5	0.5	< 0.5
1,1,1,2-Tetrachloroethane	µg/L	0.5	1.1	< 0.5
1,1,2,2-Tetrachloroethane	µg/L	0.5	0.5	< 0.5
1,1,1-Trichloroethane	µg/L	0.5	0.5	< 0.5
1,1,2-Trichloroethane	µg/L	0.5	0.5	< 0.5
Trichloroethylene	µg/L	0.5	0.5	< 0.5
Trichlorofluoromethane	µg/L	5.0	150	< 5
Vinyl Chloride	µg/L	0.2	0.5	< 0.2



EXCEEDANCE SUMMARY

				REG153 / GROUND WATER / COARSE - TABLE 1 - All Types of Property Uses - UNDEFINED
Parameter	Method	Units	Result	L1

Irondale River O.Reg 153

Cobalt	SM 3030/EPA 200.8	µg/L	4.08	3.8
Copper	SM 3030/EPA 200.8	µg/L	20.8	5
Lead	SM 3030/EPA 200.8	µg/L	3.94	1.9
Vanadium	SM 3030/EPA 200.8	µg/L	9.23	3.9



FINAL REPORT

CA14128-SEP18 R1

QC SUMMARY

Alkalinity
Method: SM 2320 | Internal ref.: ME-CA-1ENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Alkalinity	EWL0081-SEP18	mg/L as CaCO3	2	< 2	1	10	104	90	110	NA		

Ammonia by SFA
Method: SM 4500 | Internal ref.: ME-CA-1ENVISFA-LAK-AN-007

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Ammonia+Ammonium (N)	SKA0049-SEP18	mg/L	0.04	<0.04	6	10	95	90	110	104	75	125



FINAL REPORT

CA14128-SEP18 R1

QC SUMMARY

Anions by IC

Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-IENVIIC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO0098-SEP18	ug/L	200	<200	NV	20	98	80	120	NV	75	125
Sulphate	DIO0098-SEP18	mg/L	0.04	<0.04	1	20	98	80	120	96	75	125
Bromide	DIO0102-SEP18	mg/L	0.05	<0.05	17	20	98	80	120	100	75	125
Nitrite (as N)	DIO0102-SEP18	mg/L	0.003	<0.003	12	20	101	80	120	102	75	125
Nitrate (as N)	DIO0102-SEP18	mg/L	0.006	<0.006	0	20	104	80	120	101	75	125

Carbon by SFA

Method: SM 5310 | Internal ref.: ME-CA-IENVISFA-LAK-AN-009

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Dissolved Organic Carbon	SKA0044-SEP18	mg/L	1	<1	5	10	98	90	110	97	75	125
Total Organic Carbon	SKA0044-SEP18	mg/L	1	<1	5	10	98	90	110	97	75	125
Total Organic Carbon	SKA0077-SEP18	mg/L	1	<1	ND	10	98	90	110	NV	75	125



QC SUMMARY

Carbonate/Bicarbonate

Method: SM 2320 | Internal ref.: ME-CA-ENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Carbonate	EWL0081-SEP18	mg/L as CaCO3	2	< 2	ND	10	NA	90	110	NA		
Bicarbonate	EWL0081-SEP18	mg/L as CaCO3	2	< 2	1	10	NA	90	110	NA		
OH	EWL0081-SEP18	mg/L as CaCO3	2	< 2	ND	10	NA	90	110	NA		

Colour

Method: SM 2120 | Internal ref.: ME-CA-ENVIEWL-LAK-AN-002

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Colour	EWL0106-SEP18	TCU	3	< 3	ND	10	105	90	110	NA		



FINAL REPORT

CA14128-SEP18 R1

QC SUMMARY

Conductivity
Method: SM 2510 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0081-SEP18	uS/cm	2	< 2	0	10	99	90	110	NA		

Cyanide by SFA
Method: SM 4500 | Internal ref.: ME-CA-IENVISFA-LAK-AN-005

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Free Cyanide	SKA0043-SEP18	ug/L	2	<2	ND	10	104	90	110	93	75	125

Fluoride by Specific Ion Electrode
Method: SM 4500 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-014

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Fluoride	EWL0082-SEP18	mg/L	0.06	<0.06	ND	10	104	90	110	93	75	125



FINAL REPORT

CA14128-SEP18 R1

QC SUMMARY

Hexavalent Chromium by IC
Method: EPA218.6/EPA3060A | Internal ref.: ME-CA-IENVIIC-LAK-AN-008

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chromium VI	DIO0086-SEP18	ug/L	0.2	<0.2	ND	20	106	80	120	97	75	125

Mercury by CVAAS
Method: SM 3112/SM 3112B | Internal ref.: ME-CA-IENVISPE-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Mercury (total)	EMS0052-SEP18	ug/L	0.01	<0.01	ND	20	102	80	120	NV	70	130



FINAL REPORT

CA14128-SEP18 R1

QC SUMMARY

Metals in aqueous samples - ICP-MS

Method: SM 3030/EPA 200.8 | Internal ref.: ME-CA-ENVISPE-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Silver	EMS0042-SEP18	ug/L	0.002	<0.002	ND	20	103	90	110	95	70	130
Aluminum	EMS0042-SEP18	ug/L	0.3	<0.3	6	20	94	90	110	95	70	130
Arsenic	EMS0042-SEP18	ug/L	0.2	<0.2	1	20	100	90	110	95	70	130
Barium	EMS0042-SEP18	ug/L	0.02	<0.02	16	20	102	90	110	NV	70	130
Beryllium	EMS0042-SEP18	ug/L	0.007	<0.007	ND	20	93	90	110	86	70	130
Boron	EMS0042-SEP18	ug/L	2	<2	ND	20	107	90	110	NV	70	130
Boron	EMS0042-SEP18	ug/L	2	<2	ND	20	107	90	110	NV	70	130
Bismuth	EMS0042-SEP18	ug/L	0.007	<0.007	ND	20	94	90	110	NV	70	130
Calcium	EMS0042-SEP18	mg/L	0.01	<0.01	8	20	95	90	110	NV	70	130
Cadmium	EMS0042-SEP18	ug/L	0.003	<0.003	ND	20	100	90	110	102	70	130
Cobalt	EMS0042-SEP18	ug/L	0.004	<0.004	2	20	100	90	110	77	70	130
Chromium	EMS0042-SEP18	ug/L	0.03	<0.03	9	20	102	90	110	95	70	130
Copper	EMS0042-SEP18	ug/L	0.02	<0.02	3	20	100	90	110	84	70	130
Iron	EMS0042-SEP18	ug/L	7	<7	0	20	100	90	110	75	70	130
Potassium	EMS0042-SEP18	mg/L	0.003	<0.003	1	20	100	90	110	NV	70	130
Magnesium	EMS0042-SEP18	mg/L	0.001	<0.001	1	20	92	90	110	NV	70	130
Manganese	EMS0042-SEP18	ug/L	0.01	<0.01	0	20	101	90	110	NV	70	130
Molybdenum	EMS0042-SEP18	ug/L	0.01	<0.01	4	20	102	90	110	83	70	130
Sodium	EMS0042-SEP18	mg/L	0.01	<0.01	1	20	93	90	110	NV	70	130
Sodium	EMS0042-SEP18	ug/L	10	< 10	1	20	93	90	110	NV	70	130



FINAL REPORT

CA14128-SEP18 R1

QC SUMMARY

Metals in aqueous samples - ICP-MS (continued)

Method: SM 3030/EPA 200.8 | Internal ref.: ME-CA-ENVISPE-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Nickel	EMS0042-SEP18	ug/L	0.1	<0.1	1	20	103	90	110	74	70	130
Lead	EMS0042-SEP18	ug/L	0.01	<0.01	ND	20	100	90	110	97	70	130
Phosphorus	EMS0042-SEP18	mg/L	0.003	<0.003	10	20	97	90	110	NV	70	130
Antimony	EMS0042-SEP18	ug/L	0.02	0.034	16	20	91	90	110	76	70	130
Selenium	EMS0042-SEP18	ug/L	0.04	<0.04	ND	20	99	90	110	113	70	130
Silicon	EMS0042-SEP18	ug/L	20	<0.02	7	20	92	90	110	NV	70	130
Tin	EMS0042-SEP18	ug/L	0.01	<0.01	ND	20	101	90	110	NV	70	130
Strontium	EMS0042-SEP18	ug/L	0.02	<0.02	2	20	100	90	110	NV	70	130
Titanium	EMS0042-SEP18	ug/L	0.05	0.096	ND	20	102	90	110	NV	70	130
Thallium	EMS0042-SEP18	ug/L	0.005	<0.005	16	20	92	90	110	88	70	130
Uranium	EMS0042-SEP18	ug/L	0.002	<0.002	ND	20	93	90	110	90	70	130
Vanadium	EMS0042-SEP18	ug/L	0.01	<0.01	1	20	100	90	110	101	70	130
Zinc	EMS0042-SEP18	ug/L	2	<2	7	20	103	90	110	107	70	130



FINAL REPORT

CA14128-SEP18 R1

QC SUMMARY

Metals in aqueous samples - ICP-OES

Method: SM 3030/EPA 200.8 | Internal ref.: ME-CA-~~I~~ENVISPE-LAK-AN-003

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Hardness	EMS0042-SEP18	mg/L as CaCO3	0.05	<0.01	8	20	95	90	110	NV	70	130

Microbiology

Method: SM 9222D | Internal ref.: ME-CA-~~I~~ENVIMIC-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
E. Coli	BAC9112-SEP18	cfu/100mL	-	ACCEPTED	ACCEPTED							
Heterotrophic Plate Count (HPC)	BAC9130-SEP18	cfu/1mL	-	ACCEPTED	ACCEPTED							
Total Coliform	BAC9130-SEP18	cfu/100mL	-	ACCEPTED	ACCEPTED							



FINAL REPORT

CA14128-SEP18 R1

QC SUMMARY

Petroleum Hydrocarbons (F1)

Method: CCME Tier 1 | Internal ref.: ME-CA-IENVIGC-LAK-AN-010

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
F1 (C6-C10)	GCM0115-SEP18	ug/L	25	<25	ND	30	106	60	140	79	60	140

Petroleum Hydrocarbons (F2-F4)

Method: CCME Tier 1 | Internal ref.: ME-CA-IENVIGC-LAK-AN-010

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
F2 (C10-C16)	GCM0106-SEP18	µg/L	100	<100	ND	30	64	60	140	78	60	140
F3 (C16-C34)	GCM0106-SEP18	µg/L	200	<200	ND	30	64	60	140	78	60	140
F4 (C34-C50)	GCM0106-SEP18	µg/L	200	<200	ND	30	64	60	140	78	60	140



FINAL REPORT

CA14128-SEP18 R1

QC SUMMARY

pH
Method: SM 4500 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0081-SEP18	no unit	0.05	NA	2		100			NA		

Phenols by SFA
Method: SM 5530B-D | Internal ref.: ME-CA-IENVISFA-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
4AAP-Phenolics	SKA0053-SEP18	mg/L	0.002	<0.002	19	10	100	90	110	100	75	125

Reactive Phosphorus by SFA
Method: SM 4500-P F | Internal ref.: ME-CA-IENVISFA-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Phosphorus (total reactive)	SKA0040-SEP18	mg/L	0.03	<0.03	2	10	100	90	110	104	75	125



FINAL REPORT

CA14128-SEP18 R1

QC SUMMARY

Semi-Volatile Organics

Method: EPA 3510C/8270D | Internal ref.: ME-CA-IENVIGC-LAK-AN-005

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
1-Methylnaphthalene	GCM0101-SEP18	ug/L	0.5	< 0.5	NSS	30	77	50	140	NSS	50	140
2-Methylnaphthalene	GCM0101-SEP18	ug/L	0.5	< 0.5	NSS	30	77	50	140	NSS	50	140
Acenaphthene	GCM0101-SEP18	ug/L	0.1	< 0.1	NSS	30	81	50	140	NSS	50	140
Acenaphthylene	GCM0101-SEP18	ug/L	0.1	< 0.1	NSS	30	83	50	140	NSS	50	140
Anthracene	GCM0101-SEP18	ug/L	0.1	< 0.1	NSS	30	88	50	140	NSS	50	140
Benzo(a)anthracene	GCM0101-SEP18	ug/L	0.1	< 0.1	NSS	30	90	50	140	NSS	50	140
Benzo(a)pyrene	GCM0101-SEP18	ug/L	0.01	< 0.01	NSS	30	91	50	140	NSS	50	140
Benzo(b)fluoranthene	GCM0101-SEP18	ug/L	0.1	< 0.1	NSS	30	88	50	140	NSS	50	140
Benzo(ghi)perylene	GCM0101-SEP18	ug/L	0.2	< 0.2	NSS	30	93	50	140	NSS	50	140
Benzo(k)fluoranthene	GCM0101-SEP18	ug/L	0.1	< 0.1	NSS	30	92	50	140	NSS	50	140
Chrysene	GCM0101-SEP18	ug/L	0.1	< 0.1	NSS	30	90	50	140	NSS	50	140
Dibenzo(a,h)anthracene	GCM0101-SEP18	ug/L	0.1	< 0.1	NSS	30	93	50	140	NSS	50	140
Fluoranthene	GCM0101-SEP18	ug/L	0.1	< 0.1	NSS	30	90	50	140	NSS	50	140
Fluorene	GCM0101-SEP18	ug/L	0.1	< 0.1	NSS	30	85	50	140	NSS	50	140
Indeno(1,2,3-cd)pyrene	GCM0101-SEP18	ug/L	0.2	< 0.2	NSS	30	88	50	140	NSS	50	140
Naphthalene	GCM0101-SEP18	ug/L	0.5	< 0.5	NSS	30	78	50	140	NSS	50	140
Phenanthrene	GCM0101-SEP18	ug/L	0.1	< 0.1	NSS	30	88	50	140	NSS	50	140
Pyrene	GCM0101-SEP18	ug/L	0.1	< 0.1	NSS	30	90	50	140	NSS	50	140



FINAL REPORT

CA14128-SEP18 R1

QC SUMMARY

Sulphide by SFA
Method: SM 4500 | Internal ref.: ME-CA-IENVISFA-LAK-AN-008

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphide	SKA0042-SEP18	ug/L	6	<0.006	ND	20	98	80	120	NA	75	125

Suspended Solids
Method: SM 2540D | Internal ref.: ME-CA-IENVIEWL-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Total Suspended Solids	EWL0109-SEP18	mg/L	2	< 2	2	10	NV	90	110	NA		

Total Nitrogen
Method: SM 4500-N C/4500-NO3- F | Internal ref.: ME-CA-IENVISFA-LAK-AN-002

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Total Kjeldahl Nitrogen (N)	SKA0050-SEP18	mg/L	0.05	<0.05	ND	10	96	90	110	106	75	125
Total Kjeldahl Nitrogen (N)	SKA0058-SEP18	mg/L	0.05	0.09	1	10	104	90	110	101	75	125



QC SUMMARY

Turbidity
Method: SM 2130 | Internal ref.: ME-CA-ENVIEWL-LAK-AN-003

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Turbidity	EWL0071-SEP18	NTU	0.10	< 0.10	1	10	99	90	110	NA		



FINAL REPORT

CA14128-SEP18 R1

QC SUMMARY

Volatile Organics

Method: EPA 5030B/8260C | Internal ref.: ME-CA-ENVIGC-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
1,1,1,2-Tetrachloroethane	GCM0096-SEP18	ug/L	0.5	<0.5	NSS	30	94	60	130	NSS	50	140
1,1,1-Trichloroethane	GCM0096-SEP18	ug/L	0.5	<0.5	NSS	30	93	60	130	NSS	50	140
1,1,2,2-Tetrachloroethane	GCM0096-SEP18	ug/L	0.5	<0.5	NSS	30	96	60	130	NSS	50	140
1,1,2-Trichloroethane	GCM0096-SEP18	ug/L	0.5	<0.5	NSS	30	92	60	130	NSS	50	140
1,1-Dichloroethane	GCM0096-SEP18	ug/L	0.5	<0.5	NSS	30	99	60	130	NSS	50	140
1,1-Dichloroethylene	GCM0096-SEP18	ug/L	0.5	<0.5	NSS	30	93	60	130	NSS	50	140
1,2-Dichlorobenzene	GCM0096-SEP18	ug/L	0.5	<0.5	NSS	30	97	60	130	NSS	50	140
1,2-Dichloroethane	GCM0096-SEP18	ug/L	0.5	<0.5	NSS	30	93	60	130	NSS	50	140
1,2-Dichloropropane	GCM0096-SEP18	ug/L	0.5	<0.5	NSS	30	94	60	130	NSS	50	140
1,3-Dichlorobenzene	GCM0096-SEP18	ug/L	0.5	<0.5	NSS	30	96	60	130	NSS	50	140
1,4-Dichlorobenzene	GCM0096-SEP18	ug/L	0.5	<0.5	NSS	30	96	60	130	NSS	50	140
Acetone	GCM0096-SEP18	ug/L	30	<30	NSS	30	97	60	130	NSS	50	140
Benzene	GCM0096-SEP18	ug/L	0.5	<0.5	NSS	30	94	60	130	NSS	50	140
Bromodichloromethane	GCM0096-SEP18	ug/L	0.5	<0.5	NSS	30	92	60	130	NSS	50	140
Bromoform	GCM0096-SEP18	ug/L	0.5	<0.5	NSS	30	93	60	130	NSS	50	140
Bromomethane	GCM0096-SEP18	ug/L	0.5	<0.5	NSS	30	96	50	140	NSS	50	140
Carbon tetrachloride	GCM0096-SEP18	ug/L	0.2	<0.2	NSS	30	92	60	130	NSS	50	140
Chlorobenzene	GCM0096-SEP18	ug/L	0.5	<0.5	NSS	30	96	60	130	NSS	50	140
Chloroform	GCM0096-SEP18	ug/L	0.5	<0.5	NSS	30	95	60	130	NSS	50	140
cis-1,2-Dichloroethene	GCM0096-SEP18	ug/L	0.5	<0.5	NSS	30	93	60	130	NSS	50	140



FINAL REPORT

CA14128-SEP18 R1

QC SUMMARY

Volatile Organics (continued)

Method: EPA 5030B/8260C | Internal ref.: ME-CA-ENVIGC-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
cis-1,3-Dichloropropene	GCM0096-SEP18	ug/L	0.5	<0.5	NSS	30	93	60	130	NSS	50	140
Dibromochloromethane	GCM0096-SEP18	ug/L	0.5	<0.5	NSS	30	92	60	130	NSS	50	140
Dichlorodifluoromethane	GCM0096-SEP18	ug/L	2.0	<2	NSS	30	98	50	140	NSS	50	140
Ethylbenzene	GCM0096-SEP18	ug/L	0.5	<0.5	NSS	30	96	60	130	NSS	50	140
Ethylenedibromide	GCM0096-SEP18	ug/L	0.2	<0.2	NSS	30	92	60	130	NSS	50	140
n-Hexane	GCM0096-SEP18	ug/L	1.0	<1	NSS	30	106	60	130	NSS	50	140
m/p-xylene	GCM0096-SEP18	ug/L	0.5	<0.5	NSS	30	97	60	130	NSS	50	140
Methyl ethyl ketone	GCM0096-SEP18	ug/L	1	<20	NSS	30	96	60	130	NSS	50	140
Methyl Isobutyl Ketone	GCM0096-SEP18	ug/L	20	<20	NSS	30	99	50	140	NSS	50	140
Methyl-t-butyl Ether	GCM0096-SEP18	ug/L	2.0	<2	NSS	30	98	60	130	NSS	50	140
Methylene Chloride	GCM0096-SEP18	ug/L	0.5	<0.5	NSS	30	93	60	130	NSS	50	140
o-xylene	GCM0096-SEP18	ug/L	0.5	<0.5	NSS	30	98	60	130	NSS	50	140
Styrene	GCM0096-SEP18	ug/L	0.5	<0.5	NSS	30	98	60	130	NSS	50	140
Tetrachloroethylene	GCM0096-SEP18	ug/L	0.5	<0.5	NSS	30	94	60	130	NSS	50	140
Toluene	GCM0096-SEP18	ug/L	0.5	<0.5	NSS	30	95	60	130	NSS	50	140
trans-1,2-Dichloroethene	GCM0096-SEP18	ug/L	0.5	<0.5	NSS	30	93	60	130	NSS	50	140
trans-1,3-Dichloropropene	GCM0096-SEP18	ug/L	0.5	<0.5	NSS	30	96	60	130	NSS	50	140
Trichloroethylene	GCM0096-SEP18	ug/L	0.5	<0.5	NSS	30	94	60	130	NSS	50	140
Trichlorofluoromethane	GCM0096-SEP18	ug/L	5.0	<5	NSS	30	95	50	140	NSS	50	140
Vinyl Chloride	GCM0096-SEP18	ug/L	0.2	<0.2	NSS	30	98	60	130	NSS	50	140



QC SUMMARY

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.

LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

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

Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

Multielement Scan Qualifier: as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

Duplicate Qualifier: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Matrix Spike Qualifier: for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.

LEGEND

FOOTNOTES

NSS Insufficient sample for analysis.

RL Reporting Limit.

↑ Reporting limit raised.

↓ Reporting limit lowered.

NA The sample was not analysed for this analyte

ND Non Detect

Samples analysed as received. Solid samples expressed on a dry weight basis. "Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act" published by the Ministry and dated March 9, 2004 as amended.

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated. This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/terms_and_conditions.htm. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

This report must not be reproduced, except in full. This report supersedes all previous versions.

-- End of Analytical Report --

Request for Laboratory Services and CHAIN OF CUSTODY

No: 004381

Page ____ of ____

Laboratory Information Section - Lab use only

Received By: Stephane Veith/Ingram
 Received Date (mm/dd/yyyy): 01.06.18 (mm/dd/yy)
 Received Time: 08:22

Received By (signature): [Signature]
 Custody Seal Present: ☐ no
 Custody Seal Intact: ☐ no

Cooling Agent Present: ☐ ice
 Temperature Upon Receipt (°C): 8.8 54.3

LAB LIMS #: CP14128 - SEP18

REPORT INFORMATION

Company: Terraprobe Inc.
 Contact: sepielch D-Munford
 Address: 11 Indell Lane,
Brantford
 Phone: 405-396-2850
 Fax: 405-796-2250
 Email: smunford@terraprobe.ca

INVOICE INFORMATION

☒ (same as Report Information)
 Company: _____
 Contact: _____
 Address: _____
 Phone: _____
 Email: _____

REGULATIONS

Regulation 153/04:

☐ Table 1 ☐ R/P/I ☐ Soil Texture:
☐ Table 2 ☐ I/C/C ☐ Coarse
☐ Table 3 ☐ A/O ☐ Medium
☐ Table ☐ Fine

Other Regulations:

☐ Reg 347/558 (3 Day min TAT)
☐ PWQO ☐ MMER
☐ CCME ☐ Other:
☐ MISA

Sewer By-Law:

☐ Sanitary
☐ Storm
☐ Municipality:

RECORD OF SITE CONDITION (RSC) ☐ YES ☐ NO

SAMPLE IDENTIFICATION

1	Yondale River	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

Field Filtered (Y/N)

Metals & Inorganics

PAH ☐ ABN ☐ SVOC(all) ☐PCB Total ☐ Aroclor ☐PHC F1-F4 ☒ VOC ☒BTEX ☒ BTEX/F1 ☒ F2-F4 ☒VOC ☐ BTEX ☐ THM ☐Pesticides OC ☐ OP ☐TCLP M&I ☐ VOC ☐ PCB ☐B(a)P ☐ ABN ☐ Ignit. ☐Water Pkg Gen. ☐ Ext. ☐

Sewer Use:

☒ Dissolved oxygen☒ Free cyanide☒ Extended water characterization package to be compared to (PWQO)☒ Anions

COMMENTS:

including Fluoride,
 Chloride, Nitrate,
 Nitrite, Bromide,
 Sulphate, phosphate

Observations/Comments/Special Instructions: Compare the results to both Reg. 153 and PWQO

Sampled By (NAME): Fatenek
 Relinquished by (NAME): _____

Signature: [Signature]
 Signature: _____

Date: 09/05/18
 Date: ____/____/____

(mm/dd/yy)
 (mm/dd/yy)

Pink Copy - Client
 Yellow & White Copy - SGS



SAMPLE INTEGRITY REPORT

Project Number: 1-10-0347

ONTARIO REGULATION 153/04

SGS Sample ID CA 14128-SEP18

Date / Time Sampled Sept 5/18

Client Sample ID See CoC

ALL

Sample Submission General Sample Integrity Violations

- Temperature >10 C upon receipt if not sampled same day ☐
- No evidence of cooling trend initiated if sampled same day ☐
- Chain of Custody not submitted ☐
- Chain of Custody incomplete ☐
- Chain of Custody not signed / dated ☒
- Chain of Custody not a current version ☐
- Bottles / Samples listed on CoC but not received ☐
- Bottles / Samples received but not listed on the CoC ☐
- Sample container received empty ☐

Sample Specific Sample Integrity Violations

- | | | | | | | | |
|-------------------------------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Sample received past hold time | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Incorrect preservation (including no preservation where required) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Headspace present in VOC vial (aqueous) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Sample(s) received frozen | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Bottle(s) broken or damaged in transport | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Discrepancy between sample label and chain of custody | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Analysis requirements absent / unclear | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Missing or incorrect sample label(s) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Inappropriate sample container used | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Insufficient number of bottles received | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Limited sample volume | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Insufficient sample volume | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Sample contains multiple phases | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Sediment Log

- | | | | | | | | |
|----------------------------------------------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Groundwater samples contain visible sediment / particulate | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Groundwater contains greater than 1cm of sediment / particulate matter in bottle | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Additional Comments/Remarks:

No issues upon receipt

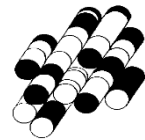


Initials:

MECP Well Records

APPENDIX D

Terraprobe Inc.



Instructions for Completing Form

- For use in the Province of Ontario only. This document is a permanent legal document. Please retain for future reference.
- All Sections must be completed in full to avoid delays in processing. Further instructions and explanations are available on the back of this form.
- Questions regarding completing this application can be directed to the Water Well Management Coordinator at 416-235-6203.
- All metre measurements shall be reported to 1/10th of a metre.
- Please print clearly in blue or black ink only.

Well Owner's Information and Location of Well Information

MUN _____ CON _____ LOT _____

HALIBURTON				MONMOUTH				28 10			
RR# Street Number/Name				City/Town/Village				Site/Compartment/Block/Tract etc.			
#19573 Hwy #118				WILBRO FORCE							
GPS Reading		NAD	Zone	Easting	Northing	Unit Make/Model	Mode of Operation:		Undifferentiated		Averaged
8.3		1.7	7.18743	4.984900	GAEMIN	44		Differentiated, specify			

Log of Overburden and Bedrock Materials (see instructions)

General Colour	Most common material	Other Materials	General Description	Depth From	Metres To
BROWN	SAND	GRAVEL	LOOSE	0	17'
BROWN	SAND, SILT	GRAVEL	HARD PACKED	17	50
BLACK	GRANITE	RED GRANITE	BEDROCK	50	290
TOTAL WELL CAPACITY 1.0 G.P.M					
RECOMMENDED PUMP SETTING 220 FEET					

Hole Diameter			Construction Record				Test of Well Yield			
Depth From	Metres To	Diameter Centimetres	Inside diam centimetres	Material	Well thickness centimetres	Depth From	Metres To	Pumping test method	Draw Down	Recovery
0	50	9"						Pump	Time min	Water Level Metres
50	240	6"	6 1/4	Steel Fibreglass	.188	0	50	Pump intake set at - (metres) 172.2	Static Level	15.7
				Plastic Concrete				Pumping rate - (litres/min) 15 GPM	1	24.6
				Galvanized				Duration of pumping 1 hrs + 0 min	2	36.9
				Steel Fibreglass				Final water level end of pumping 172.2 metres	3	48.6
				Plastic Concrete				Recommended pump type Shallow 400 GPM	4	60.5
				Galvanized				Recommended pump depth 220 metres	5	73.5
				Steel Fibreglass				Recommended pump rate 10 GPM (litres/min)	10	128.2
				Plastic Concrete				If flowing give rate - (litres/min)	15	172.2
				Galvanized					20	11
									25	11
									30	11
									40	11
									50	11
									60	11

Plugging and Sealing Record			Annular space	Abandonment
Depth set at - Metres From	To	Material and type (bentonite slurry, neat cement slurry) etc.	Volume Placed (cubic metres)	
0	50	BENTONITE SLURRY	59 GALLONS	

Method of Construction			
<input checked="" type="checkbox"/> Cable Tool	<input checked="" type="checkbox"/> Rotary (air)	<input type="checkbox"/> Diamond	<input type="checkbox"/> Digging
<input type="checkbox"/> Rotary (conventional)	<input type="checkbox"/> Air percussion	<input type="checkbox"/> Jetting	<input type="checkbox"/> Other
<input type="checkbox"/> Rotary (reverse)	<input type="checkbox"/> Boring	<input type="checkbox"/> Driving	
Water Use			
<input checked="" type="checkbox"/> Domestic	<input type="checkbox"/> Industrial	<input type="checkbox"/> Public Supply	<input type="checkbox"/> Other
<input type="checkbox"/> Stock	<input type="checkbox"/> Commercial	<input type="checkbox"/> Not used	
<input type="checkbox"/> Irrigation	<input type="checkbox"/> Municipal	<input type="checkbox"/> Cooling & air conditioning	
Final Status of Well			
<input checked="" type="checkbox"/> Water Supply	<input type="checkbox"/> Recharge well	<input type="checkbox"/> Unfinished	<input type="checkbox"/> Abandoned, (Other)
<input type="checkbox"/> Observation well	<input type="checkbox"/> Abandoned, insufficient supply	<input type="checkbox"/> Dewatering	
<input type="checkbox"/> Test Hole	<input type="checkbox"/> Abandoned, poor quality	<input type="checkbox"/> Replacement well	

Well Contractor/Technician Information	
Name of Well Contractor	Well Contractor's Licence No.
JOE LEGGE & SONS DRILLING	7052
Business Address (street name, number, city etc.)	
RR#3 BANCROFT KOLICO	
Name of Well Technician (last name, first name)	Well Technician's Licence No.
LEGGE JOE	7-1877
Signature/Contractor	Date Submitted
X [Signature]	YYYY MM DD

Location of Well	
In diagram below show distances of well from road, lot line, and building. Indicate north by arrow.	
Audit No.	Date Well Completed
Z 49150	2006 05 19
Was the well owner's information package delivered?	Date Delivered
<input checked="" type="checkbox"/> Yes	YYYY MM DD

Ministry Use Only	
Date Source	Contractor
JUN 01 2006	7052
Remarks	Well Record Number

WATER WELL RECORD

1. PRINT ONLY IN SPACES PROVIDED

2. CHECK ☒ CORRECT BOX WHERE APPLICABLE

110

270'2979

27019

cos

COUNTY OR DISTRICT	TOWNSHIP BOROUGH CITY TOWN VILLAGE	CON BLOCK TRACT SURVEY ETC	LGT
Holt County	Marmouth	10 LOT 23.	78
	#1 Tory Hill	DATE COMPLETED	88-93
		DAY 29 MO 09 YR 88	
ING	NC	ELEVATION	RC
		BASIN CODE	II III IV

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH FEET	
				FROM	TO
BLACK	TOPSOIL		SOFT	0'	3'
WHT-BLK	GRANITE		MEDIUM	3'	30'
GREEN-WHT	GRANITE		MEDIUM	30'	78'
WHITE	GRANITE		MEDIUM	78'	96'
BLK	GRANITE		MEDIUM	96'	117'
BLK-WHT	GRANITE		MEDIUM	117'	187'

31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50																				
41 WATER RECORD		51 CASING & OPEN HOLE RECORD																		61 PLUGGING & SEALING RECORD																			
WATER FOUND AT FEET		KIND OF WATER		<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 15%;">INSIDE DIAM. INCHES</th> <th style="width: 15%;">MATERIAL</th> <th style="width: 15%;">WALL THICKNESS INCHES</th> <th style="width: 15%;">DEPTH FEET</th> </tr> <tr> <td></td> <td></td> <td></td> <td>IR. M. TO</td> </tr> </table> </div> <div style="width: 45%;"> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 15%;">SIZE OF OPENING (SLOT NO.)</th> <th style="width: 15%;">DIAMETER</th> <th style="width: 15%;">LENGTH</th> <th style="width: 15%;">SCREEN</th> </tr> <tr> <td></td> <td></td> <td></td> <td></td> </tr> </table> </div> </div>																		INSIDE DIAM. INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH FEET				IR. M. TO	SIZE OF OPENING (SLOT NO.)	DIAMETER	LENGTH	SCREEN					MATERIAL AND TYPE	
INSIDE DIAM. INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH FEET																																				
			IR. M. TO																																				
SIZE OF OPENING (SLOT NO.)	DIAMETER	LENGTH	SCREEN																																				
																						INCHES		FEET															
																						DEPTH TO TOP OF SCREEN		41-64 FEET															
WATER FOUND AT FEET		KIND OF WATER		<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 15%;">INSIDE DIAM. INCHES</th> <th style="width: 15%;">MATERIAL</th> <th style="width: 15%;">WALL THICKNESS INCHES</th> <th style="width: 15%;">DEPTH FEET</th> </tr> <tr> <td></td> <td></td> <td></td> <td>IR. M. TO</td> </tr> </table> </div> <div style="width: 45%;"> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 15%;">SIZE OF OPENING (SLOT NO.)</th> <th style="width: 15%;">DIAMETER</th> <th style="width: 15%;">LENGTH</th> <th style="width: 15%;">SCREEN</th> </tr> <tr> <td></td> <td></td> <td></td> <td></td> </tr> </table> </div> </div>																		INSIDE DIAM. INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH FEET				IR. M. TO	SIZE OF OPENING (SLOT NO.)	DIAMETER	LENGTH	SCREEN					MATERIAL AND TYPE	
INSIDE DIAM. INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH FEET																																				
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																						INCHES		FEET															
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WATER FOUND AT FEET		KIND OF WATER		<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 15%;">INSIDE DIAM. INCHES</th> <th style="width: 15%;">MATERIAL</th> <th style="width: 15%;">WALL THICKNESS INCHES</th> <th style="width: 15%;">DEPTH FEET</th> </tr> <tr> <td></td> <td></td> <td></td> <td>IR. M. TO</td> </tr> </table> </div> <div style="width: 45%;"> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 15%;">SIZE OF OPENING (SLOT NO.)</th> <th style="width: 15%;">DIAMETER</th> <th style="width: 15%;">LENGTH</th> <th style="width: 15%;">SCREEN</th> </tr> <tr> <td></td> <td></td> <td></td> <td></td> </tr> </table> </div> </div>																		INSIDE DIAM. INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH FEET				IR. M. TO	SIZE OF OPENING (SLOT NO.)	DIAMETER	LENGTH	SCREEN					MATERIAL AND TYPE	
INSIDE DIAM. INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH FEET																																				
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																						INCHES		FEET															
																						DEPTH TO TOP OF SCREEN		41-64 FEET															

PUMPING TEST	PUMPING AT TEST		10	PUMPING RATE		11-14	DURATION OF PUMPING		17-18
	<input type="checkbox"/> PUMP <input type="checkbox"/> BAILER			10 GPM			15-16 HOURS		17-18 MIN.
	STATIC LEVEL		23	WATER LEVELS DURING		<input type="checkbox"/> PUMPING <input checked="" type="checkbox"/> RECOVERY			
	WATER LEVEL END OF PUMPING								
	18-21		22-24	15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES	75 MINUTES	90 MINUTES
30 FEET		150 FEET	40 FEET	30 FEET	30 FEET	30 FEET	30 FEET	30 FEET	30 FEET
IF FLOWING GIVE RATE:		25-31	PUMP INTAKE SET AT		WATER AT END OF TEST				
			125 FEET		X CLEAR		# CLOUDY		
RECOMMENDED PUMP TYPE		RECOMMENDED PUMP SETTING	23-26	RECOMMENDED PUMPING RATE					
<input type="checkbox"/> SHALLOW <input checked="" type="checkbox"/> DEEP		125 FEET	10 GPM						

FINAL STATUS OF WELL	1 <input checked="" type="checkbox"/> WATER SUPPLY 2 <input checked="" type="checkbox"/> OBSERVATION WELL 3 <input type="checkbox"/> TEST HOLE 4 <input type="checkbox"/> RECHARGE WELL	5 <input type="checkbox"/> ABANDONED INSUFFICIENT SUPPLY 6 <input type="checkbox"/> ABANDONED POOR QUALITY 7 <input type="checkbox"/> UNFINISHED 8 <input type="checkbox"/> DEWATERING
WATER USE	1 1 <input checked="" type="checkbox"/> DOMESTIC 2 <input checked="" type="checkbox"/> STOCK 3 <input type="checkbox"/> IRRIGATION 4 <input type="checkbox"/> INDUSTRIAL <input type="checkbox"/> OTHER _____	5 <input type="checkbox"/> COMMERCIAL 6 <input type="checkbox"/> MUNICIPAL 7 <input type="checkbox"/> PUBLIC SUPPLY 8 <input type="checkbox"/> COOLING OR AIR CONDITIONING <input type="checkbox"/> NOT USED
METHOD OF CONSTRUCTION	1 <input type="checkbox"/> CABLE TOOL 2 <input type="checkbox"/> ROTARY (CONVENTIONAL) 3 <input type="checkbox"/> ROTARY (REVERSE) 4 <input type="checkbox"/> ROTARY (AIR) 5 5 <input checked="" type="checkbox"/> AIR PERCUSSION	6 <input type="checkbox"/> BORING 7 <input type="checkbox"/> DIAMOND 8 <input type="checkbox"/> JETTING 9 <input type="checkbox"/> DRIVING <input type="checkbox"/> DIGGING <input type="checkbox"/> OTHER _____

LOCATION OF WELL

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

N

WELL
15' →
↑ 30'
↓

MOBILE HOME

DRIVE WAY

ROCK BLVD

25619

DILLIGS REMARKS

CONTRACTOR	NAME OF WELL CONTRACTOR	WELL CONTRACTOR'S LICENSE NUMBER
	TITUS WELL DRILLING	5020
	ADDRESS	
	GOODERMAN	
	NAME OF WELL TECHNICIAN	WELL TECHNICIAN'S LICENSE NUMBER
	CARMON TITUS	70412
	SIGNATURE OF TECHNICIAN/ CONTRACTOR	SUBMISSION DATE
	<i>[Signature]</i>	DAY 30 MO 10 YR 82

OFFICE USE ONLY	DATA SOURCE	BR	CONTRACTOR	SP-87	DATE RECEIVED	09-18
	5020		OCT 14 1988			
	DATE OF INSPECTION		INSPECTOR			
	REMARKS					
	CSS.ES					

Well ID

Well ID Number: 7274952
 Well Audit Number: Z225563
 Well Tag Number: A198782

This table contains information from the original well record and any subsequent updates.

Well Location

Address of Well Location	19758 HWY 118
Township	MONMOUTH TOWNSHIP
Lot	
Concession	
County/District/Municipality	HALIBURTON
City/Town/Village	WILBERFORCE
Province	ON
Postal Code	n/a
UTM Coordinates	NAD83 — Zone 17 Easting: 719615.00 Northing: 4985030.00
Municipal Plan and Sublot Number	
Other	

Overburden and Bedrock Materials Interval

General Colour	Most Common Material	Other Materials	General Description	Depth From	Depth To
BRWN	LOAM			0 ft	5 ft
GREY	GRNT			5 ft	105 ft
RED	GRNT			105 ft	111 ft
BLCK	GRNT			111 ft	120 ft

Annular Space/Abandonment Sealing Record

Depth From	Depth To	Type of Sealant Used (Material and Type)	Volume Placed
0 ft	20 ft	ENVIRO PLUG	

Method of Construction & Well Use

Method of Construction	Well Use
Rotary (Convent.)	Domestic

Status of Well

Water Supply

Construction Record - Casing

Inside Diameter	Open Hole or material	Depth From	Depth To
6.125 inch	STEEL	-2 ft	30 ft

Construction Record - Screen

Outside Diameter	Material	Depth From	Depth To
------------------	----------	------------	----------

Well Contractor and Well Technician Information

Well Contractor's Licence Number: 7249

Results of Well Yield Testing

After test of well yield, water was	CLEAR
If pumping discontinued, give reason	
Pump intake set at	115 ft
Pumping Rate	10 GPM
Duration of Pumping	
Final water level	
If flowing give rate	
Recommended pump depth	100 ft
Recommended pump rate	5 GPM
Well Production	
Disinfected?	Y

Draw Down & Recovery

Draw Down Time(min)	Draw Down Water level	Recovery Time(min)	Recovery Water level
SWL	20 ft		
1	24 ft	1	20 ft
2	24 ft	2	20 ft
3	24 ft	3	20 ft
4	24 ft	4	20 ft
5	24 ft	5	20 ft
10	24 ft	10	20 ft
15	24 ft	15	20 ft
20	24 ft	20	20 ft
25	24 ft	25	20 ft
30	24 ft	30	20 ft
40	24 ft	40	20 ft
45		45	
50	24 ft	50	20 ft
60	24 ft	60	20 ft

Water Details

Water Found at Depth	Kind
105 ft	Fresh

Hole Diameter

Depth From	Depth To	Diameter
0 ft	20 ft	9.625 inch
20 ft	120 ft	6 inch

Audit Number: Z225563

Date Well Completed: September 21, 2016

Date Well Record Received by MOE: November 17, 2016

Updated: June 28, 2018

RateRate

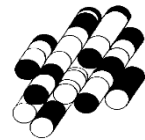
Sharefacebook twitter Print

Tags

Dewatering Analysis

APPENDIX E

Terraprobe Inc.



Irondale Culvert Replacement - Tory Hill, ON

Job No. 1-18-0347-46

Construction Dewatering

Excavation Area (m2)	Excavation Depth (mbgl)	Excavation Perimeter (m)	Water Level (mbgl)	Excavation Depth (m below water table)	Vertical Area Below Water Table (m2)	K (m/s)
171	6.7	56	3.1	3.6	202	4E-03

Darcy - flow into excavation

$$Q = kiA$$

Horizontal

Lateral ground water flow precluded due to impervious sheet piling surrounding excavation

Vertical										Factor of Safety = 1.5	Total
	Q (m^3/s)	A (m^2)	i	k (m/s)	Q (m^3/hr)	Q (L/hr)	Q (gal/min)	Q (L/day)	Q (L/day)		Q (L/day)
	1.85E-02	171	0.03	4E-03	66.4848	66485	292.76	1595635	2,393,453		2,409,100
Rainfall (25 mm storm event)								15,600 L/day			

Radius of Influence - Sichardt's equation

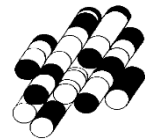
$$R = 3000d\sqrt{k}$$

R (m)	drawdown (m)	K (m/s)
648.0	3.6	3.60E-03

Engineering Drawings

APPENDIX F

Terraprobe Inc.



METRIC

CONT 2017-4000
WP 4128-10-01

IRONDALE RIVER CULVERT
SITE NO. 40-063C
PRE-STAGE

SHEET
2

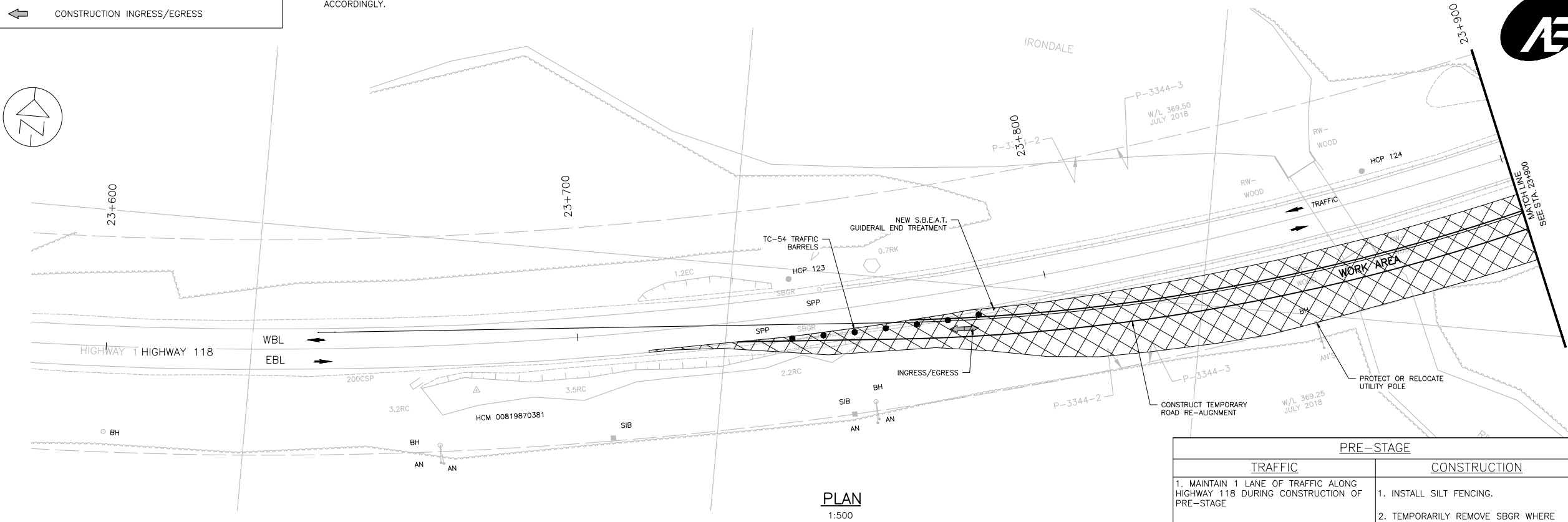


LEGEND:

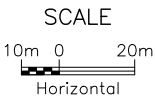
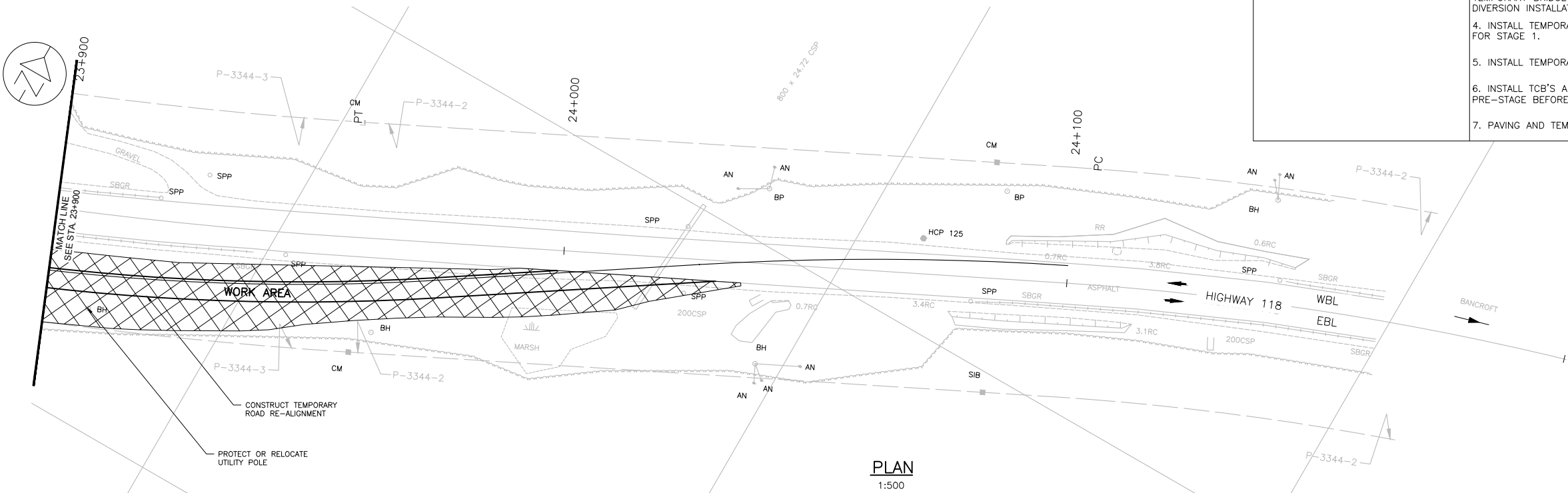
- UNDER CONSTRUCTION
- COMPLETED CONSTRUCTION
- TC-54 TRAFFIC BARRELS
- TEMPORARY CONCRETE BARRIER (TCB)
- TRAFFIC FLOW
- CONSTRUCTION INGRESS/EGRESS

NOTES:

1. TRAFFIC CONTROL AND LANE CLOSURES AS PER ONTARIO TRAFFIC MANUAL - BOOK 7.
2. THE LOCATIONS OF TEMPORARY TRAFFIC CONTROL SIGNS SHOWN ON DRAWING ARE INTENDED AS GUIDELINE ONLY. CONTRACTOR SHALL VERIFY TEMPORARY TRAFFIC CONTROL SIGN LOCATIONS AS PER ONTARIO TRAFFIC MANUAL - BOOK 7 AND INSTALL THE SIGNS ACCORDINGLY.
3. MINOR ADJUSTMENT OF SIGN POSITIONS MAY BE REQUIRED TO SUIT SITE CONDITIONS AND STAGES.
4. SEE CONSTRUCTION STAGING SECTIONS IN STRUCTURAL DRAWINGS FOR STRUCTURAL CROSS SECTION DETAILS.
5. CONSTRUCTION INGRESS & EGRESS TO BE CLOSED WITH TC-54S WHEN NOT IN USE.

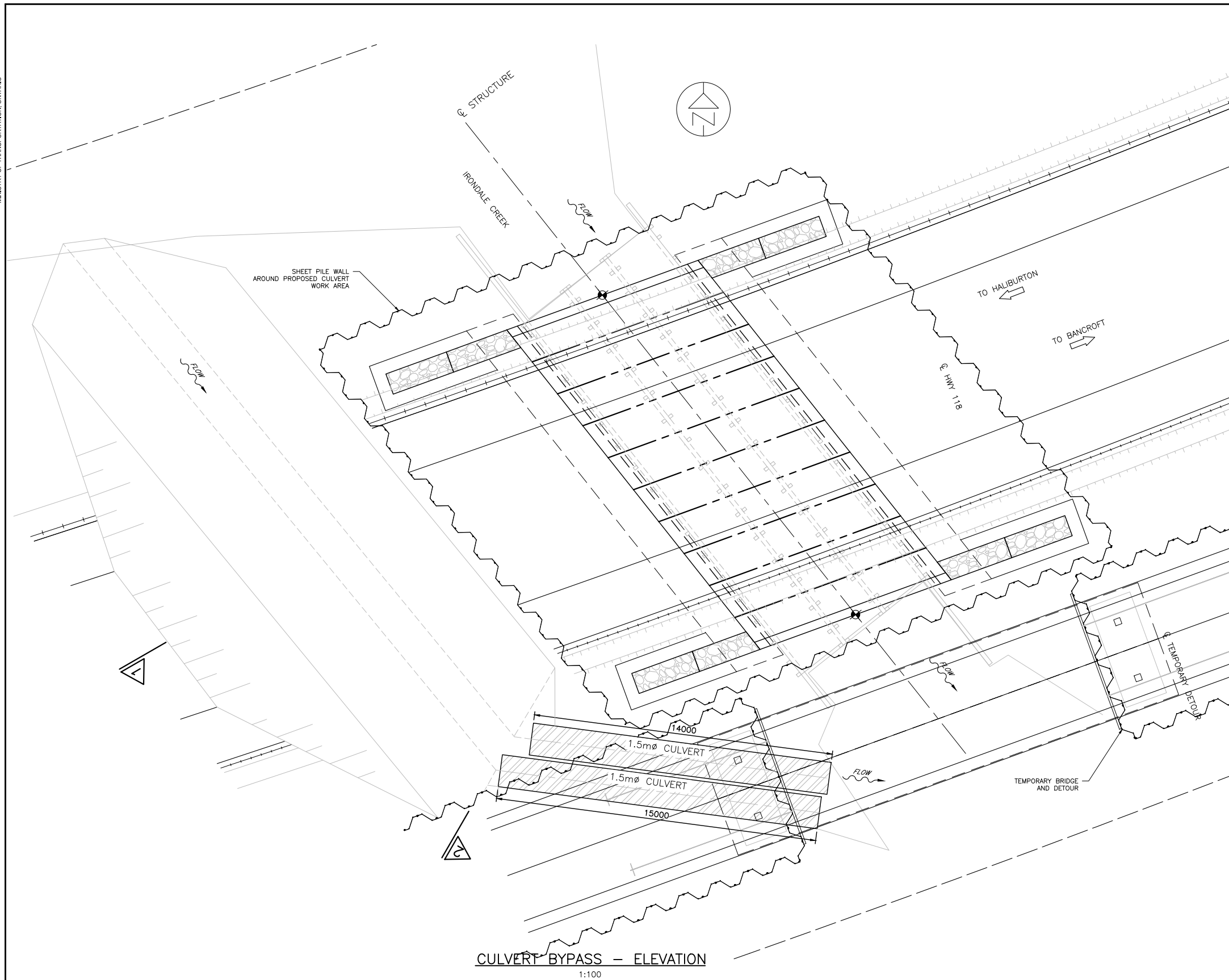


PRE-STAGE		
TRAFFIC	CONSTRUCTION	ROADS
1. MAINTAIN 1 LANE OF TRAFFIC ALONG HIGHWAY 118 DURING CONSTRUCTION OF PRE-STAGE	1. INSTALL SILT FENCING. 2. TEMPORARILY REMOVE SBGR WHERE REQUIRED AND INSTALL SBEAT. 3. CONSTRUCT ROCKFILL EMBANKMENT C/W SHEETPILE ABUTMENTS FOR TEMPORARY BRIDGE AND TEMPORARY FLOW DIVERSION INSTALLATION. 4. INSTALL TEMPORARY FLOW DIVERSION FOR STAGE 1. 5. INSTALL TEMPORARY BRIDGE. 6. INSTALL TCB'S AND PTIS AT END OF PRE-STAGE BEFORE ENTERING STAGE 1. 7. PAVING AND TEMPORARY SIGNAGE	1. ALL ROADS ARE OPEN



DRAWING NAME: P:\20185256\00_Three_Structures\Working_Dwgs\100_Civil\00-IRONDALE\5256-00-c-111_mis_details.dwg
CREATED: 2018/11/20 10:01:13 AM
MODIFIED: 2018/11/29 10:01:13 AM

MINISTRY OF TRANSPORTATION, ONTARIO



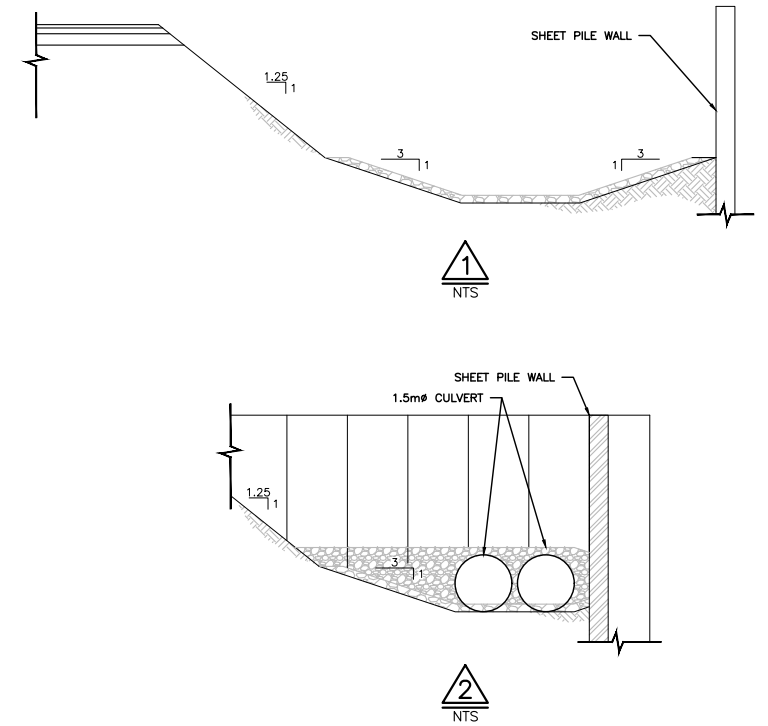
CULVERT BYPASS - ELEVATION
1:100

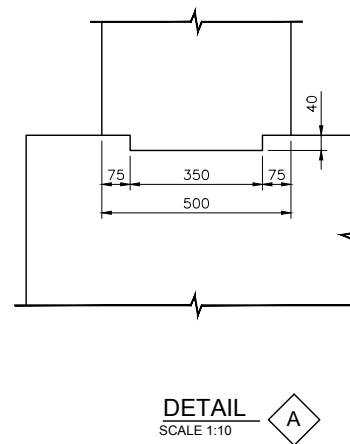
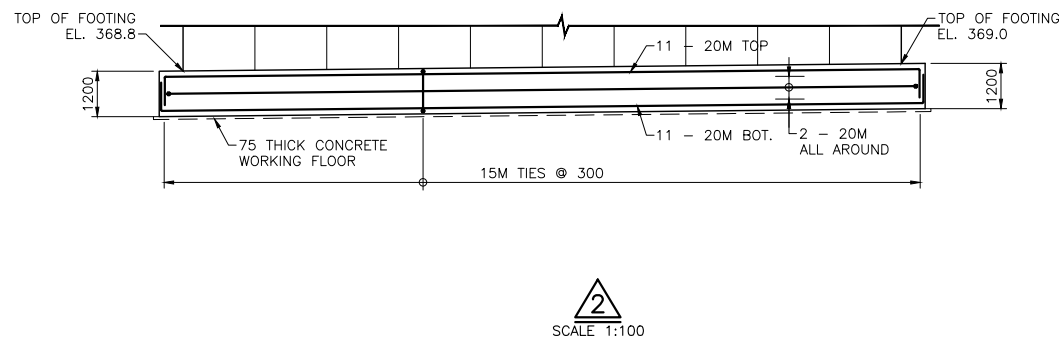
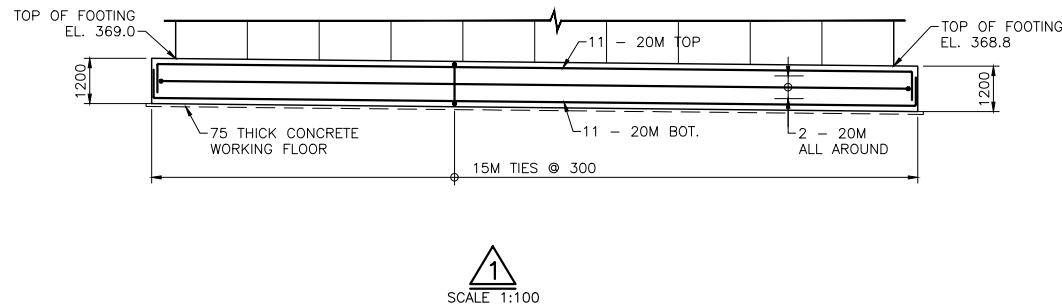
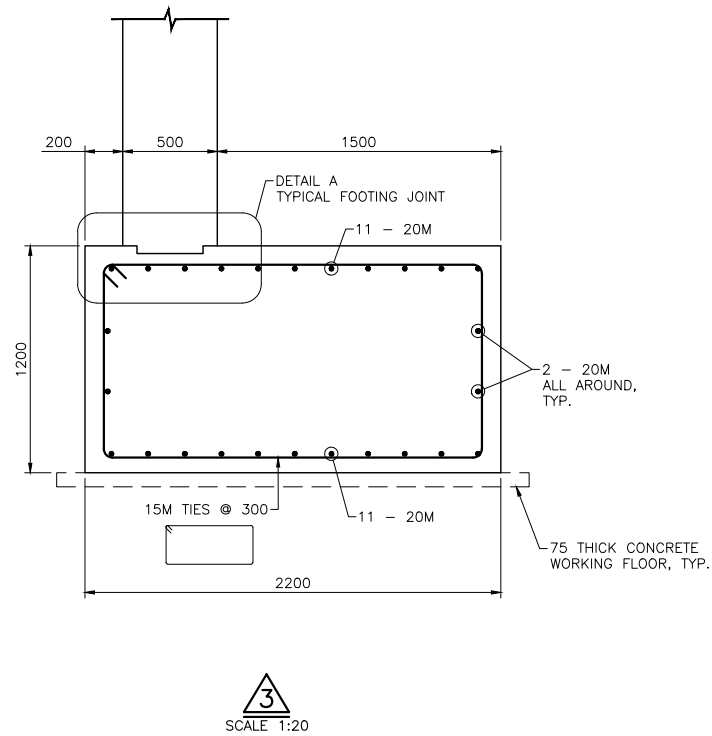
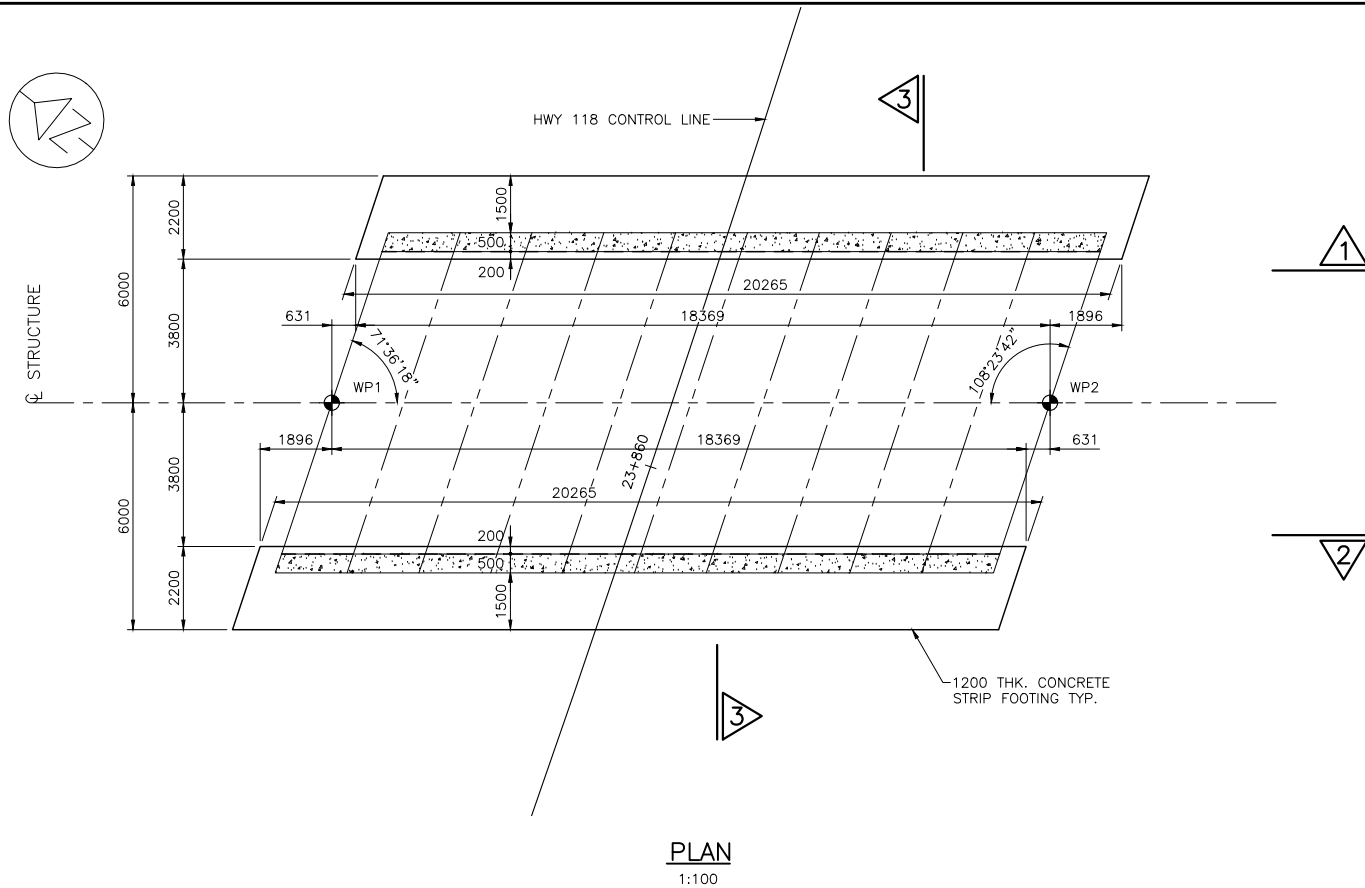
METRIC

CONT 2017-4000
WP 4128-10-01

IRONDALE RIVER CULVERT
SITE NO. 40-063C
CULVERT STAGING 1

SHEET
12





METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT 2017-4000
WP 4128-10-01

IRONDALE RIVER CULVERT
SITE NO. 40-063C
CULVERT FOUNDATION DETAILS

SHEET
14

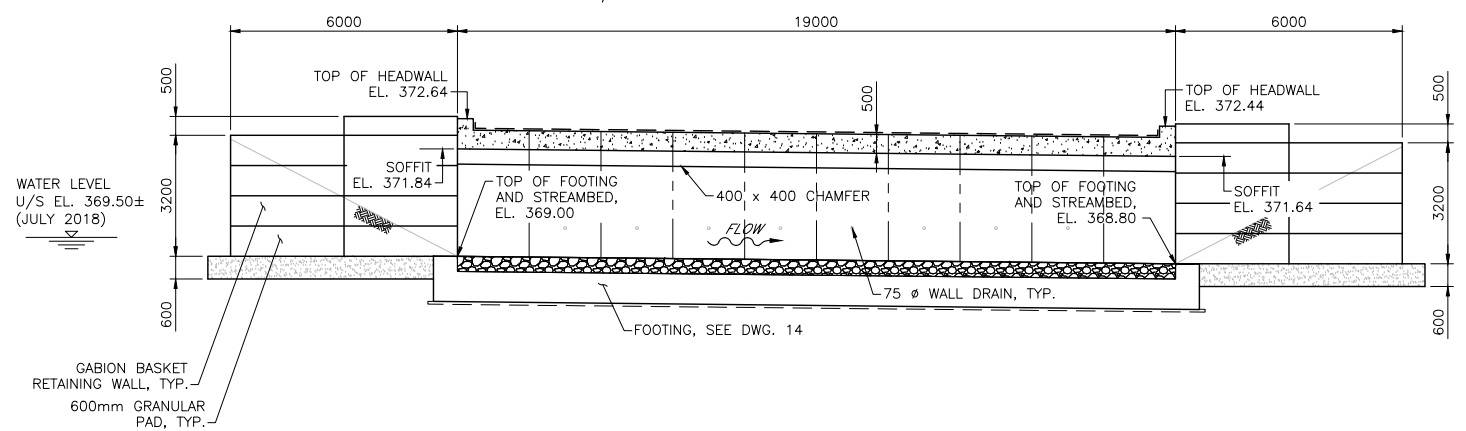


GENERAL NOTES:

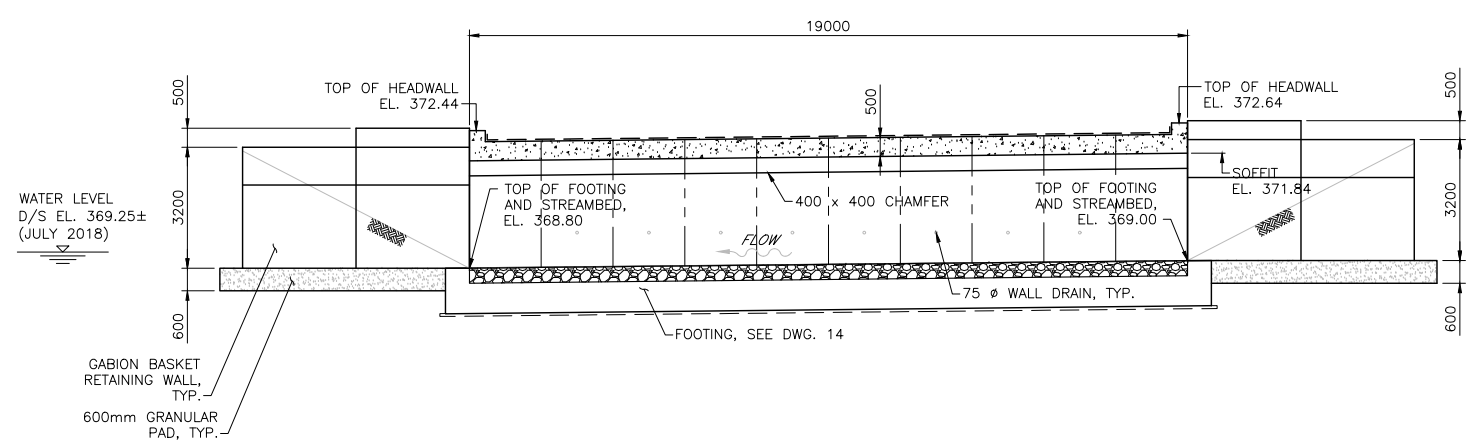
- FOR NOTES, SEE DWG. 11.
- FOR WORKPOINT CO-ORDINATES, SEE DWG. 11.

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

REVISIONS		DESCRIPTION			
DATE	BY	CHK	CODE	CHBDC-14	LOAD CL-625-ONT
DESIGN	CHK	CHK	SITE		
DRAWN	CHK				



 (ALONG FRONT FACE OF WALL)
SCALE 1:100



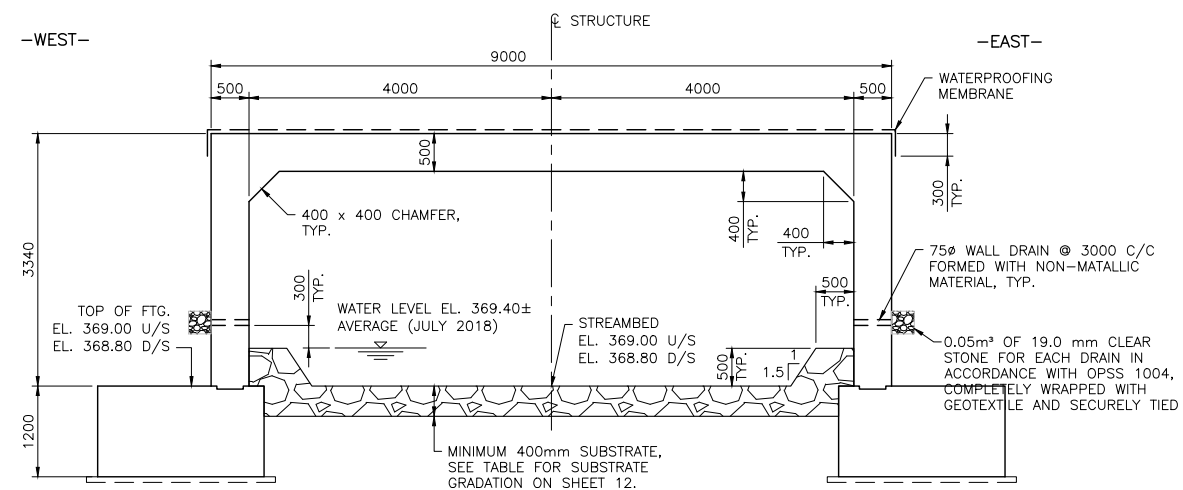
2 (ALONG FRONT FACE OF WALL)
SCALE 1:100

SHEET
15

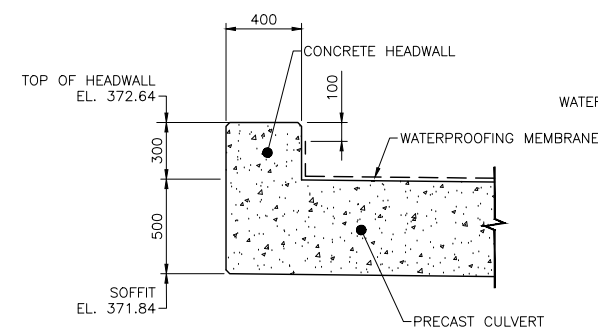


GENERAL NOTES:

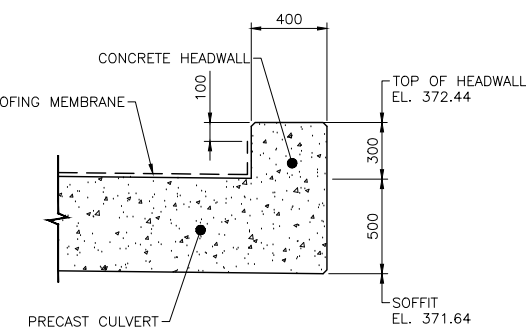
1. FOR NOTES, SEE DWG 11.
2. FOR WORKPOINT CO-ORDINATES, SEE DWG. 11.



3
SCALE 1:50



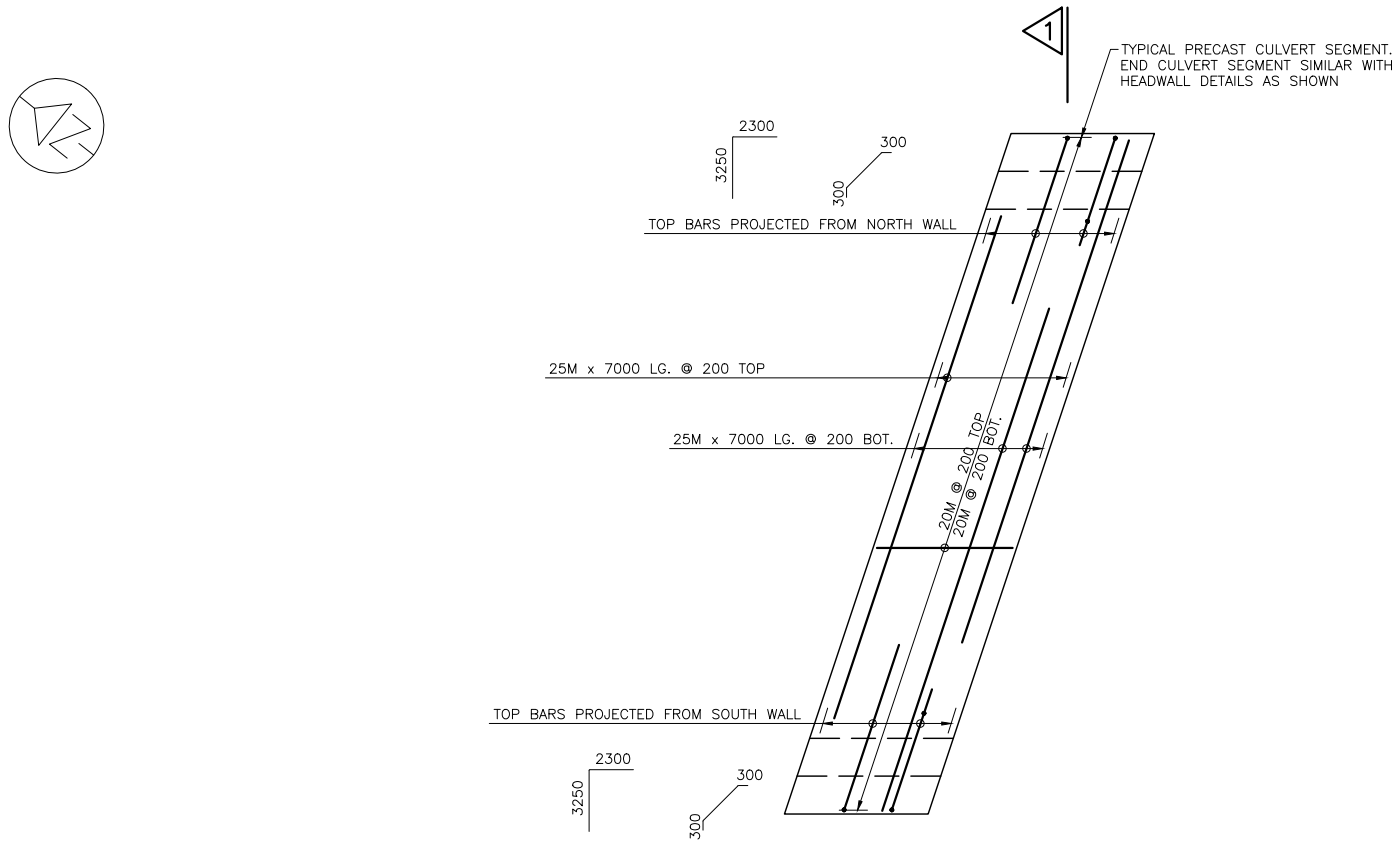
4
SCALE 1:20



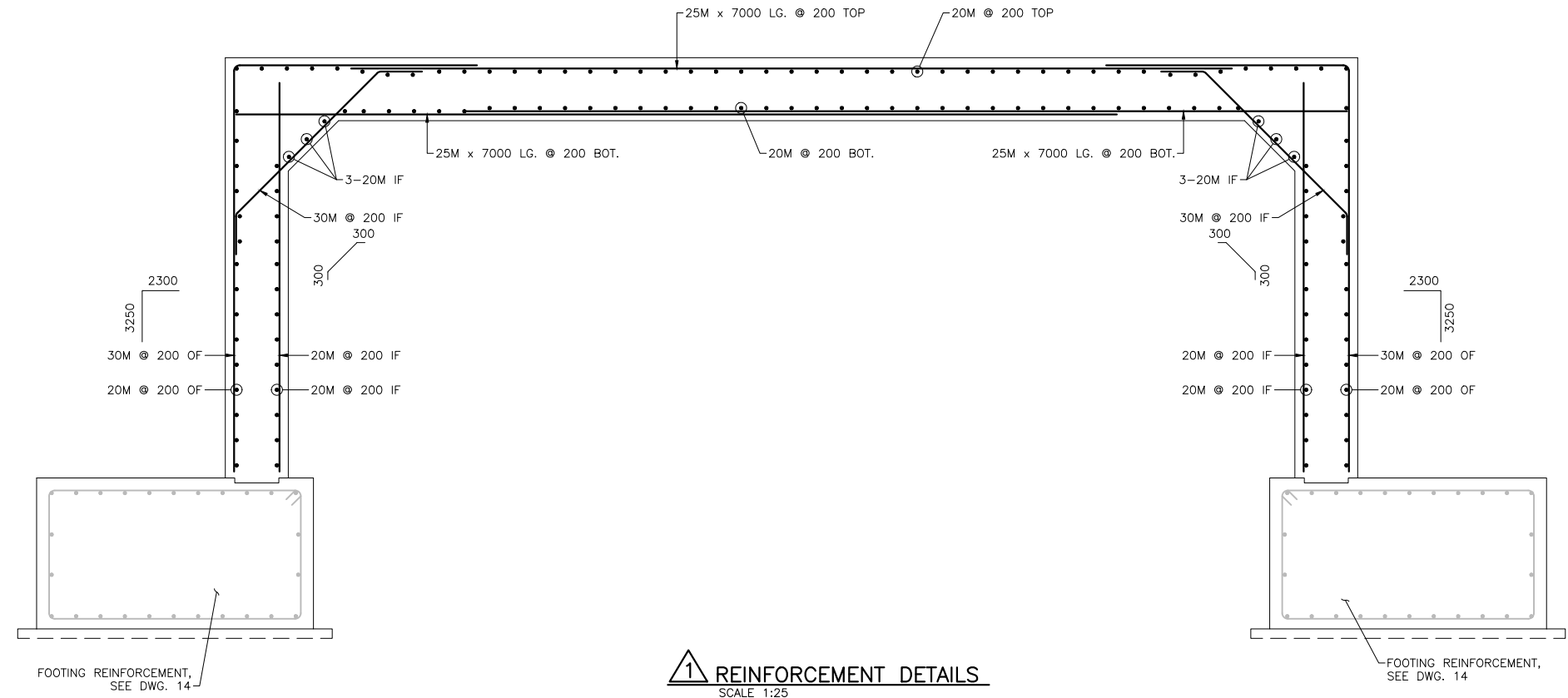
SCALE 1:20

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

REVISIONS							
	DATE	BY	DESCRIPTION				
DESIGN		CHK		CODE	CHBDC-14	LOAD	CL-625-ONT
DRAWN		CHK		SITE			DATE
							DWG



PLAN – TOP SLAB REINFORCEMENT DETAILS
SCALE 1:50



1 REINFORCEMENT DETAILS
SCALE 1:25

METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT 2017-4000
WP 4128-10-01

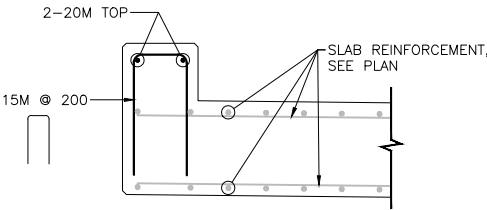
IRONDALE RIVER CULVERT
SITE NO. 40-063C
CULVERT REINFORCING DETAILS

SHEET
16

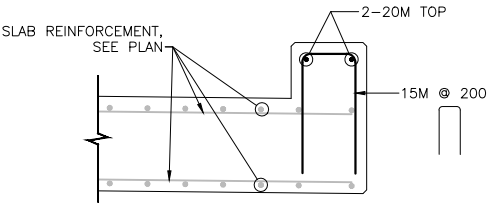


GENERAL NOTES:

1. FOR NOTES, SEE DWG. 11.



TYPICAL WEST HEADWALL DETAIL
1:50



TYPICAL EAST HEADWALL DETAIL
1:50

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION			
	DESIGN	CHK	CODE	CHBDC-14	LOAD CL-625-ONT	DATE
	DRAWN	CHK	SITE			DWG