
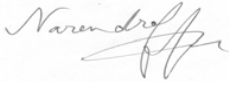



# The Windsor-Essex Parkway Project

## Geotechnical Investigation and Design Report – Pumping Stations

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# 1 Introduction

## 1.1 Preface

The Windsor Essex Parkway (the Parkway, or the WEP) was conceived to strengthen transportation and trade links between Canada and the United States, reduce road congestion, and foster economic growth. The Parkway will connect Highway 401 to a new Canadian inspection plaza and a new international crossing over the Detroit River to Interstate 75 in Michigan, USA. It will be a six-lane highway, 11 km long with 15 bridges, 11 tunnels and a four-lane service road that will provide full access to schools, neighbourhoods, natural areas, and shopping. Other components of the project include community and environmental features, such as: 300+ acres of green space, 20 km of recreational trails, extensive landscaping throughout the corridor, as well as noise and environmental mitigation measures. The environmental mitigation measures were based on Permit AY-D-001-09 which was approved in February 2010.

The Parkway's strategic international importance, urban location, and unique ecological context necessitate strong design and planning principles to guide infrastructure development. The Parkway is to be a state-of-the-art facility within a contextually sensitive landscape setting that has ecological integrity, builds physical and cultural connections, and establishes a sustainable network of amenities that can be enjoyed by present and future generations.

The plans for the Parkway strive to build and strengthen linkages within and between both human and ecological communities. Over time, restored green space will evolve into a tall grass prairie and oak savannah landscape that will, through ecological succession, allow the roadway to become a 'Parkway in a Prairie'. All of the green space areas of the Parkway, (whether associated with the Roadway, the Stormwater Management Areas, the Ecological Landscape areas, or the Screening), are ecologically based areas that in their totality will represent an extensive habitat network consisting of existing, new and rehabilitated terrestrial and aquatic communities.

Natural and cultural history are proposed to be celebrated in the artful design of three Gateways, and eleven Land Bridges that support the existing municipal road system and the inter-connected multi-use pathway system. The Gateways are conceived as bold and commanding landscapes that draw on sculpted landform, strong patterning, and public art to create strong visual elements for the driving experience within themes of 'Arrival, Settlement, and Flow'.

The Land Bridges draw on natural and cultural influences to create distinct and memorable places that serve as markers, urban respite areas, and focal points to the overall green space system. Other opportunities for artistic expression include the streetscapes and urban amenity areas, trail bridges; tunnel abutments, and noise walls. These structural elements offer opportunities for simple expression of the surrounding natural environment, area history and the 'prairie' landscape in particular, through color, form, materials, and the integration of public art.

The lasting legacy of the Windsor Essex Parkway project will not only be its significant contribution as an international trade and transportation route, but rather include the establishment of a contiguous and sustainable green space system that contributes to the quality of life in the community and supports the re-establishment of an ecologically rich Carolinian landscape.

On December 17, 2010 Infrastructure Ontario and MTO announced that the Windsor Essex Mobility Group (WEMG) reached financial close and signed a fixed-price contract with the Province to design, build, finance and maintain the Windsor-Essex Parkway. To build the initial works, WEMG has formed a Design-Build Joint Venture – Parkway Infrastructure Constructors. This team includes Dragados Canada, Inc., Acciona Infrastructure Canada Inc., and Fluor Canada Ltd. This combination brings a wide range of local and international experience to the project.

## 1.2 Report Introduction

This report provides the geotechnical factual interpretation and design recommendations for deep well and generator facilities for the pumping stations located along the Windsor-Essex Parkway (WEP) project. Design Plan and Section drawings of the stations were provided by Hatch Mott MacDonald (HMM) and are included in Appendix A.

There are a total of 5 pump station structures located along the proposed parkway as indicated in Figure 1-1. More detailed site plans for each individual pump station including the locations of the subsurface investigation and testing at, and in the vicinity of the stations, are shown in Drawings 285380-04-090-WIP2-9012, 285380-04-090-WIP2-9022, 285380-04-090-WIP1-9052, 285380-04-090-WIP1-9062 and 285380-04-090-WIP1-9072 for Pump Stations PS-1, PS-2/3, PS-5, PS-6 and PS-7, respectively.

This report is issued to support the structural pump station designs by HMM. This report also highlights geotechnical conditions anticipated to be relevant for the construction and staging of the pump stations. All temporary staging and design will be provided by others under separate cover.

## 1.3 Geological Setting

The WEP project site is located within the Essex Clay Plain (a part of the St. Clair Clay Plain physiographic region) (ref. R-10, R-12, R-13 and R-19). The Essex Clay Plain was deposited during the retreat of the late Pleistocene Era ice sheets, when a series of glacial lakes inundated the area. The ice sheets generally deposited materials with a glacial till like gradation in the Windsor area. Depending on the locations of the glacial ice sheets and depths of water in the ice-contact glacial lakes, the materials may have been directly deposited at the contact between the ice sheet and bedrock or, as the lake levels rose and the ice sheets retreated and floated, the soil and rock debris within and at the base of ice may have been deposited through the lake water (i.e., lacustrine environment). It is considered that unlike typical till deposits (that have undergone consolidation and densification under the weight of the ice sheet), the majority of the “glacial till” soils in the Windsor and Detroit area were deposited through water and have a soft to firm consistency below a surficial crust layer that has become stiff to hard due to weathering and desiccation. Geologically, the deposit in the project area is considered to be slightly over-consolidated, having experienced no major overburden stresses in excess of the existing stresses.

The overburden in the St. Clair Clay Plain has variously been described as a clayey silt till, silty clay till and glaciolacustrine clay. Hudec (ref. R-19) summarized the overburden geology in Windsor as consisting of the following successive strata: desiccated lacustrine clay, normally consolidated lacustrine clay, silty Tavistock till, glaciolacustrine clay and coarse Catfish Creek till. A distinct change in overburden deposits occurs in the east-west direction along a boundary located generally along the Huron-Church Road. Whereas, the eastern part of Windsor is underlain by firm to stiff glaciolacustrine silts and clays with upper deposits of stiff sandy to silty weathered clay and hard to stiff lacustrine clay-silt crust, the western part of Windsor is characterized by a thin surficial granular deposit underlain by thin crust layer, in turn, underlain by soft to firm glaciolacustrine silts and clays.

At the WEP project area, the glacial till like deposit is typically 20 to 35 m thick and consists primarily of silty clay and clayey silt gradation with a random distribution of coarser particles. Random and apparently discontinuous seams / lenses of silt, sand and or gravel are present at various depths within the mass of the silty clay deposit. A firm to hard surficial crust layer has formed due to desiccation. Up to 2 m thick surficial layers of lacustrine silty clay or silt and sand are also encountered in the western sector of the project. A 1 m to 6 m thick very dense or hard basal glacial till or dense silty sand may be found directly overlying the bedrock surface. The bedrock at the project area comprises the Devonian Dundee Formation of the Hamilton group of formation and the underlying Devonian Lucas Formation of the Detroit River group of formation.

The Windsor area, referred to as the Essex Domain (with respect to bedrock geology), is located in the Grenville Front Tectonic Zone (GFTZ). The bedrock geology within the Essex Domain was formed as part of the midcontinent rift south-eastern extension. The midcontinent rift south-eastern extension is composed of Paleozoic cover rocks which form the bedrock foundation of the Essex Domain. The bedrock was deposited in the Paleozoic Era during the Middle Devonian period. Within the Essex Domain the following strata were deposited the Hamilton Group, Dundee Formation, and Detroit River Group Onondaga Formation all consisting of Limestone, Dolostone, and Shale.

## 1.4 Site Seismic Background

Windsor-Tecumseh area is described in Canadian Highway Bridge Design Code (CHBDC, ref. R-6) by a seismic hazard associated to a Velocity Zone  $Z_v = 0$  and Acceleration seismic zone  $Z_a = 0$ . Zonal Velocity ratio,  $V$ , and Zonal Acceleration ratio,  $A$ , are both 0.

In accordance with the CHBDC and the results of a series of cross-hole tests completed during the background investigation program (ref. R-15), the soil profile at the site of the project generally meets the description for Soil Profile Type III (soft clay and silts greater than 12 m in depth). The above noted cross-hole tests were completed during the background investigation program at locations distributed along the project alignment between Howard Avenue (east end) and Matchette Road (west end). The measured velocities of the shear waves were consistently over 200 m/s, with the bulk of results ranging between 200 and 300 m/s.

## 1.5 Frost Depth

In accordance with MTO–SDO-90-01 Pavement Design and Rehabilitation Manual (ref. R-24) and OPSD 3090.101 the frost depth below the ground surface in Windsor area is estimated to 1.0 m<sup>1</sup>. This estimate is considered applicable for natural soils and / or conventional pavement materials where the ground surface is usually cleaned from the snow cover.

In the case of riprap, or otherwise coarse rockfill cover, the insulation effects of such materials are considered to be one half of the insulation offered by soil deposits /cover, and the depth of frost penetration will have to be increased accordingly.

## 1.6 Existing Site Conditions and Proposed Pump Station Layouts

The pump stations are situated near roadways along the length of the Parkway project and near the stations indicated in Table 1-1. For further information, references to the closest major structures are also shown in Table 1-1 and in Figure 1-1. Geotechnical reports for the nearby structures should be consulted for more detailed geotechnical design related information.

**Table 1-1: Pump Station Location, Nearby Structure and Pump Station Elevation**

Pump Station #	Approximate Station	Nearby Structures	Approximate Existing Ground Surface Elevation (m)	Proposed Finished Grade Elevation at Pump Station (m)	Estimated deepest Foundation Elevation at Pump Station (m)	Approximate Base Slab Dimension (Length x Width) (m)
PS-1	13+250W (Windsor)	Tunnel T-2	181.3	182.1	165.4±	15 x 17
PS-2/3	14+800W (Windsor)	Tunnel T-6	180.7	178.1	164.7±	17 x 30
PS-5	11+550L (LaSalle)	Tunnel T-8	182.8	184.1	169.4±	13 x 14
PS-6	12+900L (LaSalle)	Tunnel T-10A, 10B and Bridge B-11	185.3	179.7	167.8±	17 x 18
PS-7	10+200T (Tecumseh)	Bridge B-12 and B-13	186.8	182.7	169.0±	17 x 18

(1) Deepest foundation excavation elevation includes excavation for up to 100 mm subgrade protection slab

<sup>1</sup> Ontario Provisional Standard Drawings are included at the end of the report text.

## 2 Geotechnical Investigation

Geotechnical investigations involving a number of boreholes, cone penetration tests (CPT) and Nilcon vane tests had been carried out in 2007-09 by Golder (ref. R-10, R-11 to R-14) to develop the conceptual design and serve as background information for development of the WEP proposal designs. Additional geotechnical investigation was completed to supplement the available subsurface soil data, as required to support the detailed design development of the WEP embankment and structures. During the additional investigation, one sampled borehole was advanced to bedrock and equipped with piezometers and deep observations wells at the location of every station. In addition, boreholes, cone penetration tests (CPTs), Nilcon Vane tests and DMT (flat blade dilatometer probe) available from investigations completed for structures in the vicinity of the pumping stations were included to aid in defining soil property profiles. Table 2-1 lists the test holes located at or in close proximity of the pump station locations during both the previous and the current geotechnical investigations.

Drawings 285380-04-090-WIP2-9012, 285380-04-090-WIP2-9022, 285380-04-090-WIP1-9052, 285380-04-090-WIP1-9062 and 285380-04-090-WIP1-9072 show the locations of the test holes and proposed pump station structure locations at PS-1, PS-2/3, PS-5, PS-6 and PS-7, respectively.

**Table 2-1: Test Holes At and Around the Pump Stations**

Pump Station #	Boreholes	Nilcon Vane Tests	CPT's	DMT's
PS-1	BH PS1-1	NIL T2-1	CPT T2-1	DMT 3-RW
	BH T2-1			
	BH-143			
PS-2/3	BH PS2-1	NIL 12-RW	CPT 36-RW	
	BH-325		BH/CPT-324	
	BH 12-RW			
	BH 13-RW			
PS-5	BH PS5-1		BH/CPT-316	
	BH-7		CPT 43-RW	
			CPT T8-1	
			CPT-7	
			CPT 42-RW	
PS-6	BH PS6-1		BH/CPT-110	
	BH-310		BH/CPT-111	
PS-7	BH PS7-1		BH/CPT-103	
	BH-104		CPT 52-RW	

### 2.1 Fieldwork at the Pump Stations

This section describes the scope and procedure of the fieldwork carried out at the pump stations. The fieldworks carried out for adjacent structures (related to the test hole data has been used for formulating geotechnical recommendations at pump station sites) are described in their respective reports. The "PS"



series boreholes at the pump stations were advanced using track-mounted CME55 auger rigs owned and operated by Marathon Drilling Co. Ltd. under contract to AMICO and under technical supervision by AMEC engineers and technicians. Boreholes were generally advanced using 215 mm OD hollow stem augers, followed by wash boring with NW (OD=88.9 mm) casing. The depth at which the drilling methods transition occurred is noted on the borehole logs.

Soil sampling was generally carried out using a 50 mm diameter split spoon sampler and thin-walled Shelby tubes (70 mm diameter by 600 mm long). Soil sampling was carried out generally at 0.75 m depth interval in the top 7 to 8 m and at 1.5 m depth intervals thereafter. All samples were identified by a field technologist, placed in airtight containers and transported to AMEC's Tecumseh (Windsor) laboratories for further examination and testing<sup>2</sup>. Rock coring of the bedrock was carried out using 1.5 m long NQ (OD=75.7 mm) or HQ (OD=96.0 mm) sized core barrels.

Standard Penetration Tests (SPT, ASTM D1586<sup>3</sup>) were carried out in conjunction with split spoon sampling. Field vane tests (using conventional vanes) were carried out in between sampling at selected depths. The Nilcon vane tests listed in Table 2-1 were carried typically adjacent the boreholes.

Rock cores were examined in the field and transported to AMEC's Tecumseh (Windsor) laboratories for further examination. For each core run, rock core recovery and rock quality designation (RQD) were determined. The recovery and RQD values are given on the borehole logs. The rock cores were photographed in the laboratory. Compression strength tests were carried out on rock core samples selected from across the WEP length.

The boreholes were decommissioned using a bentonite-cement grout following completion of sampling, testing and instrument installation.

Nilcon vane blade was pushed into the ground from the bottom of shallow pre-augered holes through surficial soils using the hydraulic ram of the drill rig. The Nilcon vane tests were conducted in accordance with ASTM D2573-01.

The CPT cone was pushed at a constant rate into the ground using the hydraulic ram system of the drill rig. The tests were conducted following the provisions of ASTM D 5778. CPT T8-1, CPT 36-RW, CPT 42-RW and CPT 43-RW were advanced to refusal. Pore pressure dissipation tests were carried out at selected depth in CPT T2-1 and CPT 43-RW.

Similarly, the DMT probe was pushed into the ground in increments of 200 mm using the hydraulic ram of the drill rig. The tests were conducted following the provisions of ASTM D 6635.

## 2.2 Instrumentation

Geotechnical instruments (vibrating wire piezometers – VWP and standpipe piezometers) were installed at selected locations on completion of boreholes to monitor pore water pressure of the soil strata during and after construction.

<sup>2</sup> Advanced lab tests (consolidation, direct shear and triaxial tests) will be carried out in AMEC's Scarborough lab.

<sup>3</sup> American Society for Testing and Materials.

**Vibrating Wire Piezometers:** The VWP transducers (RST Model VW2100, 0.35 MPa for shallow to mid-depth and 0.7 MPa for deep installations) were installed at selected depths and electrical wires extended to the monitoring station at the ground surface to measure pore water pressures in soil strata. The borehole was filled with a bentonite-cement mixture designed to match, as near as practical, the permeability and strength-deformation characteristics of the native soils. Sensor elevation and details of installations are provided in applicable borehole logs.

Proper future decommissioning of the instrumentation holes is responsibility of WEMG/PIC.

**Standpipe Piezometers:** These piezometers comprise 1.5 m long 10 mil slotted intake screen located at the designated depth and extended to the ground surface using 52 mm diameter, flush-joint, threaded, schedule 40 PVC riser pipe. A silica sand filter pack was placed between the intake screen and the wall of the borehole and extended approximately 0.3 m above the top of the well screen. Bentonite-cement grout was used to restore grade to the ground surface. Screen elevations and details of installations are provided in Table 3-4 and applicable borehole logs.

## 2.3 Laboratory Testing

All recovered soil samples and rock cores were examined in the field and the laboratory. Natural moisture content tests were carried out on most of the recovered samples and grain size distribution and Atterberg limit were carried out on selected representative samples.

Selected samples of the silty clay and silt samples obtained from boreholes were sent to the ALS Environmental Analytical Laboratory in London, Ontario to determine the pH, redox potential, resistivity, sulphide and sulphate content of the soil to assess corrosion potential. The results of geochemical laboratory tests are summarized in section 4.2.6 and the reports are included in Appendix C.

## 2.4 Data Interpretation

**Field Vane Test Data Correction:** The chart (Figure 2-1<sup>4</sup>) developed initially by Bjerrum (1972) and updated subsequently by Ladd et al (1977) based on circular arc failure analyses of embankment failures suggest correction by multiplying the field vane data by 1.05 to 1.10 for soils with plasticity index of about 15% (ref. R-4 and R-23). However, based on re-evaluation of the Bjerrum chart by Aas et al. (1986), the Canadian Foundations Manual suggests that the vane test data for clays with PI<20% should not be corrected (ref. R-1 and R-5, Figure 2-2). Therefore, the field vane test data (from conventional and Nilcon vane tests) at this site were not corrected for PI.

**Strength Profiles from Cone Penetration Tests:** The undrained shear strength of the silty clay deposit was estimated using the CPT tip resistance,  $Q_t$ , as follows:

$$S_{u_{CPT}} = \frac{Q_t - \sigma_{vo}}{N_{kt}}$$

<sup>4</sup> All figures are included at the end of the report text.



Where:

- $S_{u\ CPT}$  is the undrained shear strength estimated from the CPT test;
- $Q_t$  is the corrected total cone tip resistance;
- $\sigma_{vo}$  is the total vertical stress at the corresponding depth of measurement of the  $Q_t$  value; and
- $N_{kt}$  is an empirical factor that varies, depending on soil type and test arrangement, typically between 8 and 20.

The CPT based  $S_u$  profiles were developed to achieve a general agreement with the nearby Nilcon vane test profiles. In this regard, the  $N_{kt}$  factor values used to calibrate the CPT strength profiles varied slightly for different segments of the WEP and the soil strata. Thus, an  $N_{kt}$  factor of 14 was used to estimate the undrained shear strength of the clay crust and transition layers. The  $N_{kt}$  factors used for the underlying grey silty clay to clayey silt stratum and the lower clayey silt stratum were 15 to 16, and 12 to 13<sup>5</sup>, respectively. Figures 2-3 to 2-7 present the undrained shear strength profiles for the WEP segments in the general area of each pump station. In CPTs indicating pore pressures higher than cone tip resistance, the undrained shear strength was estimated from the excess pore pressures (using the  $N_u$  method).

**Pre-Consolidation Pressures from Cone Penetration Tests:** The approach used for estimating the pre-consolidation pressures from the estimated  $S_u$  profiles follows the Stress History and Normalized Soil Engineering Properties (SHANSEP) method developed at MIT (Ladd and Foott, 1974, ref. R-22). The following relationship was used to compute the pre-consolidation pressures:

$$OCR = \frac{\sigma'_p}{\sigma'_{vo}} = \left[ \frac{S_u / \sigma'_{vo}}{S} \right]^{1/m}$$

Where:

- $S_u$  is the undrained shear strength;
- $\sigma'_{vo}$  is the vertical effective stress;
- $\sigma'_p$  is the pre-consolidation pressure (also referred as maximum past pressure);
- $S$  is the normalized strength ratio ( $S_u / \sigma'_v$ ) of normally consolidated soil;
- $OCR$  is the overconsolidation ratio; and
- $m$  is an empirically determined exponent, typically varying between 0.7 and 1.0.

<sup>5</sup>  $N_{kt}$  values for upper silty clay were 16 for PS-2/3, PS-5 and PS-6 and were 15 for PS-1 and PS-7.  $N_{kt}$  values for lower clayey silt were 12 for PS-1, PS-2/3, PS-5 and PS-6 and was 13 for PS-7.

Based on plasticity index of the clayey silt to silty clay deposit, preliminary values of  $S = 0.18$  and  $m = 0.95$  were chosen to estimate the maximum past pressures from the inferred undrained shear strength profile. The maximum past pressure,  $\sigma'_p$  can then be estimated as:

$$\sigma'_p = \sigma'_{vo} \times \left[ \frac{\frac{S_{uCPT}}{\sigma'_{vo}}}{0.18} \right]^{1.05}$$

**Flat Blade Dilatometer (DMT) Test Data:** DMT tests were conducted following the ASTM D6635-01 (2007) method. The soil properties from the results of these tests were developed in general using the guidelines layout in ISSMGE, 2001 (ref. R-20), except that the undrained shear strength values for the clay deposits were estimated using the relationship  $S_u = S \sigma'_{vo} (0.5 K_d)^{1.25}$ , where  $S = 0.18$  and  $K_d$  is the horizontal stress index represented by:

$$K_d = (p_0 - u_0) / \sigma'_{vo}$$

Where:

- $p_0$  is the corrected instrument lateral pressure reading at zero membrane deformation (null method)
- $u_0$  is the pore water pressure in the soil prior to the blade insertion

The constant 0.18 for  $S_u/\sigma'_{vo}$  for OCR=1 is based on average plasticity index of the silty clay to clayey silt stratum and the Chandler 1988 relationship (ref. R-8).

The undrained shear strength ( $S_u$ ), pre-consolidation pressure ( $\sigma'_p$ ), natural water content ( $w_N$ ) and compression index ( $C_c$ ) profiles based on field and laboratory testing from boreholes, CPTs and DMT carried out in the vicinity of the Pump Stations are presented in Figures 2-3 to 2-7. Also included on these figures are  $0.18 \times \sigma'_{vo}$  curve (representing undrained strength for OCR=1 condition) and simplified soil stratigraphic deposits to facilitate correlation of soil properties to the individual soil units.

### 3 Subsurface Conditions

The general soil stratigraphy at the borehole locations consists of the following successive strata: surficial layers of occasional fills, topsoil, and upper granular deposit; an extensive clayey silt to silty clay deposit below about elevations 180 to 186, and a lower granular deposit below about elevations 149 to 156, overlying limestone and dolostone bedrock below about elevation 149 to 154. The thickness of the Clayey Silt to Silty Clay deposit varies between about 30.2 m and 33.1 m. The lower granular deposit (sandy silt / silty sand / sand and gravel) varied in thickness from 0 to 2.1 m. The bedrock was encountered at depths ranging from about 32.1 m to 33.4 m below the ground surface.

#### 3.1 Topsoil, Surficial Fills and Upper Granular Deposit

All pump station boreholes encountered an up to a 0.6 m thick layer of brown to black topsoil. Borehole PS1-1 encountered 1.2 m of very loose to loose sand underlying the topsoil. Borehole PS7-1 encountered 0.1 m of compact sand and gravel fill underlying the topsoil.

**Table 3-1: Thickness of Surficial Soils**

Boreholes	Surficial Soils
BH PS1-1	0.3 m topsoil over 1.2 m sand
BH PS2-1	0.2 m topsoil
BH PS5-1	0.6 m topsoil
BH PS6-1	0.3 m topsoil
BH PS7-1	0.2 m topsoil over 0.1 m fill

#### 3.2 Silty Clay to Clayey Silt Stratum

The cohesive silty clay stratum was encountered directly underlying the surficial topsoil or fill/granular deposit. Based on the gradation, in-situ moisture content and strength characteristics, the stratum may be divided into 4 layers as follows: brown desiccated stiff to very stiff clay crust, transition zone, grey silty clay to clayey silt deposit (referred to hereafter as upper silty clay), and then a grey clayey silt deposit (referred to as lower clayey silt).

**Table 3-2: Summary of Clay Stratum Elevations**

Pump Station #	Elevation Range (m)			
	Clay Crust	Transition	Upper Silty Clay	Lower Clayey Silt
PS-1	179.8 to 177	177 to 175	175 to 160	160 to 149
PS-2/3	180.5 to 177	177 to 175	175 to 163	163 to 150
PS-5	182.2 to 178	178 to 175	175 to 163	163 to 151
PS-6	185 to 179	179 to 175	175 to 163	163 to 152
PS-7	186.5 to 181	181 to 177	175 to 164	164 to 156

### 3.3 Lower Granular Deposit

Underlying the silty clay to clayey silt stratum and overlying the bedrock, a discontinuous and heterogeneous non-cohesive material deposit (varying from sandy silt, sand and clayey sand and gravel) was encountered. Based on the Standard Penetration Test (SPT) “N” values ranging generally from 9 to greater than 70, this material is considered to be in a loose to very dense state of compactness. This layer was approximately 0 to 1.6 m thick but will vary significantly throughout the project area.

### 3.4 Bedrock

Where rock coring was undertaken, a white to grey, limestone bedrock was encountered. The bedrock was generally fresh, medium strong, fine grained, faintly to highly porous and highly fractured. Bedrock was encountered at elevations shown in Table 3-3. A 0.6 m thick layer of inferred cobbles and boulders was encountered above the bedrock at Borehole PS7-1 location.

**Table 3-3: Summary of Bedrock Elevations**

Boreholes	Elevation of Top of Bedrock (m)
BH PS1-1	149.0
BH PS2-1	148.6
BH PS5-1	148.1
BH PS6-1	151.9
BH PS7-1	154.2

The Rock Quality Designation (RQD) of the recovered rock cores varied on average between 40 to 100 per cent, indicating a fair to excellent quality. The RQD increased with depth in all boreholes except in Borehole PS6-1 where it decreased from 56 to 27 per cent. Based on this core logging the rock mass classification was estimated to range from 2.8 to 5 for the Q-System (Barton *et. al.*, 1974) and 53 to 58 for the Rock Mass Rating (RMR) based on Bieniawski (1976) and indicates that the rock mass can be considered as a Fair quality rock mass based on the later system. With the exception of Borehole BH-314, rock quality generally increases with depth.

Based on this core logging the rock mass classification was estimated to range from 2.8 to 5 for the Q-System (Barton *et. al.*, 1974, ref. R-2) and 53 to 58 for the Rock Mass Rating (RMR) based on Bieniawski (1976, ref. R-3) and indicates that the rock mass can be considered as a Fair quality rock mass based on the later system.

It was found during the preliminary investigations (ref. R-10) that little variation in the strength of the rock mass conditions was identified from site to site. For this reason in order to obtain a reasonable statistical sample, the density, unit weight and uniaxial compressive strength of the samples from all of the key sites have been grouped and are summarised in Table 3-4. A total of 12 samples were included for density and unit weight, while 16 were included for unconfined compressive strength. The average strength of the limestone is determined to be 85.5 MPa and is ‘strong rock’ based on the ISRM (1978, ref. R-21). Additionally, based on the coefficient of variation, enough tests have been performed to characterise the compressive strength.

**Table 3-4: Summary of Intact Properties of Rock Core Samples**

	Density (kg/m <sup>3</sup> )	Unit Weight (kN/m <sup>3</sup> )	UCS (MPa)
Number of Samples, N	12	12	16
Average	2502	24.54	85.5
Standard Deviation	96	0.94	25.4
Minimum Value	2340	22.95	35.5
Maximum Value	2660	26.09	135.3

Based on the rock mass classification and the strength properties assuming an  $m_i = 12$  for a crystalline limestone, a disturbance factor of 0.7, and a factor of safety of 3.0, an allowable bearing capacity of the rock has been calculated to range from 5.3 MPa to 13.5 MPa. The mean allowable bearing capacity is determined to be 9.2 MPa using the Hoek and Brown strength criterion for determining the bearing capacity of a fractured rock mass (Wyllie, 1999).

### 3.5 Groundwater Conditions

Shallow and deep standpipe and vibrating wire piezometers were installed in selected boreholes during pre-bid and additional investigations to measure the water levels within overburden and bedrock, respectively.

The piezometric water levels within the overburden and the lower granular/bedrock were observed between elevations 175.7 and 185.0, and 177.6 and 180.8, respectively (Table 3-5). The readings in piezometers in Borehole PS7-1 suggest a downward gradient between the overburden and the bedrock. However, the readings in all other pump station boreholes (BH PS1-1, PS2-1, PS5-1 and PS6-1) suggest a negligible to slight upward gradient between the overburden and the lower granular/bedrock. It is recognized that these piezometric water levels (particularly in the overburden) may not have fully stabilized. In this regard, it is considered that potential for artesian conditions in bedrock exists but the trend needs to be confirmed by future readings.

In consideration of the findings at other locations along the project alignment, occurrence of local artesian condition in bedrock cannot be ruled out. The Contractor is advised to make necessary provisions to handle the occurrence of artesian condition if encountered.

Perched groundwater is known to accumulate seasonally within the upper deposits of fill, topsoil and granular layers, and within the fissures in the silty clay crust. In adverse conditions, the perched groundwater levels can rise to near the ground surface.

**Table 3-5: Summary of Measured Water Levels**

Borehole	Surface El, m	Piezo. Type	Screen / Sensor El, m	Strata Type at Screen / Sensor Depth	Measured Water level	
					Date	El, m
BH PS1-1	182.8	VWP	162.7	Silty Clay	2011-11-03	179.0
		VWP	157.2	Silty Clay	2011-11-03	180.7
		VMP	149.1	Silty Clay		179.2
		S-Piez	147.7	Limestone	2011-11-11	180.8
BH PS2-1	180.7	VWP	162.4	Silty Clay	2011-11-03	179.3
		VWP	156.3	Silty Clay		179.2
		VWP	149.3	Lower Granular		179.1
		S-Piez	147.1	Limestone		179.4
BH PS5-1	180.7	VWP	164.5	Silty Clay	2011-11-03	179.6
		VWP	158.9	Silty Clay		178.7
		VWP	150.8	Silty to Sandy and Gravelly Clay	2011-11-11	177.6
		S-Piez	150.9	Limestone		180.2
BH PS6-1	185.3	VWP	167.0	Silty Clay	2011-11-03	179.8
		VWP	160.9	Silty Clay		175.7
		VWP	153.3	Silty Clay		177.8
		S-Piez	151.8	Limestone	2011-11-11	178.5
BH PS7-1	186.8	VWP	168.5	Silty Clay	2011-11-03	185.0
		VWP	162.4	Silty Clay		181.5
		VWP	154.8	Lower Granular		177.9
		S-Piez	153.3	Limestone	177.9 (Note 1)	

Legend: S-Piez. Standpipe Piezometer

VWP Vibrating Wire Piezometer

Note 1. Instrument plugged with grout and therefore inoperable, assume water level similar to lower granular at El. 177.9

### 3.6 Subsurface Gases

The groundwater in the project area, especially within the lower granular deposit and bedrock, is known to contain dissolved hydrogen sulphide (H<sub>2</sub>S) and methane (CH<sub>4</sub>) gases that are liberated from the water on exposure to atmospheric pressure.

The H<sub>2</sub>S gas can frequently be detected by odour at concentrations on the order of 0.5 mg/L (ppm) and can be corrosive at concentrations of about 2 to 3 mg/L in the groundwater.

A summary of sampling and testing of the groundwater by Golder (ref. R-11) and the recent investigation, in the borehole near the pump station is presented in Table 3-6.

**Table 3-6: Summary of Natural Groundwater Chemistry**

Borehole	Surface El, m	Sample El, m	Strata Type at Screen / Sensor Depth	H <sub>2</sub> S	CH <sub>4</sub>
				mg/L	µg/L
BH-104	186.15	151.45	Bedrock	0.11	6



Pumping tests were conducted at three locations across the proposed parkway to determine concentration levels of hydrogen sulphide gas in the groundwater of the area. Occurrences of H<sub>2</sub>S were observed in test holes located near Pump Station PS-1, in Borehole BH-104 near Pump Station PS-7 and may also be present near PS-2. A summary of the results of these tests is provided in Table 3-7.

**Table 3-7: Pumping Tests Data**

Test #	Approximate Location	H <sub>2</sub> S Gas Concentration (mg/L)
TOW-1	Pump Station PS-6	<0.2
TOW-2	Pump Station PS-1	20.0
TOW-3	Pump Station PS-2/3	7.0

Dissolved methane was also sampled by Golder (ref. R-11) with most samples below detection (<5 µg/L) with the largest values (up to 485 µg/L) generally measured where artesian conditions occurred. These data are consistent with general water chemistry sampling taken at the end of the pumping tests

In this regard, it is recommended that the design and construction should address the potential presence of these gases. Air monitoring should be considered during construction. In general, it is recommended that equipment operating in confined spaces be selected to safely operate in a potentially gaseous environment. Excavation lifts should be decided in consideration of the pore pressure monitoring data and the potential ground softening.

Occurrences of H<sub>2</sub>S were observed in test holes located near Pump Station PS-1, in Borehole BH-104 near Pump Station PS-7 and may also be present near PS-2. Although the presence of the H<sub>2</sub>S and CH<sub>4</sub> gases was not observed at the other pump station locations, their presence cannot be ruled out. Measures should be taken to monitor for H<sub>2</sub>S and CH<sub>4</sub> gases frequently during and after excavation and construction

The understanding of the engineering behaviour (related to the impact on design and construction) of the gassy soils is rather limited. In the case of low permeability cohesive soils it is known that these soils may experience rapid drop in undrained shear strength during unloading. Due to the relatively high compressibility of the pore fluid in gassy soils, the immediate pore water pressure response ( $\Delta u$ ) to total stress changes can be very low. This phenomena leads to reduction in effective stress and hence shear strength (ref. R-18 and R-25). It is, therefore, recommended that the design and construction methodologies should be developed in consideration of the potential presence of these gases (ref. R-9).



## 4 Geotechnical Recommendations

Design considerations for permanent works are addressed in the following sections. The design of all temporary staging and temporary works is not in the scope of this report. Where temporary conditions are discussed in this report is for the purpose of evaluating the effects on permanent structures and to identify to others potential issues that need to be considered when developing the temporary staging for construction.

The proposed pump station locations and configuration provided by HMM are provided in Appendix A and were summarized in Table 1-1.

### 4.1 Geotechnical Design

#### 4.1.1 Undrained Shear Strength

The design soil properties for the silty clay to clayey silt deposit were interpreted from the CPT, DMT and Nilcon vane test profiles and the laboratory test results. The undrained shear strength ( $S_u$ ) and preconsolidation pressure ( $\sigma'_p$ ) profiles were estimated from CPT results based on the calibration described in Section 2.4. The  $S_u$  and  $\sigma'_p$  profiles inferred from the CPT, DMT and Nilcon tests advanced around each pump station and the design values obtained from these profiles are shown in Figures 2-3 to 2-7 and summarized hereafter in Table 4-1. Effective cohesion for the upper clay crust and transition zone layers has been neglected due to long term weathering, moisture ingress and fissuring effects.

**Table 4-1: Summary of Design Soil Parameters**

Clay Substratum	Elevation Range	Unit weight (kN/m <sup>3</sup> )	Undrained Shear Strength, S <sub>u</sub> (kPa)	Effective Strength Parameter	Pre-consolidation Pressure (kPa)	OCR	Ko (In-situ)
PS-1							
Clay Crust	179* to 177	22	75	c' = 0 kPa ø = 30°	500	>6	1.3
Transition	177 to 175	21	75 to 65		500 to 350	4	1.0
Upper Clay	175 to 164	20	65 to 40		350 to 225	2.1	0.7
Lower Clay	164 to 160	19	40 to 50		225 to 265	1	0.5
Upper Silt	160 to 159	20	50 to 75		265 to 400	1.3	0.6
Lower Silt	159 to 149	21	75		400	1.3	0.6
PS-2/3							
Clay Crust	179* to 177	22	75	c' = 0 kPa ø = 30°	550	13	1.8
Transition	177 to 175	21	75 to 60		550 to 350	6	1.3
Upper Clay	175 to 166	20	60 to 41		350 to 230	2.8	0.8
Lower Clay	166 to 163	19	41 to 47		230 to 260	1.3	0.6
Upper Silt	163 to 160	20	47 to 65		260 to 400	1.5	0.6
Lower Silt	160 to 150	21	65		400	1.5	0.6
PS-5							
Clay Crust	179* to 178	22	75	c' = 0 kPa ø = 30°	600	>10	1.6
Transition	178 to 175	21	75 to 60		600 to 350	6	1.3
Upper Clay	175 to 166	20	60 to 50		350 to 225	2.3	0.8
Lower Clay	166 to 163	19	50 to 57		225 to 250	1	0.5
Upper Silt	163 to 161	20	57 to 80		250 to 450	1.4	0.6
Lower Silt	161 to 151	21	80		450	1.5	0.6
PS-6							
Clay Crust	181* to 179	22	75	c' = 0 kPa ø = 30°	550	>8	1.4
Transition	179 to 175	21	75 to 55		550 to 340	4	1.1
Upper Clay	175 to 166	20	55 to 50		340 to 280	1.8	0.7
Lower Clay	166 to 163	19	50 to 58		280 to 315	1.2	0.5
Upper Silt	163 to 161	20	58 to 100		315 to 500	1.3	0.6
Lower Silt	161 to 152	21	100		500	1.5	0.6
PS-7							
Clay Crust	182* to 181	22	75	c' = 0 kPa ø = 30°	600	>8	1.5
Transition	181 to 177	21	75 to 65		600 to 380	3	0.9
Upper Clay	177 to 167	20	65 to 60		380 to 350	1.4	0.6
Lower Clay	167 to 164	20	60 to 68		350 390	1.3	0.6
Silt	164 to 156	21	68 to 125		390 to 600	1.9	0.7

(\*) Elevations vary

c' = Cohesion intercept

φ° = Effective Angle of Internal Friction (φ°)

The design values of the coefficient of horizontal permeability ( $k_h$ ) and the hydraulic conductivity anisotropy ratio ( $A = k_h/k_v$ ) are provided in Table 4-2. The design permeability values are based on field and laboratory tests (Figure 4-1) and are considered to be within range of precision of the measurements.

**Table 4-2: Summary of Other Interpreted Design Parameters**

Clay Substratum	Horizontal Permeability, cm/sec	Anisotropy ratio, $k_h/k_v$
Clay Crust	$6.8 \times 10^{-7}$	1
Transition	$3.9 \times 10^{-7}$	2
Upper Silty Clay	$1.1 \times 10^{-7}$	
Lower Silty Clay	$1.1 \times 10^{-7}$	
Upper Clayey Silt	$1.1 \times 10^{-7}$	
Lower Clayey Silt	$1.1 \times 10^{-7}$	

#### 4.1.2 Lateral Earth Pressure

Also included in Table 4-1 are the Overconsolidation Ratios (OCR) and the estimated in-situ lateral earth pressure coefficient ( $K_0$ ) for each soil horizon. The following relationship was used to determine these values:

For normally consolidated soils  $K_0 = 1 - \sin \phi$

For overconsolidated soils  $K_0 = (1 - \sin \phi) \times \text{OCR}^{\sin \phi}$

Where:

$\phi$  is the effective friction angle, and

OCR is the overconsolidation ratio (as determined from CPT data).

##### 4.1.2.1 Earth Pressures on Temporary Braced Excavation Walls

It is understood that open cut excavation methods will be used the pump stations P1, and PS5 thru PS7, while the use of temporary shoring is planned for PS 2/3. Temporary shoring for the deep cuts in excess of 6 m required at the pump stations should be based on an engineered support system complying with Ontario Occupational Health and Safety Act.

The design earth pressures against the walls of the braced excavation should not be less than the apparent earth pressures indicated in the Canadian Foundation Engineering Manual (ref. R-5) applicable for cuts in soft-to firm or stiff cohesive soils, depending on the shear strength  $S_u$ , at the base of the excavation. The design earth pressures,  $p_e$ , can be calculated as follows:

$$p_e = \sigma_z - 2 S_u \geq 0.4 \sigma_z$$

where:

$S_u$  = soil shear strength at the base of the excavation indicated in Table 4.5 in this report

$\sigma_z$  = total vertical stress at the level of the excavation due to the weight of the soil column plus applicable surcharges at the ground surface.

Ground deformation around deep shored excavations should be anticipated. In the absence of more detailed analysis based on field measurements, a maximum ground settlement in the order of 2% of the depth of the excavation should be considered possible provided appropriate shoring is employed. The lateral extent of the zone impacted by settlements could be as wide as 3 times the depth of excavation.

The magnitude of the ground deformation is to a certain extent controllable by the stiffness of the shoring system, especially in cases where the factor of safety against basal instability,  $FS_b$ , is lower (less than 1.5). Estimated  $FS_b$  are provided in Table 4.3 for the anticipated deepest excavations.

#### 4.1.2.2 Earth Pressures on Permanent Retaining Structures

Long term earth pressures by compacted backfill against buried structures may be calculated on the basis of the parameters listed in Table 4-3.

**Table 4-3: Soil Parameters for Earth Pressure Calculations**

Soil Parameter	Group I Soils	Group II Soils	Group III Soils
Fill Unit Weight, $kN/m^3$	22	21	20.5
Friction angle, $\phi$ (degrees)	33 to 35	29 to 32	22 to 30
Coefficients of Static Lateral Earth Pressure:			
'Active' or Unrestrained, $K_a^{(*)}$	0.27 to 0.30	0.310 to 0.35	0.33 to 0.45
'At Rest' or Restrained, $K_o^{(*)}$	0.43 to 0.46	0.47 to 0.52	0.50 to 0.62
'Passive', $K_p^{(*)}$	3.3 to 3.7	2.9 to 3.2	2.2 to 3.0

- Note: Values are given for level backfill and ground surface behind the wall compacted to > 95% Standard Proctor maximum dry density. The coefficients of lateral earth pressure should be adjusted if there is sloping ground at the back of the wall.
- Group I Soils: Coarse grained soils (e.g. Granular A and B Type 2)
- Group II Soils: Finer grained than Group I noncohesive soils (e.g. Granular B Type1, pit run, etc)
- Group III Soils: Finer grained soils (e.g. approved site generated silty clay).

The long term earth pressures against the buried structures should consider the earth pressure coefficients listed above in conjunction with the bulk unit weights listed in Table 4-1. The buoyant soil weight should be used for the submerged portion of the structure.

Where applicable, hydrostatic pressures should be added to earth pressures. Permanent and temporary surcharges at the ground surface should also be considered as appropriate. In the case of compacted fill adjacent to the wet well, a minimum earth pressure of 12 kPa should be considered along any section of the buried structure to account for the effects of compaction.

Adequate width/thickness of non-frost susceptible and free draining granular fill should be placed behind the retaining walls within unheated areas to prevent excessive deformation and damage.

#### 4.1.3 USL and SLS Bearing Resistance

Conventional spread footings, concrete pads, and rafts placed at various foundation levels are anticipated to be used at these structures. The bearing resistance will vary largely with the size of the footings and the foundation grades.

Table 4-4 provides recommendations for the particular cases of the deep wells founded at on concrete rafts at the specified depth. For other situations, recommendations on a case-by-case basis can be provided on request.

#### 4.1.4 Base Heave and Uplift Considerations

As indicated at the beginning of Section 4.0, this report involves the design of permanent works only. Where temporary conditions are discussed in this report, it is for the purpose of evaluating the effects on permanent structures and to identify to others the subsurface conditions relevant for the temporary staging for construction. The detailed design for temporary excavation, shoring and dewatering requirements for temporary works is by others.

Excavations are expected to encounter surficial fills, topsoil and water bearing granular soils and will be up to about 18 m below existing grade and into the native firm silty clay.

Basal hydrostatic uplift during construction (temporary condition) at each structure was calculated based on the highest measured water level in the bedrock, anticipated excavation depth, and a silt-clay layer thickness below the deepest excavation at each structure. The calculated FS at the pump stations range from about 1.0 to 1.3 and therefore could be a risk of uplift instability at the base of excavation during construction due to hydrostatic pressures at the base of the silty clay deposit. Considering the catastrophic nature of the hydrostatic uplift failure, adequate instrumentation and monitoring of the groundwater pressures as well as the basal heave during construction will be required.

Based on the hydro-geological data available to date, the transmissivity within the bedrock could be significant at some of the pump locations and hence, a permit to take water will likely be required if temporary groundwater dewatering within the bedrock is necessary.

Table 4-4: Summary of Geotechnical Design Parameters for Pump Stations

Pump Station #	Approximate Station	Original Ground Surface Elevation (m)	Measured Elevation of GWL in Shallow Deposit (m)	Proposed Finished Grade Elevation at PS (m) (3)	Estimated deepest Foundation Elevation at Pump Station	Depth of Excavation below Original Ground Surface (m)	Closest Boreholes	Undrained Shear Strength (Su) 0.5 B below Foundation Level (kPa)	q <sub>sls</sub> (kPa) (1)	q <sub>uls</sub> (kPa) (2)	Highest GWL Elevation in Bedrock (m)	Top Elevation of Lower Granular or Bedrock (m)	Hydrostatic Pressure at the base of clay deposit (kPa)	Overburden Pressure on top of Lower Granular or Bedrock (kPa) (3)	FSu = W/HP (Temporary)
PS-1	13+250 Windsor	181.3	180.7	182.1	165.4±	15.9	PS1-1, T2-1, BH-143	45	70	120	180.8	149.0	312.0	326	1.04
PS-2/3	14+800 Windsor	180.7	179.3	178.1	164.7 ±	16.0	PS2-1, 12-RW, 13-RW, BH-325	50	85	130	179.4	150.2	286.5	292	1.02
PS-5	11+490 LaSalle	182.8	179.6	184.1	169.4±	13.4	PS5-1, BH-7	50	70	130	180.2	150.8	288.4	372	1.29
PS-6	12+730 LaSalle	185.3	179.8	179.7	167.8±	17.5	PS6-1, BH-310	55	90	140	178.5	151.9	260.9	316	1.21
PS-7	10+200 Tecumseh	186.8	185.0	182.7	169.0±	17.8	PS7-1, BH-104	75	150	190	177.9	156.3	211.9	252	1.19

Notes:  
(1) Net SLS reaction (net soil stress increase) based on assumed 25 mm post-construction settlement  
(2) Net ULS reaction (excluding embedment effect. The gross ULS reaction increases with embedment by approximately 20 kPa for each meter of embedment below finished grade  
(3) Based on an average bulk soil unit weight of 20 kN/m³



As described above, the presence of gassy soils near the bedrock surface should not be excluded, particularly at Pump Stations PS-1 and PS-2/3. It is recommended that in the case of excavations deeper than 5 m careful monitoring of basal heave and pore water pressures below of the bottom of the excavations be carried out during construction. Adequate number of heave gauges and low-displacement type piezometers shall be installed prior to initiation of the major excavations. If warranted by the monitoring of the excavation progress performance, the excavation rates will have to be adjusted to allow sufficient time to dissipate the pore pressures to safe levels. The excavation guidelines can be revised based on on-site experience.

#### 4.1.5 Corrosion Potential

Analytical testing was carried out on samples of the silt and clay stratum obtained in Boreholes BH PS1-1 (Sample 26), BH PS2-1 (Sample 25), BH PS5-1 (Sample 23), BH PS6-1 (Sample 20) and BH PS7-1 (Sample 25). Table 4-5 summarizes the results of various analyses carried out on the soil samples to assess the potential for corrosion on concrete.

**Table 4-5: Results of Analytical Testing on Soils**

Location of Soil Samples	Elevation of Soil Sample	pH	Redox Potential, mV	Resistivity, ohm.cm	Sulphide, mg/kg	Sulphate, mg/kg
Borehole BH PS1-1 (Sample 26)	150.8	7.75	290	2090	<0.2	578
Borehole BH PS2-1 (Sample 25)	148.7	7.98	300	2770	<0.2	232
Borehole BH PS5-1 (Sample 23)	153.3	7.90	230	2580	<0.2	486
Borehole BH PS6-1 (Sample 20)	160.9	7.77	227	3600	<0.2	221
Borehole BH PS7-1 (Sample 25)	156.3	7.72	285	9710	<0.2	29

The reported results of laboratory testing indicate that based on CSA A23.1 (ref. R-7), concrete in contact with the tested soil material would have a negligible degree of exposure to sulphate attack. Although the concentrations are low (< 580 mg/kg), it is considered prudent to use sulphate resistant concrete for deep buried structures.

As discussed in the sections above, dissolved hydrogen sulphide at concentrations of 7 and 20 mg/L were encountered in the groundwater pumping tests near Pump Stations PS-2/3 and PS-7, respectively, therefore construction materials should be selected accordingly.

Based on the measured electrical resistivity, pH, redox potential, sulphide contents etc., the soil would be considered to have a potential for corrosion to buried metallic elements AWWA.

The above test results should be further reviewed by a corrosion specialist.



## 4.2 Backfilling and Drainage

It is understood that open cut excavation methods will be used at most of the pump stations. As such, large areas of backfill will be required around each structure. Behind the concrete walls within unheated areas non-frost susceptible free draining granular fill should be used.

The backfill should be compacted in maximum 200 mm thick loose lifts in accordance with OPSS 501. To reduce the risks of sizeable settlements around the facility, extreme care should be given to the selection of backfill material, to its placement and protection during construction. Adequate subgrade preparation must be undertaken at the interface between the temporary slopes and the backfill to ensure smooth transition between native soils and backfill. These precautions are particularly important within settlement sensitive areas (such as under paved areas).

In the case of compactable silty clay materials, the compaction effort should not be less than 95% of the Standard Proctor maximum dry density (SPMDD) within a maximum 2% of the optimum moisture content. . In the case of approved well-graded granular material, the compaction effort should be at least 98% SPMDD

Heavy compaction equipment should not be used adjacent to the walls of the structure, where the backfill should be placed in maximum 100 mm thick loose lifts and compacted with small compactors.

For retained backfill that is placed and compacted in layers, the lateral force caused by compaction should be considered. In the absence of detailed analysis, the additional lateral pressure due to the effects of light compaction, a lateral pressure varying linearly from 12 kPa at the fill surface to 0 kPa at a depth of 1.7 m below the surface should be added to the base lateral earth pressure.

If shored excavations using sheet piles are considered, removal of the sheet pile portion driven below the excavation base (after the completion of the excavation and backfill) could cause voids below the base of the raft which could cause significant settlements during and after extraction. Consideration should be given to leave in the embedded portions of these walls.

A permanent subdrainage system should be incorporated in the design. Depending on the location of the subdrainage, or in the absence of such system, the design should include provisions against buoyancy.

Depending on the grainsize of the backfill, a filter layer may be required at the interface between the native soil excavation slope and the backfill to prevent the migration of the fines from adjacent fills and soils.

## 5 Other Geotechnical Recommendations

### 5.1 Construction Dewatering

The design of the dewatering system should comply with the Ontario Provincial Standard Specification (OPSS) 517 and 518 provisions.

Due to the relatively low permeability of the silty clay deposit, groundwater seepage is anticipated to be minor, which should be controllable by conventional temporary dewatering methods. However, runoff and seepage into the excavations from perched groundwater from the fill, old farm tiles and / or utility trenches, and upper granular layers should also be anticipated. In addition, random water bearing seams, pockets and lenses of fine sand may be intersected by the excavation slopes and walls. In adverse conditions, the runoff and seepage from perched groundwater and sand/silt lenses can be significant and accompanied by piping and wash-outs of the fines causing sloughing of the slopes.

Accordingly, provision should be made to prevent runoff and piping erosion of the open cut slope surfaces by blanketing of the slopes with filter fabric and free-draining granular material. The seepage flow should be directed to collection sumps by temporary drainage ditches properly sized, filtered and lined to accommodate the flow rates.

All surface water should be directed away from all open excavations to prevent degradation of the subgrade. Water should not be allowed to pond in open excavations.

### 5.2 General Construction Requirements

The anticipated construction conditions in this report are discussed only to the extent of their potential influence on the design of the pumping stations. References to construction methods are not intended to be the suggestions or directions on the construction methodologies. Contractors should be aware that the data presented in this report and their interpretations may not be sufficient to assess all factors that may affect the construction.

The Contractors are fully responsible for the design, construction methods and performance (stability, deformability and deterioration) of the temporary excavations, slopes and temporary works. The following recommendations and comments are considered applicable:

- All excavation works should be carried out in accordance with the guidelines outlined in Occupational Health and Safety Act (OHSA) and OPSS 902. The native undisturbed soils may be classified as Type 3 soils. The excavations below the original ground levels may intersect water bearing backfill within trenches of active and/or abandoned utilities. In these cases, Type 4 soil conditions may occur and should be addressed accordingly.
- The silty clay soils at the project site are highly susceptible to rapid deterioration when exposed to elements, weathering and/ or subjected to direct construction traffic.
- Temporary slopes, permanent slopes, and subgrade areas must be appropriately protected at all times against surface erosion due to runoff, desiccation, freeze-thaw effects, etc.

- To protect the integrity of subgrade for foundations and pavements, the final excavation layer above the design elevation should not be less than 500 mm and should be carried out only when the contractor is ready to prepare and cover the subgrade with the materials specified in the design same day the final excavation is exposed and approved. No construction traffic should be permitted over subgrade without approved protective covers.
- The final excavation layer above the design subgrade should be carried out using buckets equipped with smooth lips. Once exposed, the subgrade must be immediately inspected. Upon approval, the subgrade should be immediately protected; depending on the type of construction, geofabrics, granular mats, a skim coat (minimum 75 mm thick) of lean concrete protection (mud mat), etc. should be used.
- As discussed in Section 4, risk of hydrostatic uplift must be considered in the design of the temporary construction. .
- As indicated earlier, pore pressures, heave/settlement behavior and presence of gassy soils below the excavation should be monitored diligently during excavation.
- Regular monitoring and inspection of the condition of temporary slopes, retaining structures and excavation base for signs of instability, deterioration, sloughing, etc should be carried out by qualified personnel. Appropriate mitigation measures should be implemented.
- Appropriate monitoring of the nearby utilities and facilities is required. Monitoring should consist of a precondition survey along with regular surveying conducted of the nearby utilities, early works, etc.

### 5.3 Instrumentation and Monitoring during Construction

A program of site instrumentation and monitoring of the temporary works during construction should be implemented by the Contractor in addition to the limited instrumentation already installed during the geotechnical investigation.

Details and recommendations for additional instrumentation, monitoring program, as well as guidelines for alert levels, interpretation and contingencies are provided in a separate report 285380-04-118-0001.

The Contractor is responsible for planning, installation and maintenance of instrumentation as well as the monitoring of the response of the excavations (ground movement) during construction. Detailed plans and procedures should be submitted to HMQ for approval at least 3 month prior to commencement of the monitoring of the works.

Monitoring is required to check the safety of the work, assess the effects of construction on surrounding ground and existing facilities, evaluate design assumptions, and refine estimates of future performance.

## 6 Construction Quality Control

To ensure that construction is carried out in a manner consistent with the intent of the recommendations set forth in this report, a construction quality control program, including geotechnical inspection, field and laboratory testing and instrument monitoring, should be developed and implemented throughout the construction phase. In addition, laboratory quality control testing should be carried out in conjunction with the fieldwork to monitor compliance with the various materials and project specifications.

## 7 Limitations of Report

This report presents the subsurface soil and groundwater conditions inferred from geotechnical investigation and geotechnical design of the structures mentioned in the report. The report was prepared with the condition that the structural and other designs of the WEP will be in accordance with applicable standards and codes, regulations of authorities having jurisdiction, and good engineering practices. Further, the recommendations and opinions expressed in this report are only applicable to the proposed project as described within AMEC's report.

There should also be an ongoing liaison with AMEC during both the design and construction phases of the project to ensure that the recommendations in this report have been interpreted and implemented correctly. Also, if any further clarification and/or elaboration are needed concerning the geotechnical aspects of this project, AMEC should be contacted immediately.

The conclusions and recommendations given in this report are based on data presented in the pre-bid geotechnical investigation reports and information determined at the test hole locations during the additional investigation carried out for the geotechnical design work. The data obtained from the pre-bid investigations (carried out by others) was assumed to be valid and applicable.

The information contained herein in no way reflects on the environmental aspects of the project, unless otherwise stated.

The soil boundaries indicated have been inferred from non-continuous sampling, observations of drilling resistance, Nilcon vane, CPT and DMT probing. The boundaries typically represent a transition from one soil type to another and are not intended to define exact planes of geological change. Subsurface and groundwater conditions between and beyond the test holes may differ from those encountered at the test hole locations, and conditions may become apparent during construction, which could not be detected or anticipated at the time of the site investigation. Thus, unsuitable foundation soils may be encountered at the foundation grade requiring extra sub-excavations, subgrade improvement, and/or changes to the design. It is important that the AMEC geotechnical design engineer be involved during construction throughout the WEP project site to confirm that the subsurface conditions do not deviate materially from those encountered in test holes, and that any material deviations, if encountered, do not adversely affect the geotechnical design.

The stability analyses assumed a certain sequence of the construction; if different construction approaches are considered the geotechnical design will have to be reviewed. The calculated factors of safety assume strict adherence to the good construction practices with respect to the protection of the exposed slopes.

The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report. Since all details of the design may not be known, it is recommended that AMEC be engaged during the final design and construction stages to verify that the design and construction are consistent with AMEC's recommendations.

The comments made in this report on potential construction problems and possible methods are intended only for the guidance of the structural and other designers and constructor. The number of test holes may not be sufficient to determine all the factors that may affect construction methods and costs. For example, the thickness of the surficial topsoil and the clay crust layer, the presence of artesian conditions and exsolved natural gases, and the strength of the silty clay stratum may vary markedly and unpredictably. The constructor should, therefore, make their own interpretation of the factual information presented and draw their own conclusions as to how the subsurface conditions may affect their work. The work presented in this report has been undertaken in accordance with normally accepted geotechnical engineering practices. No other warranty is expressed or implied.

The benchmark and elevations mentioned in this report were surveyed and provided by AMICO. They should not be used by any other party for any other purpose.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. AMEC accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.



## 8 Closure

The geotechnical report for Pumping Stations was prepared Ms. Jessica Fredericks, P.Eng. (NB) and Mr. Brian Lapos, P.Eng under design direction by Dr. Dan Dimitriu, P.Eng.. The project was executed under the technical direction of Dr. Narendra S. Verma, P.Eng. who also provided the senior review of the report. Mr. Matt Oldewening, P.Eng. managed the geotechnical investigation and Mr. Brian Lapos, P.Eng. was the project manager.

The cooperation received from Ms. Biljana Rajlic, P.Eng. and Lino Belgiorgio P. Eng of Hatch Mott McDonald and Mr. Daniel Muñoz, P.Eng. of PIC during the design study is gratefully acknowledged.

Yours truly,

**AMEC Environmental and Infrastructure,**  
**a division of AMEC Americas Limited**



Brian Lapos, M.Sc., P.Eng.  
Geotechnical Engineer



Dan Dimitriu, Ph.D., P.Eng,  
Associate Geotechnical Engineer



Narendra Verma, Ph.D., P.Eng., F.ASCE, D.GE.  
Principal Geotechnical Engineer  
(Designated MTO RAQS Contact)

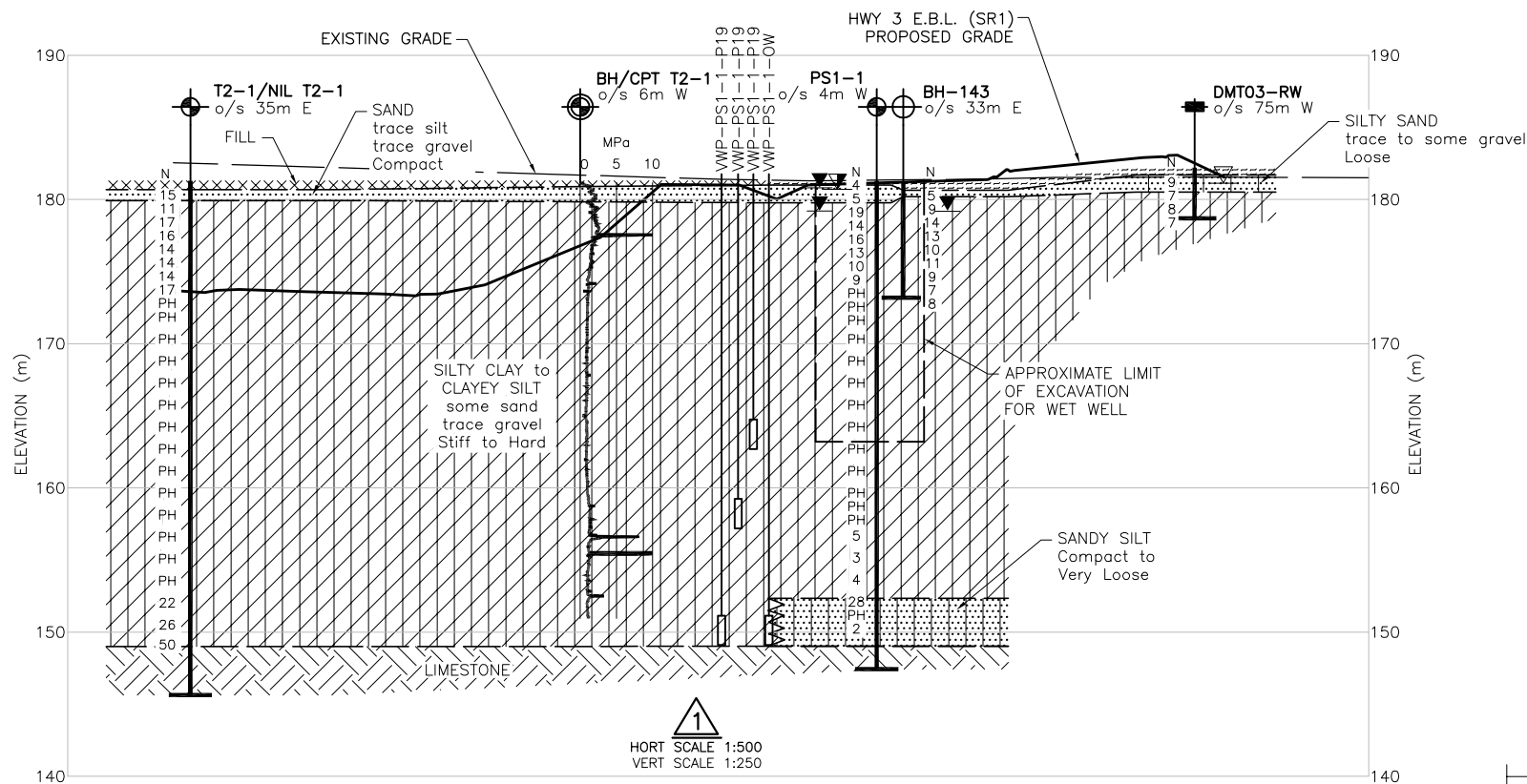
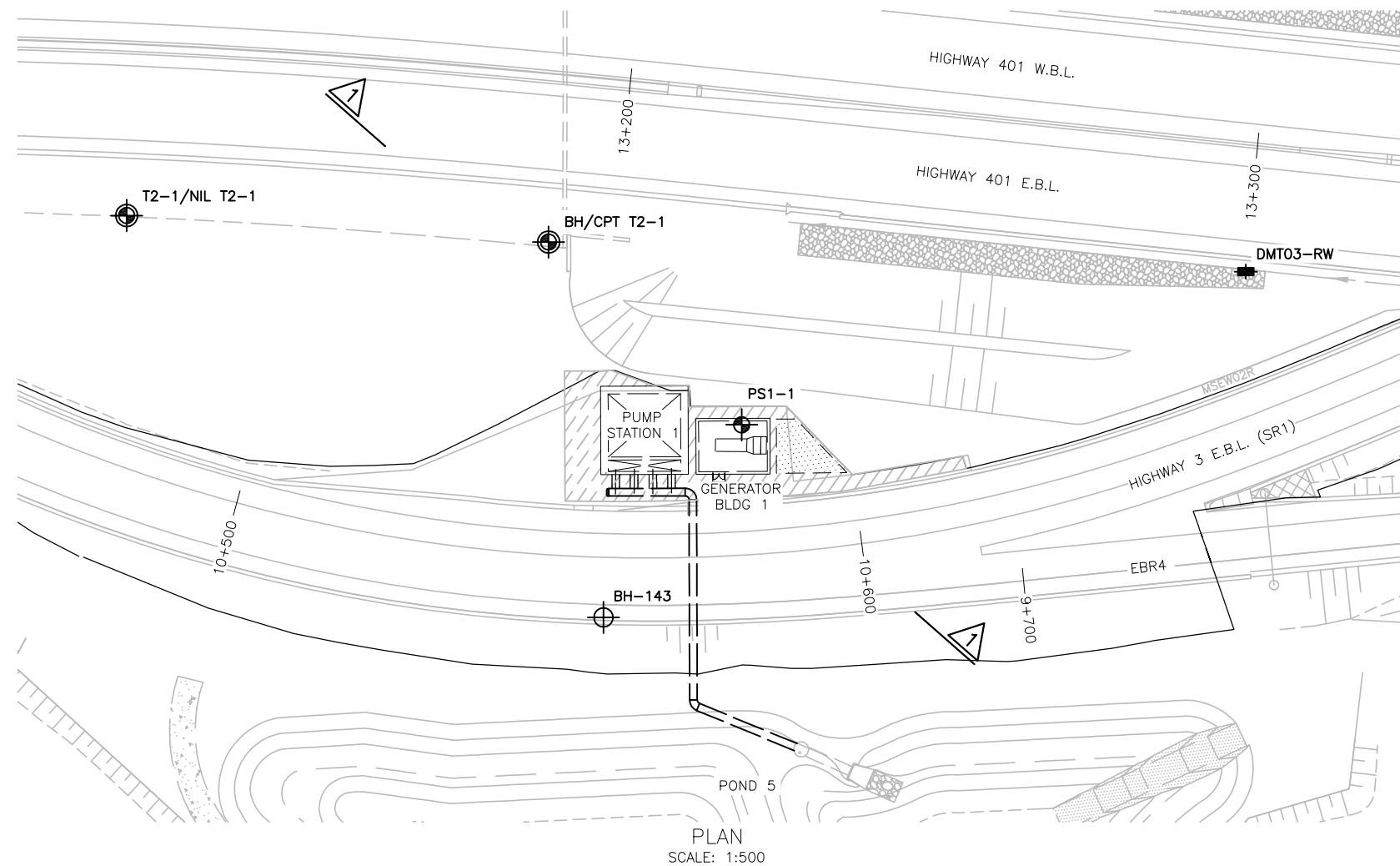


## 9 References

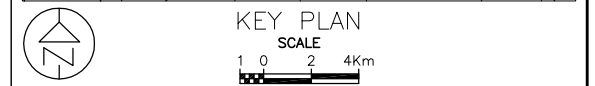
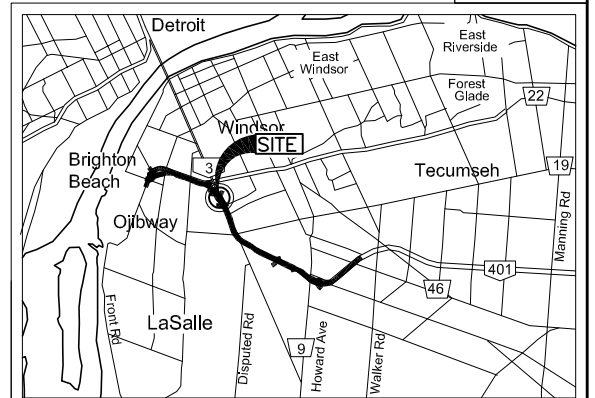
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## Drawings



## METRIC

DIMENSIONS ARE IN METRES  
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UNLESS OTHERWISE SHOWNWindsor-Essex  
Parkway Project  
RFP No. 09-54-1007NEW CONSTRUCTION  
PUMP STATION 1 AND  
DIESEL GENERATOR BUILDING 1  
BOREHOLE LOCATIONS & SOIL STRATASHEET  
G9012  
Phase 2

## LEGEND

- BOREHOLE CURRENT INVESTIGATION
- BOREHOLE AND NILCON VANE CURRENT INVESTIGATION
- SW/SP HOLE (HYDROGEOLOGY) CURRENT INVESTIGATION
- NILCON VANE CURRENT INVESTIGATION
- CPT - CURRENT INVESTIGATION
- DMT - CURRENT INVESTIGATION
- BOREHOLE PREVIOUS INVESTIGATION
- BOREHOLE, CPT AND NILCON VANE PREVIOUS INVESTIGATIONS
- CPT -PREVIOUS INVESTIGATION
- N SPT N-VALUE
- BLOWS/0.3m UNLESS OTHERWISE STATED (STD. PEN. TEST, 475 J/BLOW)
- MHSG - MAGNETIC HEAVE/SETTLEMENT GAUGE (SM)
- P - VIBRATING WIRE PIEZOMETER (VWP)
- OW - OBSERVATION WELL
- DRY BOREHOLE DRY DURING DRILLING
- WATER LEVEL DURING DRILLING
- WATER LEVEL (SHALLOW PIEZO)
- WATER LEVEL (DEEP PIEZO)

## NOTES

- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GEOTECHNICAL DESIGN REPORT.
- THE INTERPRETED STRATIGRAPHY REPRESENTS SIMPLIFIED SUBSURFACE CONDITIONS. THE BOUNDARIES BETWEEN SOIL STRATA HAVE BEEN DEFINED AT BOREHOLE LOCATIONS ONLY. CONDITIONS BETWEEN BOREHOLE LOCATIONS COULD DIFFER FROM ILLUSTRATED CONDITIONS.
- ELEVATIONS ARE REFERENCED TO GEODETIC DATUM.

## LIST OF ABBREVIATIONS

- 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 RODS

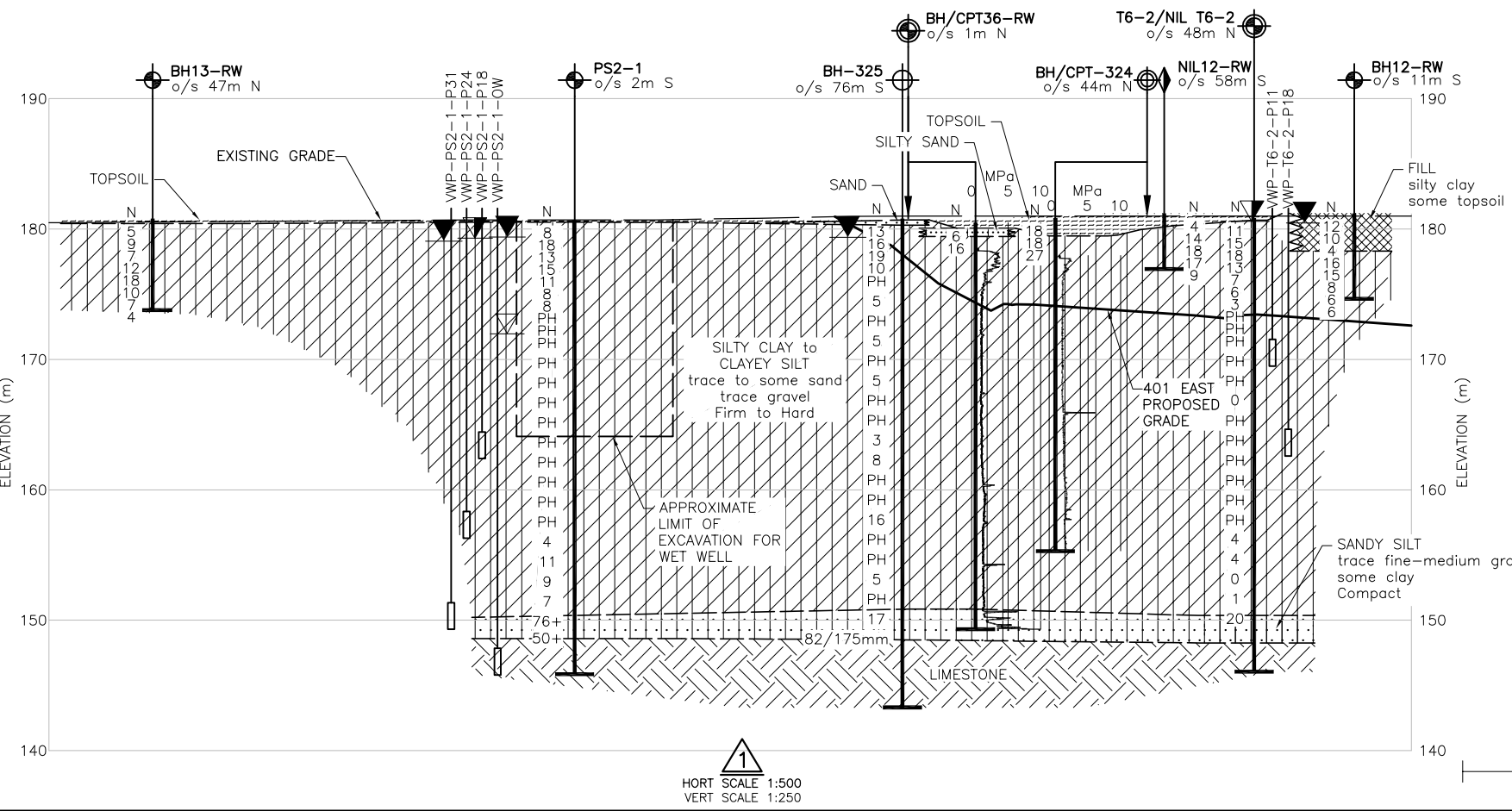
## MATERIAL LEGEND

- |                      |                       |
|----------------------|-----------------------|
| TOPSOIL/ ORGANICS    | SILT                  |
| FILL                 | SANDY SILT            |
| SAND                 | CLAYEY SILT           |
| SILTY CLAY           | SAND AND GRAVEL       |
| SILTY SAND           | SILTY SAND AND GRAVEL |
| COBBLES AND BOULDERS | LIMESTONE /BEDROCK    |

No.	ELEVATION	CO-ORDINATES (UTM, NAD 83 ZONE 17)	
		NORTHING	EASTING
AMEC BOREHOLES			
BH/CPT T2-1	181.2	4681233.1	331339.0
DMT03-RW	182.3	4681139.6	331398.4
PS1-1	181.3	4681192.0	331331.6
T2-1/NIL T2-1	181.4	4681290.3	331304.1
PREVIOUS BOREHOLES			
BH-143	181.3	4681191.8	331295.2

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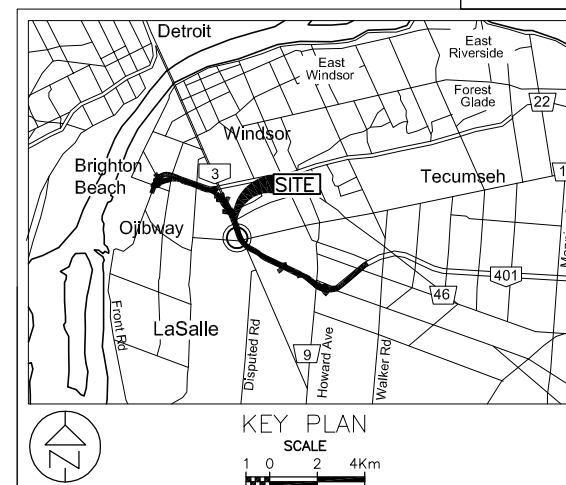


Windsor-Essex  
Parkway Project  
RFP No. 09-54-1007
















NEW CONSTRUCTION  
PUMP STATION 2/3 AND  
DIESEL GENERATOR BUILDING 2/3  
BOREHOLE LOCATIONS & SOIL STRATA

SHEET  
G9022

Phase 2



### LEGEND

- |   |   |   |
|---|---|---|
|    | BOREHOLE<br>CURRENT INVESTIGATION                                     |   |
|    | BOREHOLE AND NILCON VANE<br>CURRENT INVESTIGATION                     |   |
|    | SW/SP HOLE (HYDROGEOLOGY)<br>CURRENT INVESTIGATION                    |   |
|   | NILCON VANE<br>CURRENT INVESTIGATION                                  |   |
|  | CPT - CURRENT INVESTIGATION   |   |
|  | DMT - CURRENT INVESTIGATION   |   |
|  | BOREHOLE<br>PREVIOUS INVESTIGATION                                    |   |
|  | BOREHOLE, CPT AND NILCON VANE<br>PREVIOUS INVESTIGATIONS              |   |
|  | CPT -PREVIOUS INVESTIGATION   |   |
| N   | SPT N-VALUE   |   |
| 16  | BLOWS/0.3m UNLESS<br>OTHERWISE STATED<br>(STD. PEN. TEST, 475 J/BLOW) |  MHSG - MAGNETIC<br>HEAVE/SETTLEMENT<br>GAUGE (SM) |
|  | P - VIBRATING WIRE PIEZOMETER (VWP)<br>OW - OBSERVATION WELL          |   |
| DRY   | BOREHOLE DRY DURING DRILLING  |   |
|  | WATER LEVEL DURING DRILLING   |   |
|  | WATER LEVEL (SHALLOW PIEZO)   |   |
|  | WATER LEVEL (DEEP PIEZO)  |   |
|   |   |  CPT-qc  |

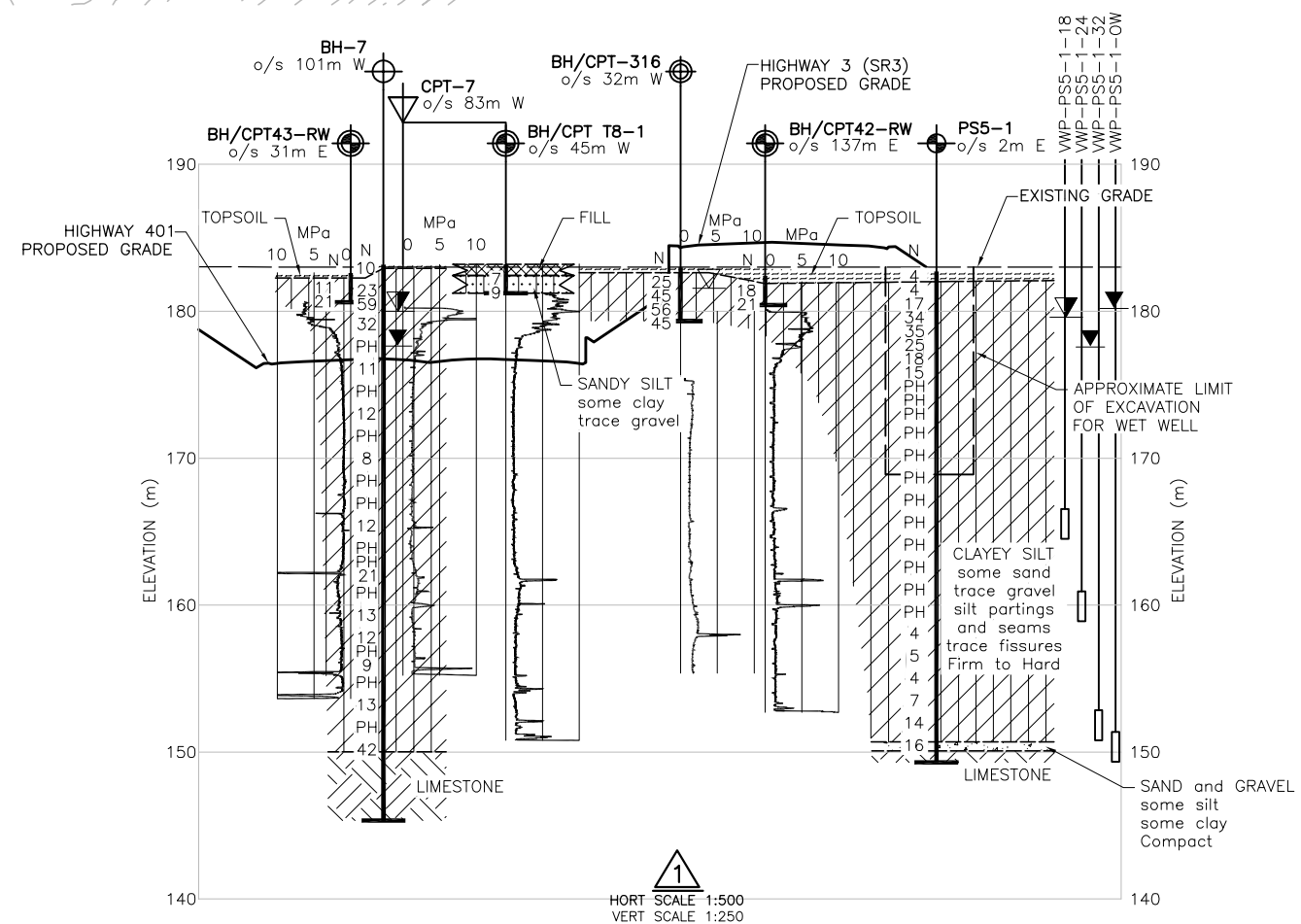
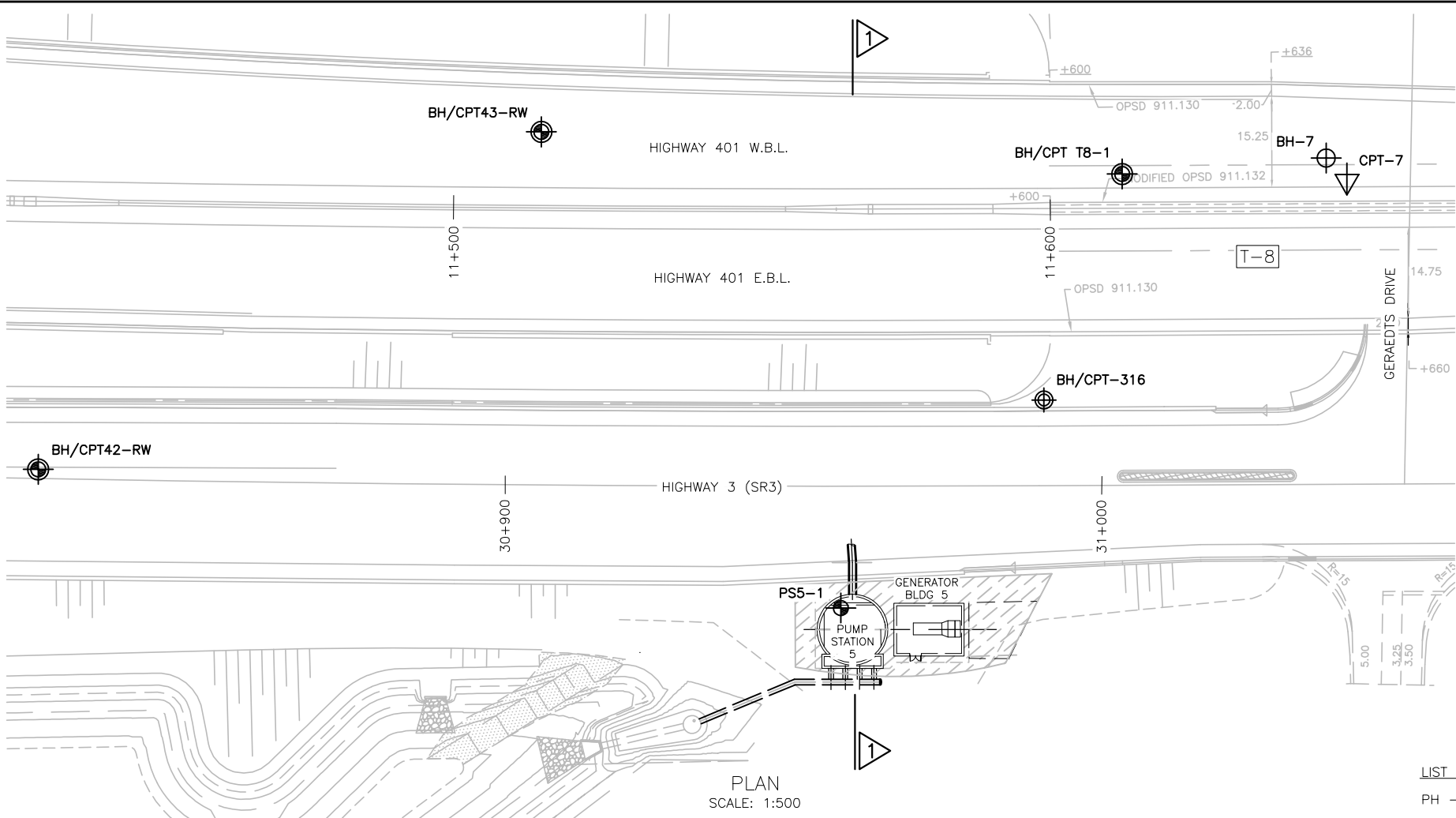
## NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GEOTECHNICAL DESIGN REPORT.
2. THE INTERPRETED STRATIGRAPHY REPRESENTS SIMPLIFIED SUBSURFACE CONDITIONS. THE BOUNDARIES BETWEEN SOIL STRATA HAVE BEEN DEFINED AT BOREHOLE LOCATIONS ONLY. CONDITIONS BETWEEN BOREHOLE LOCATIONS COULD DIFFER FROM ILLUSTRATED CONDITIONS.
3. ELEVATIONS ARE REFERENCED TO GEODETIC DATUM.

No.	ELEVATION	CO-ORDINATES (UTM, NAD 83 ZONE 17)	
		NORTHING	EASTING
AMEC BOREHOLES			
BH12-RW	181.2	4679718.1	332037.9
BH13-RW	180.8	4679672.2	331850.2
BH/CPT36-RW	180.5	4679710.0	331968.8
NIL12-RW	181.2	4679767.0	332011.4
PS2-1	180.7	4679716.5	331917.9
T6-2/NIL T6-2	180.8	4679659.9	332018.8
PREVIOUS BOREHOLES			
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CONSTRUCTION

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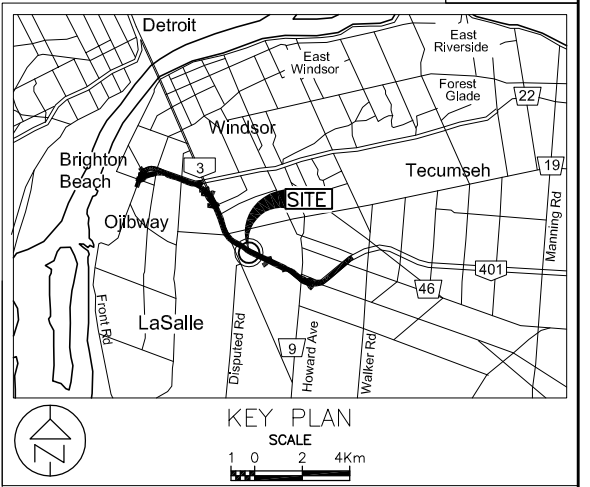
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AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

**Parkway Infrastructure Engineers**  
**amec**  
Hatch Mott MacDonald

**Windsor-Essex Parkway Project**  
RFP No. 09-54-1007

**NEW CONSTRUCTION**  
PUMP STATION 5 AND  
DIESEL GENERATOR BUILDING 5  
BOREHOLE LOCATIONS & SOIL STRATA

**SHEET**  
**G9052**  
**Phase 1**



- LEGEND**
- BOREHOLE CURRENT INVESTIGATION
  - BOREHOLE AND NILCON VANE CURRENT INVESTIGATION
  - SW/SP HOLE (HYDROGEOLOGY) CURRENT INVESTIGATION
  - NILCON VANE CURRENT INVESTIGATION
  - CPT - CURRENT INVESTIGATION
  - DMT - CURRENT INVESTIGATION
  - BOREHOLE PREVIOUS INVESTIGATION
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  - MHSG - MAGNETIC HEAVE/SETTLEMENT GAUGE (SM)
  - P - VIBRATING WIRE PIEZOMETER (VWP)
  - OW - OBSERVATION WELL
  - DRY BOREHOLE DRY DURING DRILLING
  - WATER LEVEL DURING DRILLING
  - WATER LEVEL (SHALLOW PIEZO)
  - WATER LEVEL (DEEP PIEZO)

- LIST OF ABBREVIATIONS**
- 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 RODS

- MATERIAL LEGEND**
- |                      |                       |
|----------------------|-----------------------|
| TOPSOIL/ ORGANICS    | SILT                  |
| FILL                 | SANDY SILT            |
| SAND                 | CLAYEY SILT           |
| SILTY CLAY           | SAND AND GRAVEL       |
| SILTY SAND           | SILTY SAND AND GRAVEL |
| COBBLES AND BOULDERS | LIMESTONE /BEDROCK    |

No.	ELEVATION	CO—ORDINATES (UTM, NAD 83 ZONE 17)	
		NORTHING	EASTING
AMEC BOREHOLES			
BH/CPT42—RW	182.4	4678892.0	333107.0
BH/CPT43—RW	182.6	4678907.6	333207.7
BH/CPT T8—1	183.2	4678860.0	333292.9
PS5—1	182.8	4678814.1	333219.4
PREVIOUS BOREHOLES			
BH—7	183.2	4678848.0	333325.0
BH/CPT—316	183.0	4678831.3	333265.0
CPT—7	183.2	4678844.0	333327.0

- NOTES**
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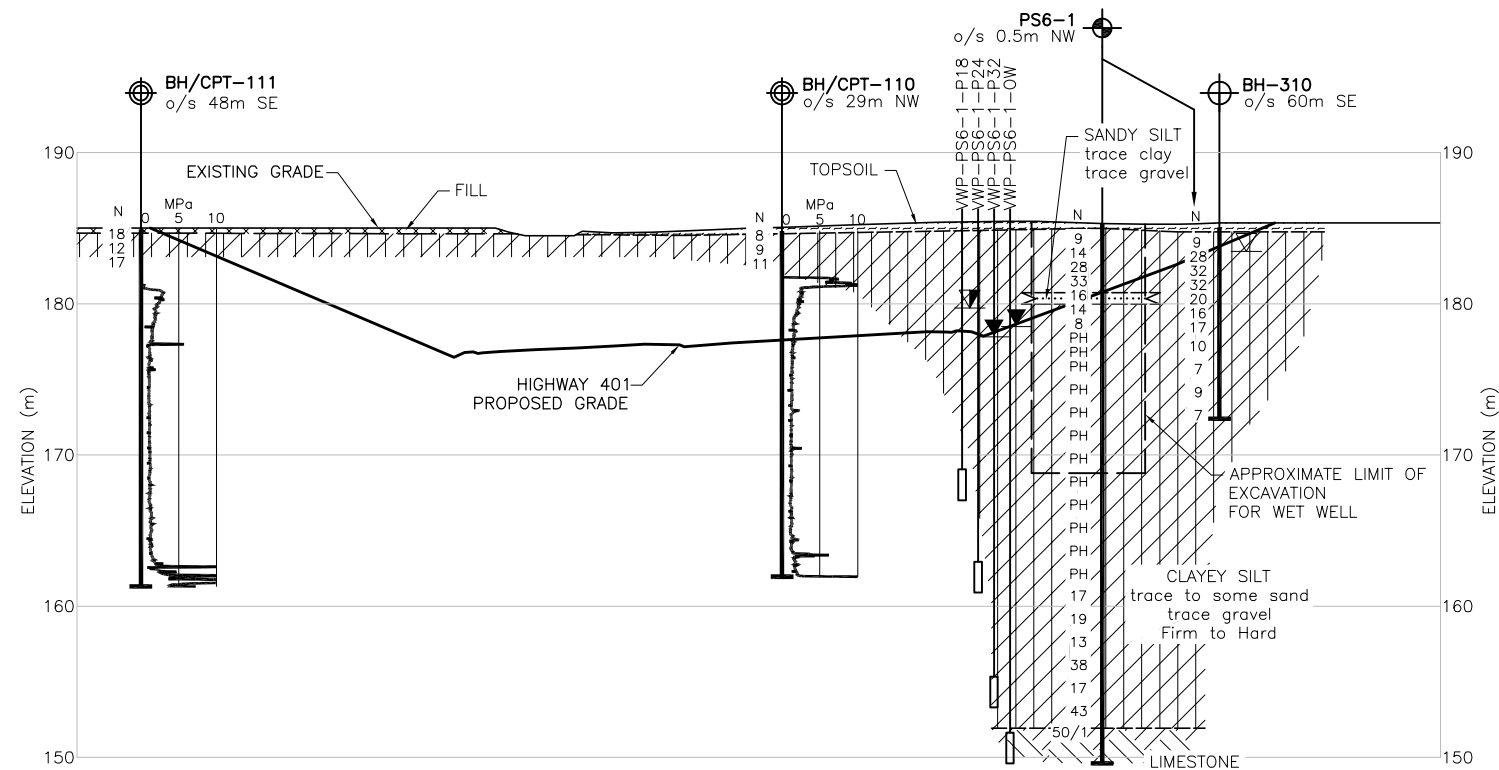
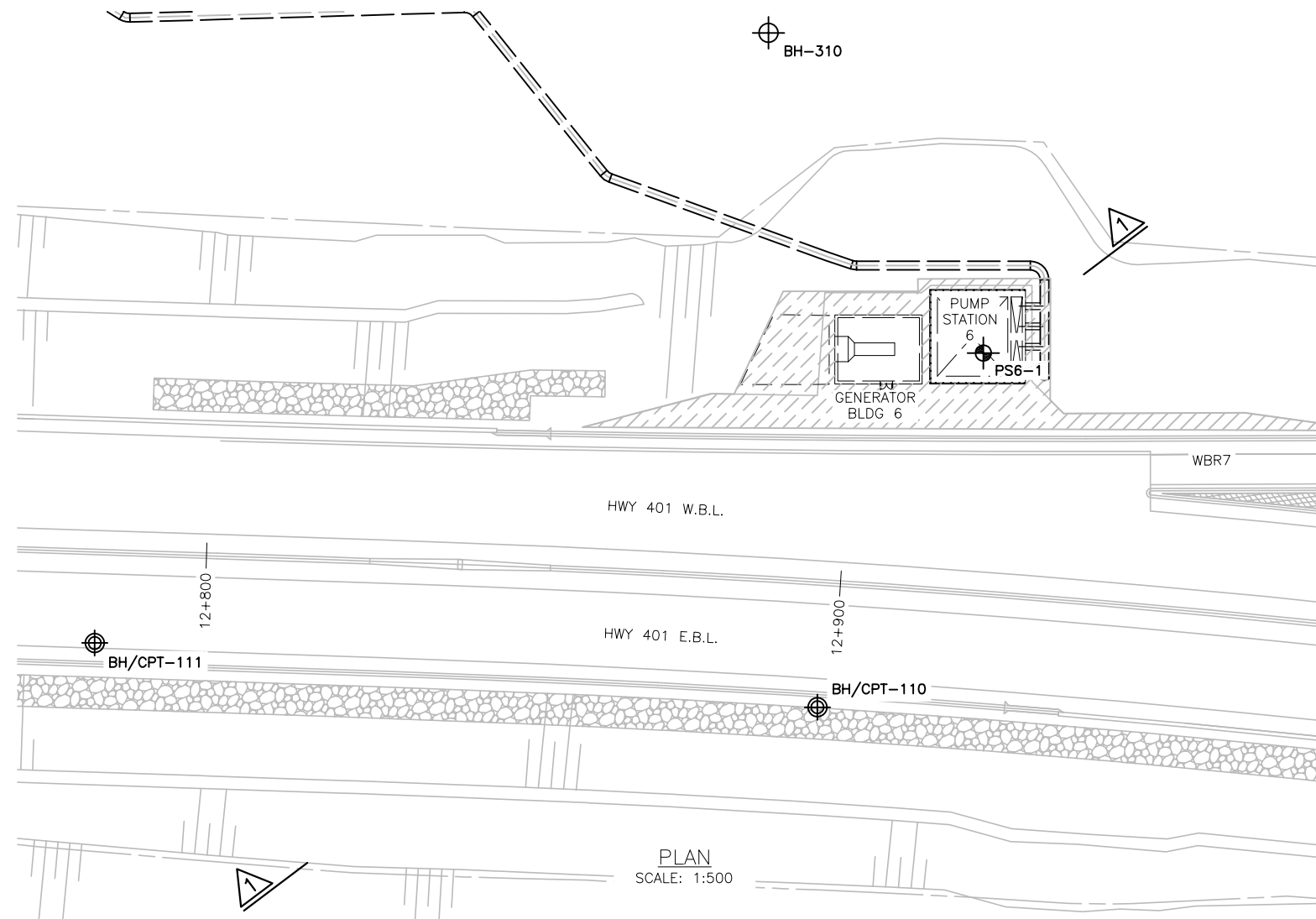
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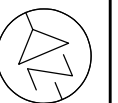
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HORIZONTAL SCALE 1:500  
VERTICAL SCALE 1:250

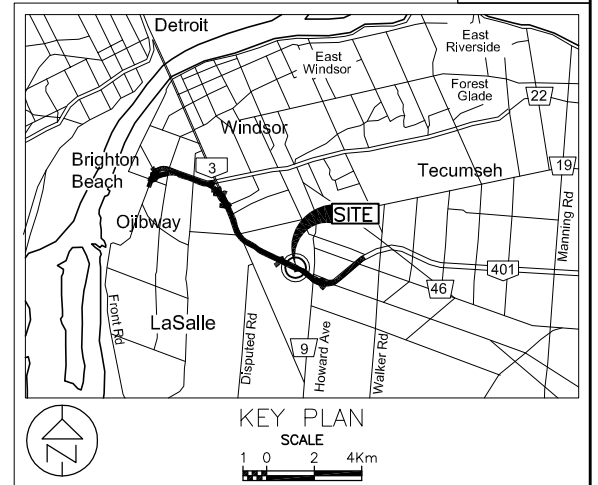
## METRIC

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Parkway Project  
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PUMP STATION 6 AND  
DIESEL GENERATOR BUILDING 6  
BOREHOLE LOCATIONS & SOIL STRATA

SHEET

G9062

Phase 1



## LEGEND

- BOREHOLE CURRENT INVESTIGATION
- BOREHOLE AND NILCON VANE CURRENT INVESTIGATION
- SW/SP HOLE (HYDROGEOLOGY) CURRENT INVESTIGATION
- NILCON VANE CURRENT INVESTIGATION
- CPT - CURRENT INVESTIGATION
- DMT - CURRENT INVESTIGATION
- BOREHOLE PREVIOUS INVESTIGATION
- BOREHOLE, CPT AND NILCON VANE PREVIOUS INVESTIGATIONS
- CPT -PREVIOUS INVESTIGATION
- N SPT N-VALUE
- BLOWS/0.3m UNLESS OTHERWISE STATED (STD. PEN. TEST, 475 J/BLOW)
- MHSG - MAGNETIC HEAVE/SETTLEMENT GAUGE (SM)
- P - VIBRATING WIRE PIEZOMETER (VWP)
- OW - OBSERVATION WELL
- DRY BOREHOLE DRY DURING DRILLING
- WATER LEVEL DURING DRILLING
- WATER LEVEL (SHALLOW PIEZO)
- WATER LEVEL (DEEP PIEZO)

## NOTES

- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GEOTECHNICAL DESIGN REPORT.
- THE INTERPRETED STRATIGRAPHY REPRESENTS SIMPLIFIED SUBSURFACE CONDITIONS. THE BOUNDARIES BETWEEN SOIL STRATA HAVE BEEN DEFINED AT BOREHOLE LOCATIONS ONLY. CONDITIONS BETWEEN BOREHOLE LOCATIONS COULD DIFFER FROM ILLUSTRATED CONDITIONS.
- ELEVATIONS ARE REFERENCED TO GEODETIC DATUM.

## LIST OF ABBREVIATIONS

- 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 RODS

## MATERIAL LEGEND

- TOPSOIL/ ORGANICS
- FILL
- SAND
- SILTY CLAY
- SILTY SAND
- COBBLES AND BOULDERS
- SILT
- SANDY SILT
- CLAYEY SILT
- SAND AND GRAVEL
- SILTY SAND AND GRAVEL
- LIMESTONE /BEDROCK
- DOLOSTONE

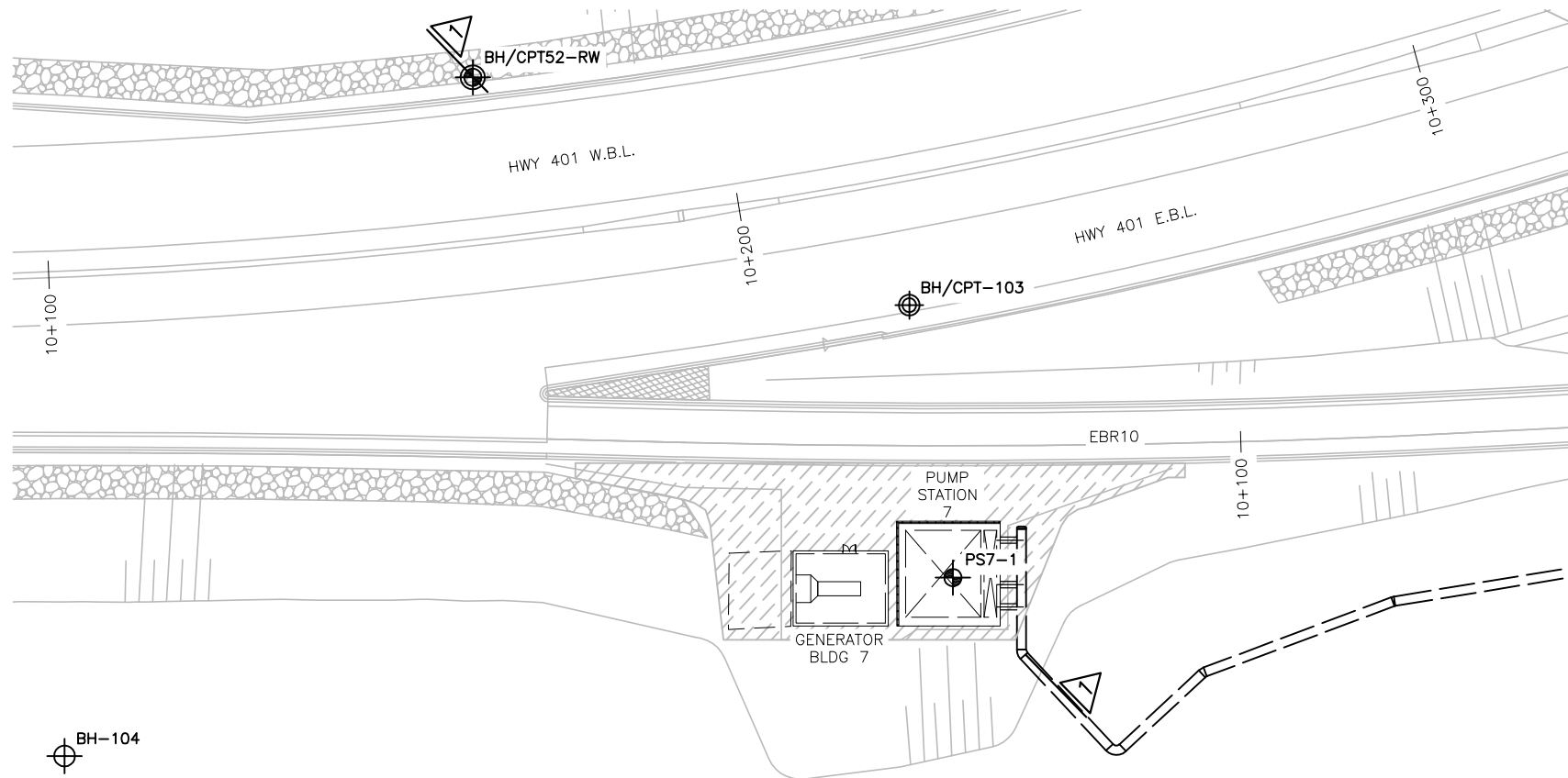
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		NORTHING	EASTING
AMEC BOREHOLES			
PS6-1	185.3	4678339.1	334494.4
PREVIOUS BOREHOLES			
BH-310	185.1	4678398.7	334482.8
BH/CPT-110	184.8	4678297.8	334448.6
BH/CPT-111	184.9	4678351.4	334347.6

DRAWING NOT TO BE SCALED  
100mm ON ORIGINAL DRAWINGNOT FOR  
CONSTRUCTION

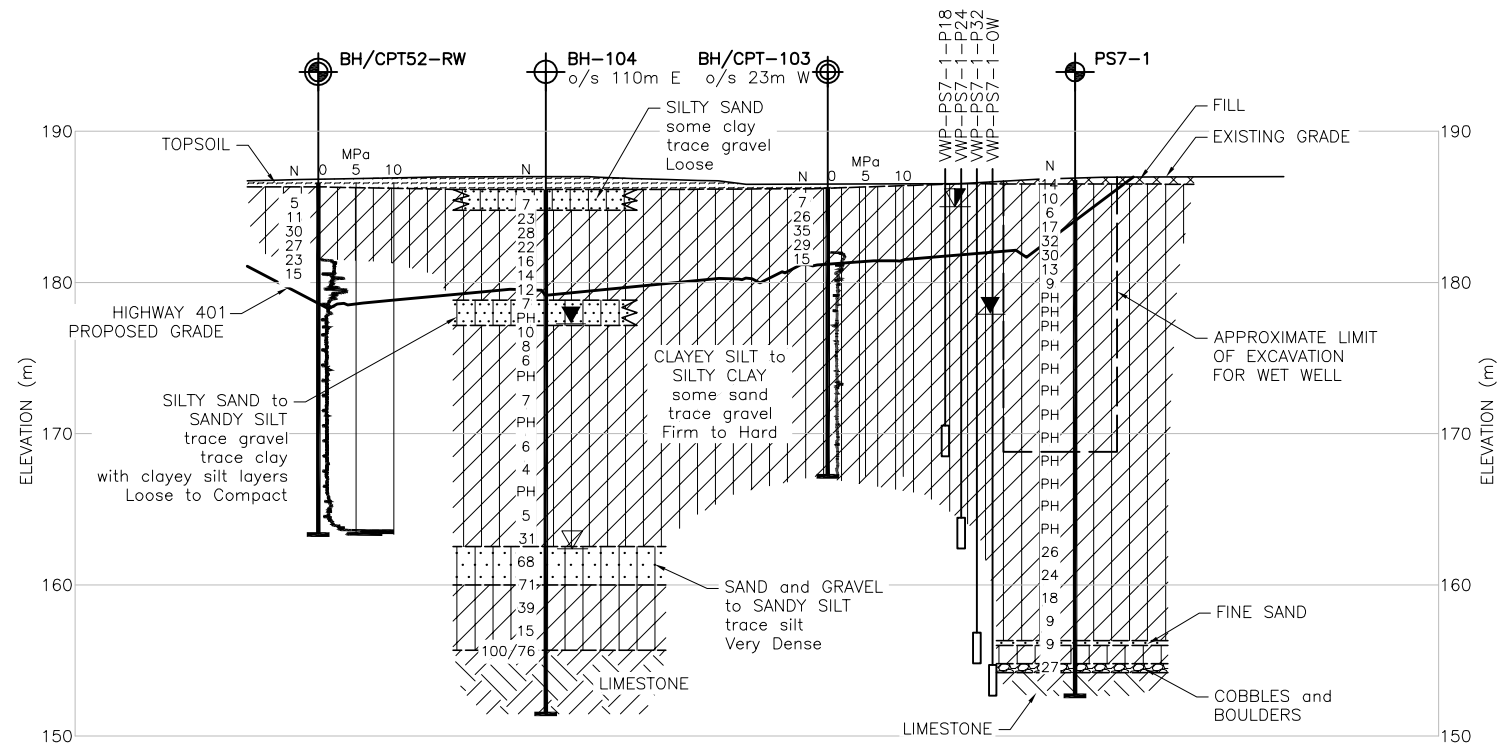
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DRAWN	MM	CHK	JF	SITE	PS-6	DATE	14-JUL-11									

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MINISTRY OF TRANSPORTATION, ONTARIO  
PR-D-707  
BB-05



PLAN  
SCALE: 1:500



HORIZONTAL SCALE 1:500  
VERTICAL SCALE 1:250

## METRIC

DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN



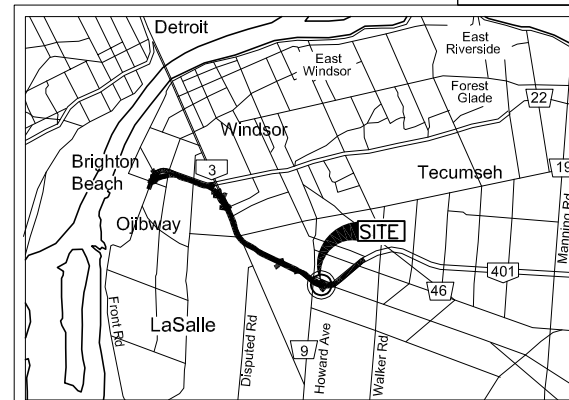
Windsor-Essex  
Parkway Project  
RFP No. 09-54-1007

NEW CONSTRUCTION  
PUMP STATION 7 AND  
DIESEL GENERATOR BUILDING 7  
BOREHOLE LOCATIONS & SOIL STRATA



SHEET  
G9072

Phase 1



KEY PLAN

SCALE  
1 0 2 4Km

### LEGEND

- BOREHOLE CURRENT INVESTIGATION
- BOREHOLE AND NILCON VANE CURRENT INVESTIGATION
- SW/SP HOLE (HYDROGEOLOGY) CURRENT INVESTIGATION
- NILCON VANE CURRENT INVESTIGATION
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- SPT N-VALUE
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- P - VIBRATING WIRE PIEZOMETER (VWP)
- OW - OBSERVATION WELL
- DRY BOREHOLE DRY DURING DRILLING
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- WATER LEVEL (SHALLOW PIEZO)
- WATER LEVEL (DEEP PIEZO)

### NOTES

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- ELEVATIONS ARE REFERENCED TO GEODETIC DATUM.

### MATERIAL LEGEND

- TOPSOIL/ ORGANICS
- FILL
- SAND
- SILTY CLAY
- SILTY SAND
- COBBLES AND BOULDERS
- SILT
- SANDY SILT
- CLAYEY SILT
- SAND AND GRAVEL
- SILTY SAND AND GRAVEL
- LIMESTONE /BEDROCK

No.	ELEVATION	CO-ORDINATES (UTM, NAD 83 ZONE 17)	
		NORTHING	EASTING
AMEC BOREHOLES			
BH/CPT52-RW	186.6	4677681.4	335365.2
PS7-1	186.8	4677583.5	335385.0
PREVIOUS BOREHOLES			
BH-104	186.2	4677630.3	335263.1
BH/CPT-103	186.3	4677620.0	335400.7

DRAWING NOT TO BE SCALED  
100mm ON ORIGINAL DRAWING

NOT FOR  
CONSTRUCTION

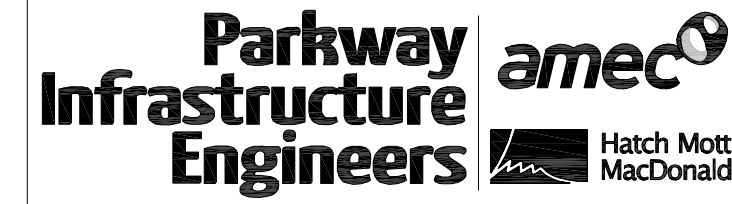
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DRAWN	MM	CHK	JF	SITE	PS-7	DATE	14-JUL-11					

DOC: 285380-04-090-WP1-9072

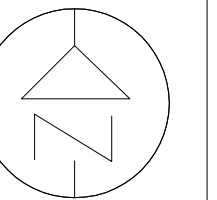
## Figures

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DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

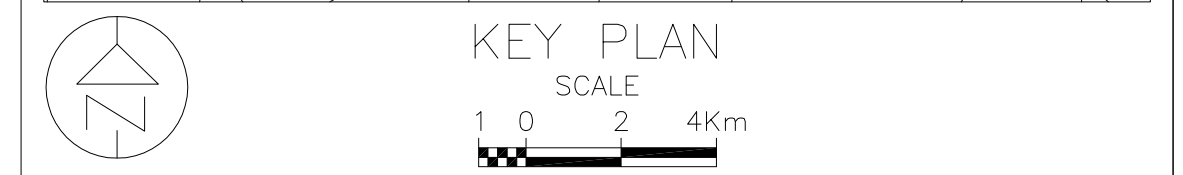
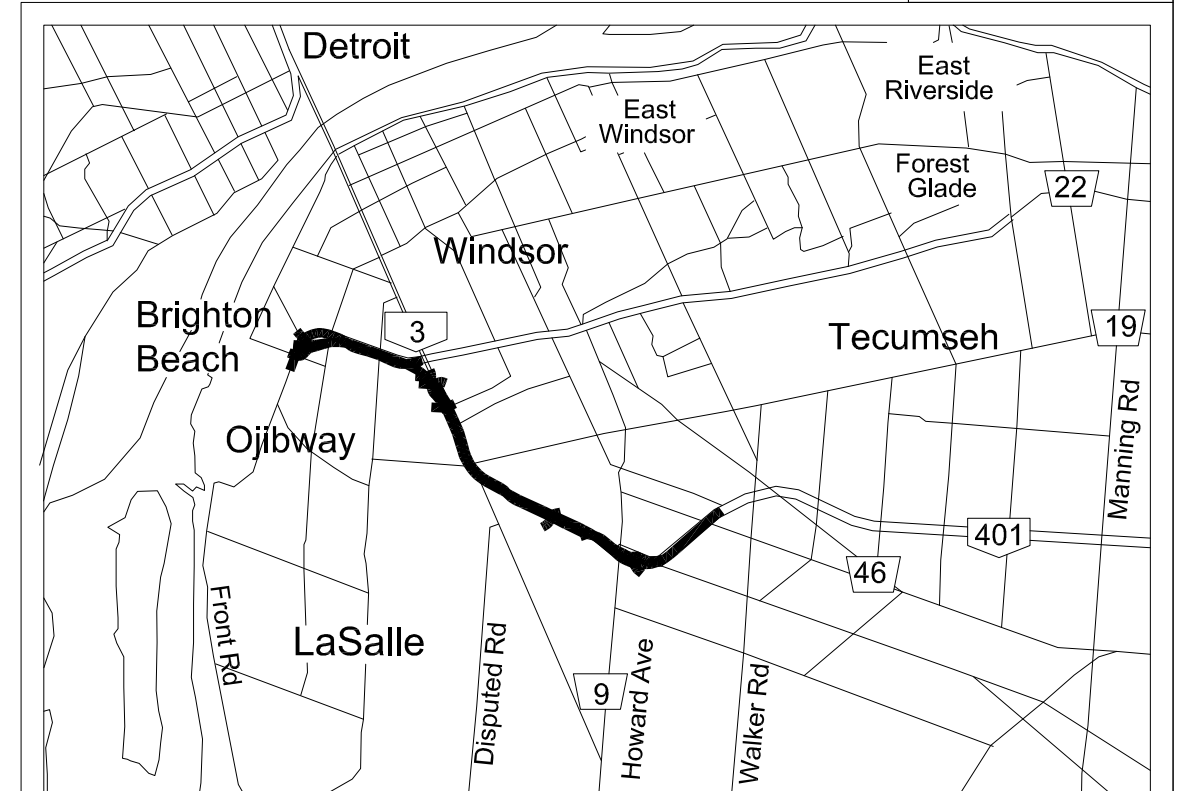
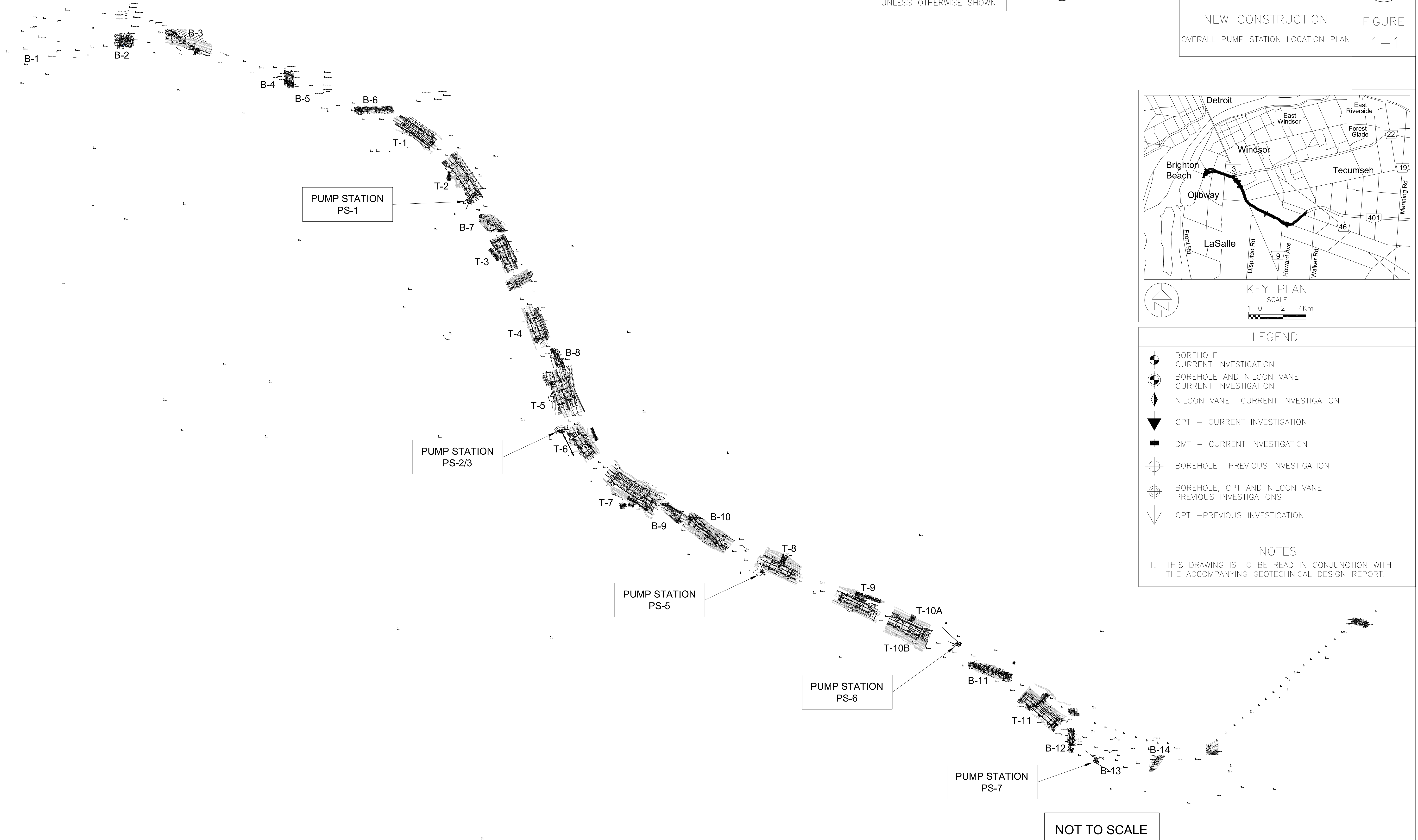


Windsor-Essex  
Parkway Project  
RFP No. 09-54-1007



NEW CONSTRUCTION  
OVERALL PUMP STATION LOCATION PLAN

FIGURE  
1-1



**LEGEND**

- BOREHOLE CURRENT INVESTIGATION
- BOREHOLE AND NILCON VANE CURRENT INVESTIGATION
- NILCON VANE CURRENT INVESTIGATION
- CPT - CURRENT INVESTIGATION
- DMT - CURRENT INVESTIGATION
- BOREHOLE PREVIOUS INVESTIGATION
- BOREHOLE, CPT AND NILCON VANE PREVIOUS INVESTIGATIONS
- CPT -PREVIOUS INVESTIGATION

**NOTES**

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GEOTECHNICAL DESIGN REPORT.

DRAWING NOT TO BE SCALED  
100mm ON ORIGINAL DRAWING

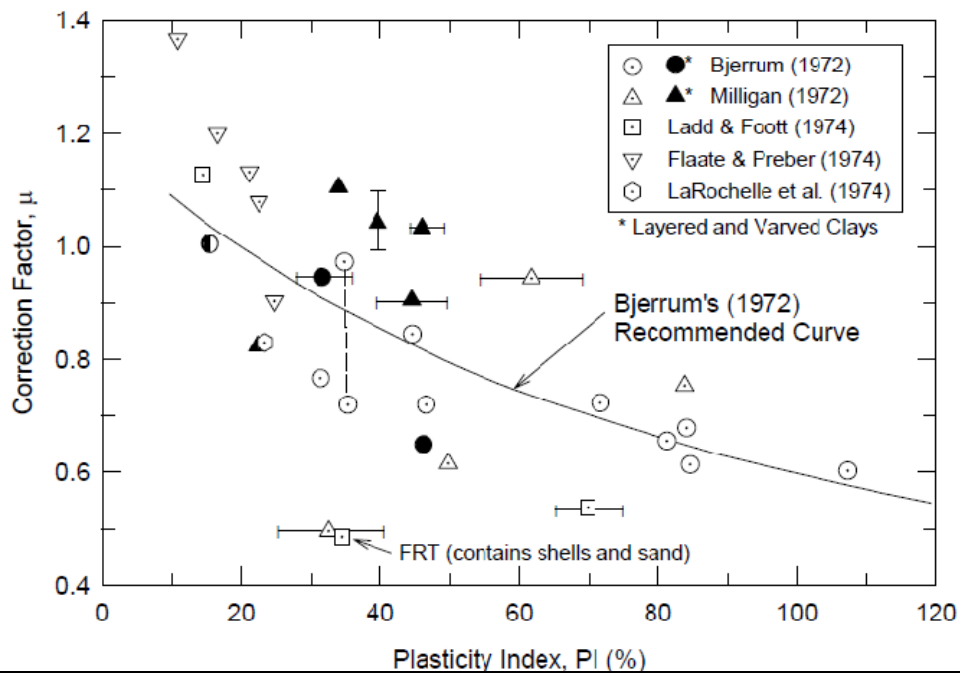
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NOT FOR  
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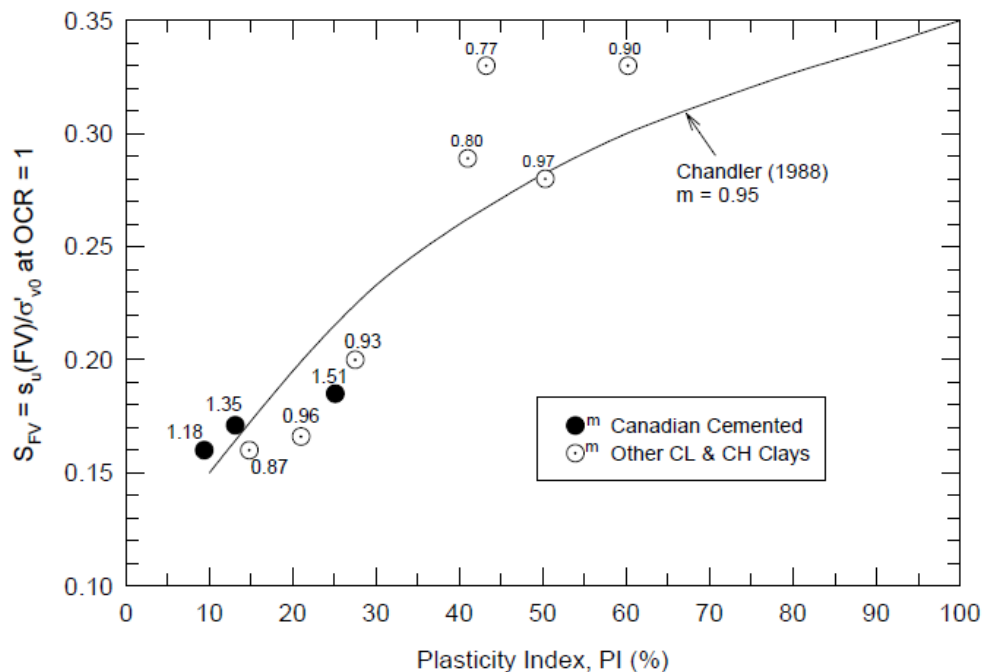
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DRAWN	SJL	CHK	JF	SITE	ALL PS/DG
		LOAD	CL-625-ONT	DATE	16-NOV-11

OVERALL PUMP STATION LOCATION PLAN

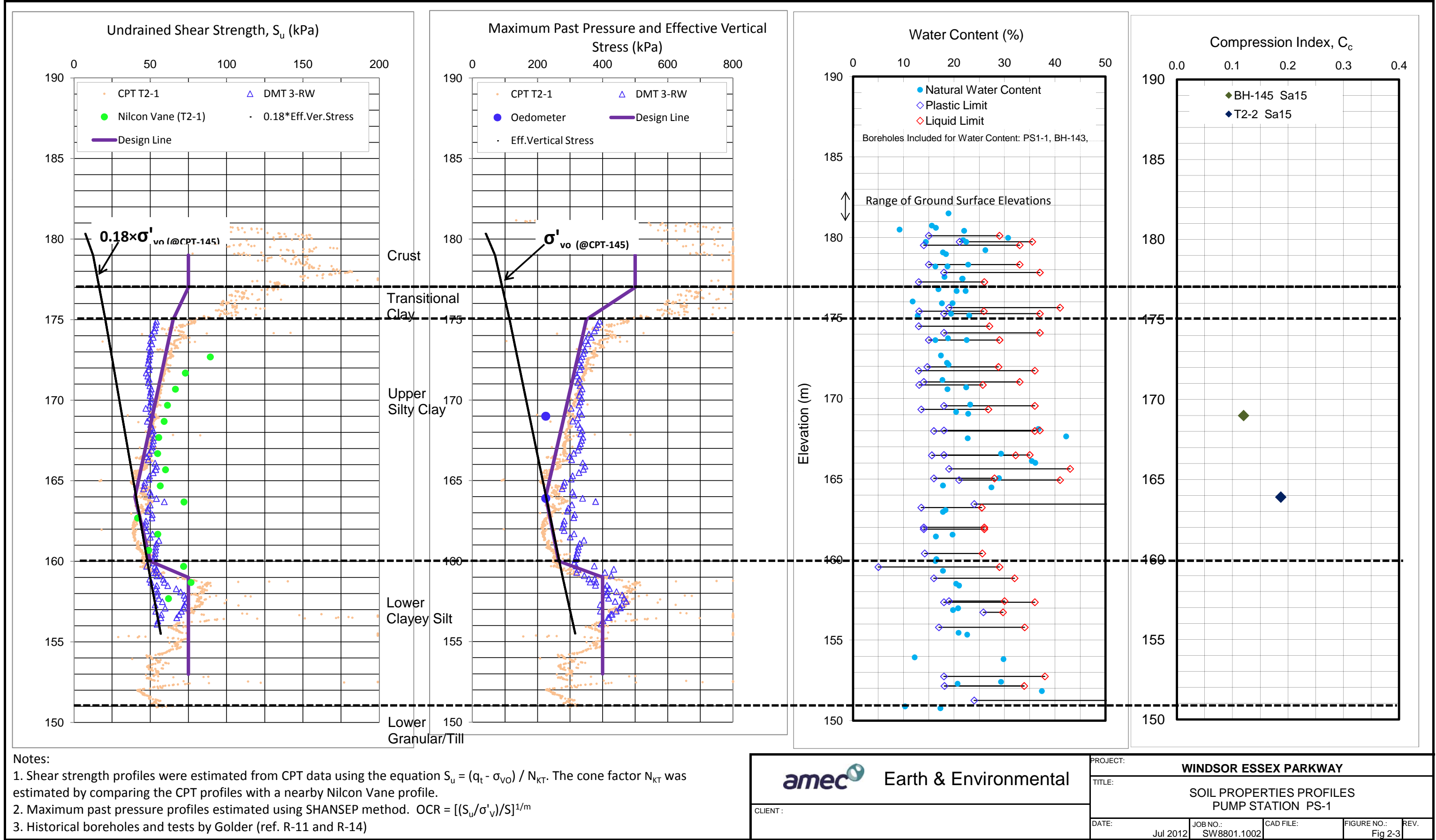
**Figure 2-1: Field Vane Correction Factor vs. Plasticity Index Derived from Embankment Failures**  
(Figure 5.1, Ladd & DeGroot, 2004, ref. R-29)



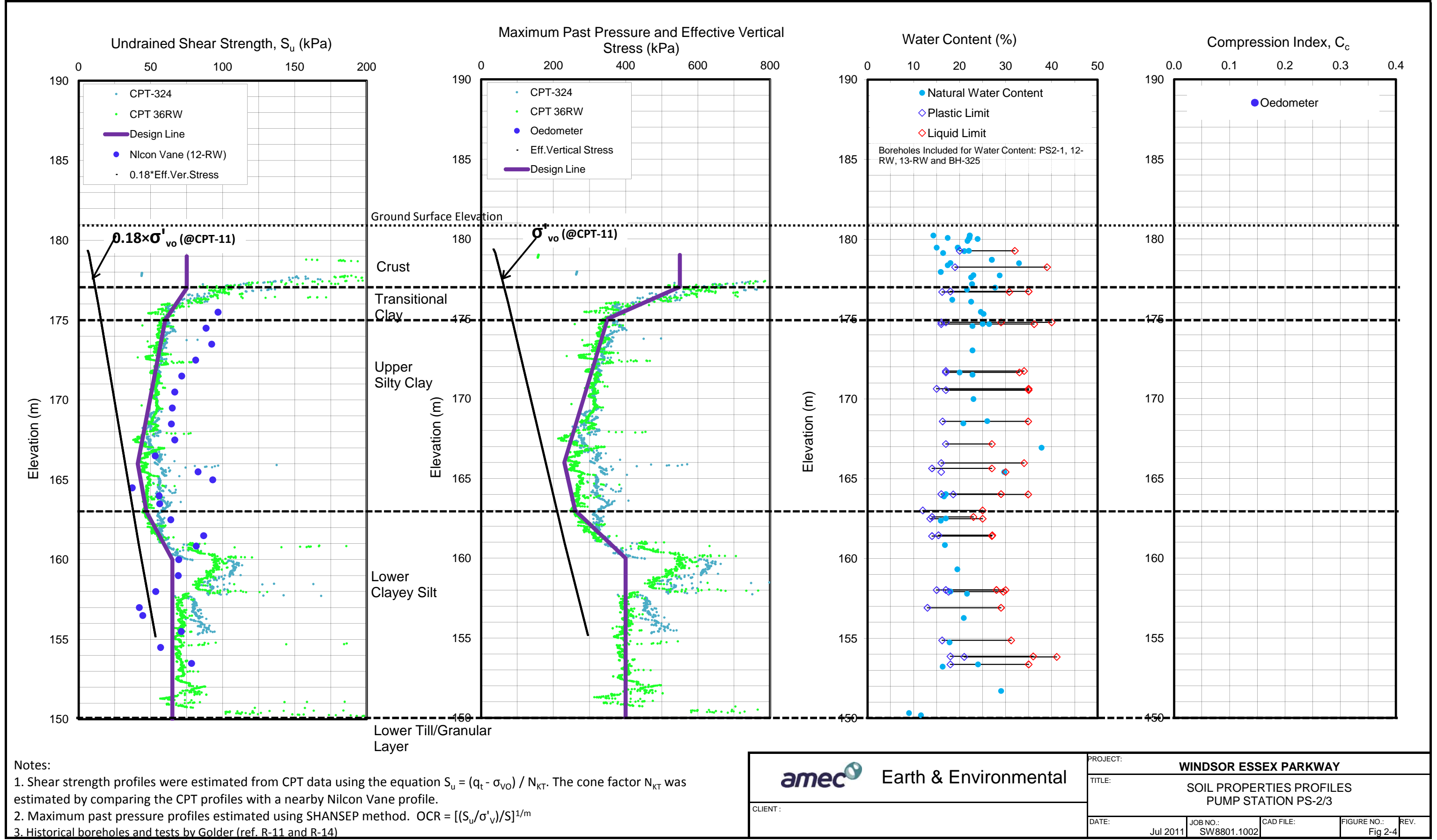
**Figure 2-2: Field Vane Undrained Strength Ratio at OCR = 1 vs. Plasticity Index for Homogeneous Clays**  
(Figure 5.2, Ladd & DeGroot, 2004, ref. R-29)












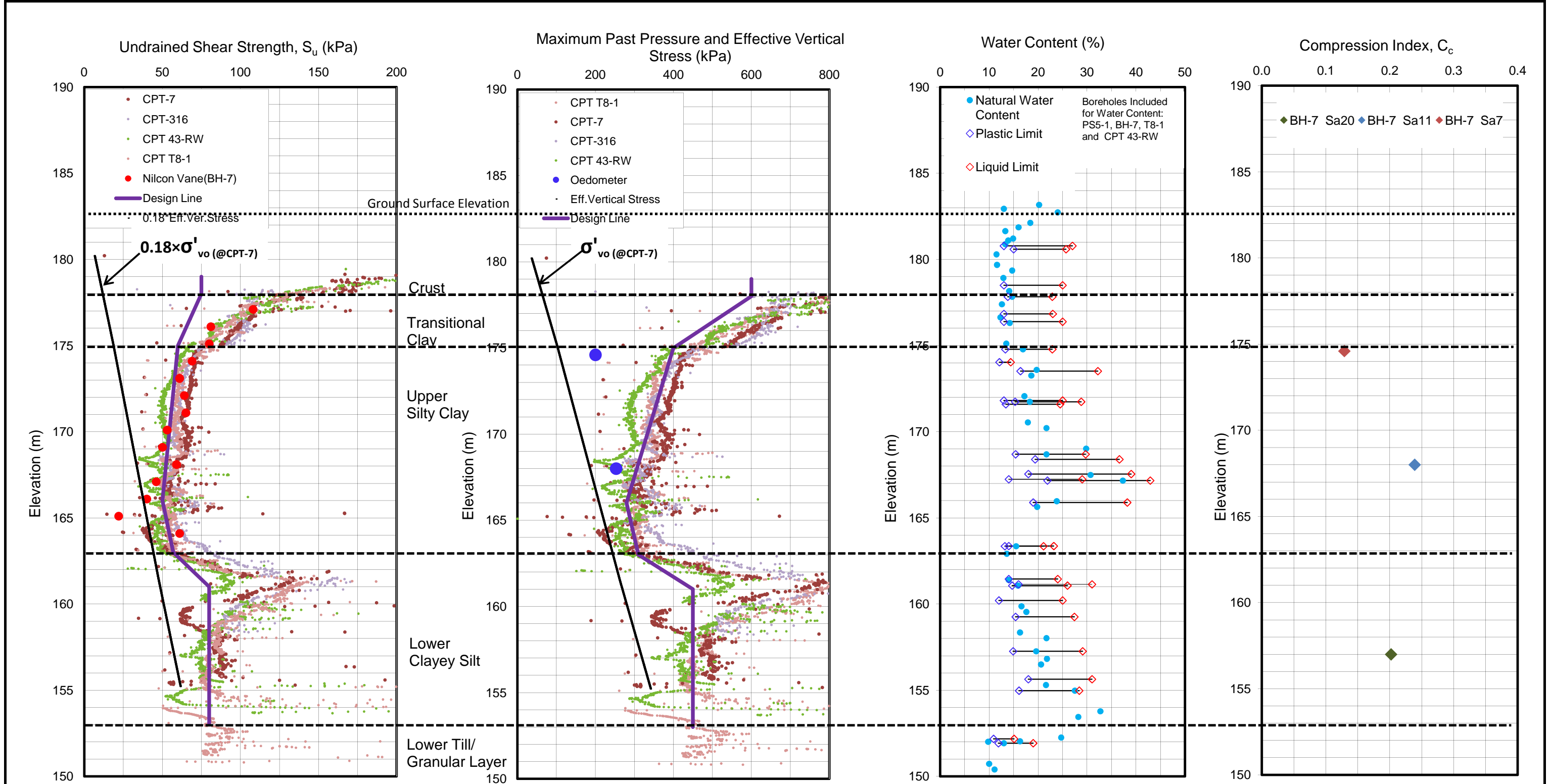
Notes:

1. Shear strength profiles were estimated from CPT data using the equation  $S_u = (q_t - \sigma_{VO}) / N_{KT}$ . The cone factor  $N_{KT}$  was estimated by comparing the CPT profiles with a nearby Nilcon Vane profile.

2. Maximum past pressure profiles estimated using SHANSEP method.  $OCR = [(S_u / \sigma'_v) / S]^{1/m}$

3. Historical boreholes and tests by Golder (ref. R-11 and R-14)

<div> Earth &amp; Environmental</div>	PROJECT: WINDSOR ESSEX PARKWAY				
	TITLE: SOIL PROPERTIES PROFILES PUMP STATION PS-2/3				
CLIENT :	DATE: Jul 2011	JOB NO.: SW8801.1002	CAD FILE:	FIGURE NO.: Fig 2-4	REV.



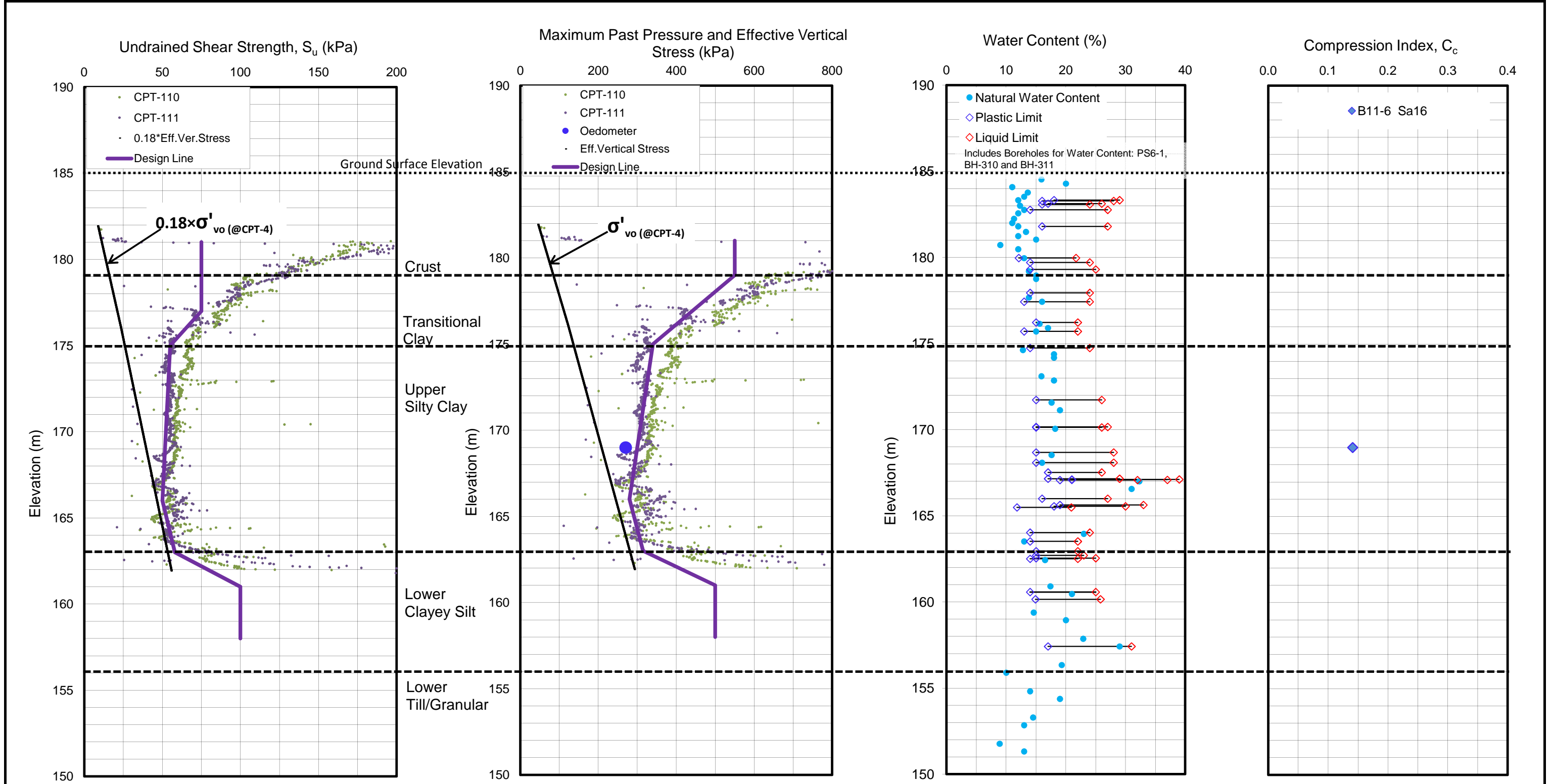
Notes:

1. Shear strength profiles were estimated from CPT data using the equation  $S_u = (q_t - \sigma_{vo}) / N_{KT}$ . The cone factor  $N_{KT}$  was estimated by comparing the CPT profiles with a nearby Nilcon Vane profile.

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3. Historical boreholes and tests by Golder (ref. R-11 and R-14)

amtec Earth & Environmental	PROJECT: WINDSOR ESSEX PARKWAY				
	TITLE: SOIL PROPERTIES PROFILES PUMP STATION PS-5				
	CLIENT :	DATE: Jul 2012	JOB NO.: SW8801.1002	CAD FILE:	FIGURE NO.: Fig 2-5 REV.



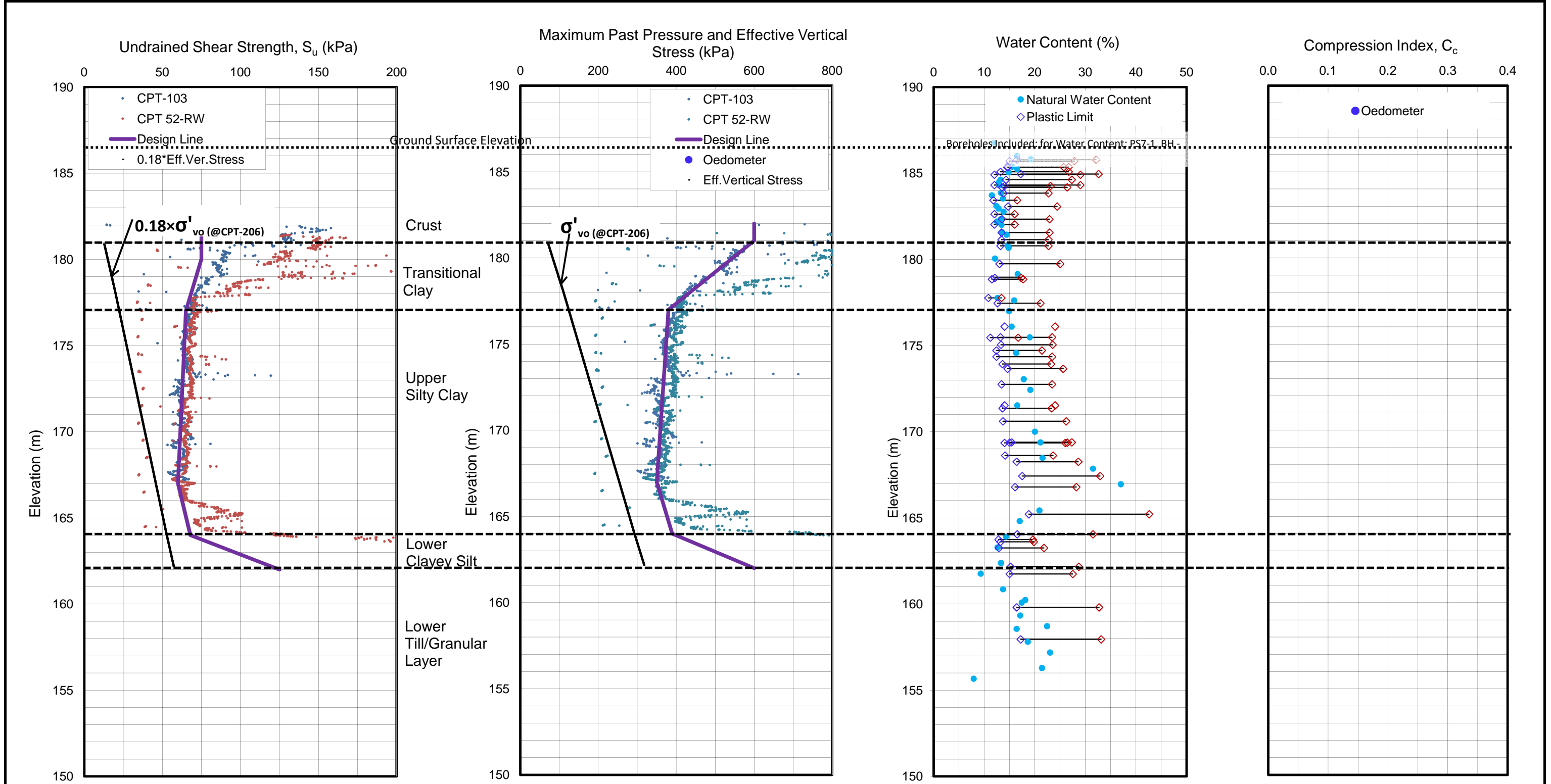
Notes:

1. Shear strength profiles were estimated from CPT data using the equation  $S_u = (q_t - \sigma_{vo}) / N_{KT}$ . The cone factor  $N_{KT}$  was estimated by comparing the CPT profiles with a nearby Nilcon Vane profile.

2. Maximum past pressure profiles estimated using SHANSEP method.  $OCR = [(S_u / \sigma'_v) / S]^{1/m}$

3. Historical boreholes and tests by Golder (ref. R-11 and R-14)

amtec Earth & Environmental	PROJECT: WINDSOR ESSEX PARKWAY				
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Notes:

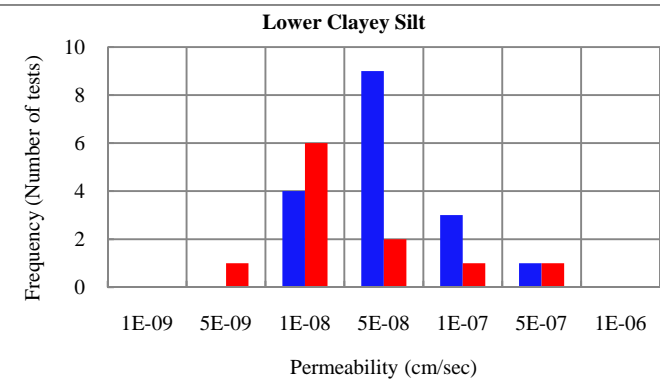
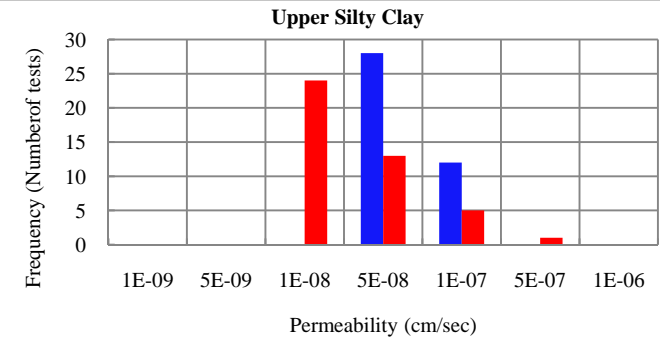
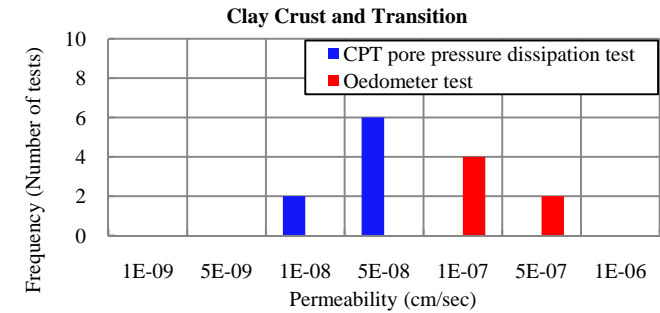
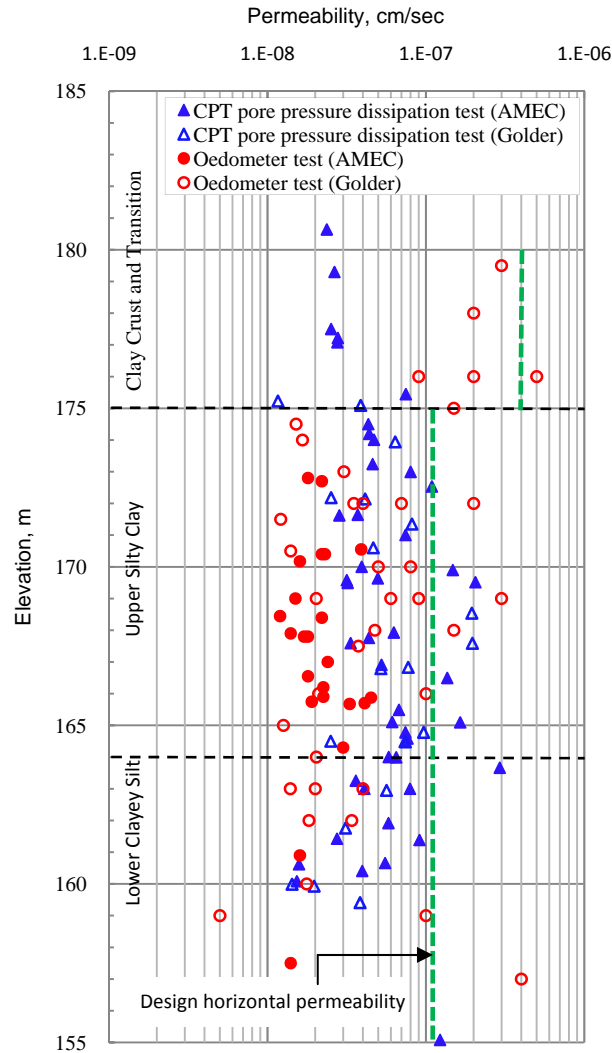
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2. Maximum past pressure profiles estimated using SHANSEP method.  $OCR = [(S_u / \sigma'_v) / S]^{1/m}$

3. Historical boreholes and tests by Golder (ref. R-11 and R-14)

amtec Earth & Environmental	PROJECT: WINDSOR ESSEX PARKWAY				
	TITLE: SOIL PROPERTIES PROFILES PUMP STATION PS-7				
	CLIENT :	DATE: Jul 2012	JOB NO.: SW8801.1002	CAD FILE:	FIGURE NO.: Fig 2-7 REV.

**Figure 4-1: Inferred Clay Stratum Permeability from CPT Pore Pressure Dissipation and Oedometer Tests**



## Appendix A      HMM Pump Station Plans and Sections



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DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

**Parkway  
Infrastructure  
Engineers**



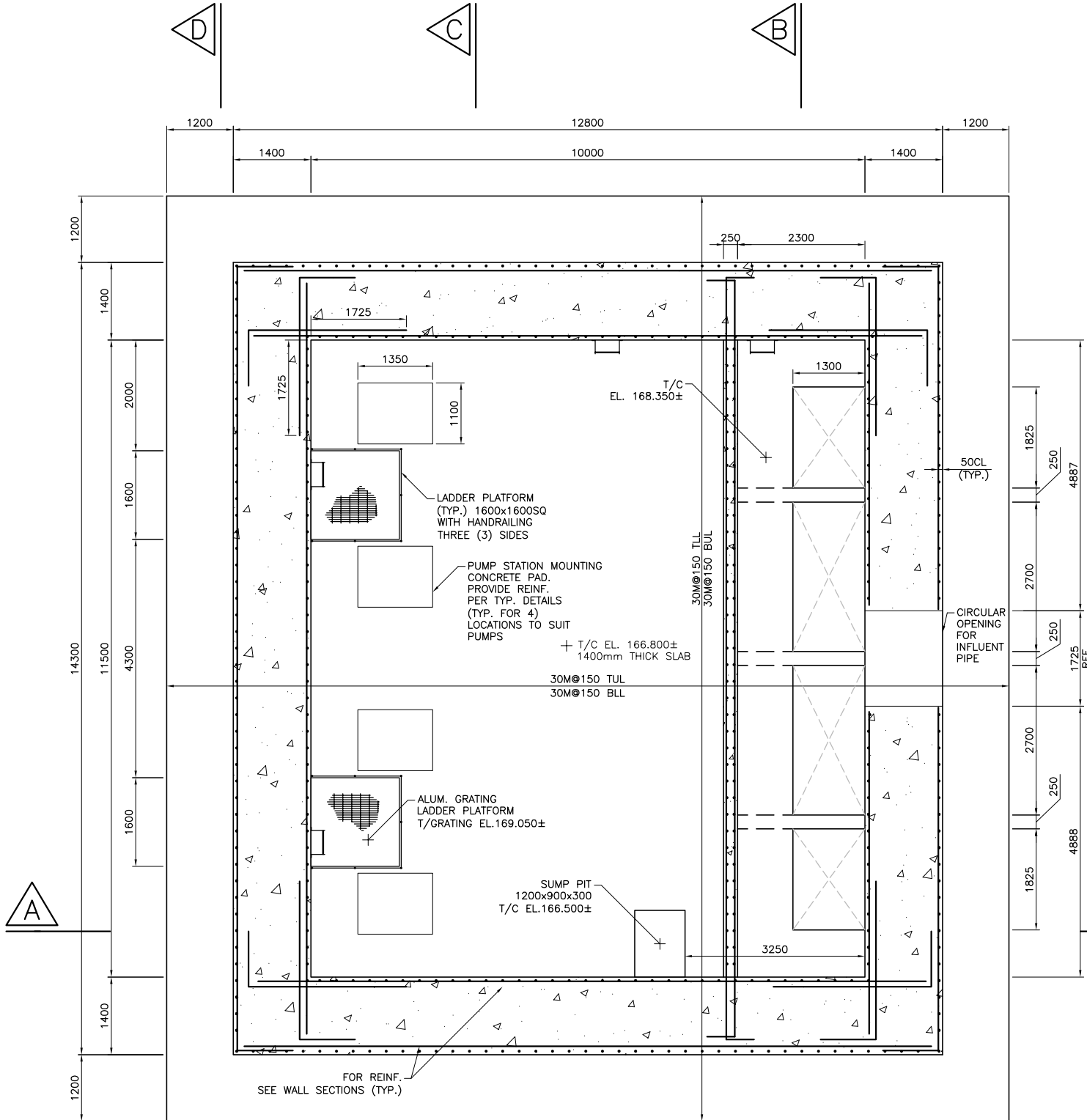
Windsor-Essex  
Parkway Project  
RFP No. 09-54-1007

NEW CONSTRUCTION  
PUMP STATION 1  
FOUNDATION AND MID-LEVEL PLANS  
STRUCTURAL



SHEET  
S1001

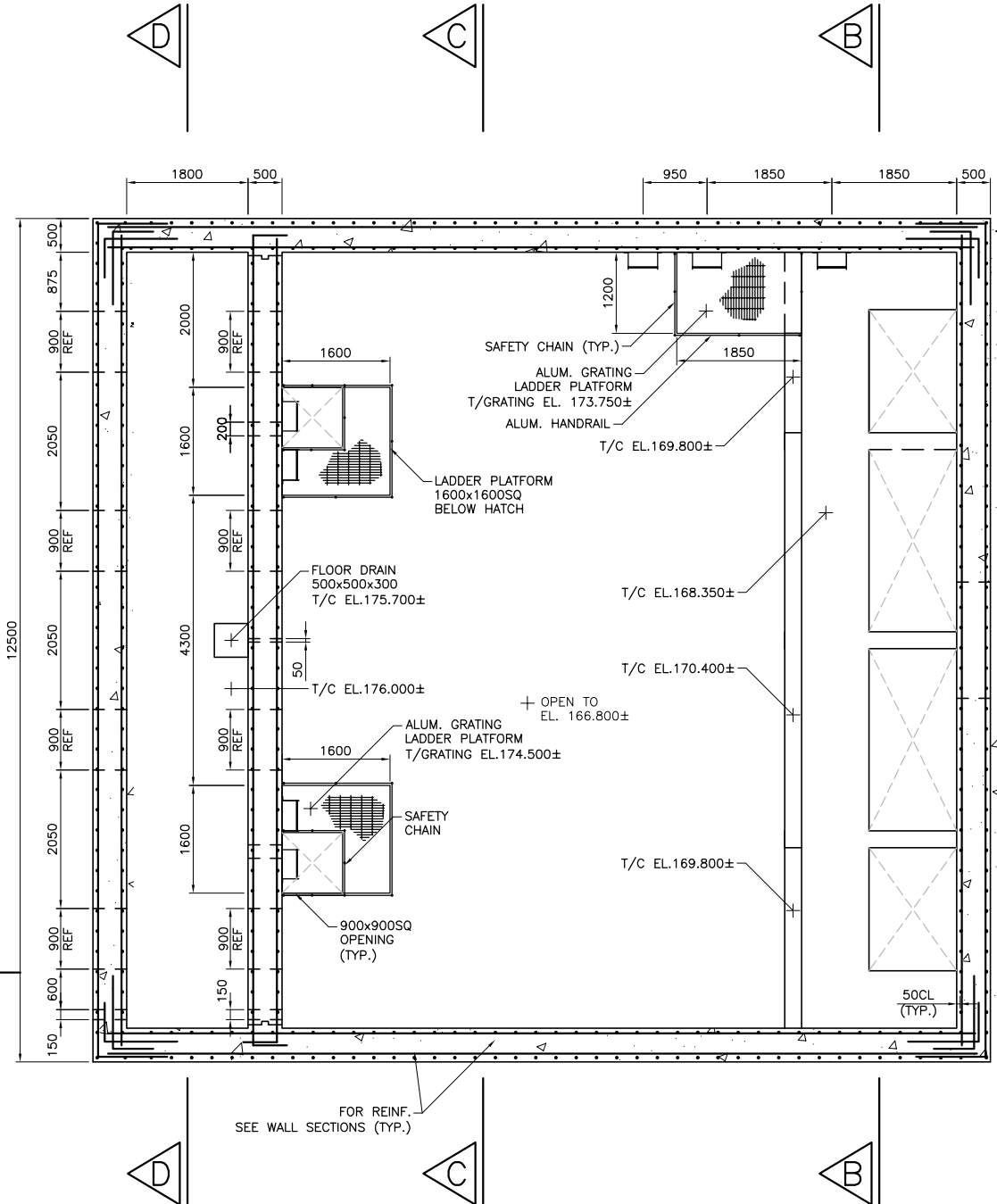
Phase 2  
90% Sub



FOUNDATION PLAN PUMP STATION No. 1 EL. 169.080

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NOTE: BENCHING NOT SHOWN FOR CLARITY, SEE PROCESS DRAWING



PLAN PUMP STATION No. 1 EL. 177.200

SCALE: 1:50

DRAWING NOT TO BE SCALED  
100mm ON ORIGINAL DRAWING

**NOT FOR  
CONSTRUCTION**

REVISIONS	DATE	REV.	BY	DESCRIPTION
02-NOV-12	B	MW		90% IDR SUBMISSION
11-JAN-12	A	MW		60% MTO SUBMISSION
DESIGN	MW/M	CHK	JM	CODE CHBDC 00000/LOAD
DRAWN	AK	CHK	MW	SITE xxx-xxxx DATE 11-JAN-12

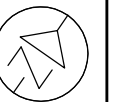
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DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

**Parkway  
Infrastructure  
Engineers**



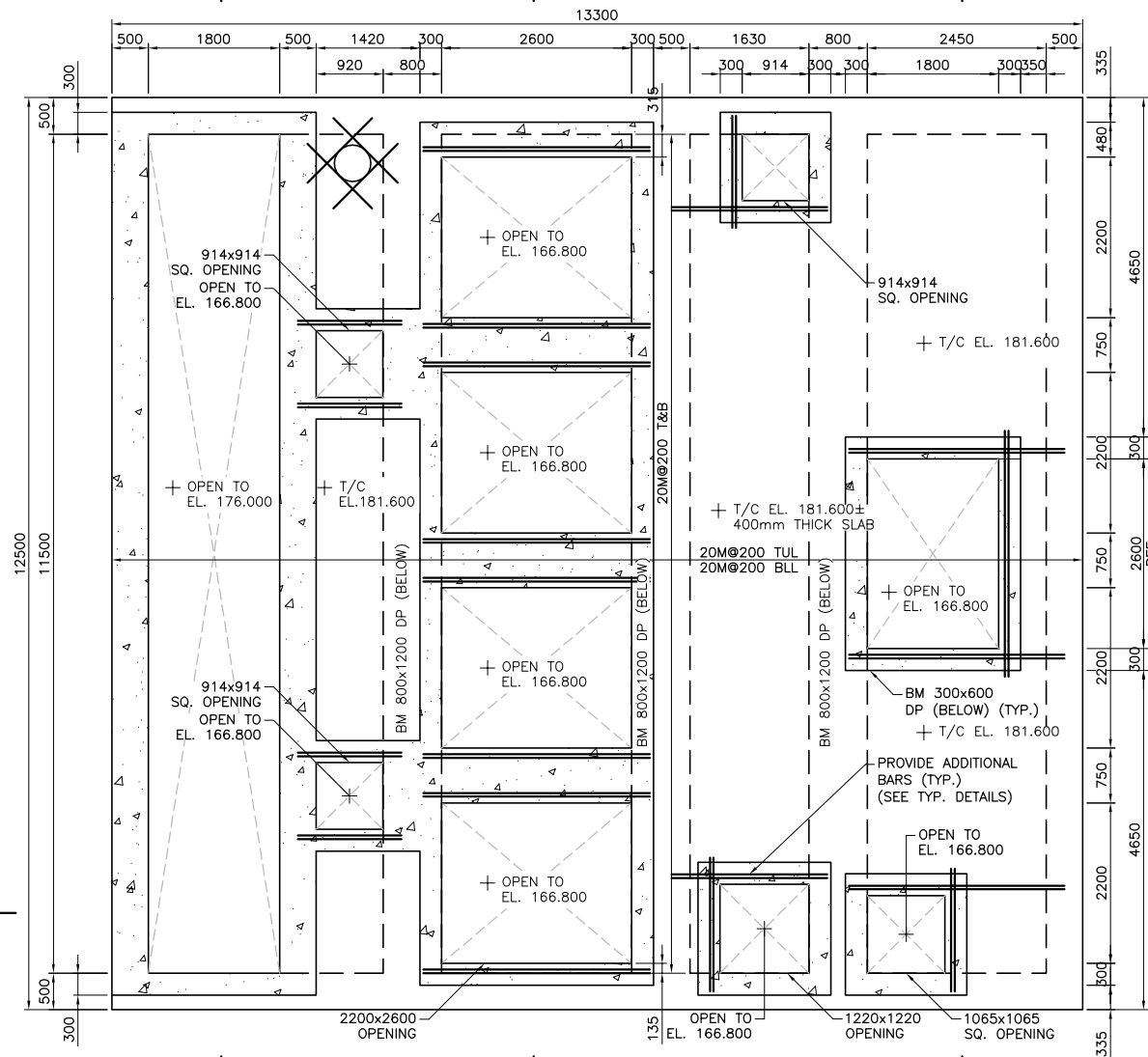
Windsor-Essex  
Parkway Project  
RFP No. 09-54-1007

NEW CONSTRUCTION  
PUMP STATION 1  
UPPER LEVEL AND ROOF PLANS  
STRUCTURAL



SHEET  
S1002

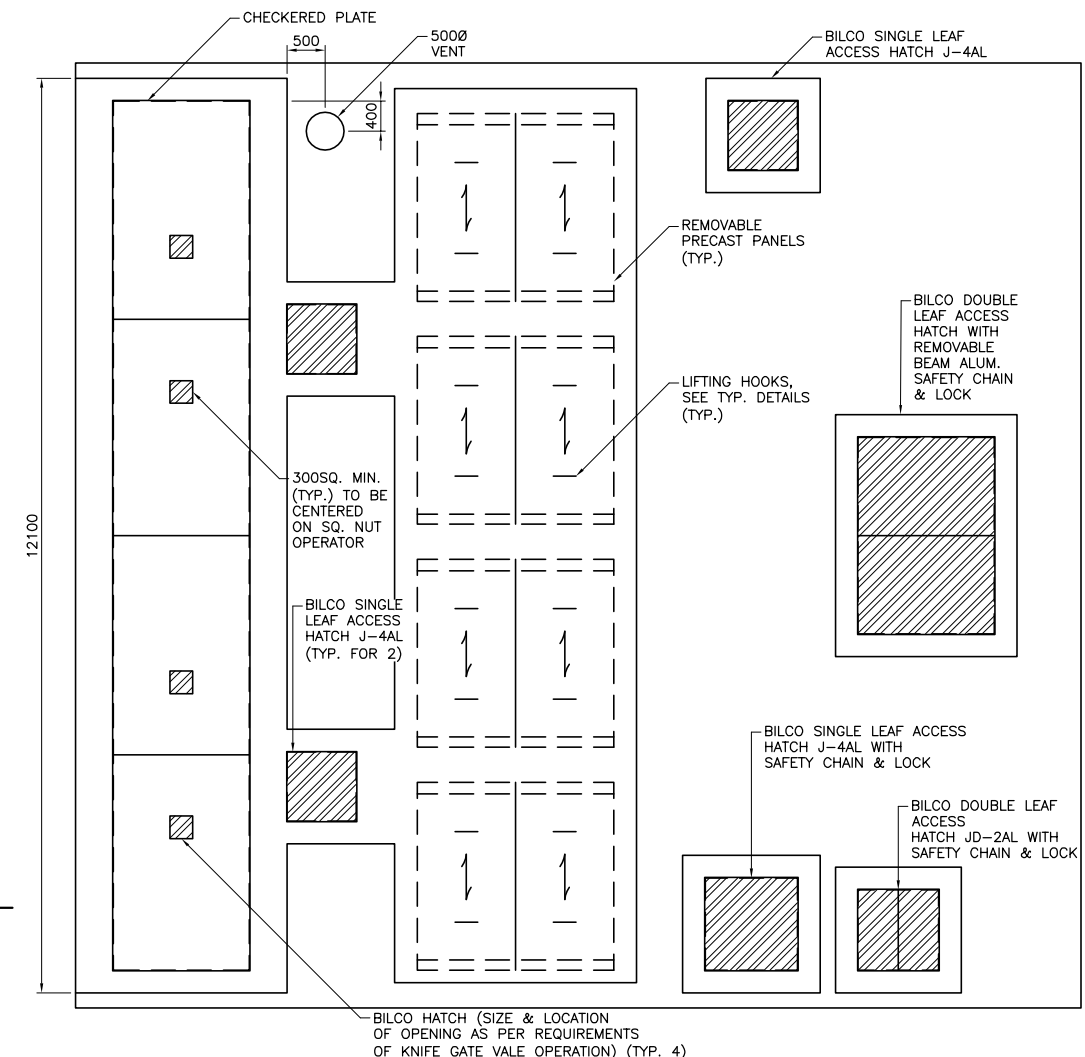
Phase 2  
90% Sub



TOP SLAB PLAN PUMP STATION No. 1 EL. 181.600

SCALE: 1:50

NOTE: DESIGN LIVE LOAD FOR SLABS @ EL. 181.600



CURB PLAN PUMP STATION No. 1 EL. 182.100

SCALE: 1:50

NOTE: DESIGN LIVE LOAD FOR ALL HATCHES & SLABS @ 182.100

DRAWING NOT TO BE SCALED  
100mm ON ORIGINAL DRAWING

**NOT FOR  
CONSTRUCTION**

REVISIONS		DATE	REV.	BY	DESCRIPTION
02-NOV-12	B	MW	90% IDR SUBMISSION		
11-JAN-12	A	MW	60% MTO SUBMISSION		
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DRAWN	AK	CHK	MW	SITE	xxx-xxxx DATE 11-JAN-12

# METRIC

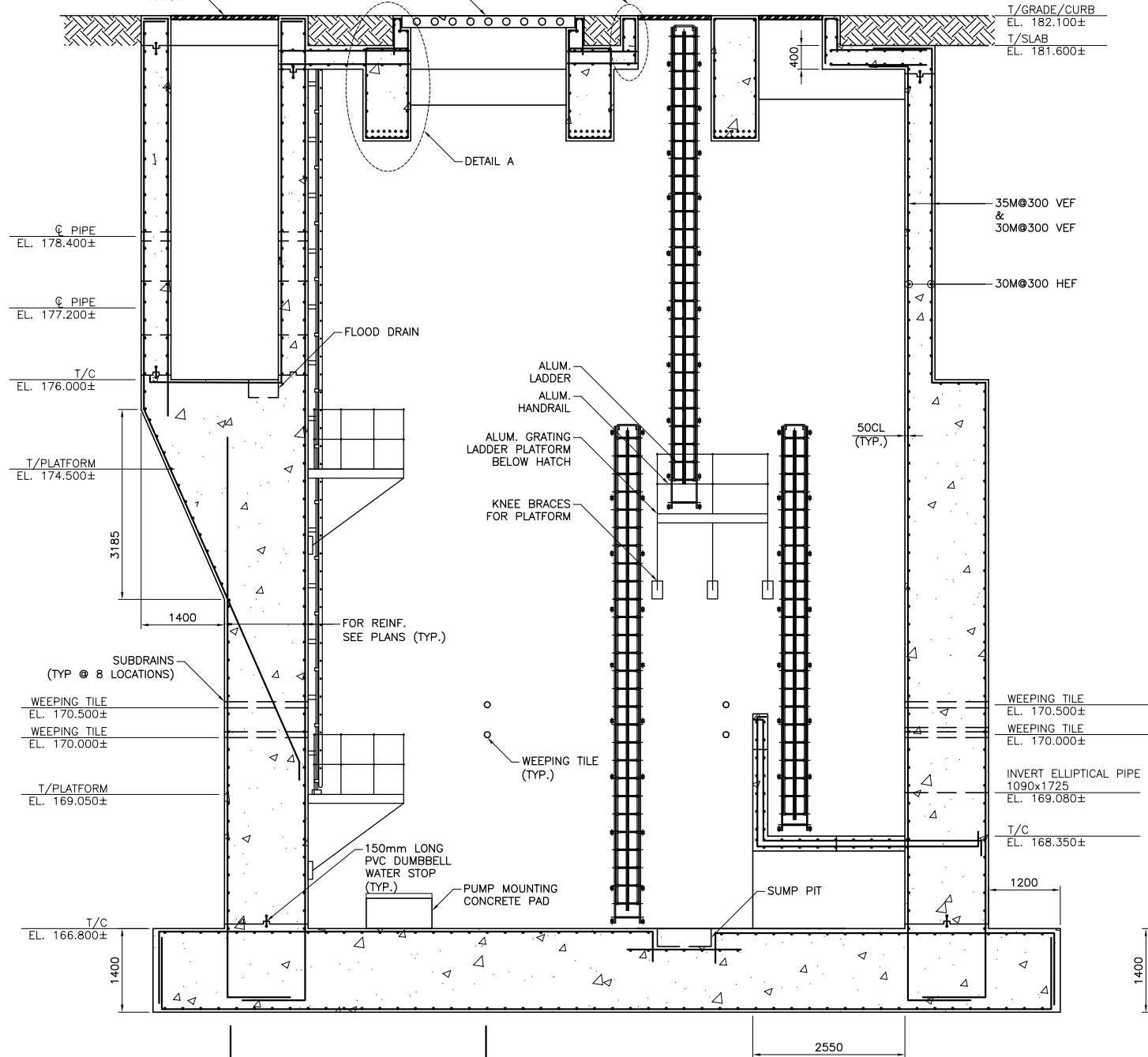
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

**DETAIL A**

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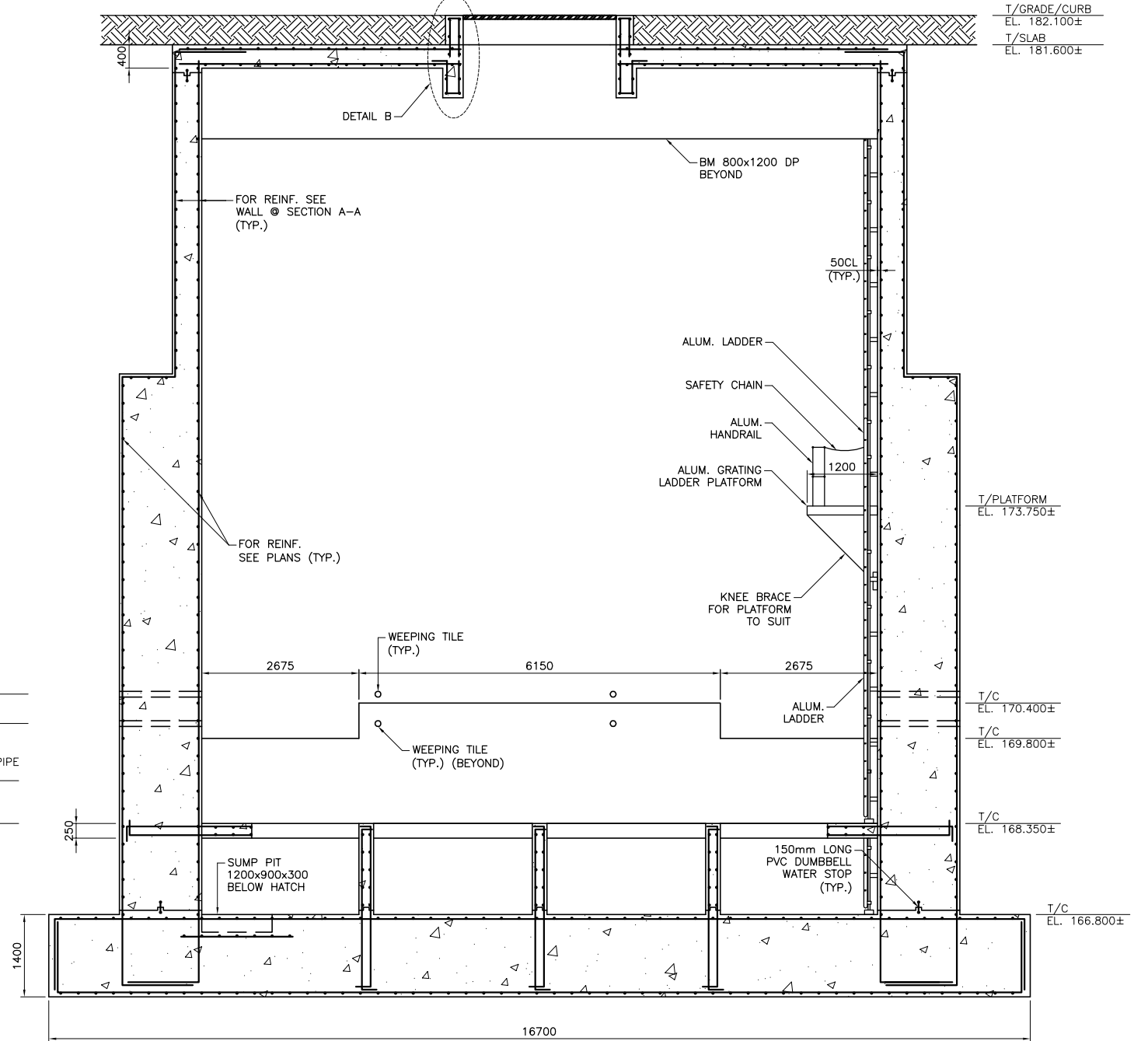
**DETAIL B**

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**SECTION A-A PUMP STATION No. 1**

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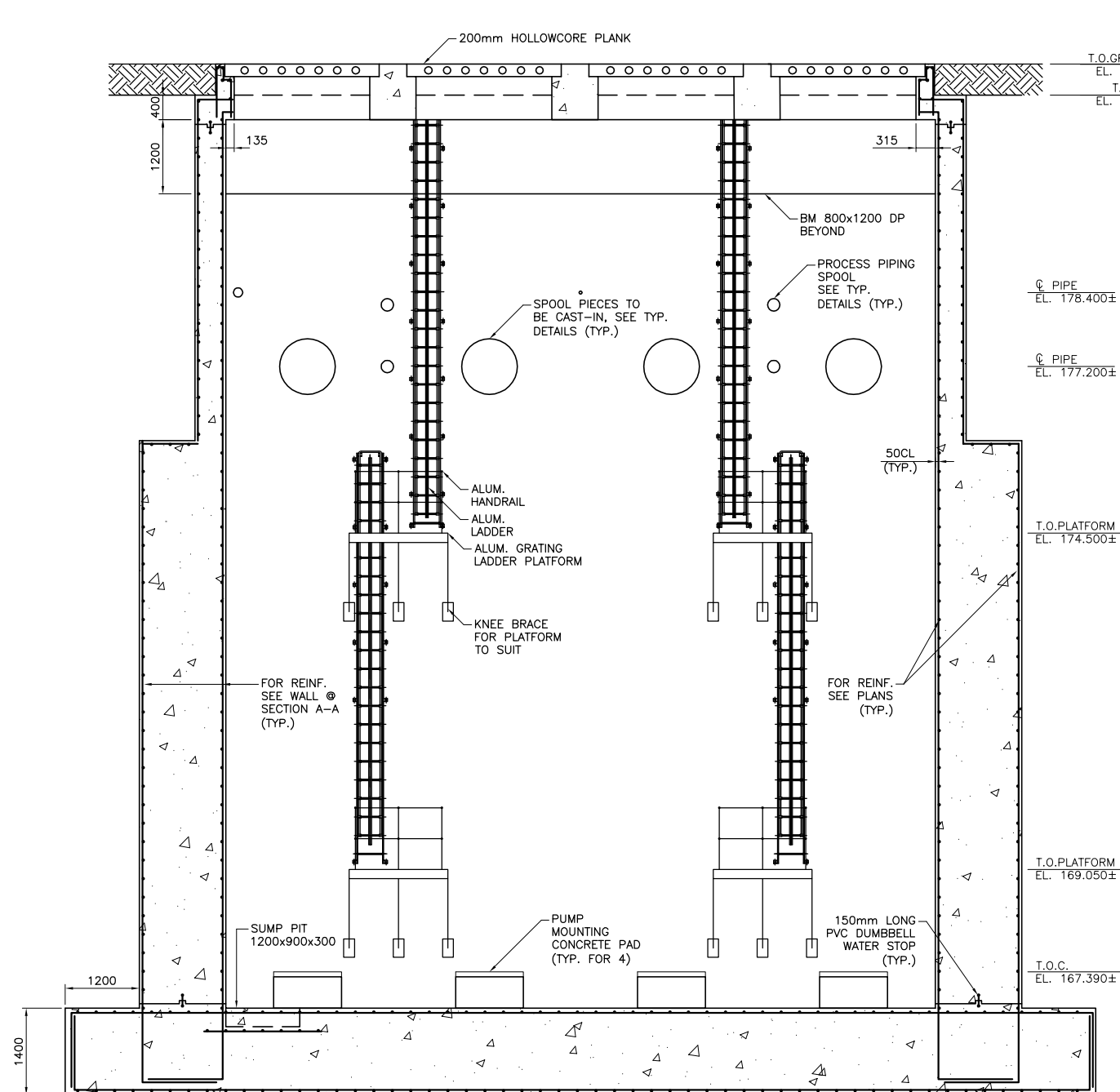
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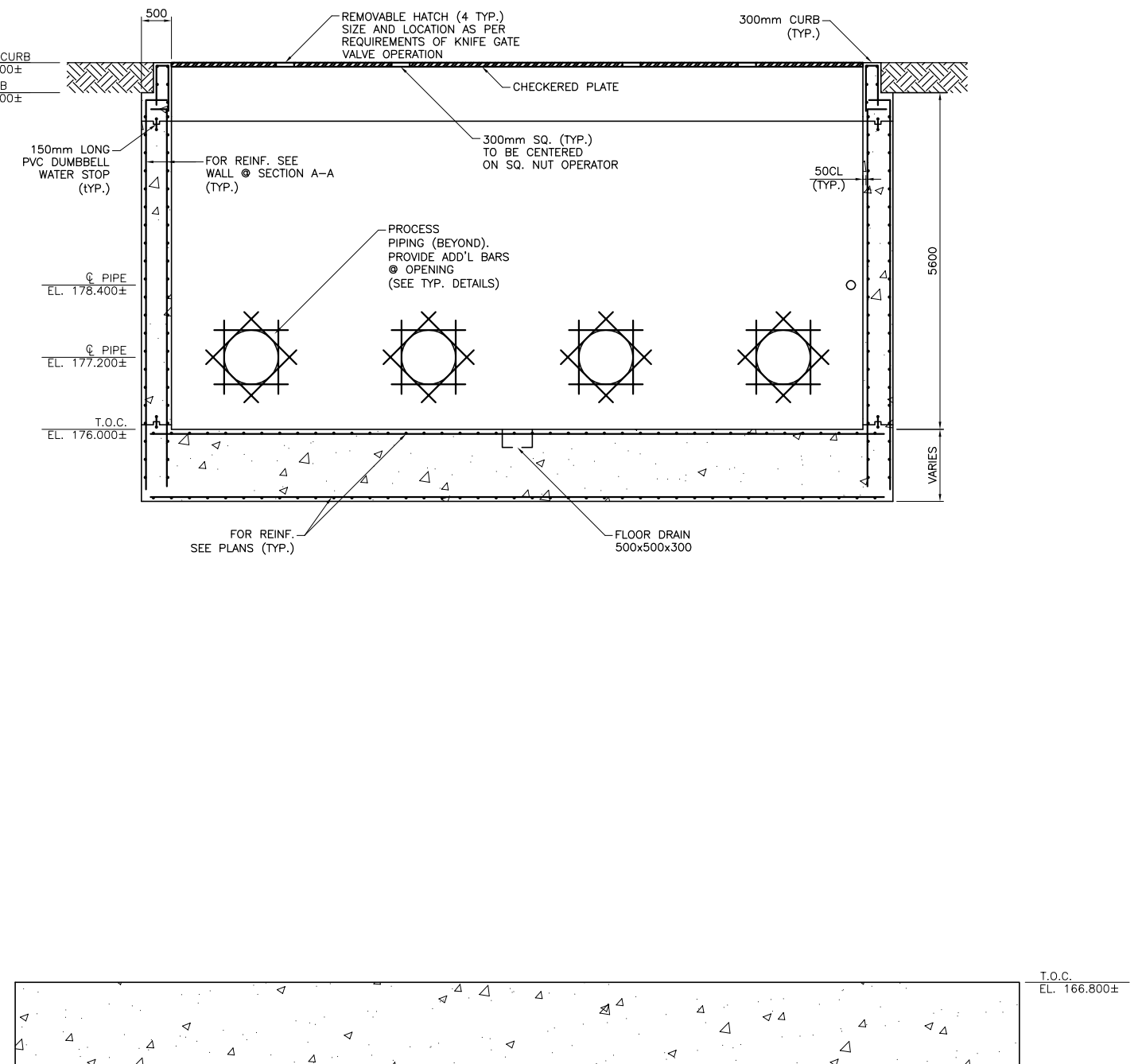
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**NOT FOR  
CONSTRUCTION**

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11-JAN-12	A	MW		60% MTO SUBMISSION
DESIGN	MW/MK	CHK	JM	CODE CHBDC 00000/LOAD
DRAWN	AK	CHK	MW	SITE xxx-xxxx DATE 11-JAN-12



SECTION C-C PUMP STATION No. 1  
SCALE: 1:50



SECTION D-D PUMP STATION No. 1  
SCALE: 1:50

DRAWING NOT TO BE SCALED  
100mm ON ORIGINAL DRAWING

NOT FOR  
CONSTRUCTION

REVIEWS							
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	11-JAN-12	A	MW	60% MTO SUBMISSION			
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MINISTRY OF TRANSPORTATION, ONTARIO  
PR-D-707 88-06

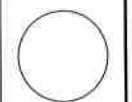
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SUBMISSION:	90% Interim IDR	
NAME (PRINT)	DATE	
CADD TECHNICIAN	David Godin	NOV. 08/12
ORIGINATOR	Jahangir Chowdhury	NOV. 08/12

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



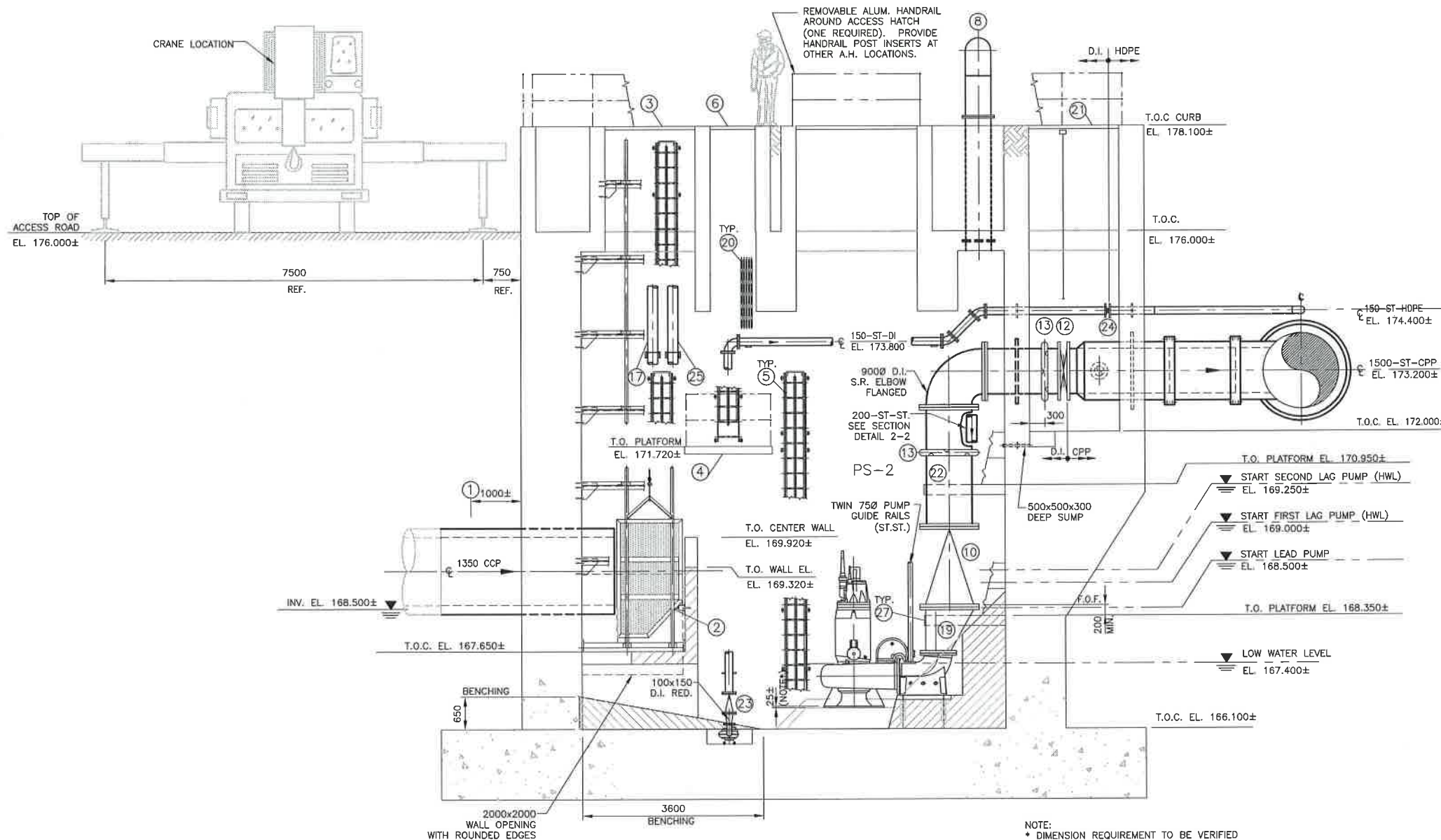
Windsor-Essex  
Parkway Project  
RFP No. 09-54-1007

NEW CONSTRUCTION  
PUMP STATION 2  
SECTION  
MECHANICAL

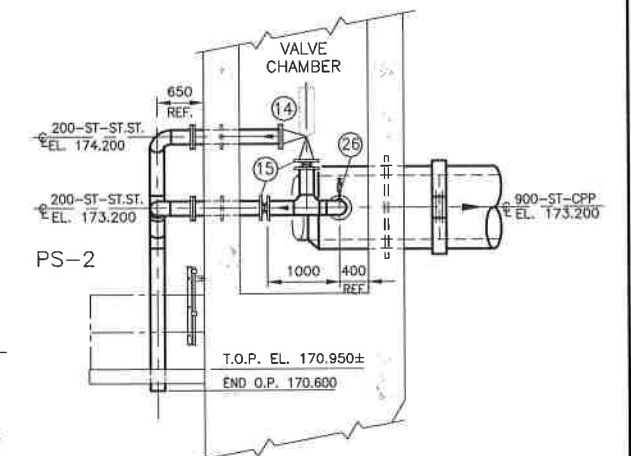


SHEET  
P2008

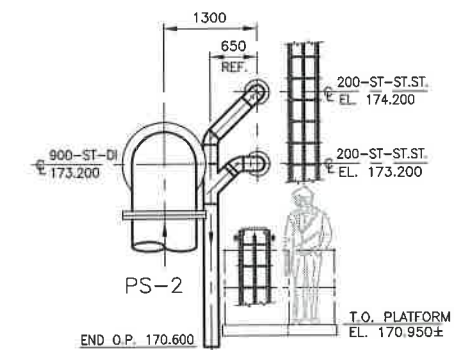
Phase 2  
90% Sub



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SECTION-DETAIL 2-2 DWG. P2006  
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SECTION-DETAIL 3-3 DWG. P2006  
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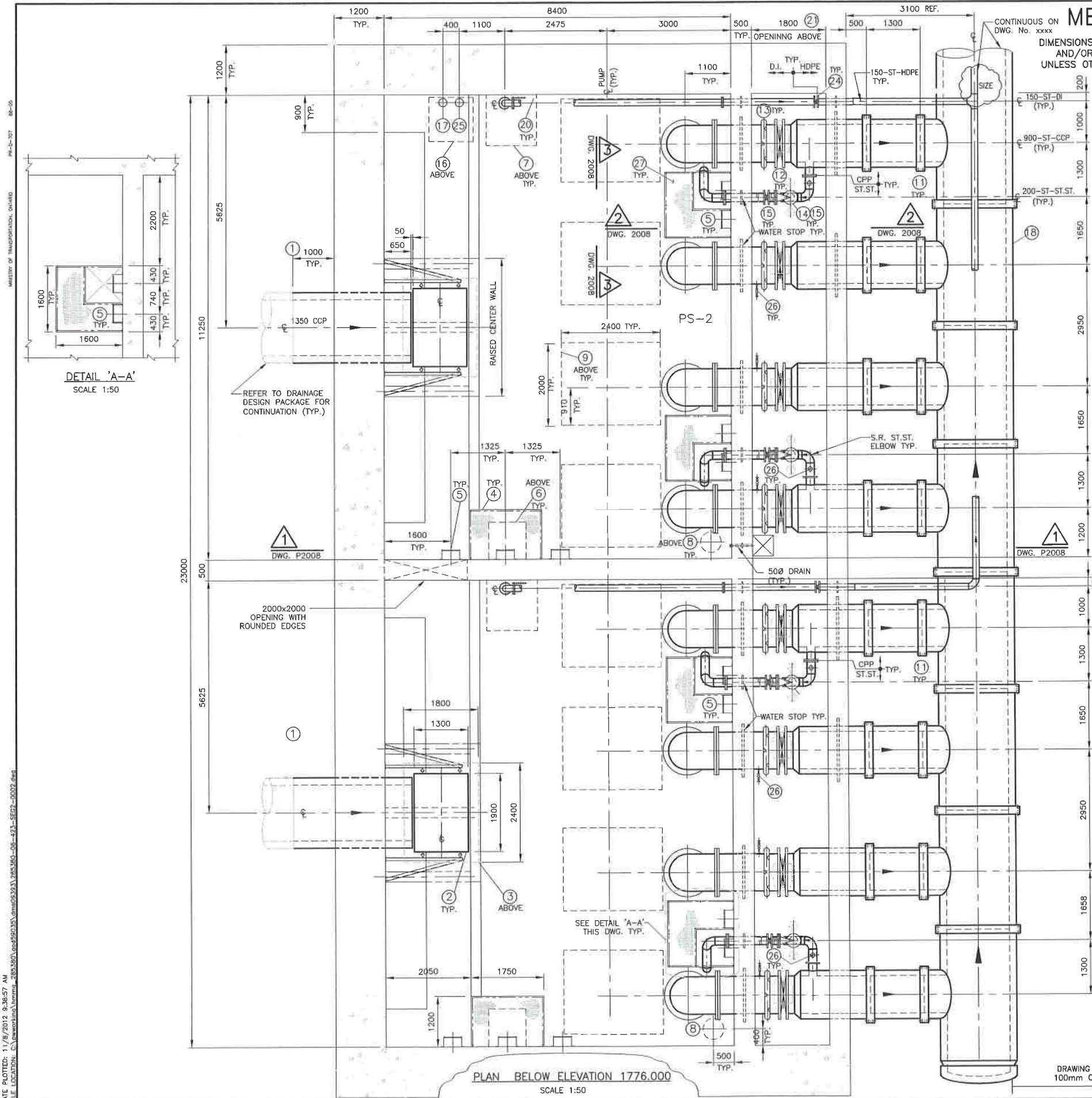
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100mm ON ORIGINAL DRAWING

NOT FOR  
CONSTRUCTION

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DESIGN	JDD	CHK	LB	CODE CHBDC 00000 LOAD XX-XXX-XXX
DRAWN	RP	CHK	JDD	SITE XXX-XXX DATE 11-JAN-12

DOC: 285380-06-424-SEG2-0002





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



Windsor-Essex  
Parkway Project  
RFP No. 09-54-1007



READY FOR CHECK	
SUBMISSION:	90% Interim IDR
NAME (PRINT)	DATE
CADD TECHNICIAN	David Godin
ORIGINATOR	Jahangir Chowdhury
	NOV. 08/12
	NOV. 08/12

NEW CONSTRUCTION  
PUMP STATION 2  
PLAN AND EQUIPMENT LIST  
MECHANICAL

SHEET  
P2006

Phase 2  
60% Sub

EQUIPMENT LIST

ITEM	DESCRIPTION
1	RCP - BELL AND SPIGOT C/W RUBBER GASKET JOINT WRAPPED IN GEOTEXTILE AND IMBEDDED IN U/FILL
2	2-FABRICATED TRASH BASKET: 2800x2000x1400 (REFER TO DRAWING No. 2008 FOR DETAILS)
3	2-2400x1800 ALUMINUM ACCESS HATCH (LOCKABLE): WITH REMOVABLE BEAM WITH HINGED COVER PLATE, INSULATION AND BOTTOM PAN. DESIGN: H20 LOADING. MANUFACTURER: BILCO SPECIALTY DESIGN (REFER TO STRUCTURAL DRAWINGS FOR DETAILS)
4	2-1850x1200 INTERMEDIATE LANDING/PLATFORM: FABRICATED ALUM. OPEN GRATING STRUCTURE C/W HANDRAIL AND SAFETY CHAINS. (REFER TO STRUCTURAL DRAWINGS FOR DETAILS)
5	ALUMINUM LADDERS WITH SAFETY SLIDE RAILS OR SAFETY CAGES, TOP LADDER WITH LADDER UP ASSEMBLY. (REFER TO STRUCTURAL DRAWINGS FOR DETAILS)
6	2-914x914 ACCESS HATCH (LOCKABLE): ALUMINUM WITH HINGED COVER PLATE. DESIGN: H20 LOADING. MANUFACTURER: BILCO CANADA. (REFER TO STRUCTURAL DRAWINGS FOR DETAILS)
7	2-1220x1220 ALUMINUM ACCESS HATCH (LOCKABLE): WITH HINGED COVER PLATE. DESIGN: H20 LOADING. MANUFACTURER: BILCO J-SALH50. (REFER TO STRUCTURAL DRAWINGS FOR DETAILS)
8	2-VENT PIPES, 500 DIAMETER ST. ST. C/W GOOSE NECK, BIRD AND INSECT SCREENS. LENGTH: 1.5 METER ABOVE STATION T.O.C. ELEV. TO TOP OF INLET PIPE IN STATION. REFER TO DWG. No. P2013 DETAIL 2
9	6-3200x2400 ACCESS HATCH (LOCKABLE): REMOVABLE PRECAST HOLLOWCORE PLANKS WITH LIFTING HOOKS DESIGN: H20 LOADING. MANUFACTURER: BILCO (REFER TO STRUCTURAL DRAWINGS FOR DETAILS)
10	6-9000 SURGE BUSTER SWING CHECK VALVE SUPPLIER: VALMATIC CHECK VALVES OF P2A, P2E, P2B AND P2F ACCESS PORT FACE CHECK VALVES OF P2C AND P2D ACCESS PORT FACE
11	HOLDFAST OR APPROVED EQUIVALENT JOINTS, SUPPLY BY CCP SUPPLIER. THE FINAL CONFIGURATION OF, NUMBER OF JOINTS AND INSTALLATION METHOD TO BE PER THE PIPE MANUFACTURERS RECOMMENDATION
12	8-9000 KNIFE GATE VALVE: C/W EXTENSION STEM, SPUR GEARBOX MANUAL ACTUATOR AND SQUARE NUT OPERATOR.
13	12-9000 GROOVED COUPLING: VICTAULIC COUPLING STYLE 31 SUPPLIER: VICTAULIC/SYNTEC
14	WASTEWATER PRESSURE RELIEF VALVE: 4-2000 FLANGED, VALMATIC, SINGER MODEL 106-DL DYNAMIC LIFTER SPRING
15	8-2000 FLANGED KNIFE GATE VALVE, TRUeline, SUPPLIER: VALMATIC/SYNTEC. NON-RISING STEM, HAND WHEEL OPERATED
16	2-1065x1065 ACCESS HATCH (LOCKABLE): ALUMINUM COVER AND FRAME C/W STAINLESS STEEL BOLTS AND RUBBER GASKET. (REFER TO STRUCTURAL DRAWINGS FOR DETAILS)
17	MILLTRONICS ULTRASONIC LEVEL TRANSDUCER MOUNTED ON FLANGED PVC STILLING TUBE; LENGTH: FROM STATION T.O.C. ELEVATION TO UNDERSIDE OF INLET BAFFLE HORIZONTAL CONCRETE SLAB. MOUNTED TO WALL WITH (4) STAINLESS STEEL SUPPORT BRACKETS.
18	CONCRETE PRESSURE PIPE (CPP) - AWWA C 301, CLASS 10: HANSON/MUNRO OR EQUIVALENT SUPPLY, BEDDING: WELL COMPACTED MATERIAL (98% STANDARD PROCTOR MAXIMUM DRY DENSITY)
19	8-900x600 ECCENTRIC REDUCER, DUCT IRON
20	5-BACK UP LEVEL CONTROL FLOATS REFER TO DWG. P2013 DETAIL 4
21	2-12500x1800 ACCESS HATCH (LOCKABLE) REMOVABLE CHECKERED PLATES WITH LIFTING HOOKS W/4-300x300 ACCESS HATCHES. DESIGN: H20 LOADING. MANUFACTURER: BILCO CANADA. (REFER TO STRUCTURAL DRAWINGS FOR DETAILS)
22	CEMENT LINED DUCTILE IRON PIPE.
23	2-1500 SURGE BUSTER SWING CHECK VALVE SUPPLIER: VALMATIC
24	2-1500 FLANGED KNIFE GATE VALVE, TRUeline, SUPPLIER: VALMATIC/SYNTEC. NON-RISING STEM, HAND WHEEL OPERATED
25	SUBMERSIBLE PRESSURE LEVEL TRANSMITTER C/W MANUFACTURE CABLE AND MOUNTED ON FLANGED PVC STILLING TUBE, REFER TO DETAIL DWG. P7013 DETAIL 3
26	4-250 BALL VALVE C/W PLUG, FOR INSTALLATION OF PRESSURE MONITORING INSTRUMENT
27	1800x1600 LANDING/PLATFORM: FABRICATED ALUM. OPEN GRATING STRUCTURE C/W HANDRAIL (REFER TO STRUCTURAL DRAWINGS FOR DETAILS)

NOTES:

- FOR FILL AT BASE OF FOUNDATION SEE DWG. S8010 DETAIL 40
- FOR PIPE BEDDING AND BACKFILL SEE DWG. P1004 DETAIL 2
- ITEM NUMBERS AND EQUIPMENT LIST SHOWN IN TABLE ABOVE APPLIES TO DWG's. P2006, P2007 AND P2008

DRAWING NOT TO BE SCALED  
100mm ON ORIGINAL DRAWING

NOT FOR  
CONSTRUCTION

REVISIONS	DATE	REV.	BY	DESCRIPTION
11-JAN-12	A	LB	60% MTO SUBMISSION	
DESIGN	JDD	CHK	LB	CODE CHBDC 00000/LOAD xx-xxx-xxx
DRAWN	RP	CHK	JDD	SITE xxx-xxx DATE 11-JAN-12

DOC: 285380-06-423-SEG2-0002

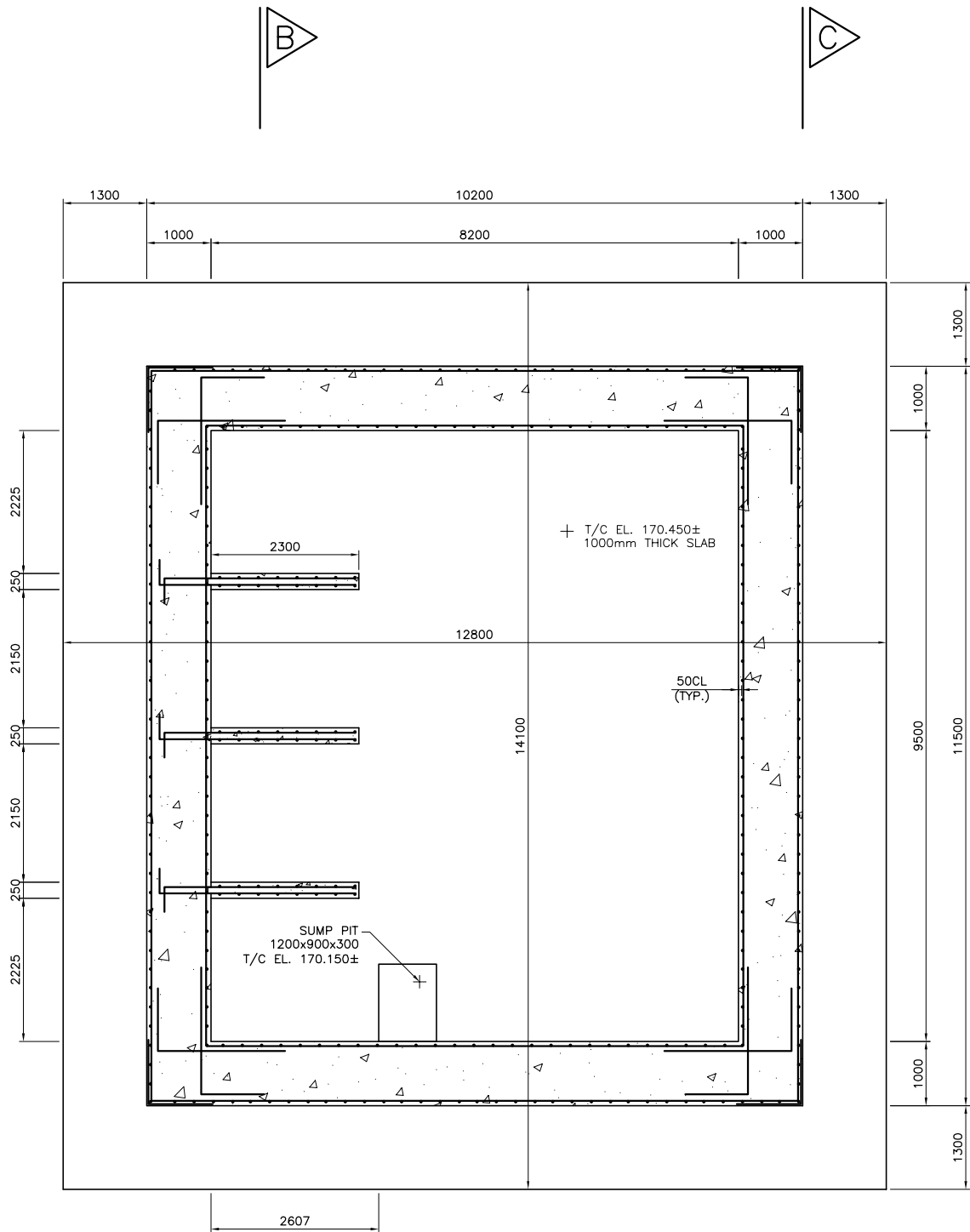
PH-1-107 18-05

MINISTRY OF TRANSPORTATION, ONTARIO

DATE PLOTTED: 11/8/2012 9:36:57 AM  
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READY FOR CHECK		
SUBMISSION: 90% Interim IDR		
	NAME (PRINT)	DATE
CADD TECHNICIAN	Rosauro Pangan	July 25/12
ORIGINATOR	Jahangir Chowdhury	July 25/12



FOUNDATION PLAN PUMP STATION NO. 5 EL. 170.450  
SCALE 1:50

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

Parkway  
Infrastructure  
Engineers



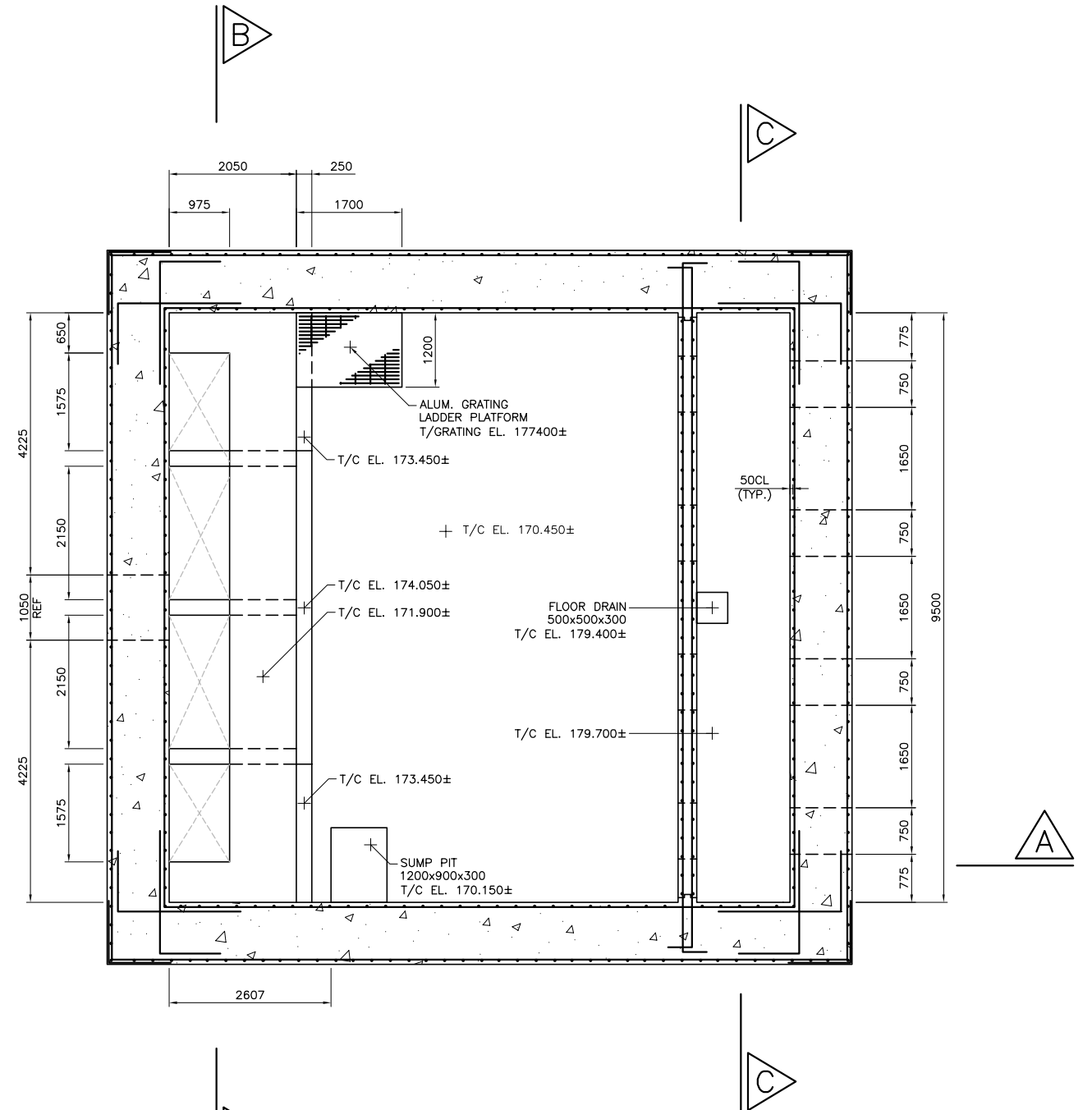
Windsor-Essex  
Parkway Project  
RFP No. 09-54-1007

NEW CONSTRUCTION  
PUMP STATION 5  
FOUNDATION AND MID-LEVEL PLANS  
STRUCTURAL



SHEET  
S5001

Phase 1  
90% Sub



PLAN PUMP STATION NO. 5 EL. 180.800  
SCALE 1:50

DRAWING NOT TO BE SCALED  
100mm ON ORIGINAL DRAWING

NOT FOR  
CONSTRUCTION

REVISIONS	DATE	REV.	BY	DESCRIPTION
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DESIGN	MW/M	CHK	JM	CODE CHBDC 00000/LOAD
DRAWN	AK	CHK	MW	SITE xxx-xxxx DATE 11-JAN-12

READY FOR CHECK		
SUBMISSION: 90% Interim IDR		
	NAME (PRINT)	DATE
CADD TECHNICIAN	Rosauro Pangan	July 25/12
ORIGINATOR	Jahangir Chowdhury	July 25/12

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

Parkway  
Infrastructure  
Engineers



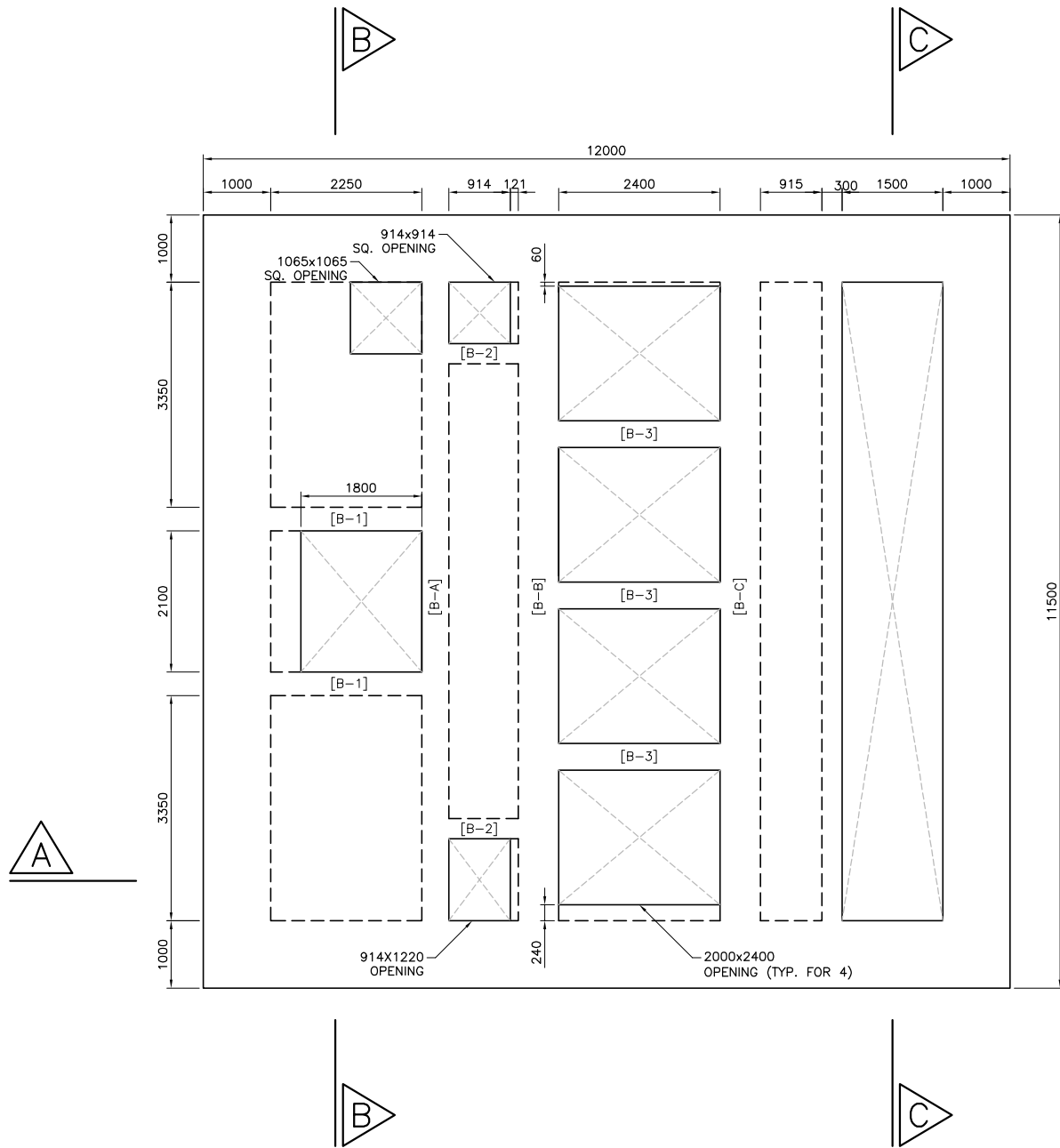
Windsor-Essex  
Parkway Project  
RFP No. 09-54-1007

NEW CONSTRUCTION  
PUMP STATION 5  
UPPER LEVEL AND ROOF PLANS  
STRUCTURAL

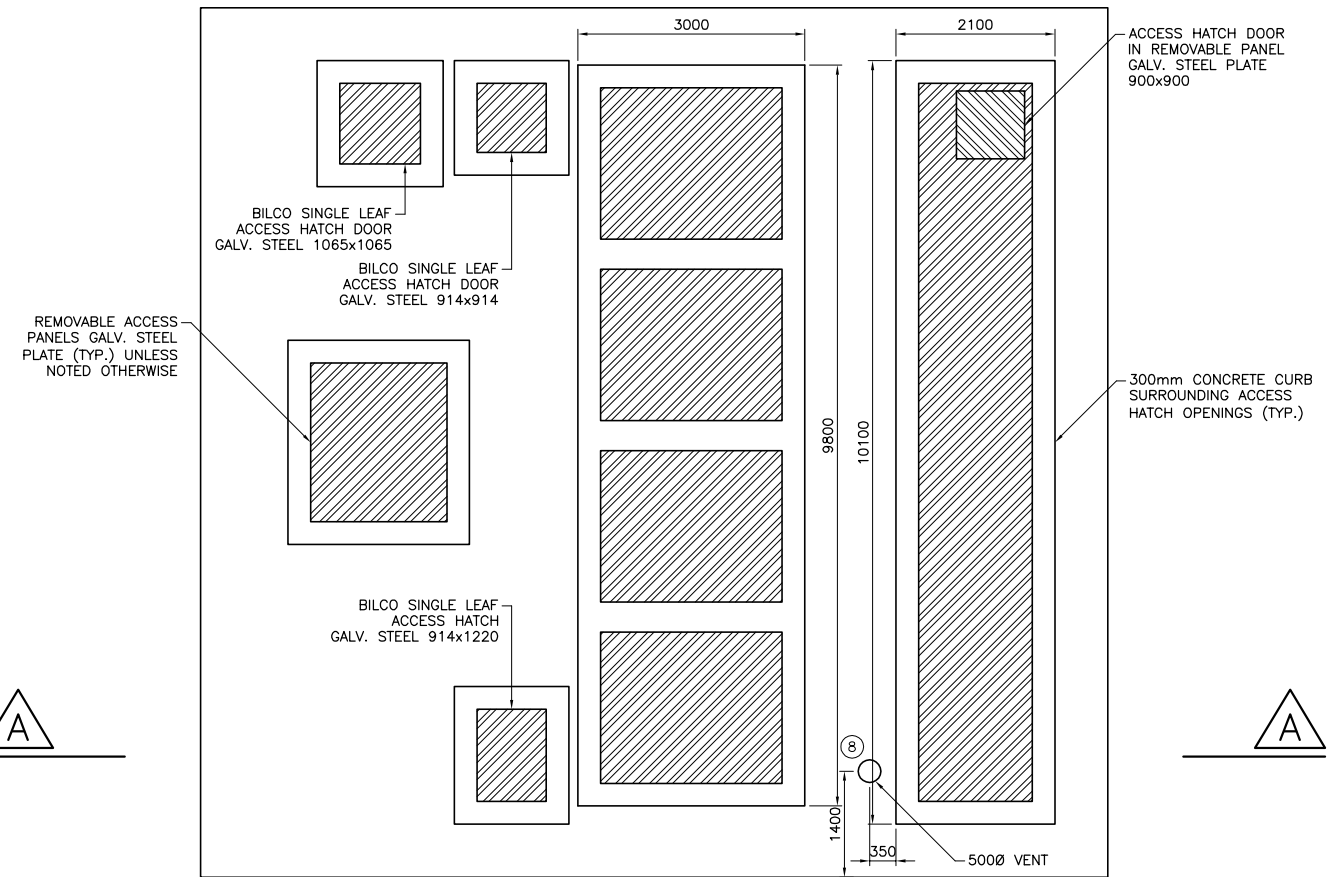


SHEET  
S5002

Phase 1  
90% Sub



TOP SLAB PLAN PUMP STATION NO. 5 EL. 183.600  
SCALE 1:50



CURB PLAN PUMP STATION NO. 5 EL. 184.100  
SCALE 1:50

BEAM SCHEDULE								
BEAM MARK	SIZE		REINF.		STIRRUPS			REMARKS
	WIDTH	DEPTH	TOP CONT.	BOTTOM CONT.	SIZE	TYPE	SPACING	
B-1	350							
B-2	300							
B-3	400							
B-A	400	1000						
B-B	600	1000						
B-C	600	1000						

DRAWING NOT TO BE SCALED  
100mm ON ORIGINAL DRAWING

NOT FOR  
CONSTRUCTION

REVISIONS							
11-JAN-12	A	MW	60% MTO SUBMISSION				
DATE	REV.	BY	DESCRIPTION				
DESIGN MW/AK	CHK JM	CODE CHBDC	00000	LOAD			
DRAWN AK	CHK MW	SITE xxx-xxxx	DATE	11-JAN-12			

READY FOR CHECK		
SUBMISSION: 90% Interim IDR		
	NAME (PRINT)	DATE
CADD TECHNICIAN	Rosauro Pangan	July 25/12
ORIGINATOR	Jahangir Chowdhury	July 25/12

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

Parkway  
Infrastructure  
Engineers

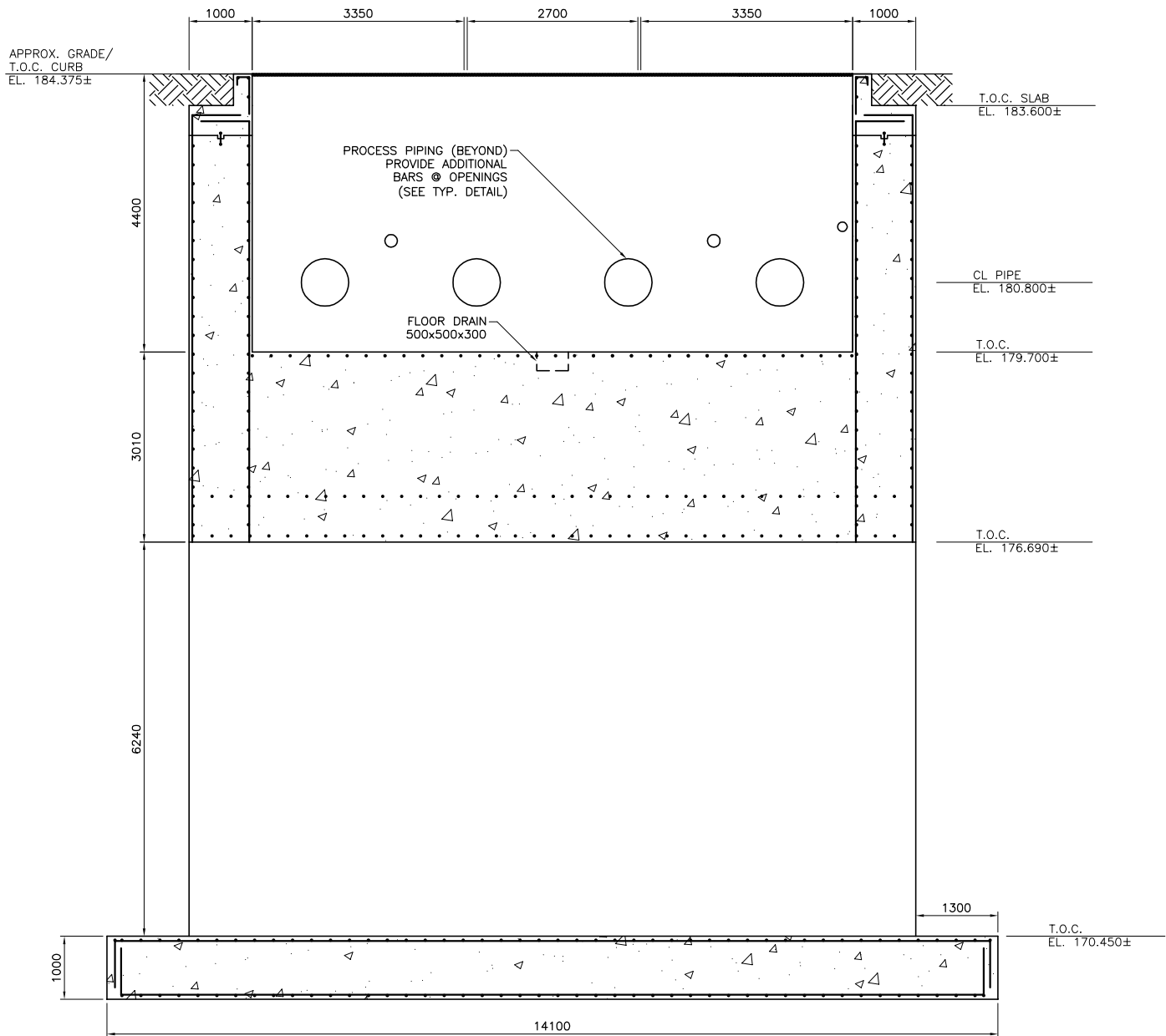


Windsor–Essex  
Parkway Project  
RFP No. 09–54–1007

NEW CONSTRUCTION  
PUMP STATION 5  
SECTIONS  
STRUCTURAL



SHEET  
S5003  
Phase 1  
90% Sub



SECTION C-C PUMP STATION NO. 5  
SCALE 1:50

DRAWING NOT TO BE SCALED  
100mm ON ORIGINAL DRAWING

NOT FOR  
CONSTRUCTION

REVISIONS			
11-JAN-12	A	MW	60% MTO SUBMISSION
DATE	REV.	BY	DESCRIPTION
DESIGN MW/AK	CHK JM	CODE CHBDC	00000/LOAD
DRAWN AK	CHK MW	SITE xxx-xxxx	DATE 11-JAN-12

READY FOR CHECK		
SUBMISSION: 90% Interim IDR		
	NAME (PRINT)	DATE
CADD TECHNICIAN	Rosauro Pangan	July 25/12
ORIGINATOR	Jahangir Chowdhury	July 25/12

# METRIC

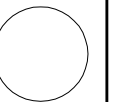
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AND/OR MILLIMETRES  
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**Parkway  
Infrastructure  
Engineers**



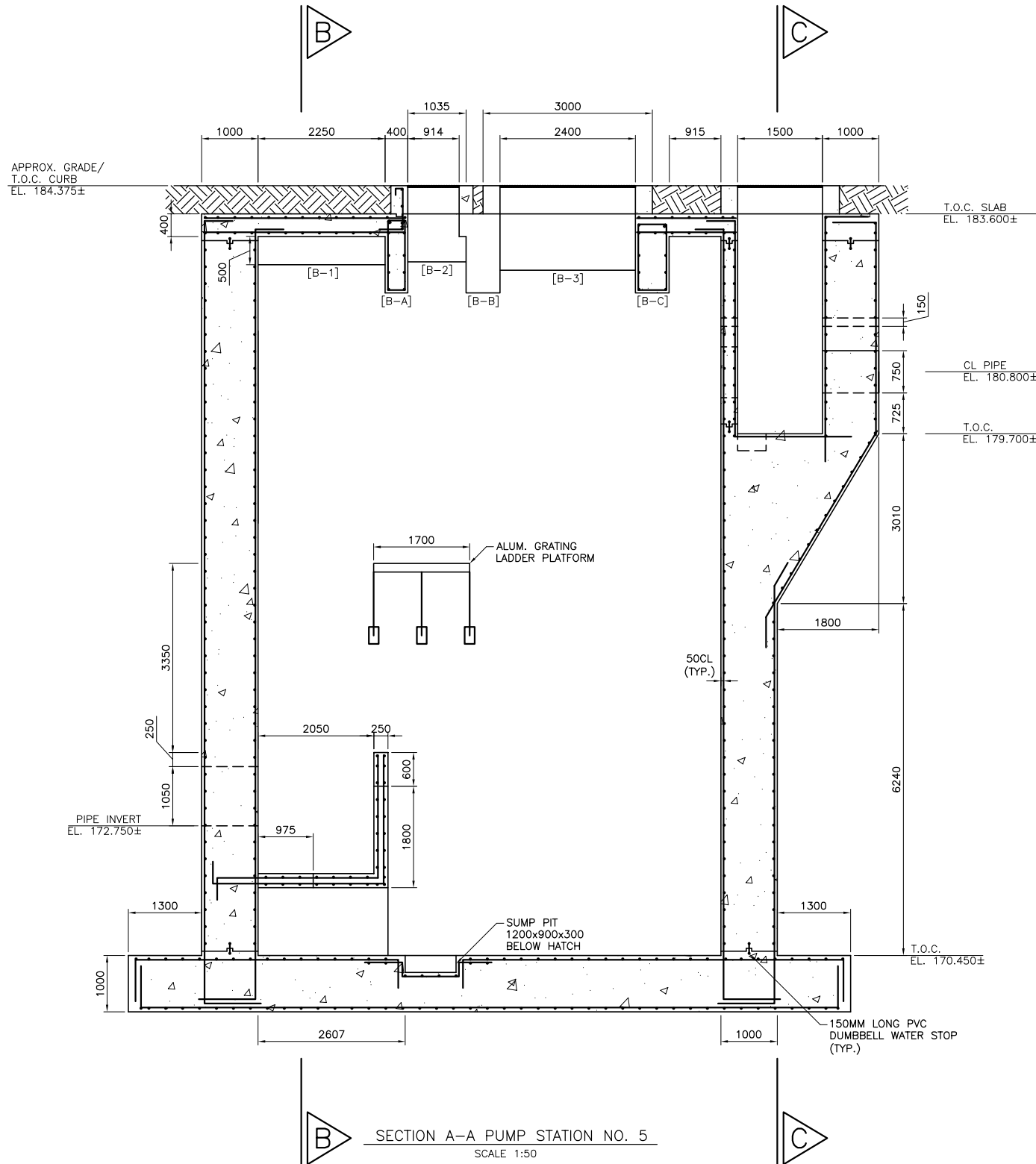
Windsor-Essex  
Parkway Project  
RFP No. 09-54-1007

NEW CONSTRUCTION  
PUMP STATION 5  
SECTIONS  
STRUCTURAL

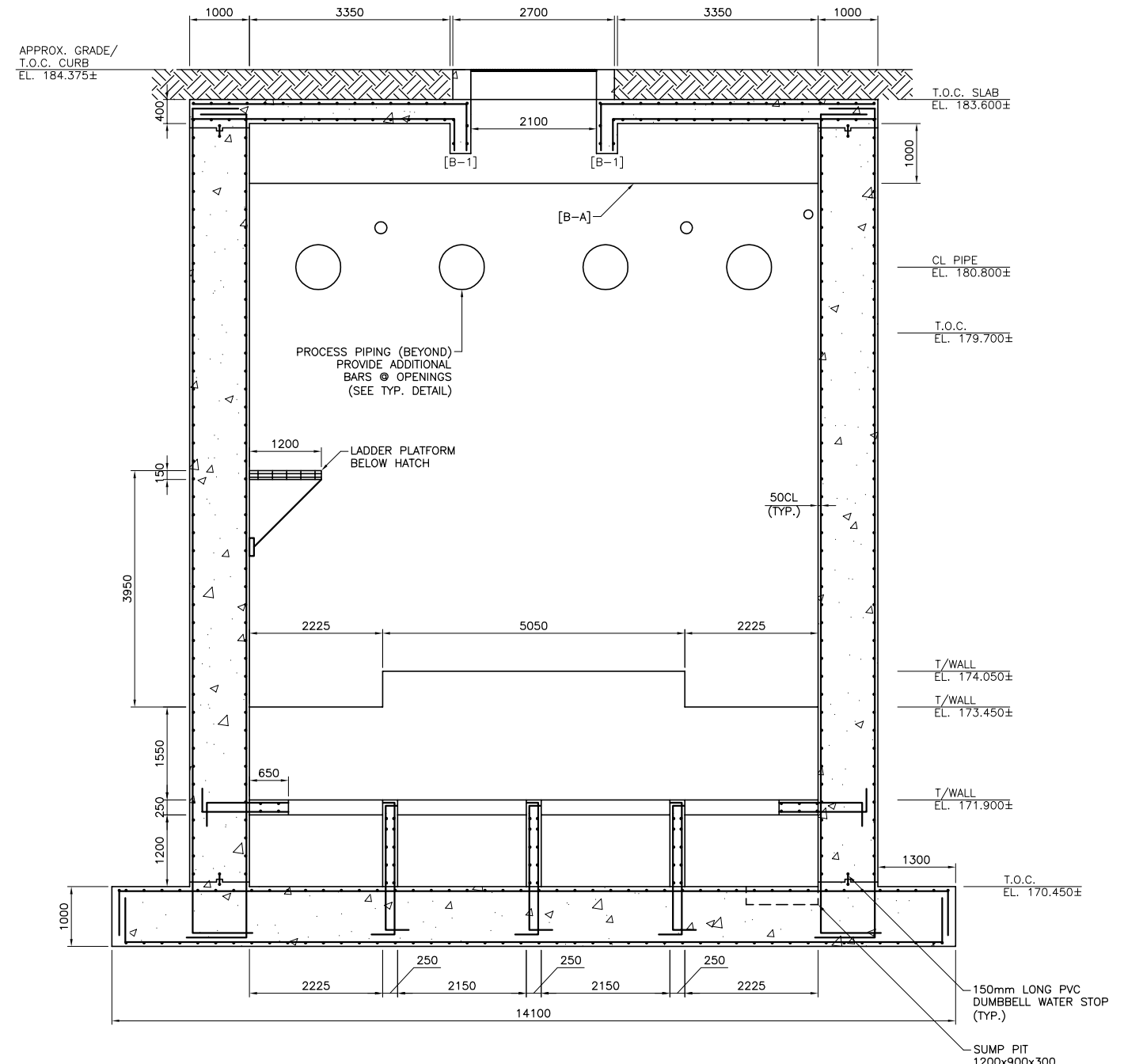


SHEET  
S5003

Phase 1  
90% Sub



SECTION A-A PUMP STATION NO. 5  
SCALE 1:50



SECTION B-B PUMP STATION NO. 5  
SCALE 1:50

DRAWING NOT TO BE SCALED  
100mm ON ORIGINAL DRAWING

NOT FOR  
CONSTRUCTION

REVISIONS			
11-JAN-12	A	MW	60% MTO SUBMISSION
DATE	REV.	BY	DESCRIPTION
DESIGN	MW/AK	CHK JM	CODE CHBDC 00000/LOAD
DRAWN	AK	CHK MW	SITE xxx-xxxx DATE 11-JAN-12

READY FOR CHECK		
SUBMISSION:		
	NAME (PRINT)	DATE
CADD TECHNICIAN		
ORIGINATOR		

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

Parkway  
Infrastructure  
Engineers



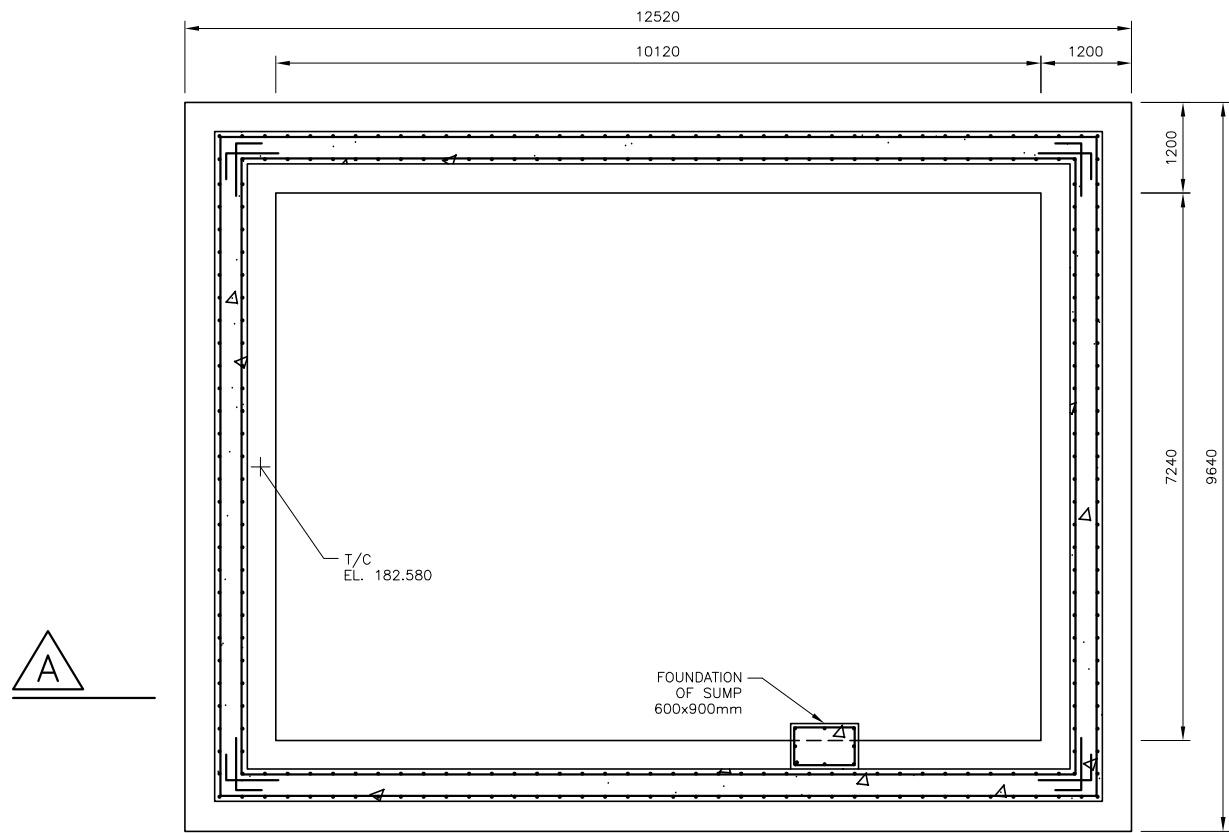
Windsor-Essex  
Parkway Project  
RFP No. 09-54-1007

NEW CONSTRUCTION  
DIESEL GENERATOR STATION 5  
FOUNDATION PLAN  
STRUCTURAL

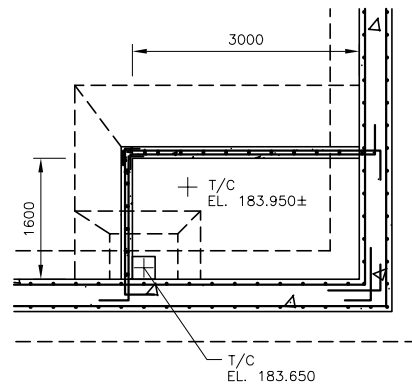


SHEET  
S5002

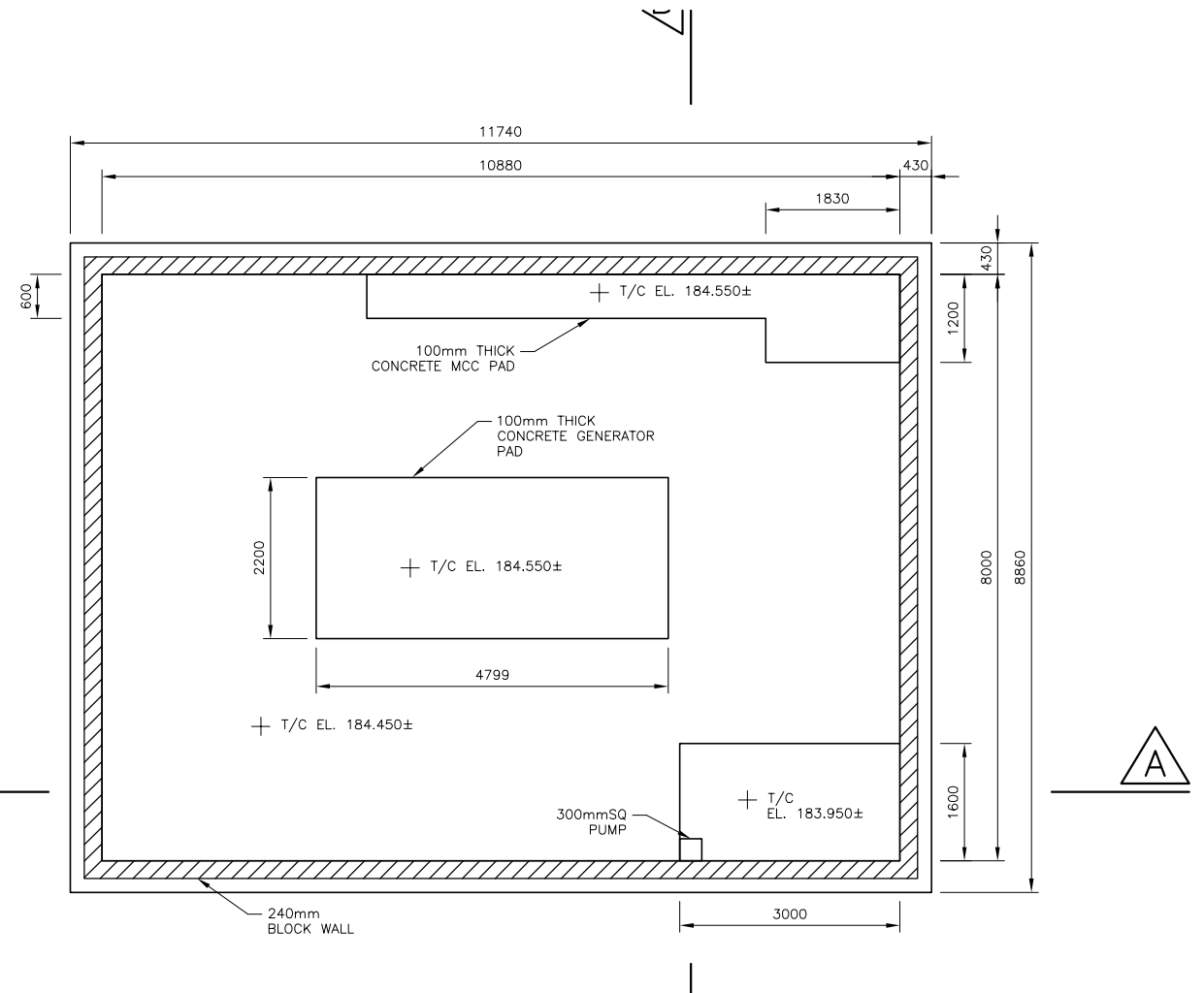
Phase 1  
90% Sub



DIESEL GENERATOR NO. 5 FOUNDATION AT EL. 183.300  
SCALE 1:50



DIESEL GENERATOR NO. 5 PARTIAL PLAN AT EL. 183.650  
SCALE 1:50



DIESEL GENERATOR NO. 5 GROUND FLOOR PLAN AT EL. 184.600  
SCALE 1:50

DRAWING NOT TO BE SCALED  
100mm ON ORIGINAL DRAWING

NOT FOR  
CONSTRUCTION

REVISIONS				
11-JAN-12	A	MW	60% MTO SUBMISSION	
DATE	REV.	BY	DESCRIPTION	
DESIGN MW/AK	CHK JM	CODE CHBDC	00000	LOAD
DRAWN AK	CHK MW	SITE	xxx-xxxx	DATE 11-JAN-12

READY FOR CHECK		
SUBMISSION: 90% Interim IDR		
	NAME (PRINT)	DATE
CADD TECHNICIAN	Rosauro Pangan	May 18/12
ORIGINATOR	Jahangir Chowdhury	May 10/12

METRIC  
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Parkway  
Infrastructure  
Engineers



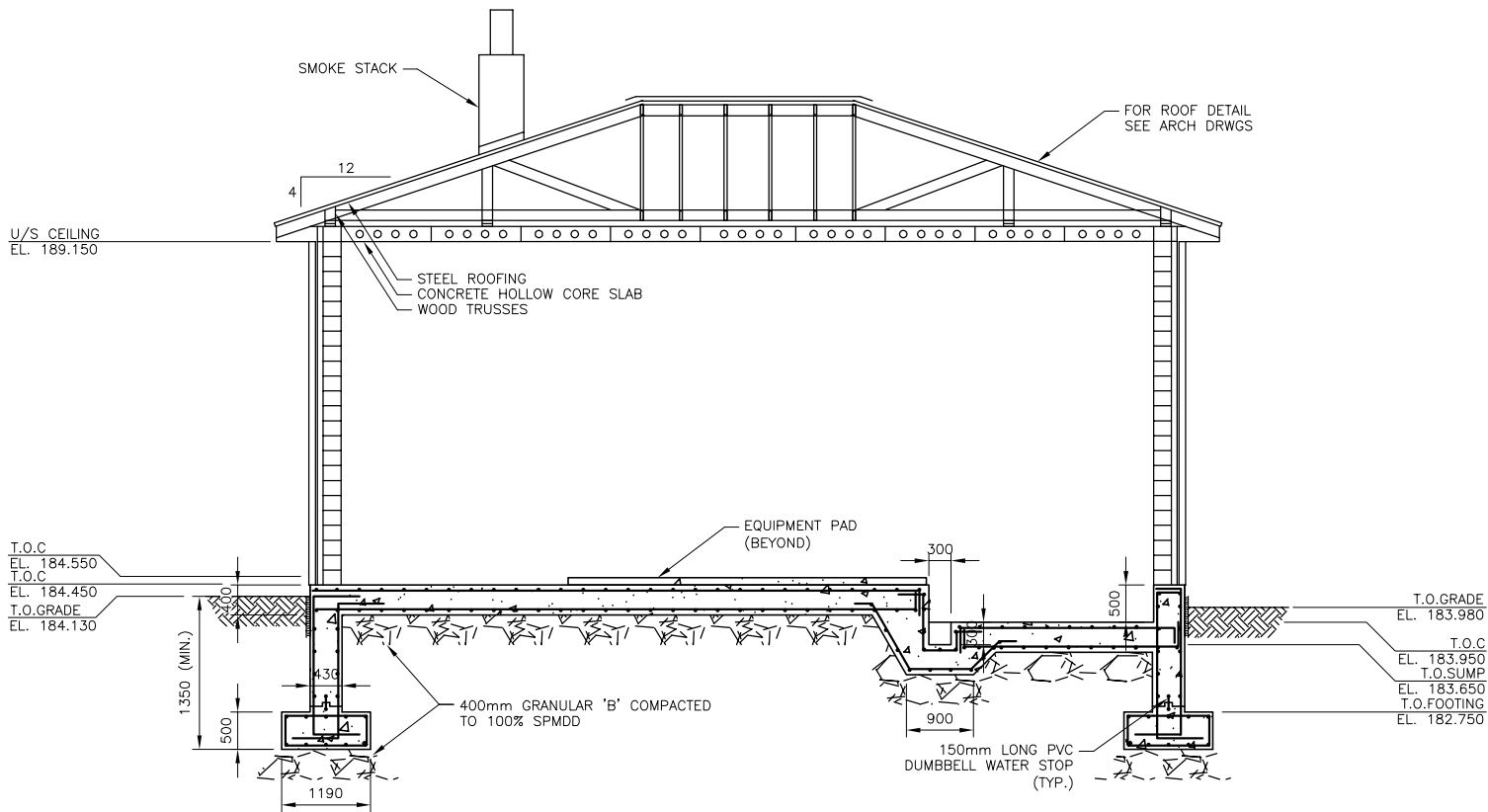
Windsor-Essex  
Parkway Project  
RFP No. 09-54-1007

NEW CONSTRUCTION  
DIESEL GENERATOR STATION 5  
CROSS SECTION  
STRUCTURAL

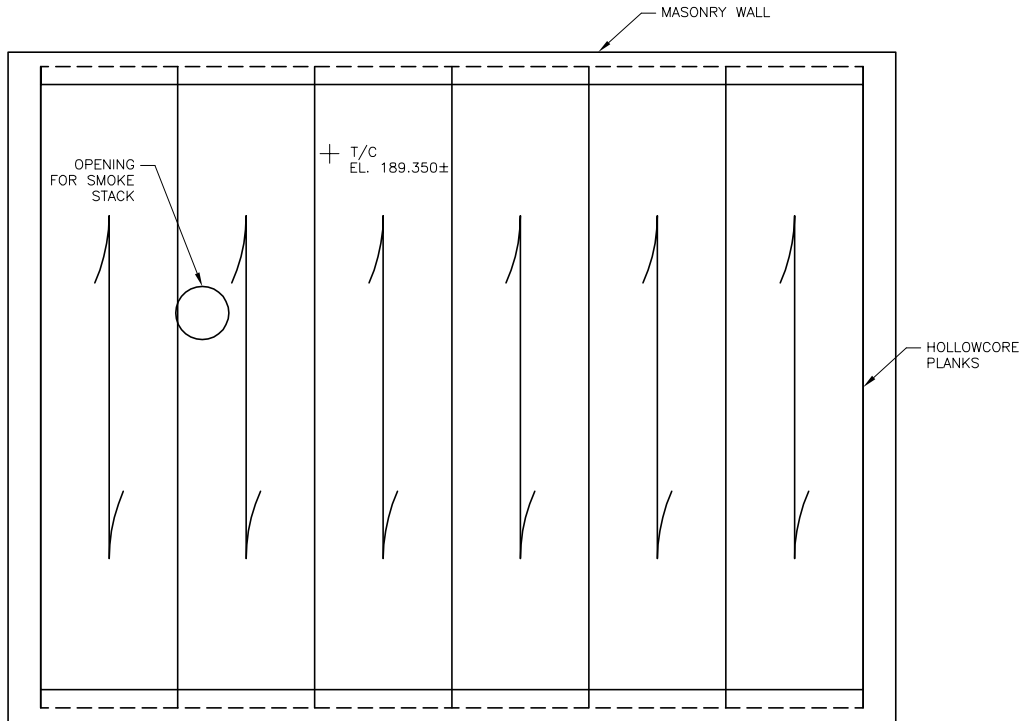


SHEET  
S5002

Phase 1  
90% Sub



DIESEL GENERATOR NO. 5 SECTION A-A  
SCALE 1:50



DIESEL GENERATOR NO. 5 ROOF PLAN AT EL. 189.350  
SCALE 1:50

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100mm ON ORIGINAL DRAWING

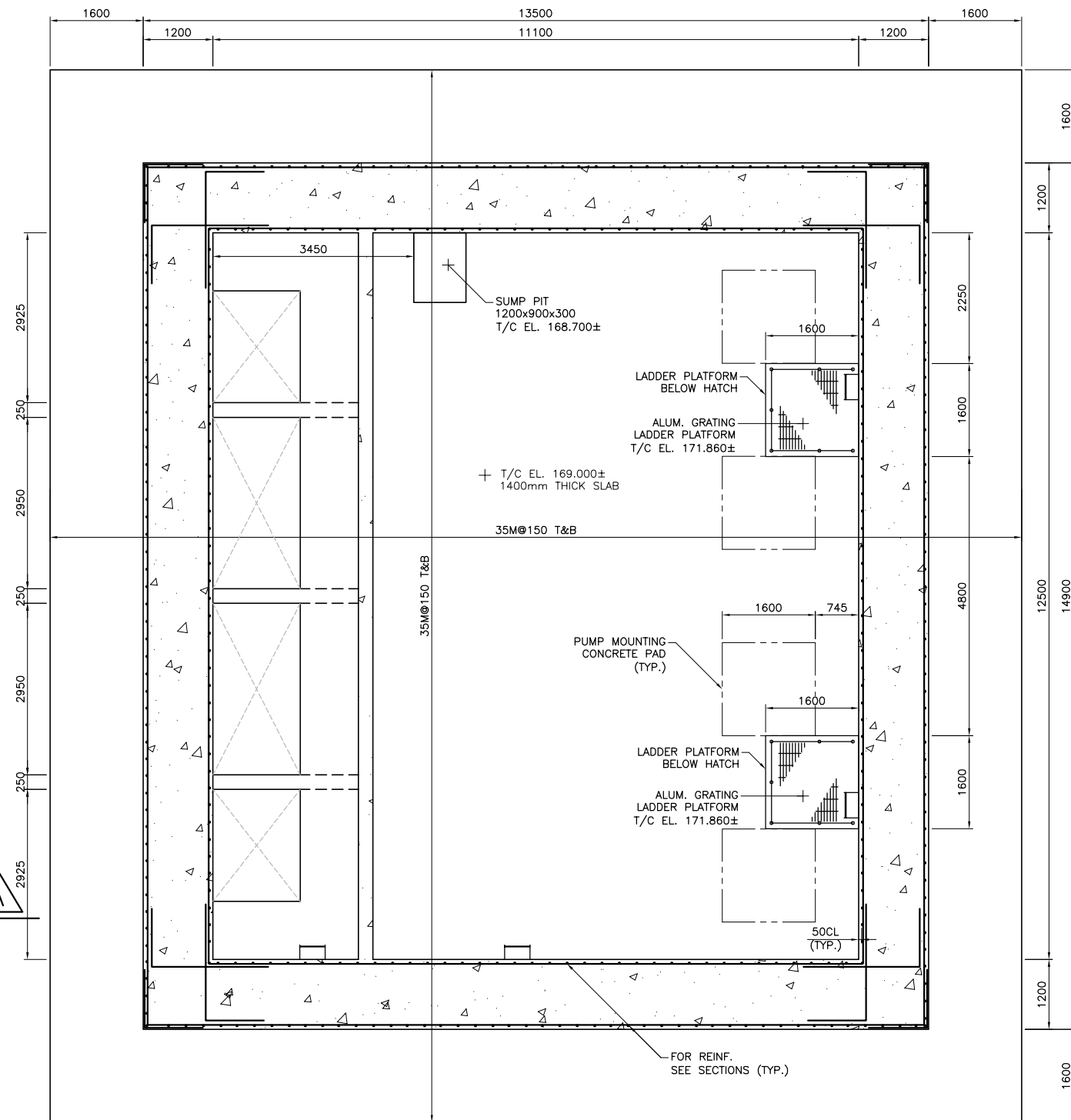
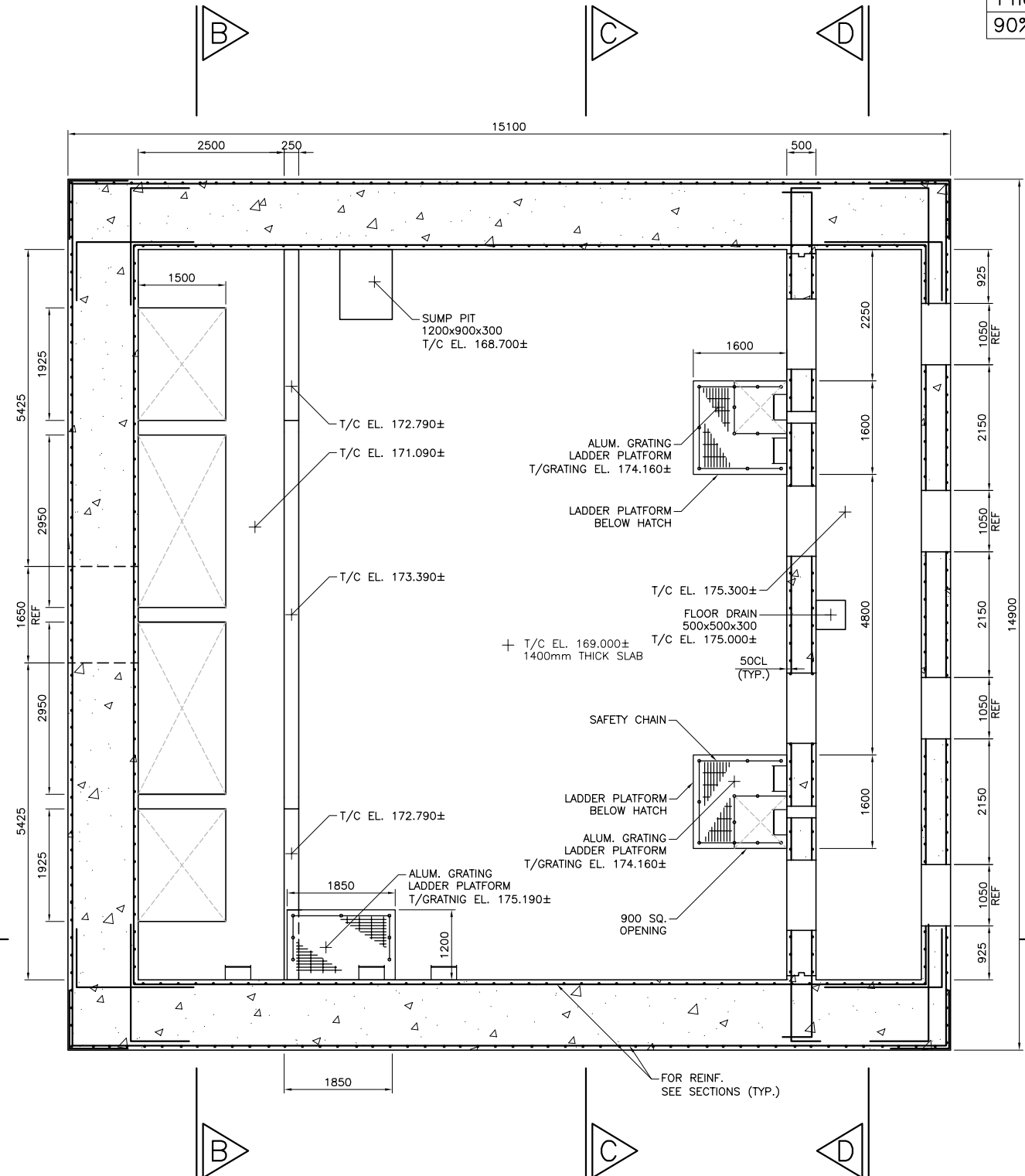
NOT FOR  
CONSTRUCTION

REVISIONS			
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DATE	REV.	BY	DESCRIPTION
DESIGN MW/AK	CHK JM	CODE CHBDC	00000 LOAD
DRAWN AK	CHK MW	SITE xxx-xxxx	DATE 11-JAN-12



READY FOR CHECK		
SUBMISSION: 90% Interim IDR		
NAME (PRINT)	DATE	
CADD TECHNICIAN	Kyle Guglielmo	Aug. 30/12
ORIGINATOR	Jahangir Chowdhury	Aug. 30/12

## METRIC

DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWNParkway  
Infrastructure  
EngineersWindsor-Essex  
Parkway Project  
RFP No. 09-54-1007NEW CONSTRUCTION  
PUMP STATION 6  
FOUNDATION AND MID-LEVEL PLANS  
STRUCTURALSHEET  
S6001Phase 1  
90% SubFOUNDATION PLAN PUMP STATION NO. 6 EL. 171.980  
SCALE 1:50PLAN PUMP STATION NO. 6 EL. 176.800  
SCALE 1:50DRAWING NOT TO BE SCALED  
100mm ON ORIGINAL DRAWINGNOT FOR  
CONSTRUCTION

REVISIONS		DATE	REV.	BY	DESCRIPTION
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		11-JAN-12	A	MW	60% MTO SUBMISSION
		DATE	REV.	BY	DESCRIPTION
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DRAWN	AK	CHK	MW	SITE	xxx-xxxx DATE 30-AUG-12

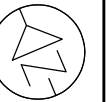
READY FOR CHECK		
SUBMISSION: 90% Interim IDR		
CADD TECHNICIAN	Kyle Guglielmo	Aug. 30/12
ORIGINATOR	Jahangir Chowdhury	Aug. 30/12

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

Parkway  
Infrastructure  
Engineers



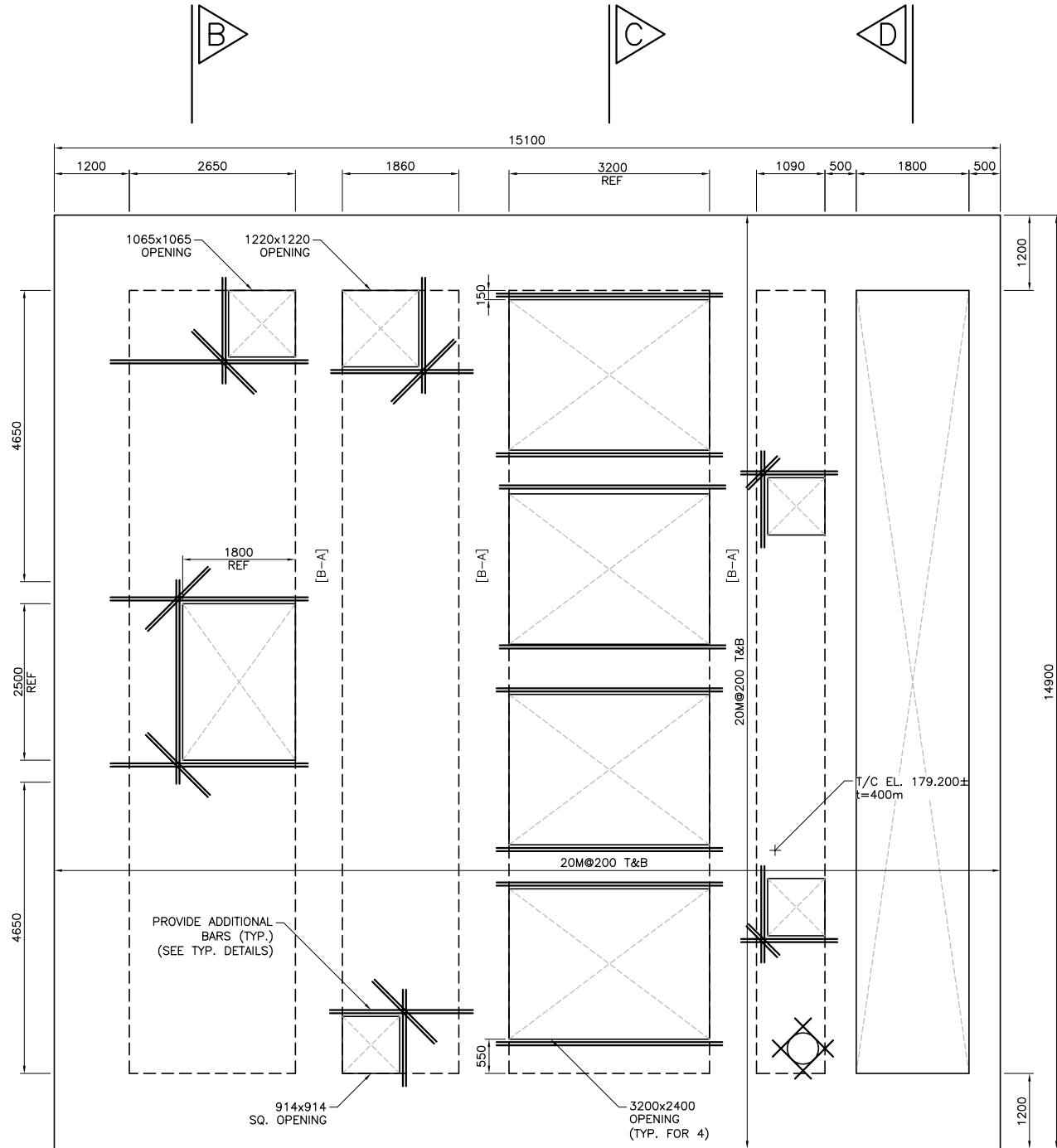
Windsor-Essex  
Parkway Project  
RFP No. 09-54-1007



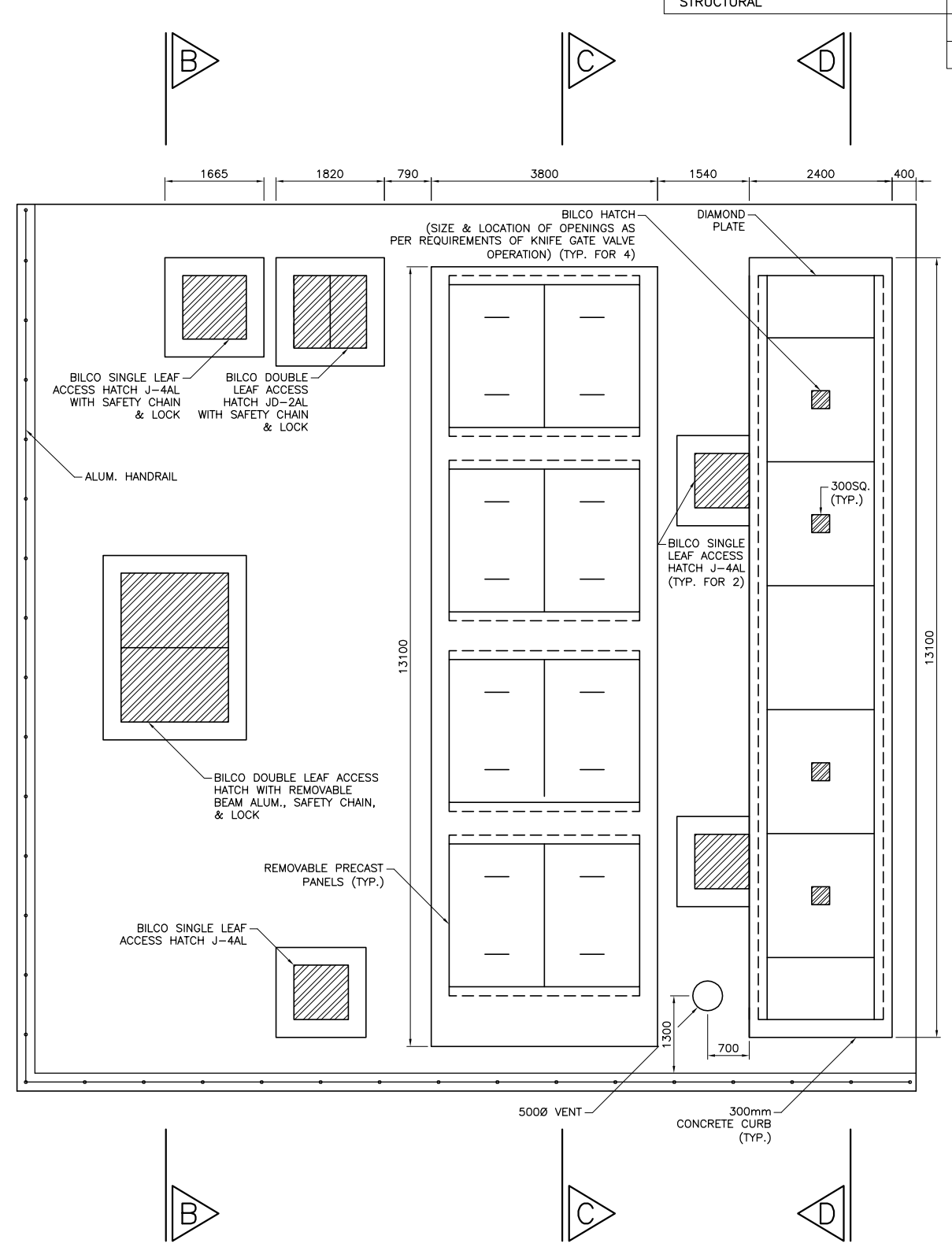
NEW CONSTRUCTION  
PUMP STATION 6  
UPPER LEVEL AND ROOF PLANS  
STRUCTURAL

SHEET  
S6002

Phase 1  
90% Sub



TOP SLAB PUMP STATION NO. 6 EL. 179.200  
SCALE 1:50



CURB PLAN PUMP STATION NO. 6 EL. 179.700  
SCALE 1:50

DRAWING NOT TO BE SCALED  
100mm ON ORIGINAL DRAWING

NOT FOR  
CONSTRUCTION

REVISIONS		DATE	REV.	BY	DESCRIPTION
30-AUG-12	B1	MW			90% IDR SUBMISSION
11-JAN-12	A	MW			60% MTO SUBMISSION
DESIGN MW/MK CHK JM CODE CHBDC 00000/LOAD					
DRAWN AK CHK MW SITE xxx-xxxx DATE 30-AUG-12					



DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

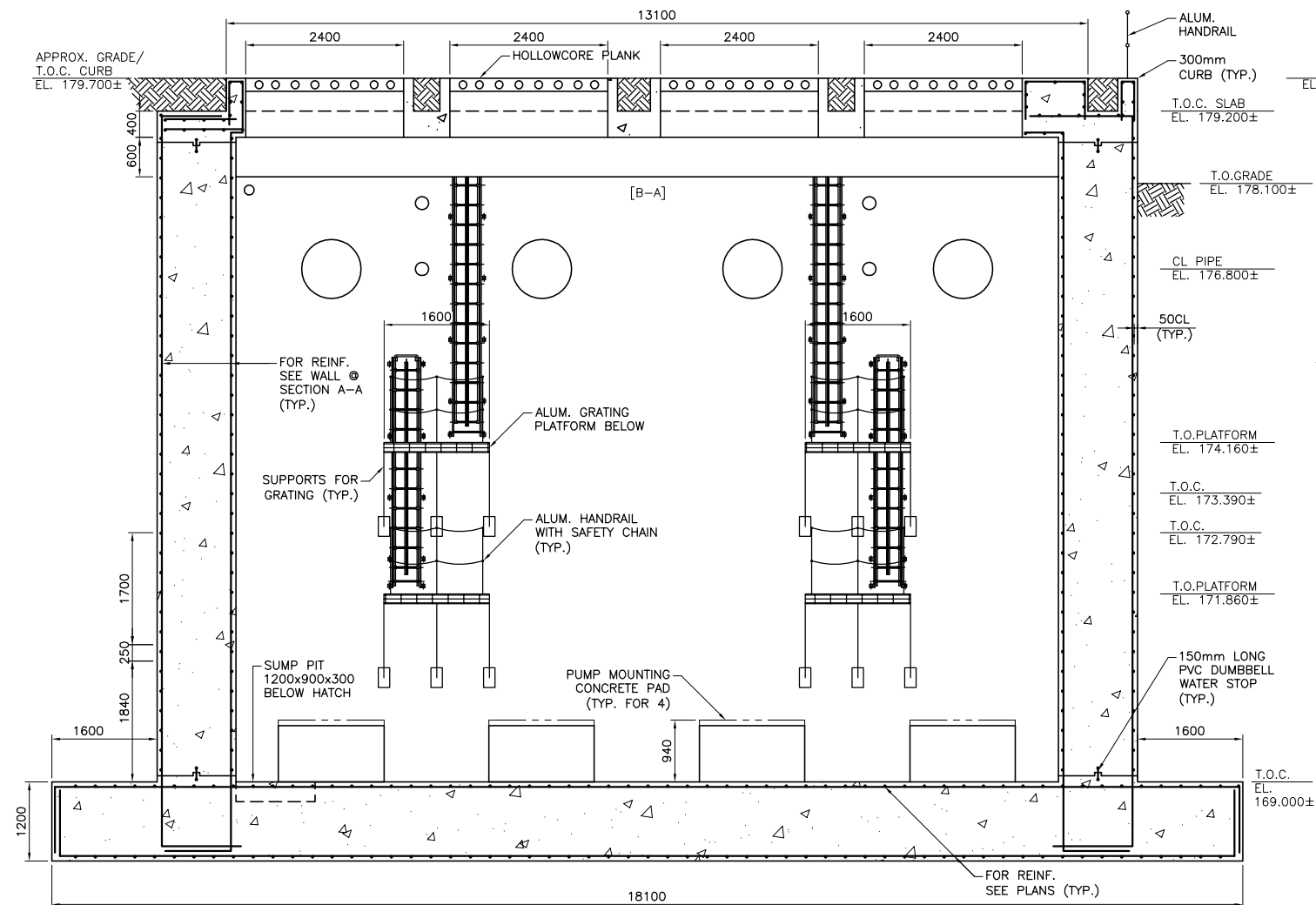


**Hatch Mott  
MacDonald**

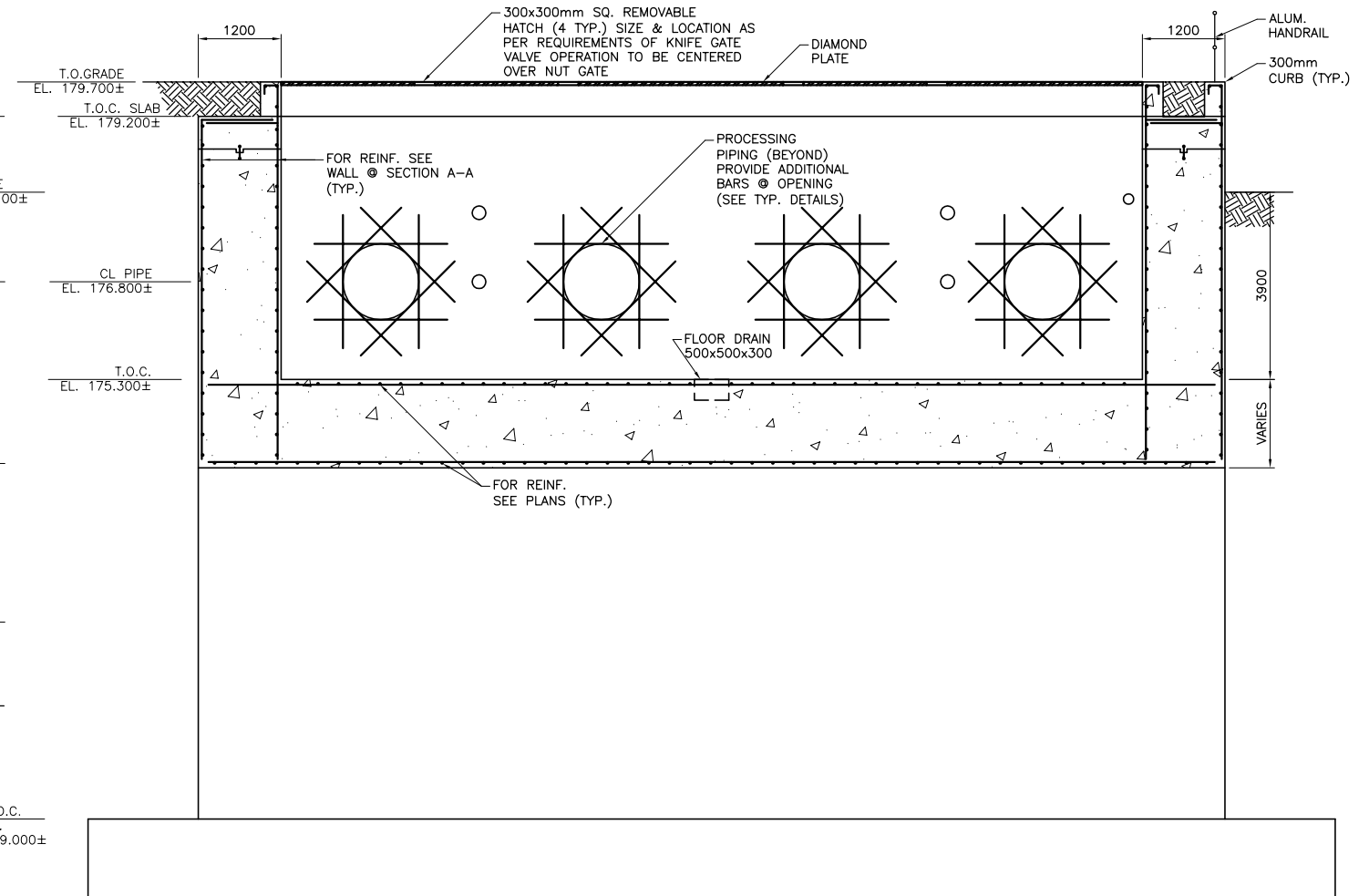
SHEET  
S6004

Phase 1
100% Sub

	READY FOR CHECK	
	SUBMISSION: 90% Interim IDR	
	NAME (PRINT)	DATE
CADD TECHNICIAN	Kyle Guglielmo	Aug. 30/12
ORIGINATOR	Jahangir Chowdhury	Aug. 30/12



SECTION C-C PUMP STATION NO. 6  
SCALE 1:50



SECTION D-D PUMP STATION NO. 6  
SCALE 1:50

100mm ON ORIGINAL DRAWING

NOT FOR  
CONSTRUCTION

[illegible]

DOC: 285380-03-071-SEG1-0005

PR-D-707 88-05

MINISTRY OF TRANSPORTATION, ONTARIO

DATE PLOTTED: 11/5/2012 1:30:16 PM  
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READY FOR CHECK		
SUBMISSION:		
	NAME (PRINT)	DATE
CADD TECHNICIAN		
ORIGINATOR		

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

Parkway  
Infrastructure  
Engineers



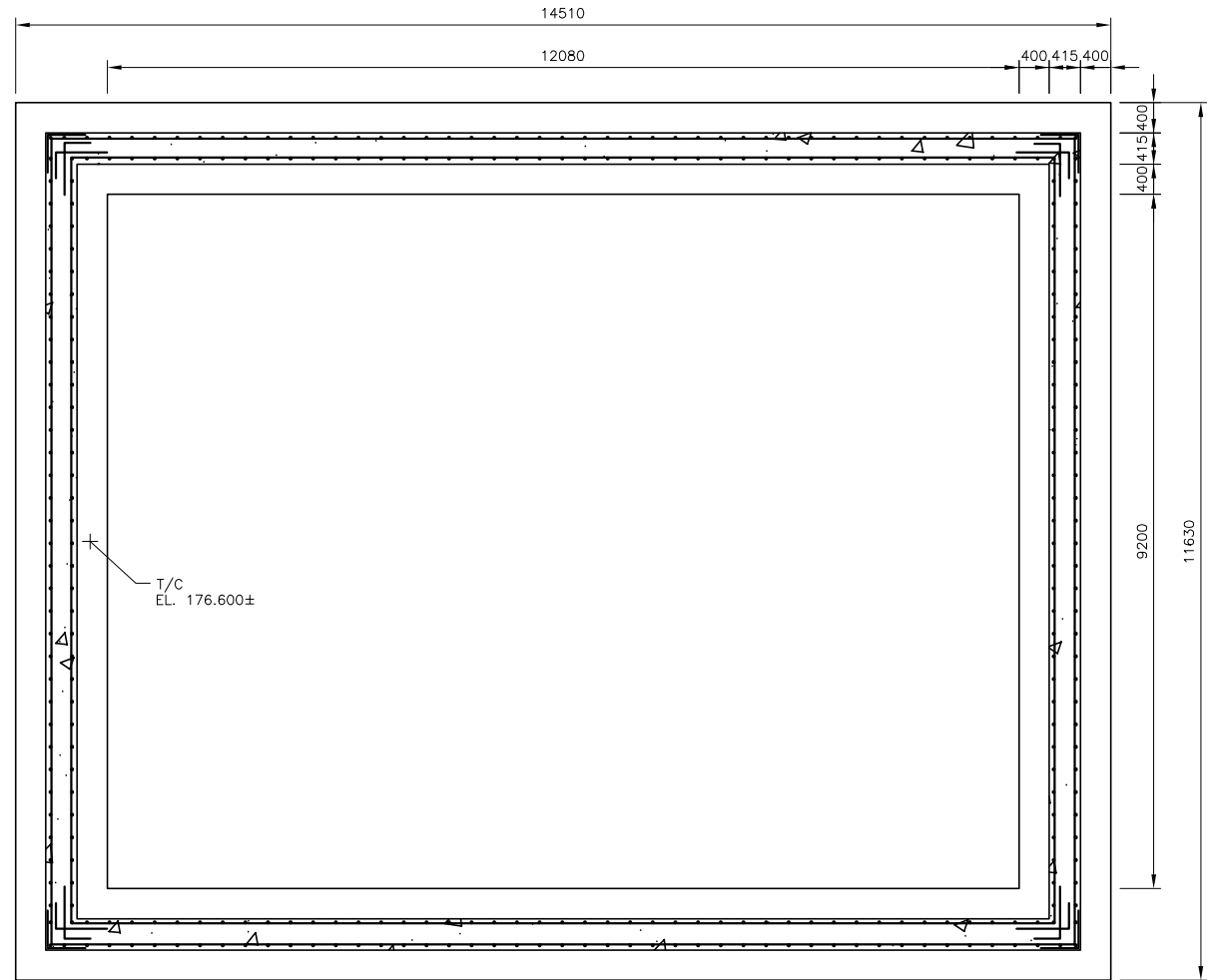
Windsor-Essex  
Parkway Project  
RFP No. 09-54-1007

NEW CONSTRUCTION  
DIESEL GENERATOR 6  
FOUNDATION AND GROUND PLANS  
STRUCTURAL

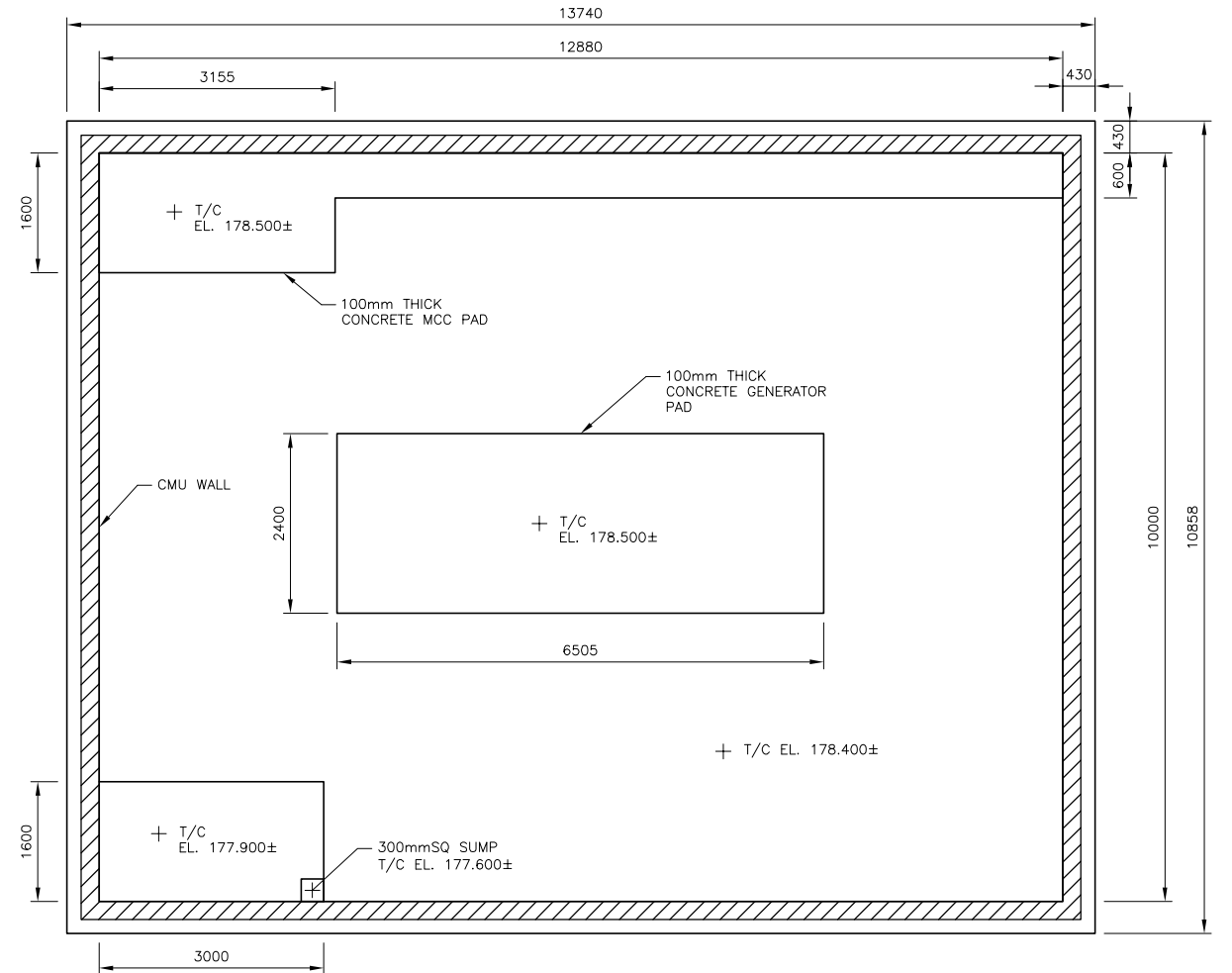


SHEET  
S6005

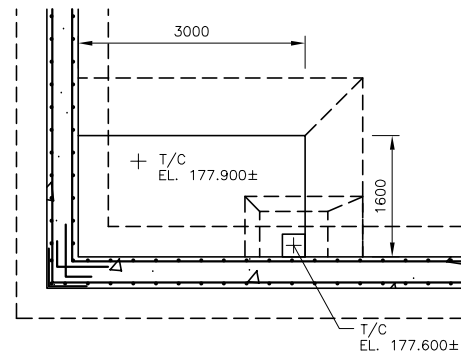
90% Sub



DIESEL GENERATOR NO. 6 FOUNDATION AT EL. 177.200  
SCALE 1:50



DIESEL GENERATOR NO. 6 GROUND FLOOR PLAN AT EL. 179.000  
SCALE 1:50



DIESEL GENERATOR NO. 6 PARTIAL PLAN AT EL. 178.400  
SCALE 1:50

DRAWING NOT TO BE SCALED  
100mm ON ORIGINAL DRAWING

NOT FOR  
CONSTRUCTION

REVISIONS		DATE	REV.	BY	DESCRIPTION
30-AUG-12	A1	MW	90% IDR SUBMISSION		
DESIGN	MW/M	CHK	JM	CODE	CHBDC 00000/LOAD
DRAWN	AK	CHK	MW	SITE	xxx-xxxx DATE 30-AUG-12

READY FOR CHECK		
SUBMISSION: 90% Interim IDR		
	NAME (PRINT)	DATE
CADD TECHNICIAN	Rosaura Pangan	Apr 30/12
ORIGINATOR	Jahangir Chowdhury	Apr 27/12

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

Parkway  
Infrastructure  
Engineers



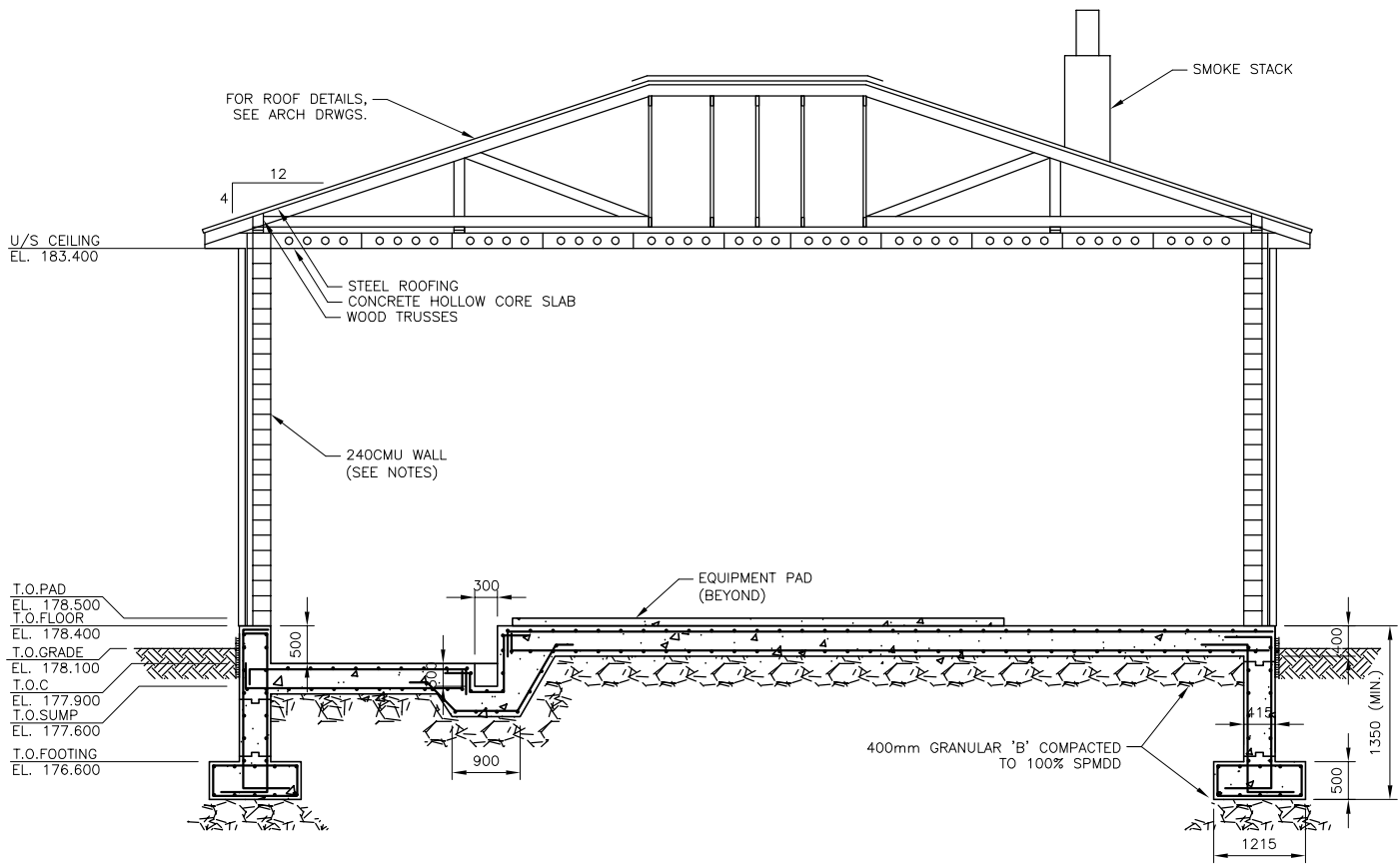
Windsor-Essex  
Parkway Project  
RFP No. 09-54-1007

NEW CONSTRUCTION  
DIESEL GENERATOR 6  
ROOF PLAN AND BUILDING SECTION  
STRUCTURAL



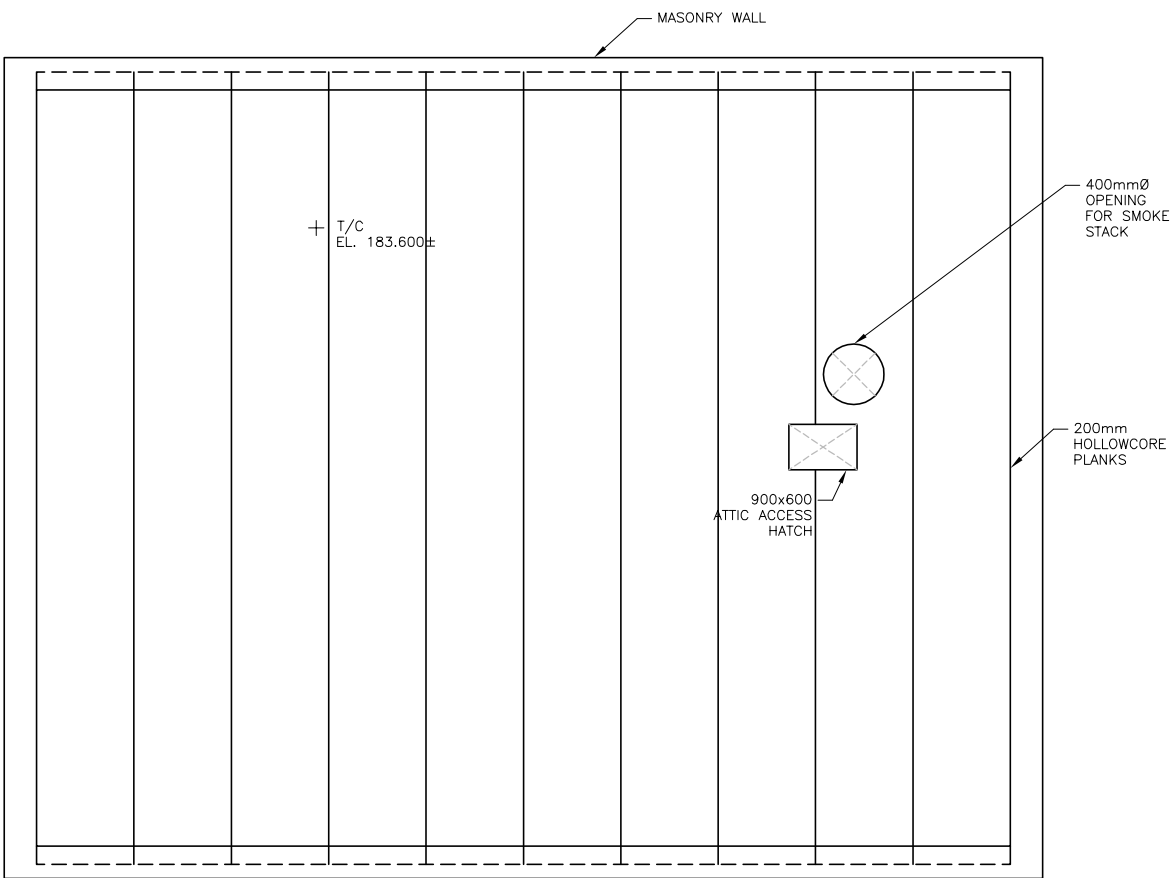
SHEET  
S6006

90% Sub



DIESEL GENERATOR NO. 6 SECTION A-A  
SCALE 1:50

- NOTE:
1. CMU WALL TO BE 20MPa, WITH TYPE "S" MORTAR.
  2. 2 CORES GROUTED PER 800mm & REINFORCED WITH 15M@400.
  3. BACKFILL UNDER GENERATOR BUILDING TO BE GRANULAR B, COMPACTED TO 100% SPMD IN LIFTS OF 100mm OR LESS.



DIESEL GENERATOR NO. 6 ROOF PLAN AT EL. 183.600  
SCALE 1:50

DRAWING NOT TO BE SCALED  
100mm ON ORIGINAL DRAWING

NOT FOR  
CONSTRUCTION

REVISIONS		DATE	REV.	BY	DESCRIPTION
30-AUG-12	A1	MW	90% IDR SUBMISSION		
DESIGN	MW/M	CHK	JM	CODE	CHBDC 00000/LOAD
DRAWN	AK	CHK	MW	SITE	xxx-xxxx DATE 30-AUG-12



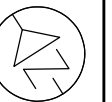
**METRIC**  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

**Parkway  
Infrastructure  
Engineers**



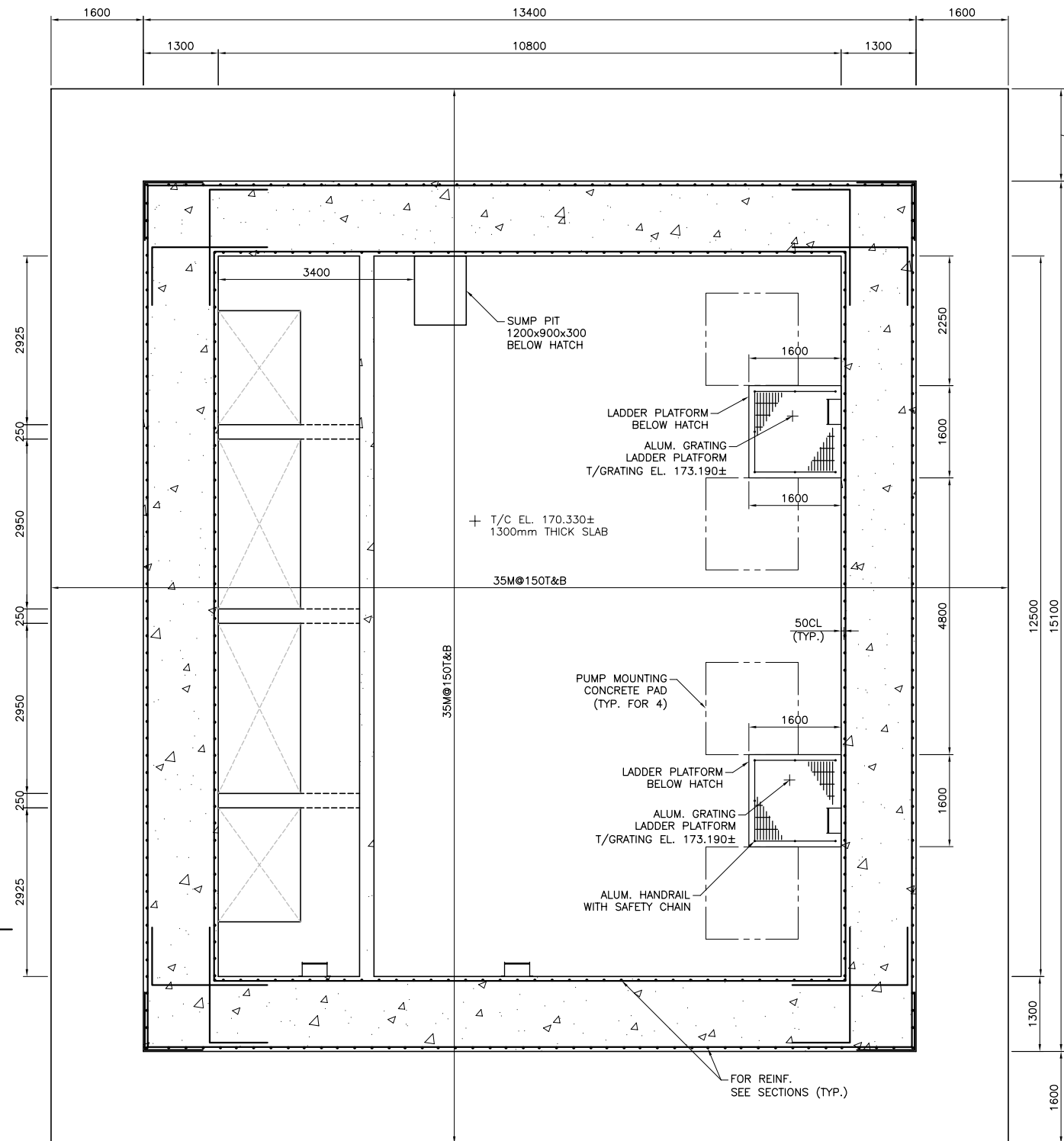
Windsor-Essex  
Parkway Project  
RFP No. 09-54-1007

NEW CONSTRUCTION  
PUMP STATION 7  
FOUNDATION AND MID LEVEL PLANS  
STRUCTURAL

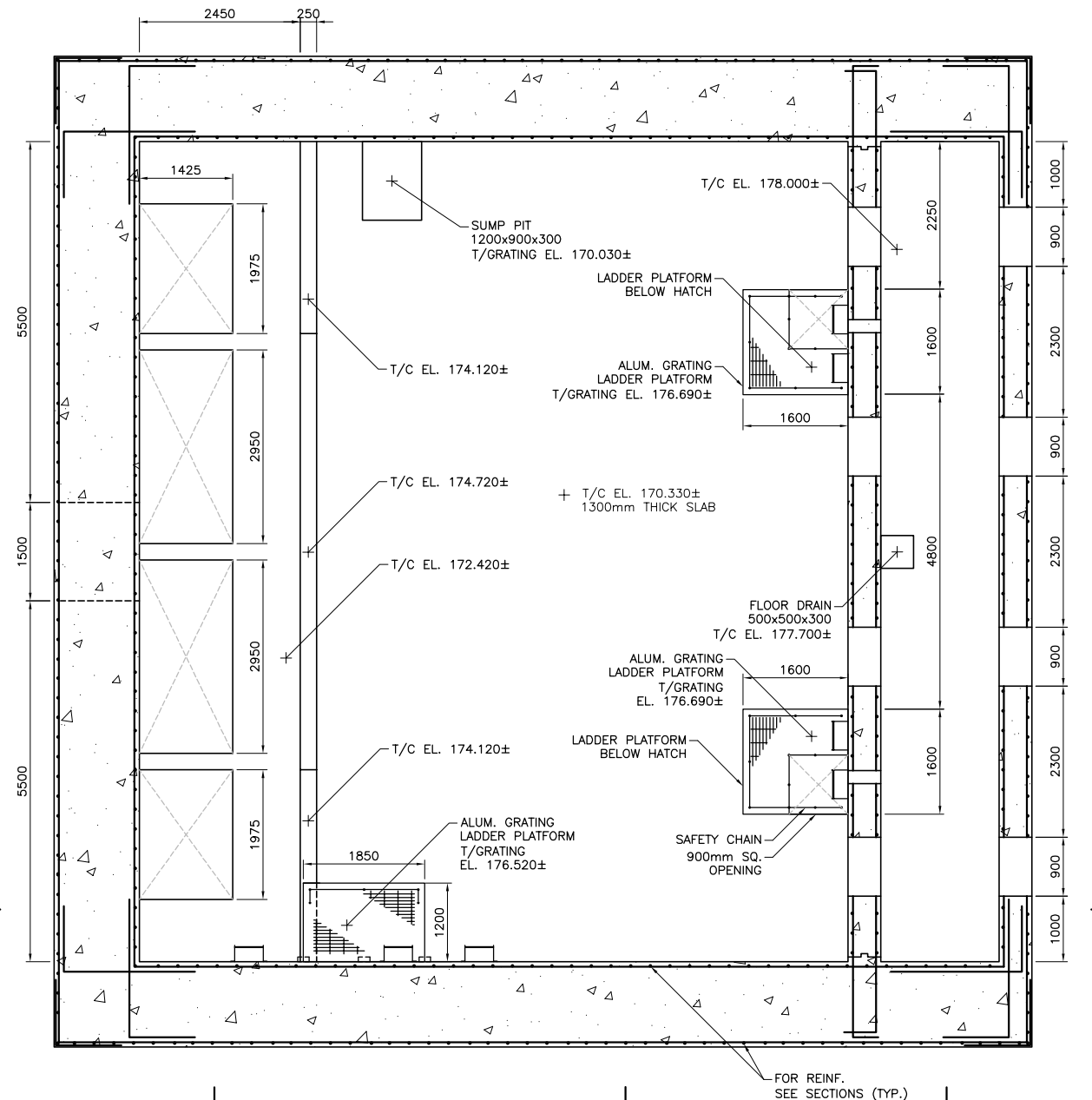


SHEET  
S7001

Phase 1  
90% Sub



FOUNDATION PLAN PUMP STATION NO. 7 EL. 173.190  
SCALE 1:50



PLAN PUMP STATION NO. 7 EL. 179.300  
SCALE 1:50

DRAWING NOT TO BE SCALED  
100mm ON ORIGINAL DRAWING

**NOT FOR  
CONSTRUCTION**

REVISIONS	DATE	REV.	BY	DESCRIPTION
	30-AUG-12	B1	MW	90% IDR SUBMISSION
	11-JAN-12	A	MW	60% MTO SUBMISSION
DESIGN	MW/AK	CHK	JM	CODE CHBDC 00000/LOAD xx-xxx-xxx
DRAWN	AK	CHK	MW	SITE xxx-xxxx DATE 30-AUG-12

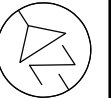
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DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

**Parkway  
Infrastructure  
Engineers**



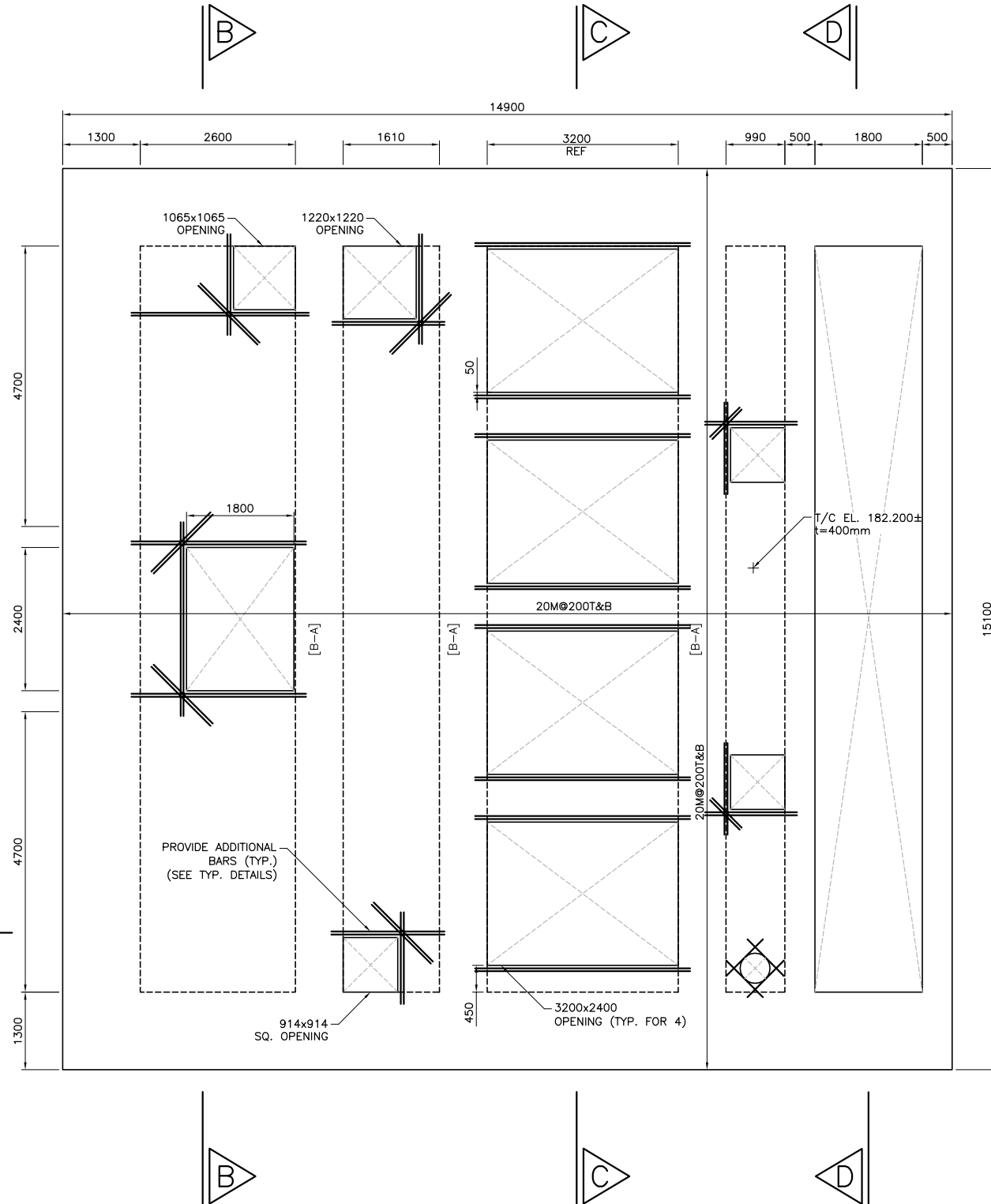
Windsor-Essex  
Parkway Project  
RFP No. 09-54-1007



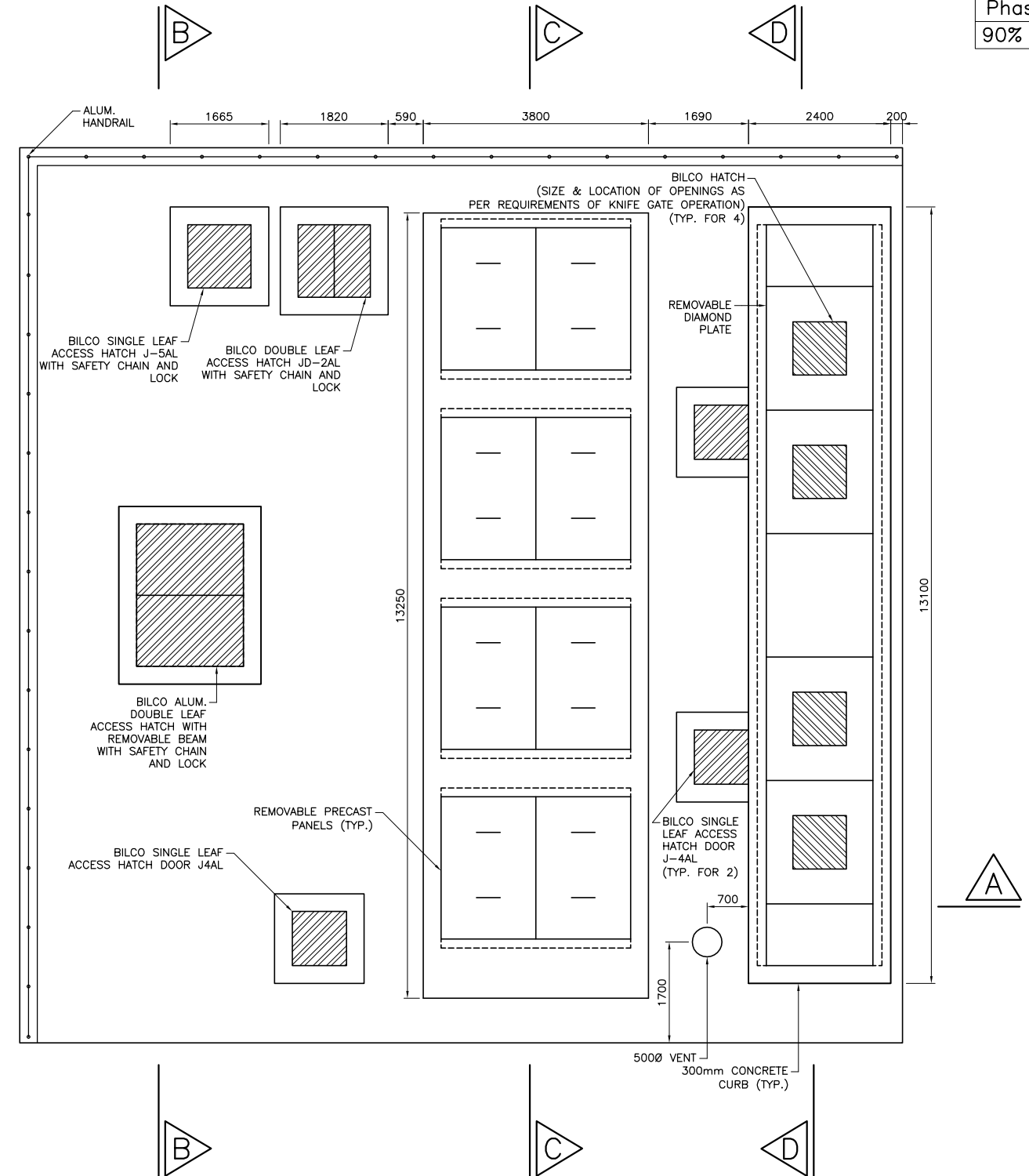
NEW CONSTRUCTION  
PUMP STATION 7  
UPPER LEVEL AND ROOF PLANS  
STRUCTURAL

SHEET  
S7002

Phase 1  
90% Sub



TOP SLAB PLAN PUMP STATION NO. 7 EL. 182.200  
SCALE 1:50



CURB PLAN PUMP STATION NO. 7 EL. 182.700  
SCALE 1:50

DRAWING NOT TO BE SCALED  
100mm ON ORIGINAL DRAWING

NOT FOR  
CONSTRUCTION

REVISIONS		DATE	REV.	BY	DESCRIPTION
		30-AUG-12	B1	MW	90% IDR SUBMISSION
		11-JAN-12	A	MW	60% MTO SUBMISSION
		DATE	REV.	BY	DESCRIPTION
DESIGN	MW/K	CHK	JM	CODE	CHBDC 00000
DRAWN	AK	CHK	MW	SITE	xxx-xxxx
					LOAD xx-xxx-xxx
					DATE 30-AUG-12

# METRIC

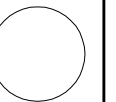
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

**Parkway  
Infrastructure  
Engineers**



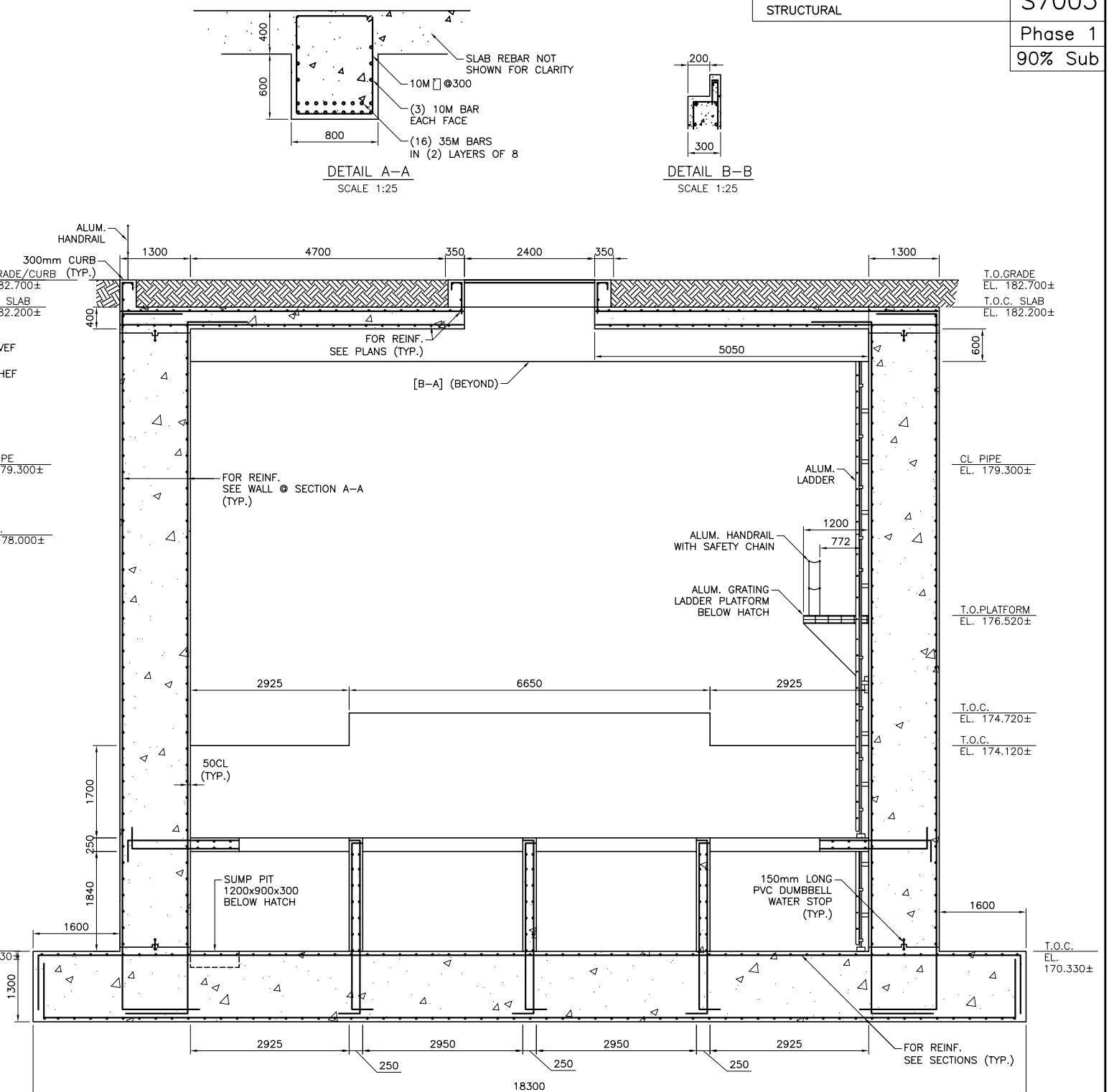
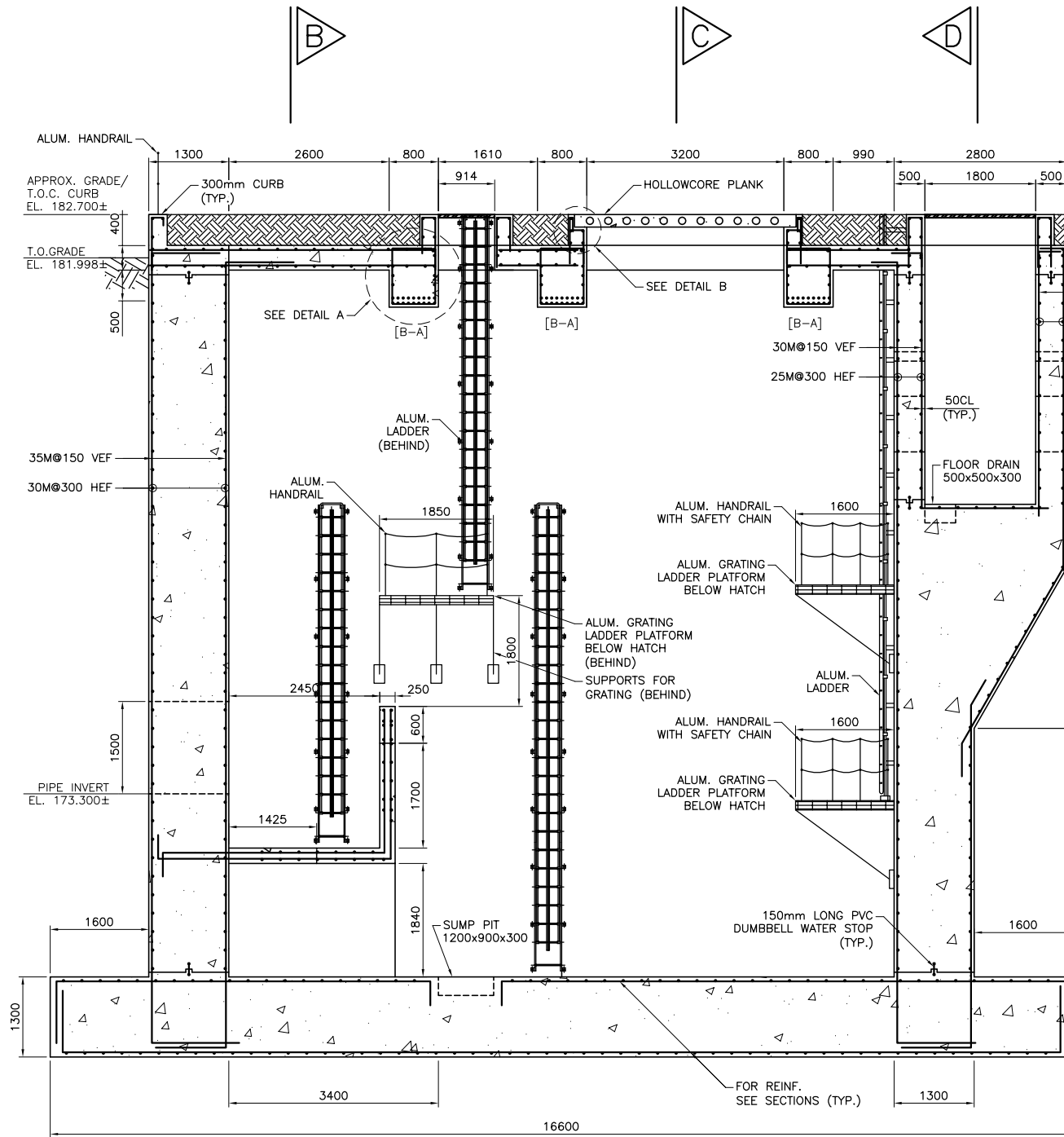
Windsor-Essex  
Parkway Project  
RFP No. 09-54-1007

NEW CONSTRUCTION  
PUMPING STATION 7  
SECTIONS A-A & B-B  
STRUCTURAL



SHEET  
S7003

Phase 1  
90% Sub



DETAIL A-A  
SCALE 1:25

DETAIL B-B  
SCALE 1:25

DRAWING NOT TO BE SCALED  
100mm ON ORIGINAL DRAWING

**NOT FOR  
CONSTRUCTION**

REVISIONS	DATE	REV.	BY	DESCRIPTION
	30-AUG-12	B1	MW	90% IDR SUBMISSION
	11-JAN-12	A	MW	60% MTO SUBMISSION
DESIGN	MW/K	CHK	JM	CODE CHBDC 00000/LOAD xx-xxx-xxx
DRAWN	AK	CHK	MW	SITE xxx-xxxx DATE 30-AUG-12



READY FOR CHECK		
SUBMISSION: 90% Interim IDR		
	NAME (PRINT)	DATE
CADD TECHNICIAN	Rosauro Pangan	Apr 30/12
ORIGINATOR	Jahangir Chowdhury	Apr 27/12

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

Parkway  
Infrastructure  
Engineers



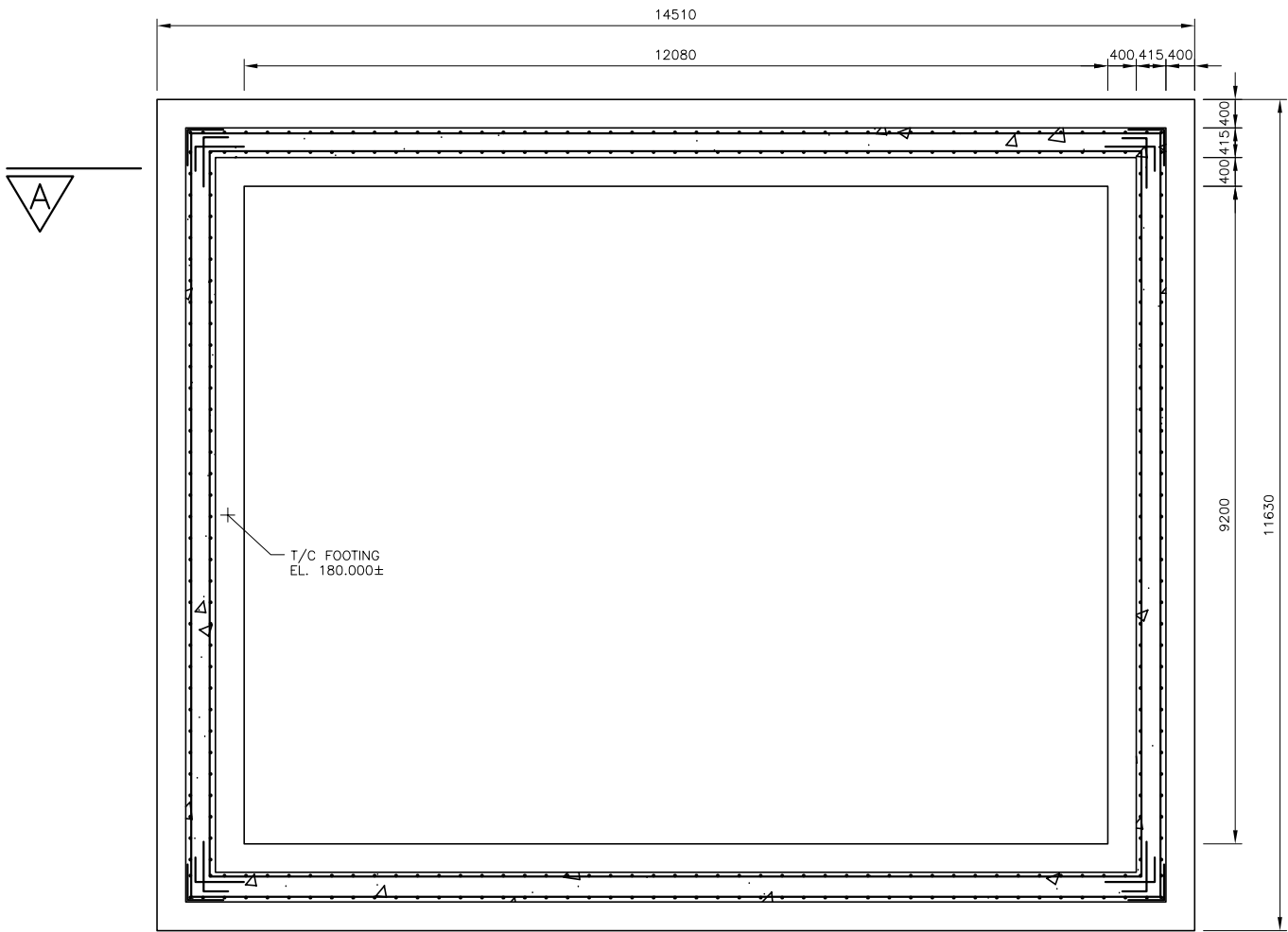
Windsor-Essex  
Parkway Project  
RFP No. 09-54-1007

NEW CONSTRUCTION  
DIESEL GENERATOR BUILDING 7  
FOUNDATION AND GROUND FLOOR PLANS  
STRUCTURAL

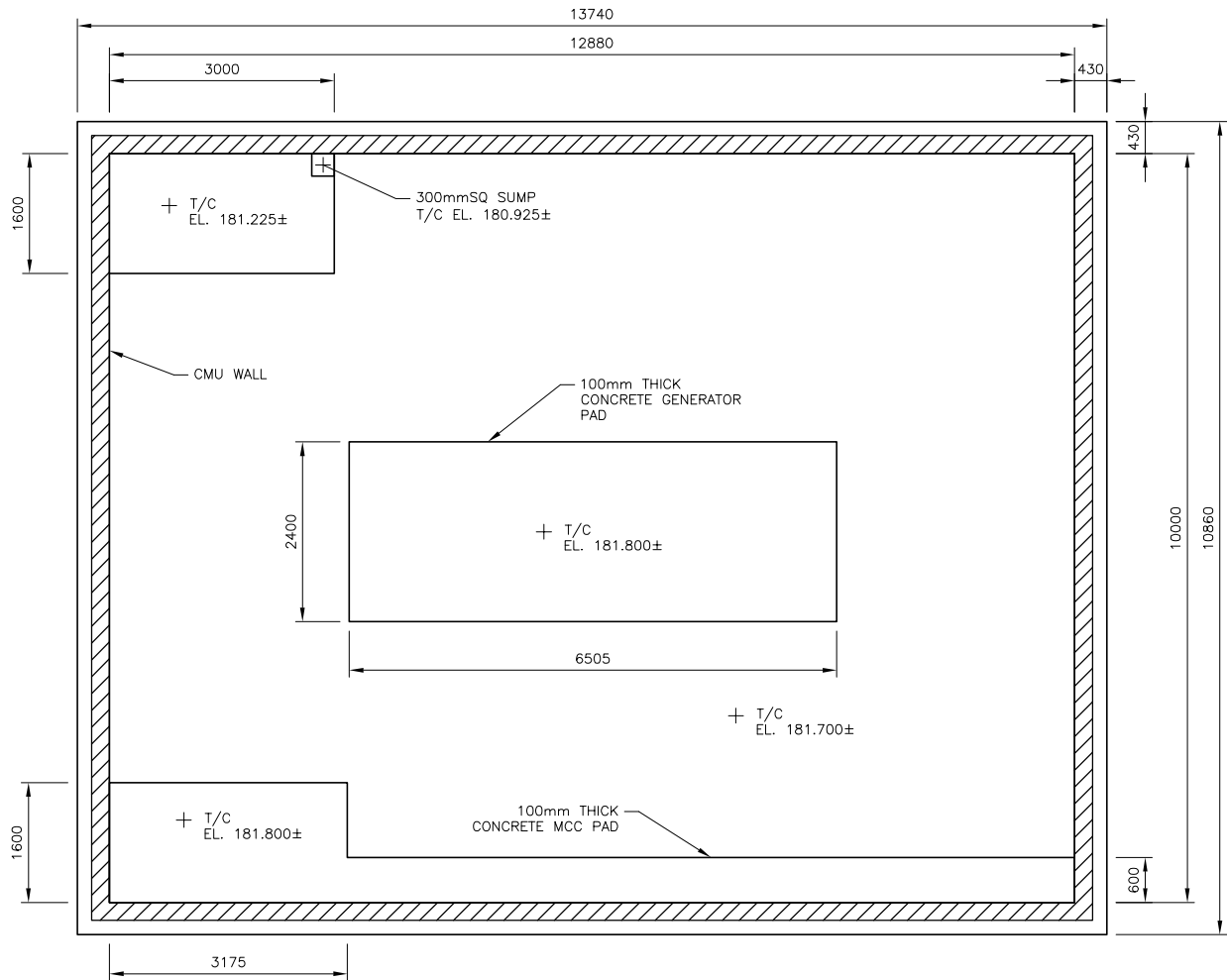


SHEET  
S7005

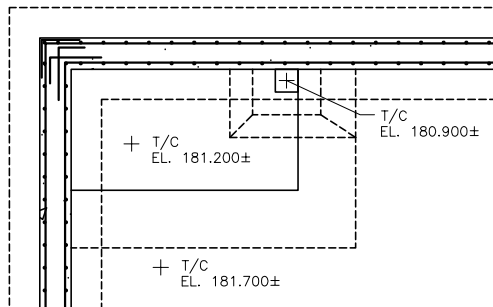
90% Sub



DIESEL GENERATOR NO. 7 FOUNDATION PLANS AT EL. 180.600  
SCALE 1:50



DIESEL GENERATOR NO. 7 GROUND FLOOR PLAN AT EL. 181.900  
SCALE 1:50



DIESEL GENERATOR NO. 7 PARTIAL PLANS AT EL. 181.700±  
SCALE 1:50

DRAWING NOT TO BE SCALED  
100mm ON ORIGINAL DRAWING

NOT FOR  
CONSTRUCTION

REVISIONS		DATE	REV.	BY	DESCRIPTION
30-AUG-12		A1	MW		90% IDR SUBMISSION
DESIGN	MW/AK	CHK	JM	CODE	CHBDC 00000
DRAWN	AK	CHK	MW	SITE	xxx-xxxx
		DATE	30-AUG-12		

READY FOR CHECK		
SUBMISSION: 90% Interim IDR		
NAME (PRINT)		DATE
CADD TECHNICIAN	Rosaura Pangan	Apr 30/12
ORIGINATOR	Jahangir Chowdhury	Apr 27/12

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

Parkway  
Infrastructure  
Engineers



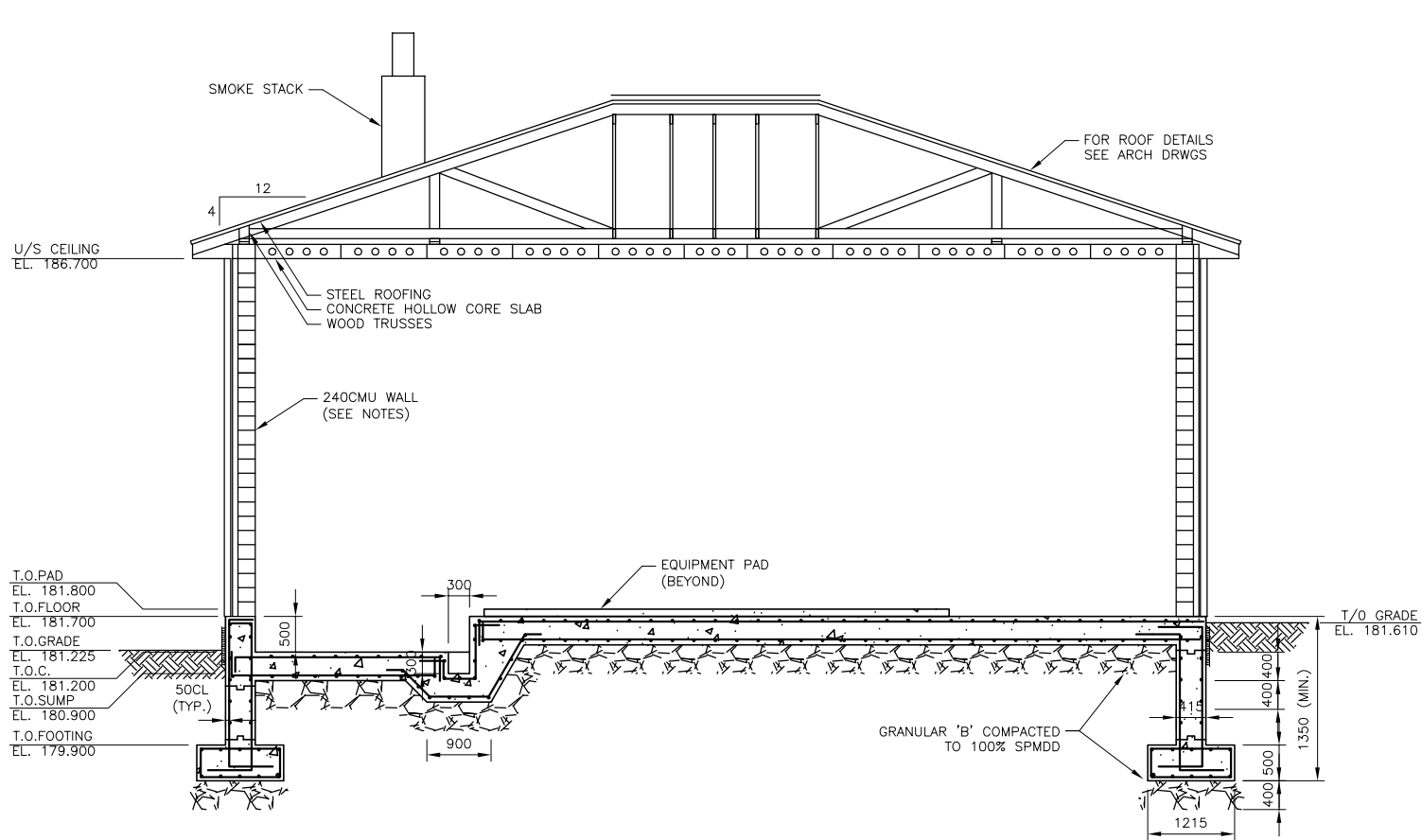
Windsor-Essex  
Parkway Project  
RFP No. 09-54-1007

NEW CONSTRUCTION  
DIESEL GENERATOR BUILDING 7  
ROOF PLAN AND BUILDING SECTION  
STRUCTURAL



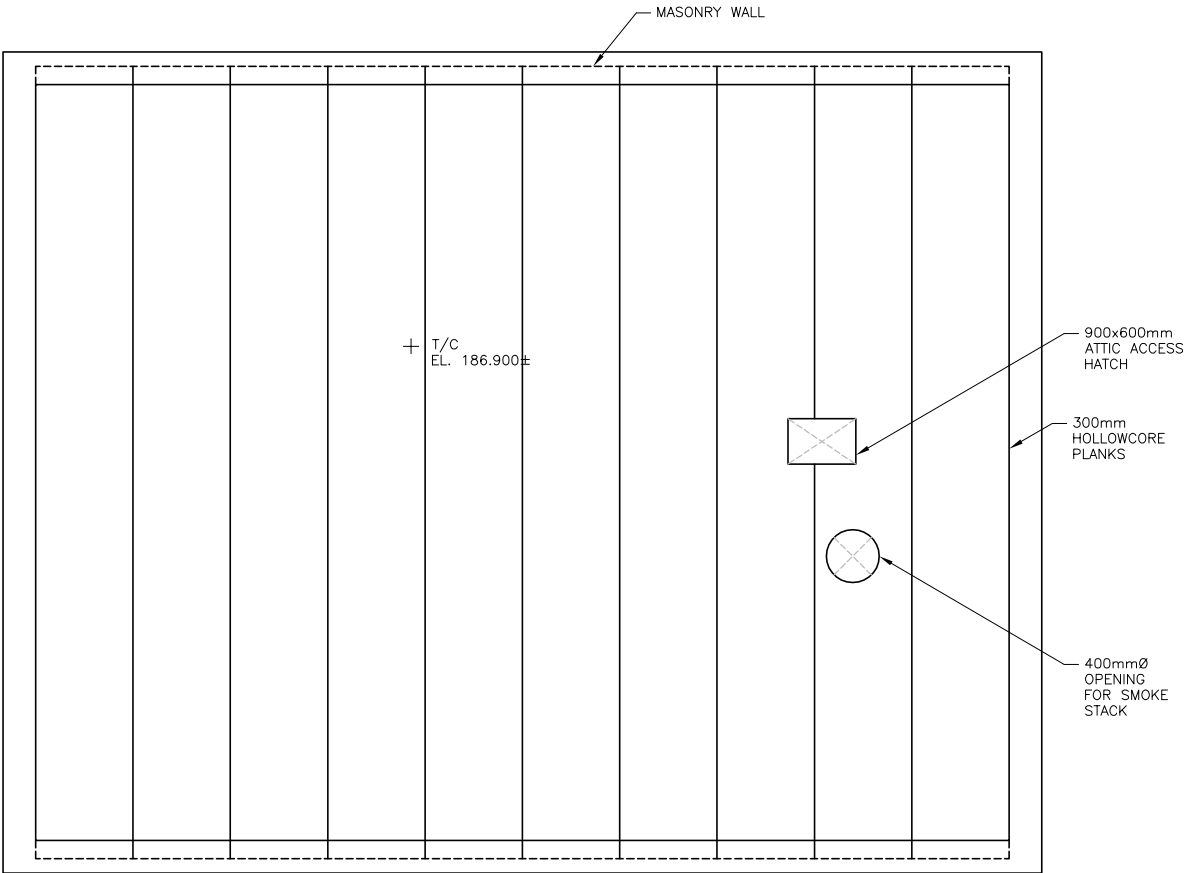
SHEET  
S7006

90% Sub



DIESEL GENERATOR NO. 7 SECTION A-A  
SCALE 1:50

- NOTE:
1. CMU WALL TO BE 20MPa, WITH TYPE "S" MORTAR.
  2. 2 CORES GROUTED PER 800mm & REINFORCED WITH 15M@400.
  3. BACKFILL UNDER GENERATOR BUILDING TO BE GRANULAR B, COMPACTED TO 100% SPMD IN LIFTS OF 100mm OR LESS.



DIESEL GENERATOR NO. 7 ROOF PLAN AT EL. 186.900  
SCALE 1:50

DRAWING NOT TO BE SCALED  
100mm ON ORIGINAL DRAWING

NOT FOR  
CONSTRUCTION

REVISIONS									
	30-AUG-12	A1	MW	90% IDR SUBMISSION					
	DATE	REV.	BY	DESCRIPTION					
	DESIGN MW/K	CHK JM	CODE CHBDC	00000	LOAD	xx-xxx-xxx			
	DRAWN AK	CHK MW	SITE	xxx-xxxx	DATE	30-AUG-12			



## **Appendix B      Borehole Logs from Geotechnical Investigations**

## EXPLANATION OF BOREHOLE LOG

This form describes some of the information provided on the borehole logs, which is based primarily on examination of the recovered samples, and the results of the field and laboratory tests. Additional description of the soil/rock encountered is given in the accompanying geotechnical report.

### GENERAL INFORMATION

Project details, borehole number, location coordinates and type of drilling equipment used are given at the top of the borehole log.

### SOIL LITHOLOGY

#### ***Elevation and Depth***

This column gives the elevation and depth of inferred geologic layers. The elevation is referred to the datum shown in the Description column.

#### ***Lithology Plot***

This column presents a graphic depiction of the soil and rock stratigraphy encountered within the borehole.

#### ***Description***

This column gives a description of the soil strata, based on visual and tactile examination of the samples augmented with field and laboratory test results. Each stratum is described according to the *MTC Soil Classification Manual*.

The compactness condition of cohesionless soils (SPT) and the consistency of cohesive soils (undrained shear strength) are defined as follows (Ref. *MTC Soil Classification Manual*):

<b>Compactness of Cohesionless Soils</b>	<b>SPT N-Value*</b>
Very loose	0 to 5
Loose	5 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	> 50

<b>Consistency of Cohesive Soils</b>	<b>Undrained Shear Strength kPa</b>
Very soft	0 to 12
Soft	12 to 25
Firm	25 to 50
Stiff	50 to 100
Very stiff	100 to 200
Hard	Over 200

\* For penetration of less than 0.3 m, N-values are indicated as the number of blows for the penetration achieved (e.g. 50/25: 50 blows for 25 centimeter penetration).

### Soil Sampling

Sample types are abbreviated as follows:

SS Split Spoon	TW Thin Wall Open (Pushed)	RC Rock Core	GS Grab Sample
AS Auger Sample	TP Thin Wall Piston (Pushed)	WS Washed Sample	AR Air Return Sample

Additional information provided in this section includes sample numbering, sample recovery and numerical testing results.

### Field and Laboratory Testing

Results of field testing (e.g., SPT, pocket penetrometer, and vane testing) and laboratory testing (e.g., natural moisture content, and limits) executed on the recovered samples are plotted in this section.

### Instrumentation Installation

Instrumentation installations (monitoring wells, piezometers, inclinometers, etc.) are plotted in this section. Water levels, if measured during fieldwork, are also plotted. These water levels may or may not be representative of the static groundwater level depending on the nature of soil stratum where the piezometer tips are located, the time elapsed from installation to reading and other applicable factors.

### Comments

This column is used to describe non-standard situations or notes of interest.

## BEDROCK DESCRIPTION

### STRENGTH CLASSIFICATION

Term (Grade)	Field Identification	Approximate Range of Uniaxial Compressive Strength (MPa)
Extremely Weak (R0)	Indented by thumbnail.	0.25 – 1.0
Very Weak (R1)	Crumbles under firm blows with point of geological hammer, can be peeled by a pocket knife.	1.0 – 5.0
Weak (R2)	Can be peeled with a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer.	5.0 – 25
Medium Strong (R3)	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with a single firm blow of geological hammer.	25 – 50
Strong (R4)	Specimen requires more than one blow of geological hammer to fracture it.	50 – 100
Very Strong (R5)	Specimen requires many blows of geological hammer to fracture it.	100 – 250
Extremely Strong (R6)	Specimen can only be chipped with geological hammer.	>250

### JOINT SPACING CLASSIFICATION

Term	Average Joint Spacing (m)
Extremely close	< 0.02
Very close	0.02 – 0.06
Close	0.06 – 0.20
Moderately close	0.20 – 0.6
Wide	0.6 – 2.0
Very wide	2.0 – 6.0
Extremely wide	> 6.0

### ROCK QUALITY CLASSIFICATION

Rock Quality Designation, RQD (%)	Description of Rock Quality
0 – 25	Very Poor
25 – 50	Poor
50 – 75	Fair
75 – 90	Good
90 – 100	Excellent

Reference: Deere et al, 1967

### WEATHERING CLASSIFICATION

Term (Grade)	Description
Fresh (W1)	No visible sign of rock material weathering; perhaps slight discoloration on major discontinuity surfaces.
Slightly Weathered (W2)	Discoloration indicates weathering of rock material on discontinuity surfaces. Less than 5 % of rock mass altered.
Moderately Weathered (W3)	Less than half of the rock material is decomposed and/or disintegrated into a soil. Fresh or discoloured rock is present either as a continuous framework or as core stones.
Highly Weathered (W4)	More than half of the rock material is decomposed and/or disintegrated into a soil. Fresh or discoloured rock is present either as a discontinuous framework or as core stones.
Completely Weathered (W5)	All rock material is decomposed and/or disintegrated into soil. The original mass structure is still largely intact.
Residual Soil (W6)	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume but the soil has not been significantly transported.

Reference: Brown, 1981, "Suggested Methods for Rock Characterization Testing and Monitoring". International Society for Rock Mechanics.

### TERMINOLOGY

*Rock Quality Designation (RQD)* is defined as the percentage of intact core pieces longer than 100 mm (4 inches) to the total length of core. The core should be at least NW size (54.7 mm or 2.15 inches in diameter) and typically 5 ft (nominally 1.5 m) in length.

*Solid Core Recovery (SCR)* is defined as the percentage of intact cylindrical core pieces to the total length of core.

*Total Core Recovery (TCR)* is defined as the percentage of intact core pieces to the total length of core.

# MTC SOIL CLASSIFICATION

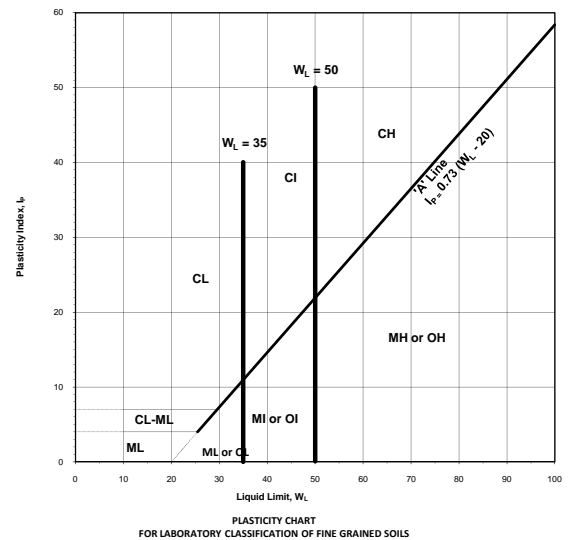
## Based on MTC Soil Classification Manual



MAJOR DIVISION					GROUP SYMBOL	TYPICAL DESCRIPTION	INFORMATION REQUIRED FOR DESCRIBING SOILS	LABORATORY CLASSIFICATION CRITERIA			
COARSE GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN 75µm)	GRAVELS MORE THAN HALF THE COARSE FRACTION LARGER THAN 4.75mm	CLEAN GRAVELS (LITTLE OR NO FINES)	WIDE RANGE IN GRAIN SIZE & SUBSTANTIAL AMOUNTS OF ALL INTERMEDIATE PARTICULAR SIZE		GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	GIVE TYPE, NAME, IF NECESSARY, INDICATE APPROX % OF SAND & GRAVEL ; MAX SIZE; ANGULARITY, SURFACE CONDITION, & HARDNESS OF THE COARSE GRAINS. LOCAL OR GEOLOGICAL NAME & OTHER PERTINENT DESCRIPTIVE INFORMATION, & SYMBOL IN PARENTHESIS.  FOR UNDISTURBED SOILS ADD INFORMATION ON STRATIFICATION, DEGREE OF COMPACTNESS, CEMENTATION, MOISTURE CONDITION & DRAINAGE CHARACTERISTICS	$C_u = \frac{D_{60}}{D_{10}}$  GREATER THAN 4;			
			PREDOMINANTLY ONE SIZE OF A RANGE OF SIZES WITH STONE INTERMEDIATE SIZES MISSING		GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES			$C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$  BETWEEN 1 AND 3		
		GRAVEL WITH FINES (APPLICABLE AMOUNT OF FINES)	NON PLASTIC FINES (FOR IDENTIFICATION PROCEDURES SEE ML BELOW)		GM	SILTY GRAVELS, POORLY GRADED GRAVEL-SAND- SILT MIXTURES					
			PLASTIC FINES (FOR IDENTIFICATION PROCEDURES SEE CL BELOW)		GC	CLAYEY GRAVELS, POORLY GRADED GRAVEL-SAND-CLAY MIXTURES					
	SANDS MORE THAN HALF THE COARSE FRACTION SMALLER THAN 4.75mm	CLEAN SANDS (LITTLE OR NO FINES)	WIDE RANGE IN GRAIN SIZE & SUBSTANTIAL AMOUNT OF ALL INTERMEDIATE PARTICLE SIZES		SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES		FOR UNDISTURBED SOILS ADD INFORMATION ON STRATIFICATION, DEGREE OF COMPACTNESS, CEMENTATION, MOISTURE CONDITION & DRAINAGE CHARACTERISTICS	NOT MEETING ALL GRADATION REQUIREMENTS FOR GW		
			PREDOMINANTLY ONE SIZE OR A RANGE OF SIZES WITH SOME INTERMEDIATE SIZE MISSING		SP	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES					
		SANDS WITH FINES (APPLICABLE AMOUNT OF FINES)	NON PLASTIC FINES (FOR IDENTIFICATION PROCEDURES SEE ML BELOW)		SM	SILTY SANDS, POORLY GRADED SAND-SILT MIXTURES					
			PLASTIC FINES (FOR IDENTIFICATION PROCEDURES SEE CL BELOW)		SC	CLAYEY SANDS, POORLY GRADED SAND-CLAY MIXTURES					
	FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT SMALLER THAN 75µm)	IDENTIFICATION PROCEDURE ON FRACTION SMALLER THAN 425µm							USE GRAIN SIZE CURVE IN IDENTIFYING THE FACTORS AS GIVEN UNDER FIELD IDENTIFICATION  DETERMINE PERCENTAGE OF GRAVEL & SAND FROM GRAIN SIZE CURVE. DEPENDING ON PERCENTAGE OF FINES (FRACTION SMALLER THAN 75 µm) COARSE GRAINED SOILS ARE CLASSIFIED AS FOLLOWS:  LESS THAN 5% GW, GP, SW, SP MORE THAN 12% GM, GC, SM, SC 5% TO 12% BORDER LINE CASES REQUIRE USE OF DUAL SYMBOL.  FOR UNDISTURBED SOILS AND INFORMATION ON STRUCTURE, STRATIFICATION, CONSISTENCY IN UNDISTURBED AND REMOLDED STATES, MOISTURE & DRAINAGE CONDITION.	$C_u = \frac{D_{60}}{D_{10}}$  GREATER THAN 6;	
		LIQUID LIMIT LESS THAN 35 AND 50	DRY STRENGTH (CRUSHING CHARACTERISTICS)	DILATANCY (REACTION TO SHAKING)	TOUGHNESS (CONSISTENCY NEAR PLASTIC LIMIT)	ML		INORGANIC SILTS & SANDY SILTS OR SLIGHTLY PLASTICITY, ROCK FLOUR			$C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$  BETWEEN 1 AND 3
NONE			QUICK	NONE	CL	SILTY CLAYS (INORGANIC), GRAVELLY CLAYS, SANDY CLAYS, LEAN CLAYS					
MEDIUM TO HIGH			NONE TO VERY SLOW	MEDIUM	OL	ORGANIC SILT OF LOW PLASTICITY, ORGANIC SANDY SILTS					
SLIGHT TO MEDIUM			SLOW	SLIGHT	MI	INORGANIC COMPRESSIBLE FINE SANDY SILT WITH CLAY OF MEDIUM PLASTICITY, CLAYEY SILTS					
LIQUID LIMIT BETWEEN 35 AND 50		NONE TO SLIGHT	SLOW TO QUICK	SLIGHT	CI	SILTY CLAYS (INORGANIC) OF MEDIUM PLASTICITY	NOT MEETING ALL GRADATION FOR SW				
		HIGH	NONE	MEDIUM TO HIGH	OI	ORGANIC SILTY CLAYS OF MEDIUM PLASTICITY					
		SLIGHT TO MEDIUM	VERY SLOW	SLIGHT	MH	INORGANIC SILTS, HIGHLY COMPRESSIBLE MICACEOUS OR DIATOMEACOUS FINE SANDY SILTS, ELASTIC SILTS					
		SLIGHT TO MEDIUM	SLOW TO NONE	MEDIUM	CH	CLAYS (INORGANIC) OF HIGH PLASTICITY, FAT CLAYS					
LIQUID LIMIT GREATER THAN 50		HIGH TO VERY HIGH	NONE	HIGH	OH	ORGANIC CLAYS OF HIGH PLASTICITY	ATTEBERG LIMITS BELOW A- LINE OR Ip LESS THAN 4				
		MEDIUM TO HIGH	NONE TO VERY SLOW	SLIGHT TO MEDIUM				ATTEBERG LIMITS ABOVE A- LINE WITH Ip GREATER THAN 7			
HIGH ORGANIC SOILS		READILY IDENTIFIED BY COLOUR, ODOUR, SPONGY FEEL & FREQUENTLY BY FIBROUS TEXTURE			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS					

USE GRAIN SIZE CURVE IN IDENTIFYING THE FACTORS AS GIVEN UNDER FIELD IDENTIFICATION

FRACTION	U.S STANDARD SIEVE SIZE		DEFINING RANGES OF PERCENTAGE BY WEIGHT OF MINOR COMPONENTS		
GRAVEL	COARSE	PASSING	RETAINED	PERCENT	DESCRIPTOR
		75 mm	26.5 mm	40-50  30-40 20-30 10-20 1-10	AND  Y/EY WITH SOME TRACE
	FINE	26.5 mm	4.75 mm		
SAND	COARSE	4.75 mm	2.00 mm		
	MEDIUM	2.00 mm	425 µm		
	FINE	425 µm	75 µm		
	FINES (SILT OR CLAY BASED ON PLASTICITY)		75 µm		
OVERSIZED MATERIAL					
ROUNDED OR SUBROUNDED: COBBLES 75 mm TO 200 mm BOULDERS > 200 mm				NOT ROUNDED: ROCK FRAGMENTS > 75 mm ROCKS > 0.76 CUBIC METRE IN VOLUME	



**BOUNDARY CLASSIFICATION:** BOUNDARY CLASSIFICATION: SOILS POSSESSING CHARACTERISTICS OF TWO GROUPS ARE DESIGNATED BY COMBINATIONS OF GROUP SYMBOLS FOR EXAMPLE GW-GC WELL GRADED GRAVEL-SAND MIXTURE WITH CLAY BINDER



AMEC Earth & Environmental,  
a Division of AMEC American

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**MTC SOIL CLASSIFICATION MANUAL  
ENGINEERING PROPERTIES OF SOIL**



TYPICAL NAMES OF SOIL GROUPS	GROUP SYMBOLS	PERMEABILITY WHEN COMPACTED	STRENGTH WHEN COMPACTED	COMPRESSIBILITY WHEN COMPACTED	WORKABILITY AS A CONSTRUCTION MATERIAL	SCOUR RESISTANCE	SUSCEPTIBILITY TO SURFICIAL EROSION	SUSCEPTIBILITY TO FROST ACTION	DRAINAGE CHARACTERISTICS
WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	GW	PERVIOUS	EXCELLENT	NEGLECTIBLE	EXCELLENT	MEDIUM	NEGLECTIBLE	NEGLECTIBLE	EXCELLENT
POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	GP	VERY PERVIOUS	GOOD	NEGLECTIBLE	GOOD	MEDIUM	NEGLECTIBLE	NEGLECTIBLE	EXCELLENT
SILTY GRAVELS, POORLY GRADED GRAVEL- SAND-SILT MIXTURES	GM	SEMI-PERVIOUS TO IMPERVIOUS	GOOD	NEGLECTIBLE	GOOD	LOW TO MEDIUM	SLIGHT	SLIGHT	FAIR TO SEMI IMPERVIOUS
CLAYEY GRAVELS, POORLY GRADED GRAVEL-SAND-CLAY MIXTURES	GC	IMPERVIOUS	GOOD TO FAIR	VERY LOW	GOOD	MEDIUM	SLIGHT	NEGLECTIBLE TO SLIGHT	PRACTICALLY IMPERVIOUS
WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	SW	PERVIOUS	EXCELLENT	NEGLECTIBLE	EXCELLENT	LOW TO MEDIUM	SLIGHT	NEGLECTIBLE	EXCELLENT
POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	SP	PERVIOUS	GOOD	VERY LOW	FAIR TO GOOD	LOW TO MEDIUM	MODERATE	NEGLECTIBLE TO SLIGHT	EXCELLENT
SILTY SANDS, POORLY GRADED SAND-SILT MIXTURES	SM	SEMI-PERVIOUS TO IMPERVIOUS	GOOD	LOW	FAIR	LOW	MODERATE	SLIGHT TO MODERATE	FAIR TO SEMI IMPERVIOUS IMPERVIOUS
CLAYEY SANDS, POORLY GRADED SAND WITH SOME CLAY MIXTURES	SC	IMPERVIOUS	GOOD TO FAIR	LOW	GOOD	VERY LOW TO LOW	MODERATE TO SLIGHT	NEGLECTIBLE	PRACTICALLY IMPERVIOUS
INORGANIC SILTS AND SANDY SILTS OF SLIGHT PLASTICITY, ROCK FLOUR	ML	SEMI-PERVIOUS TO IMPERVIOUS	FAIR	MEDIUM	FAIR	VERY LOW	SEVERE	SEVERE	FAIR TO POOR
INORGANIC CLAYEY SILTS OF LOW PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, LEAN CLAYS	CL	IMPERVIOUS	FAIR	MEDIUM	GOOD TO FAIR	LOW TO MEDIUM	SLIGHT TO MODERATE	MODERATE TO SEVERE	PRACTICALLY IMPERVIOUS
ORGANIC SILTS OF LOW PLASTICITY	OL	SEMI-PERVIOUS TO IMPERVIOUS	POOR	MEDIUM	FAIR TO POOR	VERY LOW TO LOW	SEVERE	SEVERE	POOR
INORGANIC COMPRESSIBLE SILTS OF MEDIUM PLASTICITY	MI	SEMI-PERVIOUS TO IMPERVIOUS	FAIR	MEDIUM TO HIGH	FAIR TO POOR	LOW	MODERATE	MODERATE TO SEVERE	FAIR TO POOR
INORGANIC SILTY CLAYS OF MEDIUM PLASTICITY	CI	IMPERVIOUS	FAIR TO POOR	HIGH	FAIR	LOW TO MEDIUM	SLIGHT	MODERATE TO SEVERE	SEMI IMPERVIOUS TO PRACTICALLY
ORGANIC SILTY CLAY OF MEDIUM PLASTICITY	OI	SEMI-PERVIOUS TO IMPERVIOUS	POOR	HIGH	POOR	VERY LOW TO LOW	SEVERE	MODERATE TO SEVERE	POOR TO PRACTICALLY IMPERVIOUS
INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS	MH	SEMI-PERVIOUS TO IMPERVIOUS	FAIR TO POOR	HIGH	POOR	VERY LOW	MEDIUM	SEVERE	POOR
INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	CH	IMPERVIOUS	POOR	HIGH	FAIR TO POOR	LOW TO MEDIUM	SLIGHT TO NEGLECTIBLE	NEGLECTIBLE	PRACTICALLY IMPERVIOUS
ORGANIC CLAYS OF HIGH PLASTICITY	OH	IMPERVIOUS	POOR	HIGH	POOR	LOW	MODERATE	NEGLECTIBLE TO SLIGHT	PRACTICALLY IMPERVIOUS
PEAT AND OTHER HIGHLY ORGANIC SOILS	Pt	-	-	-	-	LOW	SEVERE	-	FAIR TO GOOD

# RECORD OF BOREHOLE No PS1-1

1 OF 3

**METRIC**

W.P. RFP No. 09-54-1007 LOCATION N4681192.0, E331331.6 ORIGINATED BY LC  
 DIST                      HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS  
 DATUM Geodetic DATE Aug 17, 11 - Aug 19, 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
								○ UNCONFINED	+ FIELD VANE	● POCKET PEN.	× LAB VANE							
181.3	Ground Surface																	
0.0	<b>TOPSOIL</b> Sandy		1	SS	4											-Observation Well (OW) installed in sampled borehole; Vibrating Wire Piezometers (VWP) installed in adjacent boring advanced without sampling		
181.0																		
0.3	<b>SAND</b> Fine-Medium Brown-Grey		2	SS	5													
179.8	<b>CLAYEY SILT</b> Some sand, trace gravel Soft to very stiff, grey, sand and silt-filled fissures and lenses between 5m to 6m and between 16m to 17m		3	SS	19										21.2			
1.5																		
					4	SS	14											
					5	SS	16											
					6	SS	13											
					7	SS	10											
					8	SS	9											
					9	TW	PH											
					10	TW	PH											
					11	TW	PH											
					VT													
			12	TW	PH									20.3				
			13	TW	PH													
			VT															
			14	TW	PH													

Continued Next Page

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



## METRIC

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○<sup>3%</sup> STRAIN AT FAILURE

ONTARIO MOT SW8801.1004.101.GPJ ONTARIO MOT.GDT 16/11/11

## METRIC


+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○<sup>3%</sup> STRAIN AT FAILURE

# RECORD OF BOREHOLE No PS2-1

1 OF 3

**METRIC**

W.P. RFP No. 09-54-1007 LOCATION N4679716.5, E331917.9 ORIGINATED BY TA  
 DIST                      HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS  
 DATUM Geodetic DATE Aug 15, 11 - Aug 17, 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)	
								○ UNCONFINED	+ FIELD VANE	● POCKET PEN.	× LAB VANE							
180.7	Ground Surface							20	40	60	80	100	10	20	30	GR SA SI CL		
180.6	TOPSOIL															-Observation well and vibrating wire piezometer (VWP) installed in sampled borehole		
0.2	CLAYEY SILT Trace to some sand, trace gravel, soft to very stiff Mottled Brown-Grey to Brown Grey below approx 3.7m (EL. 177m), pink grey between approx 14m and 17m (EL. 167m to EL. 165m), trace silt seams between approx 3m and 4m (EL. 178m to EL. 177m), Sandy at approx 15m (EL. 156m)		1	SS	8													
			2	SS	18													
			3	SS	13													
			4	SS	15													
			5	SS	11													
			6	SS	8													
			7	SS	8													
			8	TW	PH													
			VT															
			9	TW	PH													
			VT															
			11	TW	PH													
VT																		
12	TW	PH													-end of drilling Aug 15; continue August 16			
VT																		
13	TW	PH																
VT																		
166.6																-seepage observed		

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

## METRIC

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○<sup>3%</sup> STRAIN AT FAILURE

ONTARIO MOT SW8801.1004.101.GPJ ONTARIO MOT.GDT 16/11/11

**RECORD OF BOREHOLE No PS2-1**

3 OF 3

**METRIC**

W.P. RFP No. 09-54-1007 LOCATION N4679716.5, E331917.9 ORIGINATED BY TA  
DIST                      HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS  
DATUM Geodetic DATE Aug 15, 11 - Aug 17, 11 CHECKED BY MSO

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							WATER CONTENT (%)				
								○ UNCONFINED	+ FIELD VANE	● POCKET PEN.	× LAB VANE	w <sub>p</sub>			w	w <sub>L</sub>			
							20	40	60	80	100					GR	SA	SI	CL
150.2																			
30.5	<b>SANDY SILT</b> Trace to some gravel, trace clay, Grey  -Limestone fragments		24	SS	76+								○						
148.6	-Some gravel, trace clay		25	SS	50+														
32.1	Grey <b>LIMESTONE</b> Fine grained, laminated, stylolites present. Fractured between 32.10m and 32.19m		26	RC															
147.5	and fractured between 32.46m and 33.00m which is running parallel to the length of the core.																		
33.2																			
	Brown <b>LIMESTONE</b> Medium to coarse grained, laminated		27	RC															
146.5																			
34.2	porous, stylolites present. Fractured present between 34.10m and 34.17m running parallel to the core length and is filled with solution activity or calcareous cement.																		
145.9	Grey <b>LIMESTONE</b> Fine grained to medium coarse grained, laminated, pitted, stylolites present and vuggy between 34.81m and 34.85m <b>END OF BOREHOLE</b>																		
34.8																			
	Groundwater seepage inferred during drilling with hollow-stem augers at approx 8.7m (EL. 172.0m) on Aug 16, 2011. No further grounwater observation during drilling due to wash boring once past depth of 15m																		
	Water levels in deep observation well: Nov 3, 2011: EL. 179.4m																		
	Piezometric levels in VWP PS2-1-P18 (shallow): Nov 3, 2011: EL. 179.3m																		
	Piezometric levels in VWP PS2-1-P24 (mid-depth): Nov 3, 2011: EL. 179.2m																		
	Piezometric levels in VWP PS2-1-P31 (deep): Nov 3, 2011: EL. 179.1m																		

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No PS5-1

1 OF 3

**METRIC**

W.P. RFP No. 09-54-1007 LOCATION N4678814.1, E333219.4 ORIGINATED BY LC  
 DIST                      HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS  
 DATUM Geodetic DATE 24 Aug 11 - 24 Aug 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
								○ UNCONFINED	+ FIELD VANE	● POCKET PEN.	× LAB VANE					
182.8	Ground Surface															
0.0	Clayey TOPSOIL		1	SS	4											-Observation Well (OW) installed in sampled borehole; Vibrating Wire Piezometers (VWP) installed in adjacent boring
182.2	CLAYEY SILT Some sand, trace gravel, soft to hard  Brown changing to grey below approx 3m (EL. 179.7m) Trace silt/sand seams and lenses occur randomly throughout		2	SS	4											
0.6																
			3	SS	17											
			4	SS	34											
			5	SS	35											
			6	SS	25											
			7	SS	18											
			8	SS	15											
		9	TW	PH					×							
				</												

Continued Next Page

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

ONTARIO MOT SW8801.1004.101.GPJ ONTARIO MOT.GDT 04/07/12



## METRIC

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

ONTARIO MOT SW8801.1004.101.GPJ ONTARIO MOT.GDT 04/07/12

# RECORD OF BOREHOLE No PS5-1

3 OF 3

**METRIC**

W.P. RFP No. 09-54-1007 LOCATION N4678814.1, E333219.4 ORIGINATED BY LC  
 DIST                      HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS  
 DATUM Geodetic DATE 24 Aug 11 - 24 Aug 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	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	×						
								● POCKET PEN.	×	LAB VANE						
	<b>CLAYEY SILT</b> Firm, grey, and layers of <b>FINE SAND</b> and <b>SILT</b> (continued)		25A,B,C	SS	14											
150.8							152									
32.0	<b>SAND AND GRAVEL</b> Some silt, some clay, compact, grey		26	SS	16		151									
150.2																
32.6	Grey to white <b>LIMESTONE</b>						150									
149.8	Fine Grained		27	RC												
33.0	Pitted, porous															
149.4	Grey to white <b>LIMESTONE</b>															
33.4	Stylolites present, well crystallized, dense						149									
	<b>END OF BOREHOLE</b>															
	No groundwater observed during drilling due to wash boring						148									
	Water levels in deep observation well: Nov 3, 2011: EL. 180.1m Nov 11, 2011: EL. 180.2m						147									
	Piezometric levels in VWP PS5-1-P18 (shallow): Nov 3, 2011: EL. 179.6m Nov 11, 2011: EL. 179.6m						146									
	Piezometric levels in VWP PS5-1-P24 (mid-depth): Nov 3, 2011: EL. 178.8m Nov 11, 2011: EL. 178.8m						145									
	Piezometric levels in VWP PS5-1-P32 (deep): Nov 11, 2011: EL. 177.6m						144									
							143									
							142									
							141									
							140									
							139									
							138									

-VWP PS5-1-P32 installed at 32.00m below ground surface (EL. 150.8m)

## METRIC

ONTARIO MOT SW8801.1004.101.GPJ ONTARIO MOT.GDT 16/11/11

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○<sup>3%</sup> STRAIN AT FAILURE

**METRIC**

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○<sup>3%</sup> STRAIN AT FAILURE

ONTARIO MOT SW8801.1004.101.GPJ ONTARIO MOT.GDT 16/11/11

**METRIC**

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

# RECORD OF BOREHOLE No PS7-1

1 OF 3

**METRIC**

W.P. RFP No. 09-54-1007 LOCATION N4677583.5, E335385.0 ORIGINATED BY NB  
 DIST                      HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS  
 DATUM Geodetic DATE Aug 17, 11 - Aug 17, 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
186.8	Fill Surface													GR SA SI CL	
186.0	Topsoil		1	SS	14										
186.2	FILL														
0.3	FILL Sand and Gravel Grey		2	SS	10										
	CLAYEY SILT Some sand, trace gravel, firm to very stiff, brown changing to grey below approx. 4.6m (EL. 182.2m), thin sand seams between approx 24m and 25m (EL. 163m and EL. 162m)		3	SS	6										
			4	SS	17										
			5	SS	32										
			6	SS	30										
			7	SS	13										
			8	SA	9										
			9	TW	PH										
			VT												
			10	TW	PH										
		11	TW	PH											
		VT													
		12	TW	PH											
		13	SS	PH											
		VT													
		14	SS	PH											

Continued Next Page

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

ONTARIO MOT SW8801.1004.101.GPJ ONTARIO MOT.GDT 17/11/11

## METRIC

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

ONTARIO MOT SW8801.1004.101.GPJ ONTARIO MOT.GDT 17/11/11



# RECORD OF BOREHOLE No PS7-1

3 OF 3

**METRIC**

W.P. RFP No. 09-54-1007 LOCATION N4677583.5, E335385.0 ORIGINATED BY NB  
 DIST            HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS  
 DATUM Geodetic DATE Aug 17, 11 - Aug 17, 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT   NATURAL   LIQUID LIMIT   MOISTURE   LIMIT CONTENT			UNIT WEIGHT  γ  kN/m³	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									
								○ UNCONFINED   + FIELD VANE									
								● POCKET PEN.   × LAB VANE									
								20   40   60   80   100									
										10   20   30							
156.3																	
30.5																	
156.0																	
30.8																	
154.8																	
32.0																	
154.2																	
32.6																	

-VWP PS7-1-P32 installed at 32.0m below ground surface (EL. 154.8m)  
  
RQD = 97%  
TCR = 97%  
SCR = 100%

# RECORD OF BOREHOLE No T2-1

1 OF 3

**METRIC**

W.P. RFP No. 09-54-1007 LOCATION 4681290.3N, 331304.1E ORIGINATED BY TA  
 DIST                      HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS  
 DATUM Geodetic DATE Apr 7, 11 - Apr 11, 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)	
								○ UNCONFINED ● POCKET PEN.	+ FIELD VANE × LAB VANE							
								20 40 60 80 100	20 40 60 80 100						10 20 30	
181.4	Fill Surface															
0.0	Brown FILL															
180.8	Silty Clay															
0.6	Some sand, trace gravel, occasional broken brick		1	SS	15											
180.0	Brown SAND															
1.4	Well-Graded Trace silt, trace gravel Compact		2	SS	11											
	Grey SILTY CLAY															
	Some sand, trace gravel, trace pink clay nodules		3	SS	17											
	Stiff															
	Very stiff		4	SS	16									4 14 36 43		
			5	SS	14											
	Stiff		6	SS	14											
			7	SS	14											
			8	SS	17											
			9	TW	PH											
				VT												
	-Trace sand seams		10	TW	PH											
				VT												
			11	TW	PH											
				VT												
			12	TW	PH											
				VT												
			13	TW	PH											
				VT												
											</					

Continued Next Page

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

ONTARIO MOT SW8801.1004.101.GPJ ONTARIO MOT.GDT 31/10/11

## METRIC

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○<sup>3%</sup> STRAIN AT FAILURE

# RECORD OF BOREHOLE No T2-1

3 OF 3

METRIC

W.P. RFP No. 09-54-1007 LOCATION 4681290.3N, 331304.1E ORIGINATED BY TA  
 DIST                      HWY WEP BOREHOLE TYPE CME 55 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS  
 DATUM Geodetic DATE Apr 7, 11 - Apr 11, 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							PLASTIC LIMIT  W <sub>p</sub>	NATURAL MOISTURE CONTENT  W	LIQUID LIMIT  W <sub>L</sub>
								<div><div></div><div>20</div><div>40</div><div>60</div><div>80</div><div>100</div></div>	<div><div></div><div>20</div><div>40</div><div>60</div><div>80</div><div>100</div></div>	<div><div></div><div>20</div><div>40</div><div>60</div><div>80</div><div>100</div></div>	<div><div></div><div>20</div><div>40</div><div>60</div><div>80</div><div>100</div></div>	<div><div></div><div>20</div><div>40</div><div>60</div><div>80</div><div>100</div></div>					
151.2							151								-split spoon refusal at 32.3m Rock Core Cu = 94.3 MPa RQD = 39% TCR = 85% SCR = 46% RQD = 89% TCR = 100% SCR = 94%  RQD = 89% TCR = 100% SCR = 89%		
30.2	Grey <b>CLAYEY SILT</b> Some sand, some gravel very stiff		24	SS	26												
							150										
149.1			25	SS	50/ 0.5mm		149										
32.3	Light Grey to tan brown <b>LIMESTONE</b> , fine grained, fairly porous, 20-40mm thick <b>SHALE</b> layer present at depth of approximately 33.60m; laminated to bedded, stylolites and calcite crystals present; soft to semi-hard		26	RC			148										
			27	RC			147										
			28	RC			146										
145.7																	
35.7	END OF BOREHOLE						145										
							144										
							143										
							142										
							141										
							140										
							139										
							138										
							137										

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No BH12-RW

1 OF 1

**METRIC**

W.P. RFP No. 09-54-1007 LOCATION N4679718.1, E332037.9 ORIGINATED BY SD  
 DIST                      HWY WEP BOREHOLE TYPE Truck Mounted Drill - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS  
 DATUM Geodetic DATE Jul 16, 11 - Jul 16, 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
								○ UNCONFINED	+ FIELD VANE	● POCKET PEN.	× LAB VANE					
181.2	Fill Surface						20	40	60	80	100	10	20	30		
180.0	Black FILL Topsoil															
0.2	Brown-Black FILL Possible Silty clay, some topsoil		1	SS	12								○			
	Mottled Brown Silty Clay		2	SS	10								○			
	Grey, some brown Silty Clay, wet		3	SS	4									○		
178.3	Brown CLAYEY SILT Some sand, trace gravel Very stiff		4	SS	16								○			-corrosivity sample
2.9			5	SS	15								○			
	Grey Stiff Wet Firm		6	SS	8								○			
			7	SS	6								○			
			8	SS	6									○		
174.6	END OF BOREHOLE (no refusal) Borehole dry on completion															
6.6																
							174									
							173									
							172									
							171									
							170									
							169									
							168									
							167									

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

# RECORD OF BOREHOLE No BH13-RW

1 OF 1

**METRIC**

W.P. RFP No. 09-54-1007 LOCATION N4679672.2, E331850.2 ORIGINATED BY TA  
 DIST                      HWY WEP BOREHOLE TYPE CME 75 - 200mm Dia. Continuous Flight Hollow Stem Augers COMPILED BY SS  
 DATUM Geodetic DATE Jul 7, 11 - Jul 7, 11 CHECKED BY MSO

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	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	● POCKET PEN.	× LAB VANE									
								20 40 60 80 100												
180.8	Ground Surface																			
0.0	TOPSOIL																			
180.4																				
0.4	Mottled Brown and Grey CLAYEY SILT Some sand, trace gravel to approx. 3m Trace organics Stiff		1	SS	5															
			2	SS	9															
	Highly fissured		3	SS	7															
	Brown -Trace fissures		4A, B	SS	12															
			5	SS	18															
	Grey -Trace oxidation		6	SS	10															
			7	SS	7															
			8	SS	4															
173.8																				
7.0	END OF BOREHOLE (no refusal) Borehole dry on completion			VT																

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

## RECORD OF NILCON VANE TEST NIL T2-1

Project : Windsor-Essex Parkway

Test Date: 4/12/2011

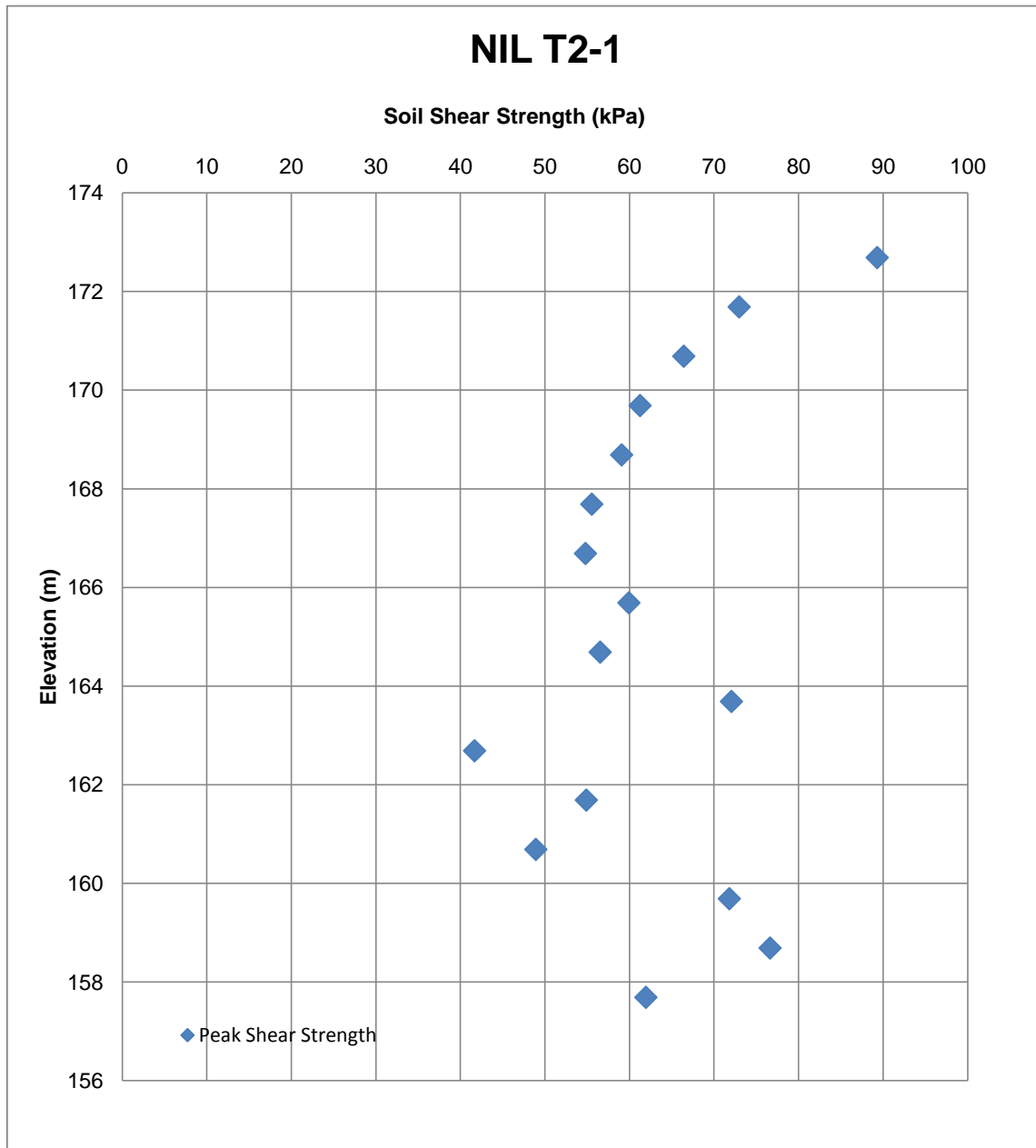
Sheet 1 of 1

Location: N4681291.5; E331304.2

Predrill Depth : 5.93 m

Datum Geodetic

Ground Surface Elevation: 181.4 m



Operator: TA

Checked: DD



## RECORD OF NILCON VANE TEST NIL 12-RW

Project : Windsor-Essex Parkway

Test Date: 8/24/2011

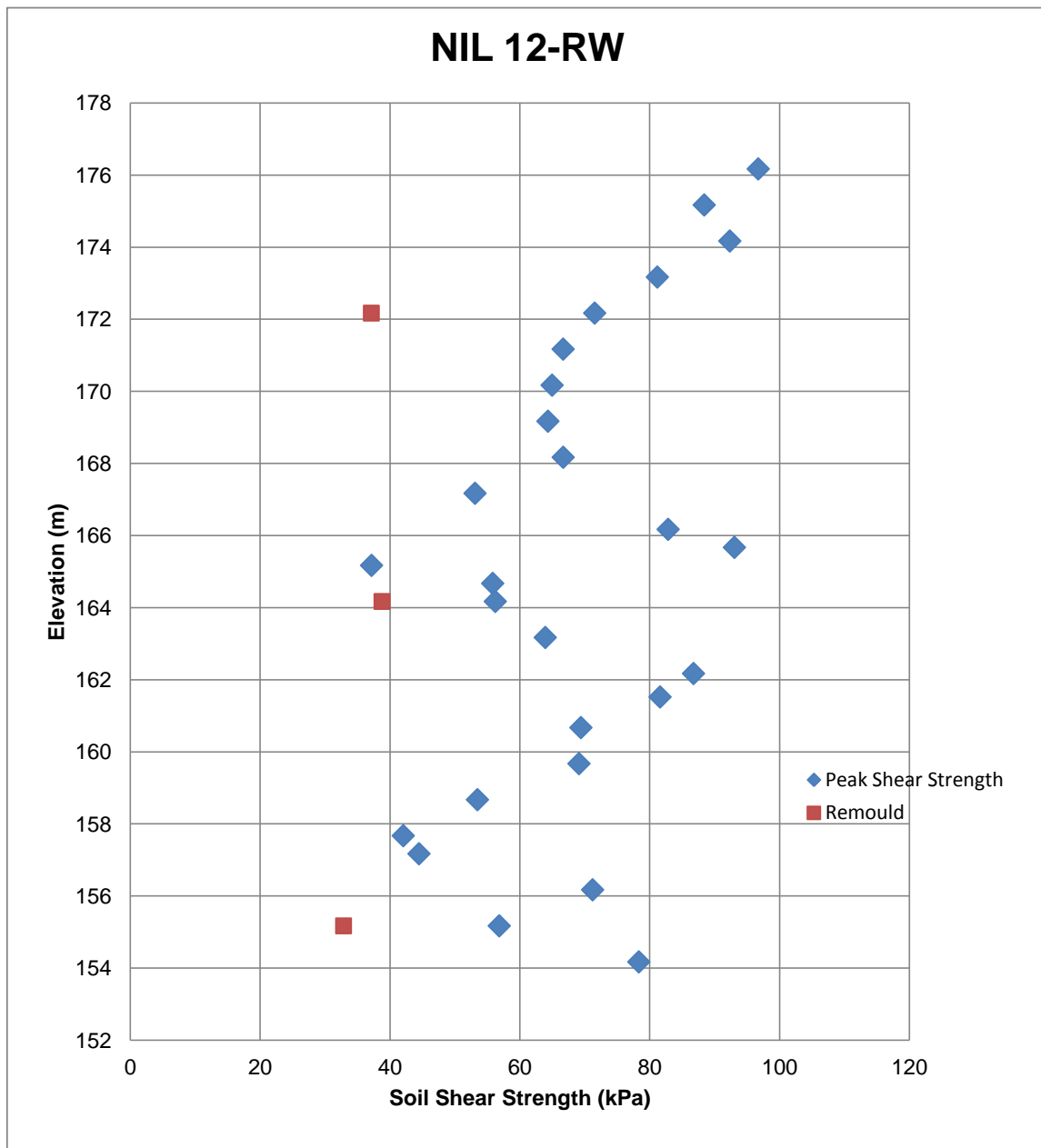
Sheet 1 of 1

Location: N4679767.0; E332011.4

Predrill Depth : 4.3 m

Datum Geodetic

Ground Surface Elevation: 181.2 m



Operator: TR

Checked: DD

# RECORD OF CONE PENETRATION TEST CPT T2-1

METRIC

PROJECT Windsor-Essex Parkway

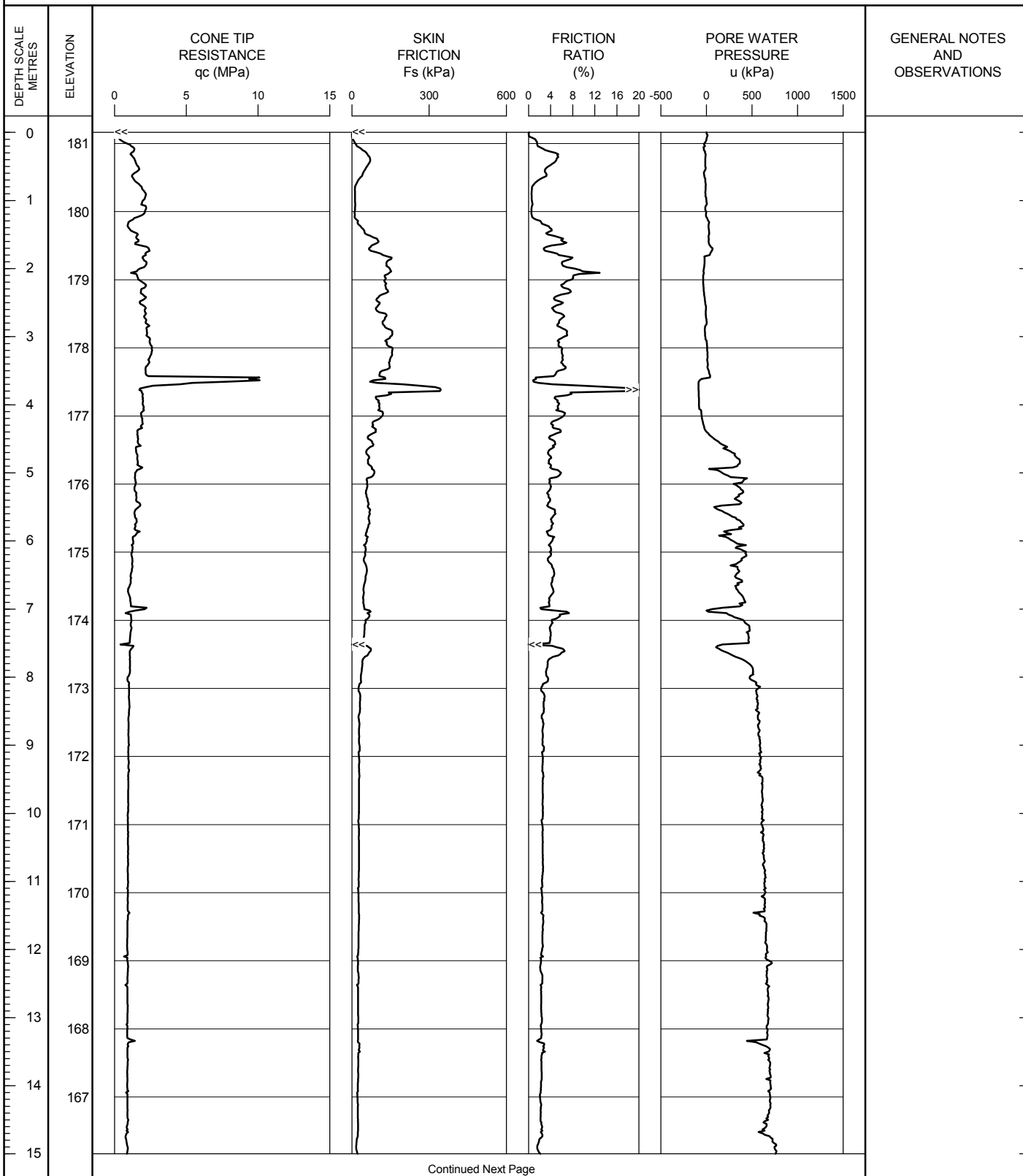
TEST DATE 4/14/2011 - 4/14/2011

SHEET 1 OF 3

LOCATION N4681233.1; E331339.0

DATUM Geodetic

GROUND SURFACE ELEVATION: 181.2 PREDRILL DEPTH: 0 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



WEP CPT LOG CPT T2-1.GPJ ONTARIO.MOT.GDT 21/12/11

OPERATOR: TA

CHECKED: DD

# RECORD OF CONE PENETRATION TEST CPT T2-1

**METRIC**

PROJECT Windsor-Essex Parkway

TEST DATE 4/14/2011 - 4/14/2011

SHEET 2 OF 3

LOCATION N4681233.1; E331339.0

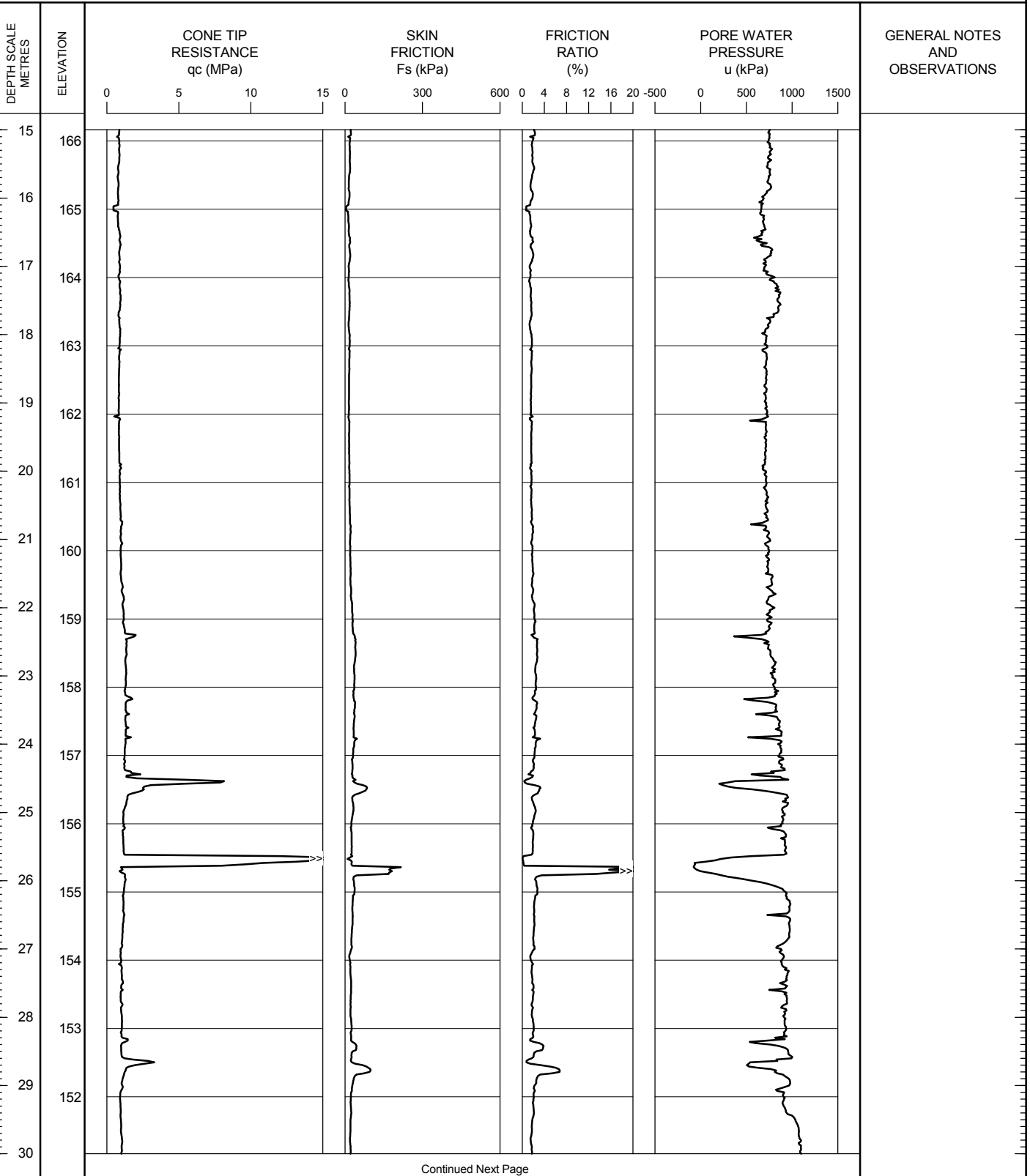
DATUM Geodetic

GROUND SURFACE ELEVATION: 181.2

PREDRILL DEPTH: 0

CORRECTION FACTOR A: 0.8

CORRECTION FACTOR B: 0



OPERATOR: TA

CHECKED: DD

# RECORD OF CONE PENETRATION TEST CPT T2-1

**METRIC**

PROJECT Windsor-Essex Parkway

TEST DATE 4/14/2011 - 4/14/2011

SHEET 3 OF 3

LOCATION N4681233.1; E331339.0

DATUM Geodetic

GROUND SURFACE ELEVATION: 181.2    PREDRILL DEPTH: 0    CORRECTION FACTOR A: 0.8    CORRECTION FACTOR B: 0

DEPTH SCALE METRES	ELEVATION	CONE TIP RESISTANCE qc (MPa)	SKIN FRICTION Fs (kPa)	FRICTION RATIO (%)	PORE WATER PRESSURE u (kPa)	GENERAL NOTES AND OBSERVATIONS
		0    5    10    15	0    300    600	0    4    8    12    16    20	-500    0    500    1000    1500	
30	151					

OPERATOR: TA

CHECKED: DD

# RECORD OF CONE PENETRATION TEST CPT T8-1

**METRIC**

PROJECT Windsor-Essex Parkway

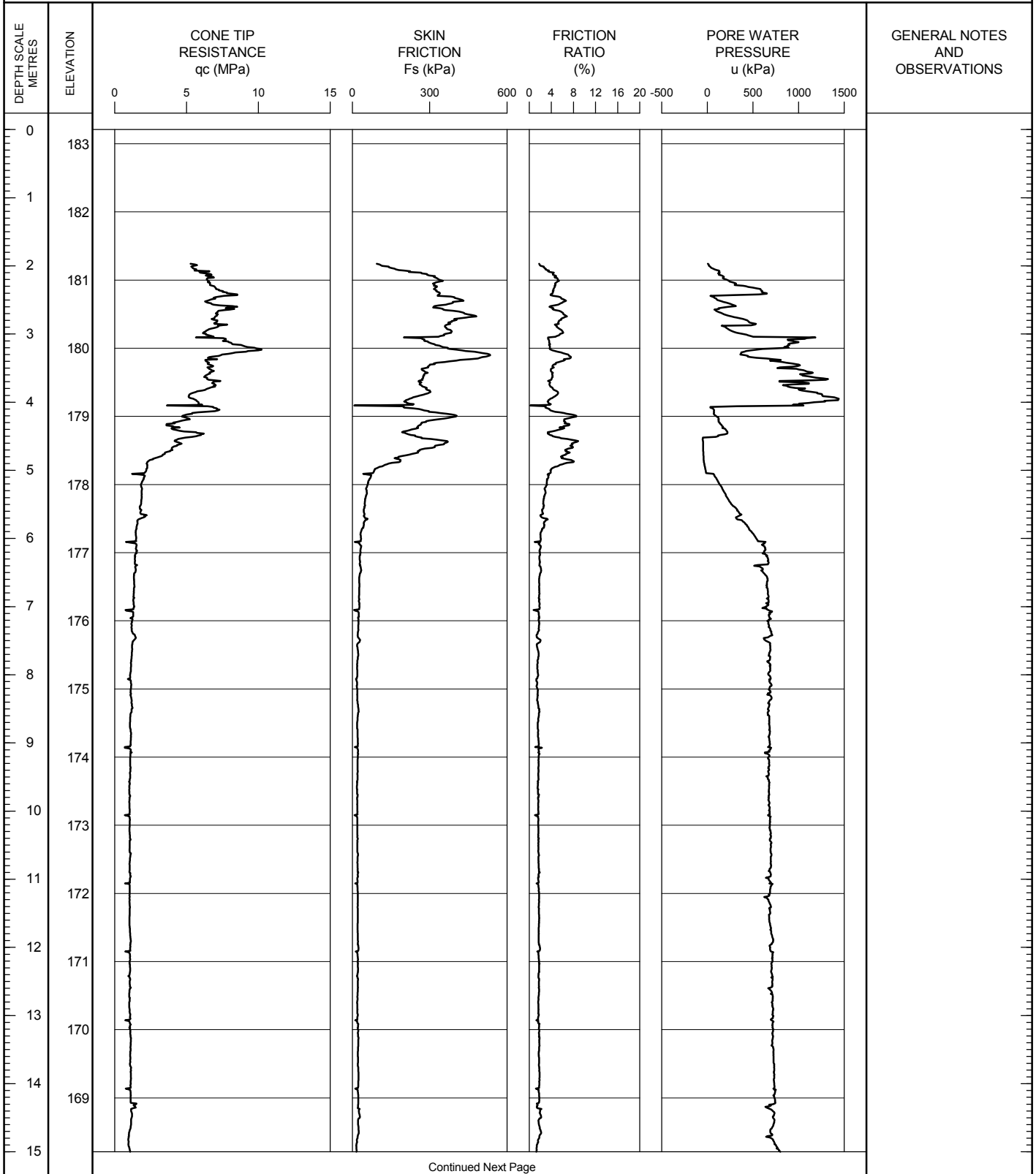
TEST DATE 8/4/2011 - 8/4/2011

SHEET 1 OF 3

LOCATION N4678860.0; E333292.9

DATUM Geodetic

GROUND SURFACE ELEVATION: 183.2 PREDRILL DEPTH: 1.82 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



OPERATOR: TA

CHECKED: DD

# RECORD OF CONE PENETRATION TEST CPT T8-1

**METRIC**

PROJECT Windsor-Essex Parkway

TEST DATE 8/4/2011 - 8/4/2011

SHEET 2 OF 3

LOCATION N4678860.0; E333292.9

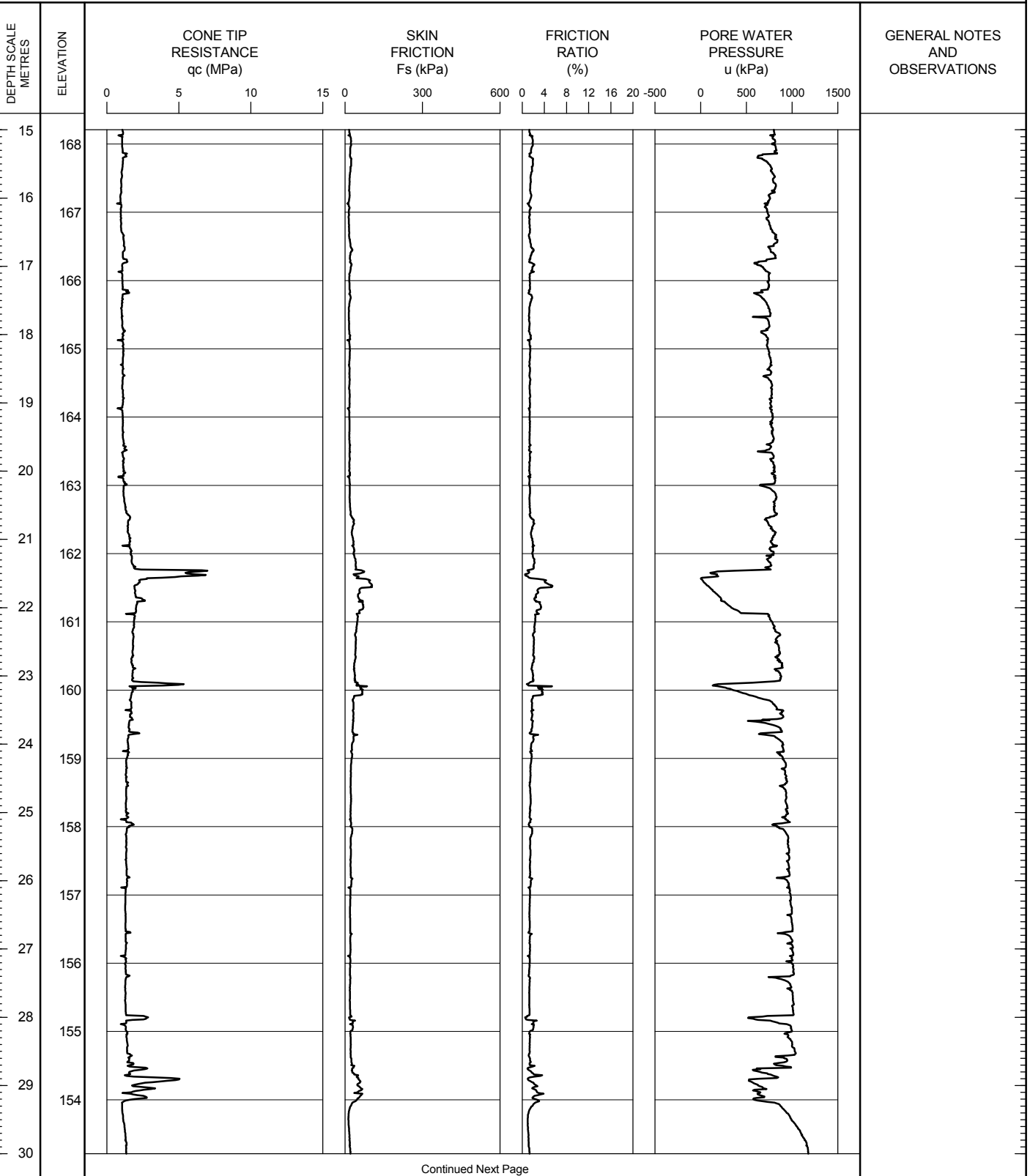
DATUM Geodetic

GROUND SURFACE ELEVATION: 183.2

PREDRILL DEPTH: 1.82

CORRECTION FACTOR A: 0.8

CORRECTION FACTOR B: 0



OPERATOR: TA

CHECKED: DD

# RECORD OF CONE PENETRATION TEST CPT T8-1

**METRIC**

PROJECT Windsor-Essex Parkway

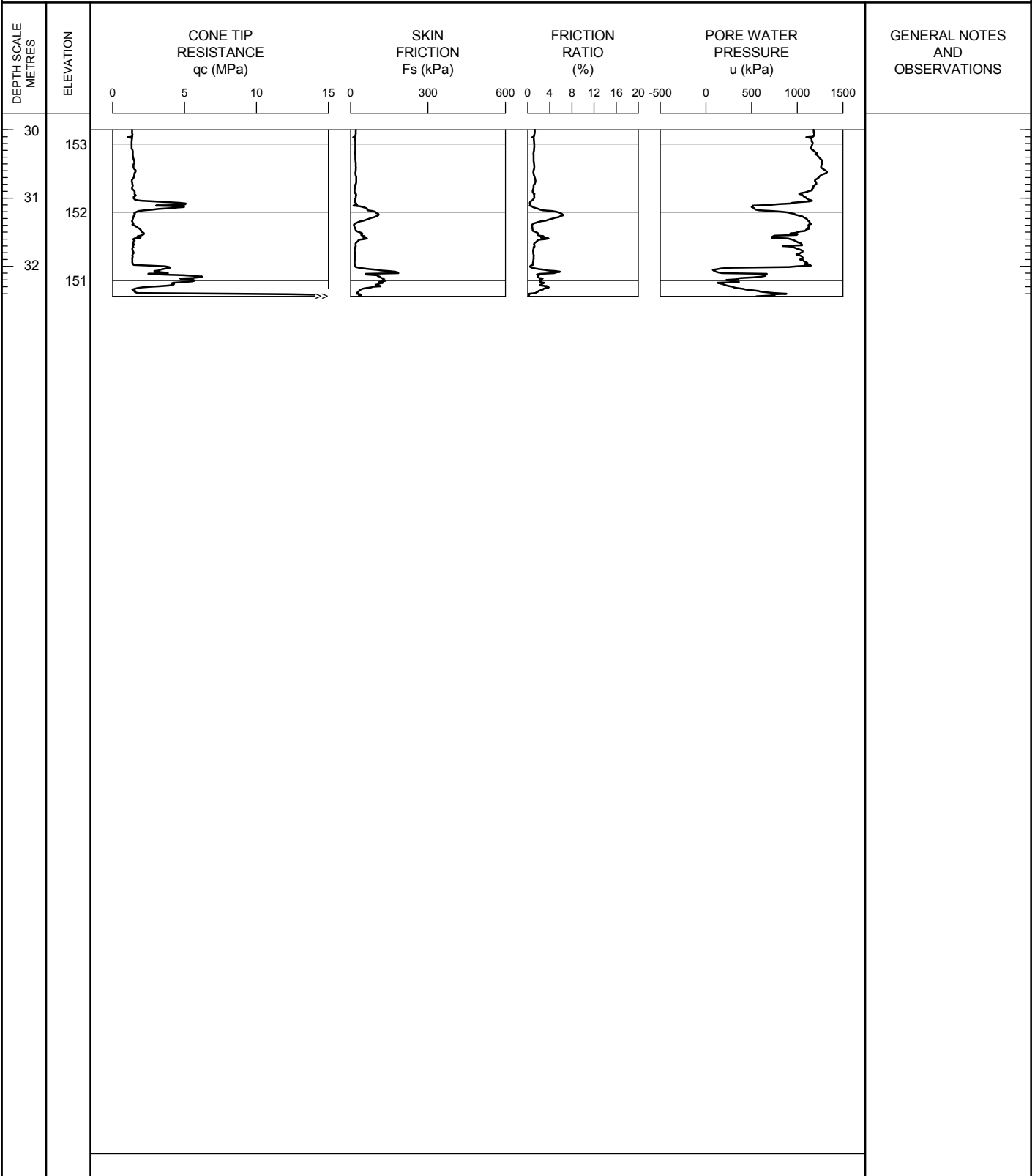
TEST DATE 8/4/2011 - 8/4/2011

SHEET 3 OF 3

LOCATION N4678860.0; E333292.9

DATUM Geodetic

GROUND SURFACE ELEVATION: 183.2    PREDRILL DEPTH: 1.82    CORRECTION FACTOR A: 0.8    CORRECTION FACTOR B: 0



WEP CPT LOG CPT T8-1.GPJ ONTARIO MOT. GDT 22/12/11

OPERATOR: TA

CHECKED: DD



# RECORD OF CONE PENETRATION TEST CPT 36-RW

**METRIC**

PROJECT Windsor-Essex Parkway

TEST DATE 8/15/2011 - 8/15/2011

SHEET 1 OF 3

LOCATION N4679710.0; E331968.8

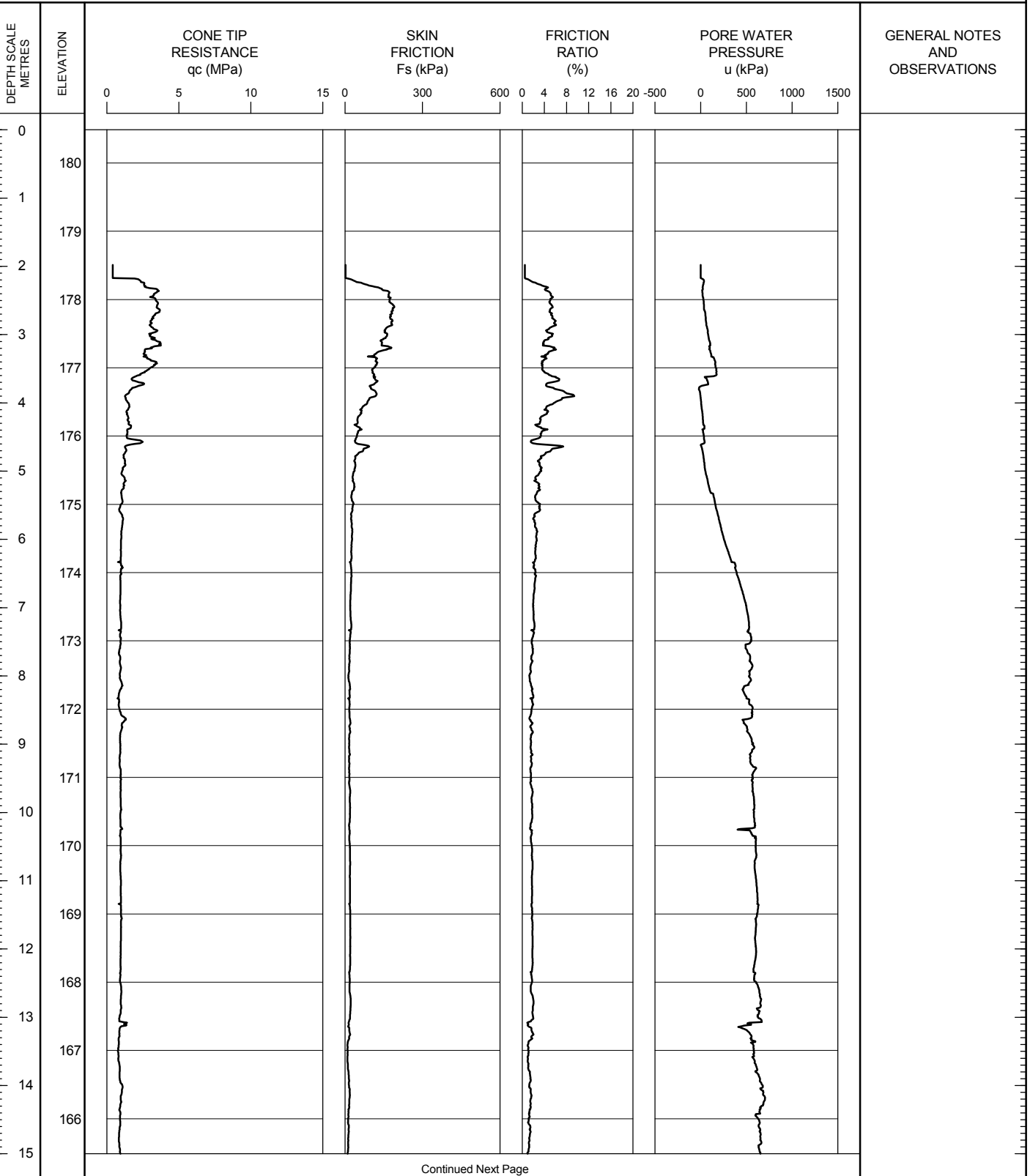
DATUM Geodetic

GROUND SURFACE ELEVATION: 180.5

PREDRILL DEPTH: 2.17

CORRECTION FACTOR A: 0.8

CORRECTION FACTOR B: 0



OPERATOR: TA

CHECKED: DD

# RECORD OF CONE PENETRATION TEST CPT 36-RW

METRIC

PROJECT Windsor-Essex Parkway

TEST DATE 8/15/2011 - 8/15/2011

SHEET 2 OF 3

LOCATION N4679710.0; E331968.8

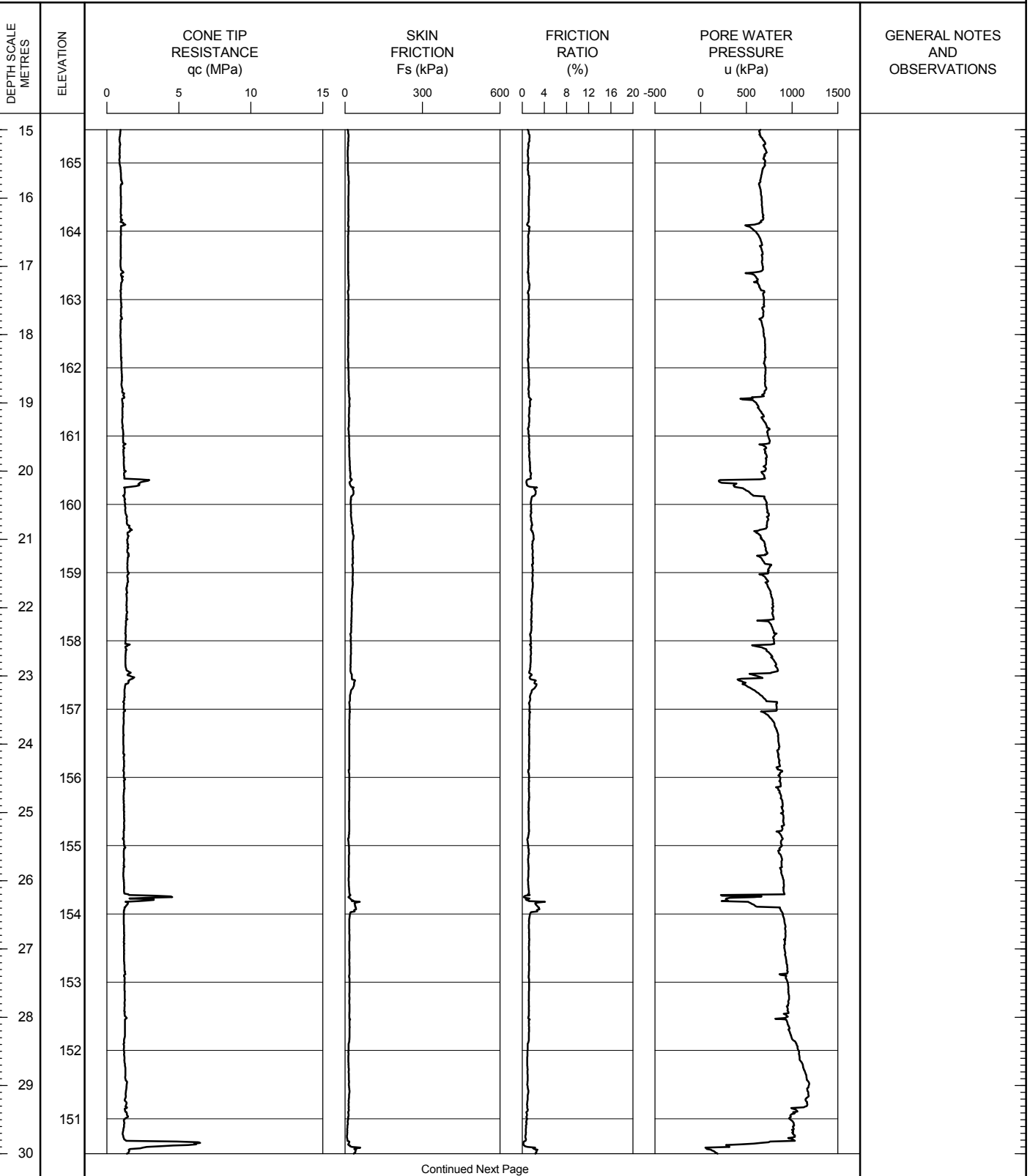
DATUM Geodetic

GROUND SURFACE ELEVATION: 180.5

PREDRILL DEPTH: 2.17

CORRECTION FACTOR A: 0.8

CORRECTION FACTOR B: 0



OPERATOR: TA

CHECKED: DD

# RECORD OF CONE PENETRATION TEST CPT 36-RW

**METRIC**

PROJECT Windsor-Essex Parkway

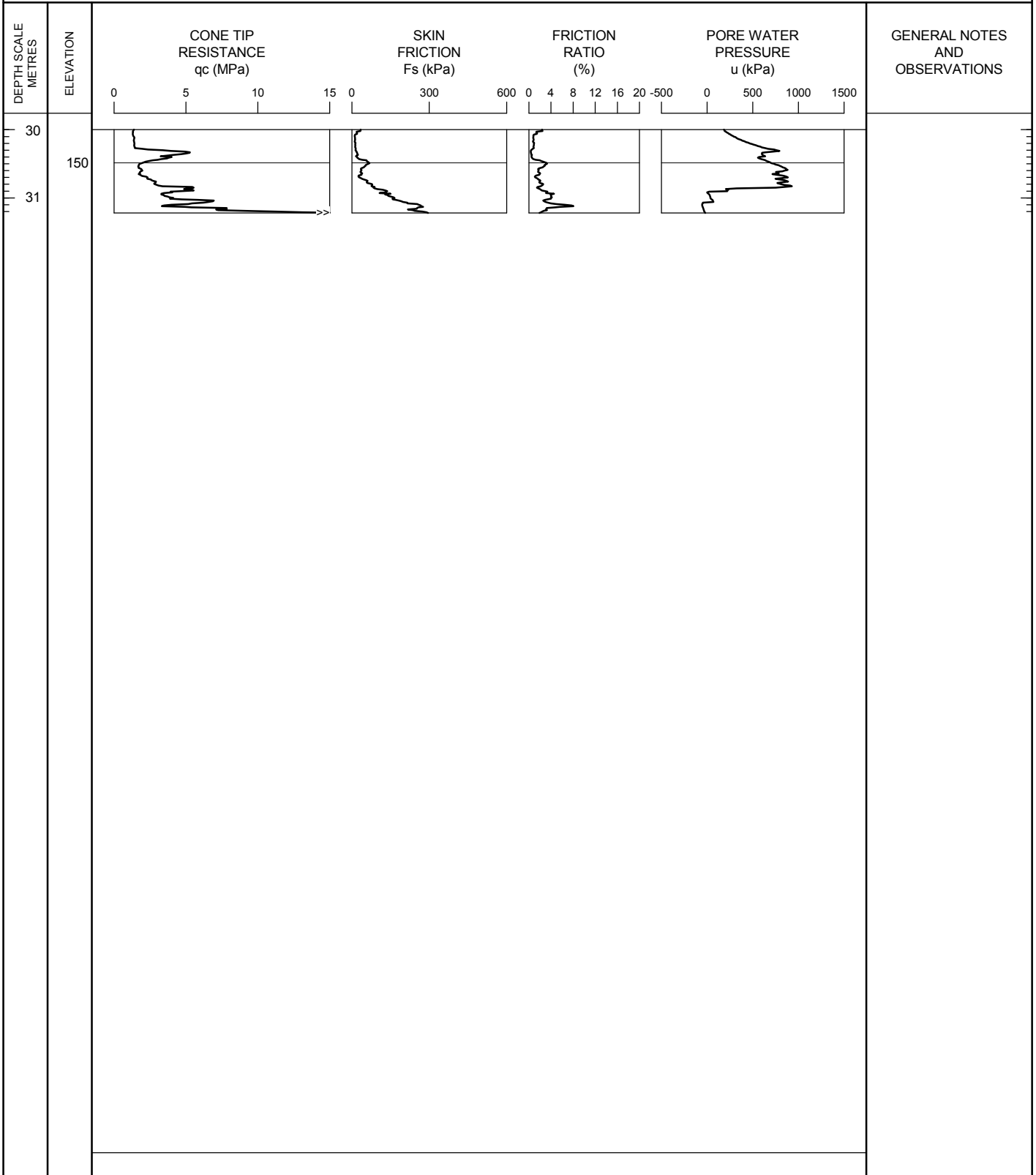
TEST DATE 8/15/2011 - 8/15/2011

SHEET 3 OF 3

LOCATION N4679710.0; E331968.8

DATUM Geodetic

GROUND SURFACE ELEVATION: 180.5    PREDRILL DEPTH: 2.17    CORRECTION FACTOR A: 0.8    CORRECTION FACTOR B: 0



OPERATOR: TA

CHECKED: DD

# RECORD OF CONE PENETRATION TEST CPT 42-RW

**METRIC**

PROJECT Windsor-Essex Parkway

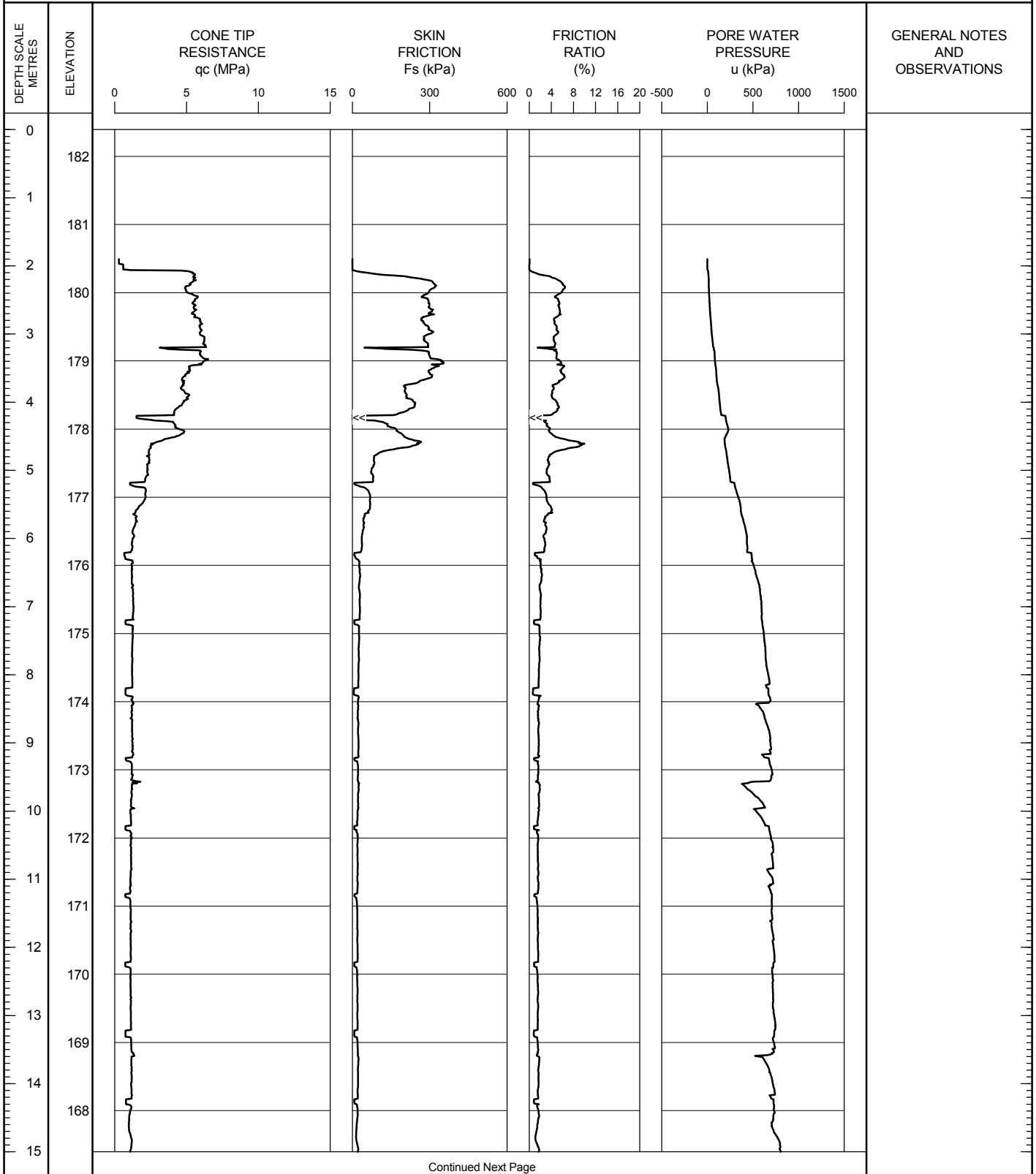
TEST DATE 7/3/2011 - 7/3/2011

SHEET 1 OF 2

LOCATION N4678892.0; E333107.4

DATUM Geodetic

GROUND SURFACE ELEVATION: 182.4 PREDRILL DEPTH: 1.97 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



OPERATOR: TA

CHECKED: DD

# RECORD OF CONE PENETRATION TEST CPT 42-RW

**METRIC**

PROJECT Windsor-Essex Parkway

TEST DATE 7/3/2011 - 7/3/2011

SHEET 2 OF 2

LOCATION N4678892.0; E333107.4

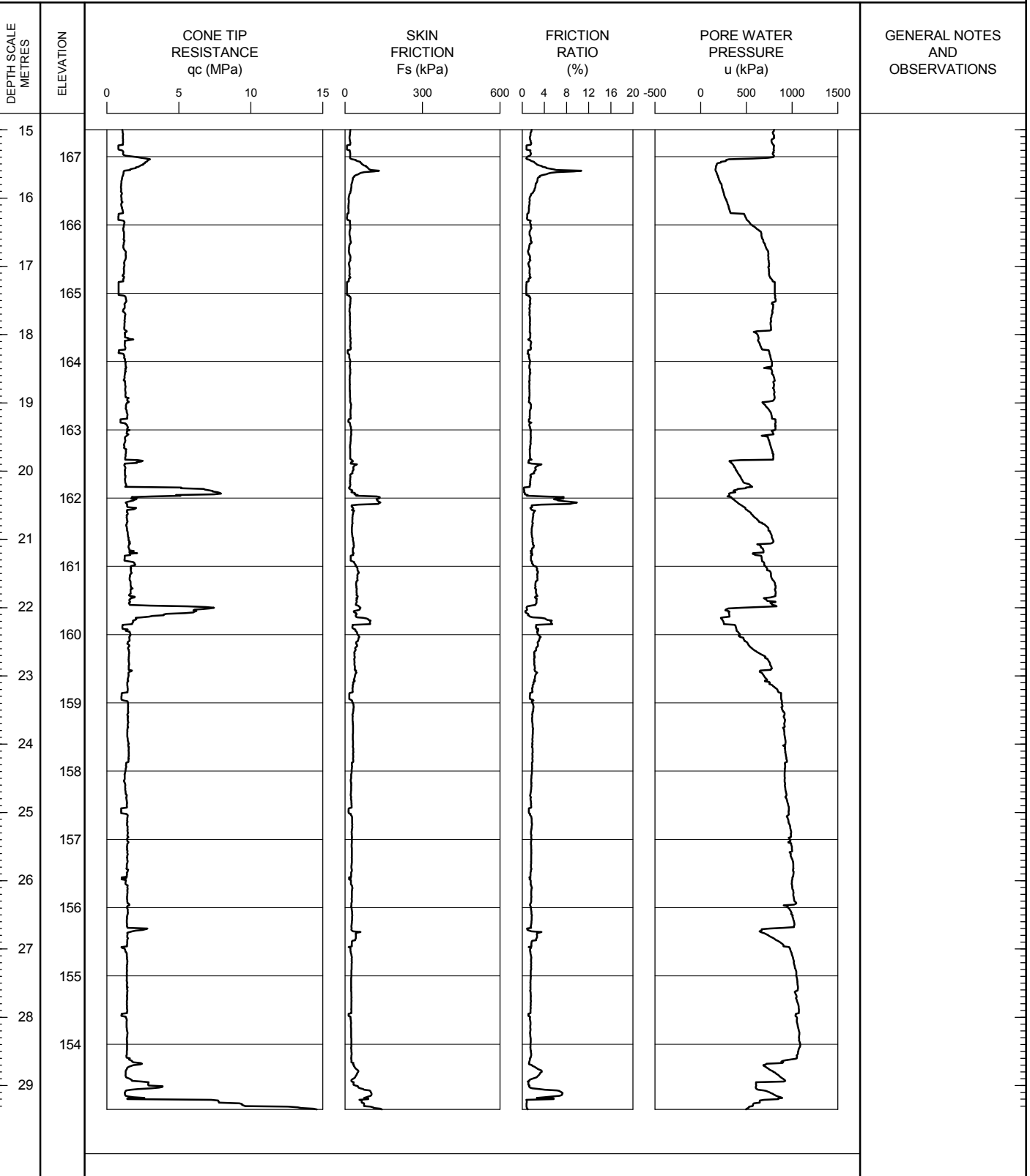
DATUM Geodetic

GROUND SURFACE ELEVATION: 182.4

PREDRILL DEPTH: 1.97

CORRECTION FACTOR A: 0.8

CORRECTION FACTOR B: 0



OPERATOR: TA

CHECKED: DD

# RECORD OF CONE PENETRATION TEST CPT 43-RW

METRIC

PROJECT Windsor-Essex Parkway

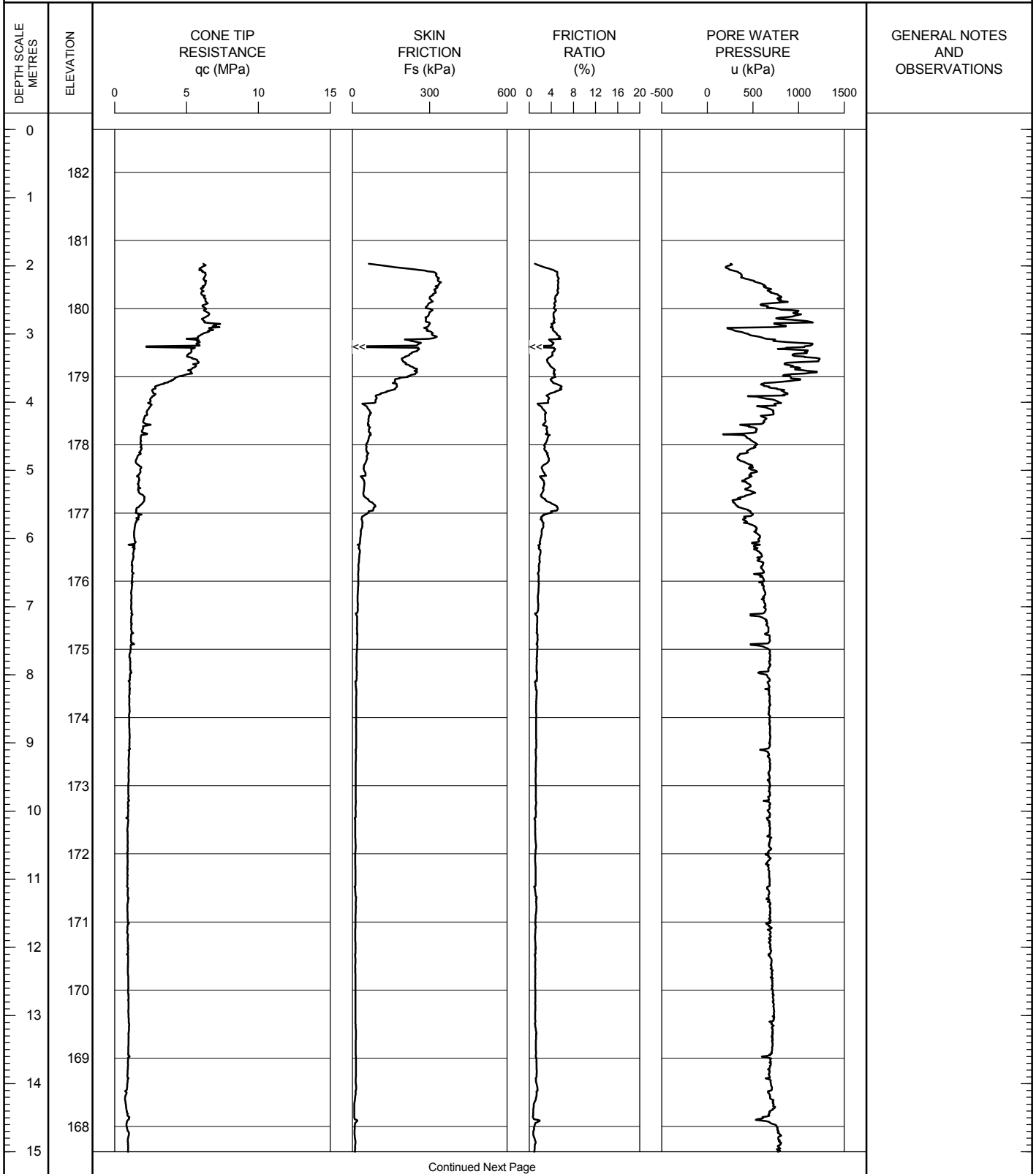
TEST DATE 8/3/2011 - 8/3/2011

SHEET 1 OF 2

LOCATION N4678907.6; E333207.7

DATUM Geodetic

GROUND SURFACE ELEVATION: 182.6 PREDRILL DEPTH: 1.97 CORRECTION FACTOR A: 0.8 CORRECTION FACTOR B: 0



WEP CPT LOG CPT-RW.GPJ ONTARIO MOT.GDT 06/01/12

OPERATOR: TA

CHECKED: DD

# RECORD OF CONE PENETRATION TEST CPT 43-RW

METRIC

PROJECT Windsor-Essex Parkway

TEST DATE 8/3/2011 - 8/3/2011

SHEET 2 OF 2

LOCATION N4678907.6; E333207.7

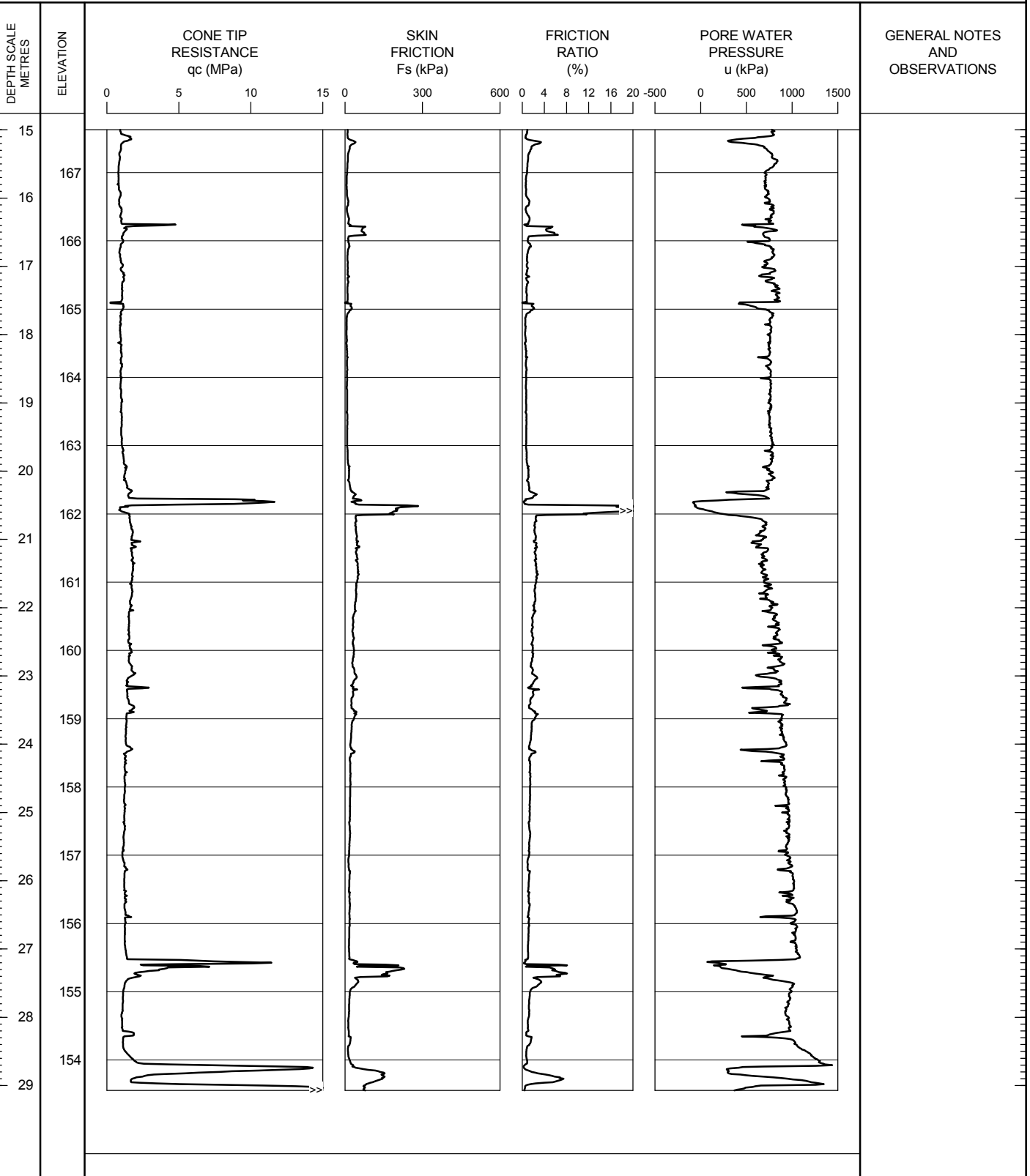
DATUM Geodetic

GROUND SURFACE ELEVATION: 182.6

PREDRILL DEPTH: 1.97

CORRECTION FACTOR A: 0.8

CORRECTION FACTOR B: 0



OPERATOR: TA

CHECKED: DD

# RECORD OF CONE PENETRATION TEST CPT 52-RW

METRIC

PROJECT Windsor-Essex Parkway

TEST DATE 5/17/2011 - 5/17/2011

SHEET 1 OF 2

LOCATION N4677681.4; E335365.2

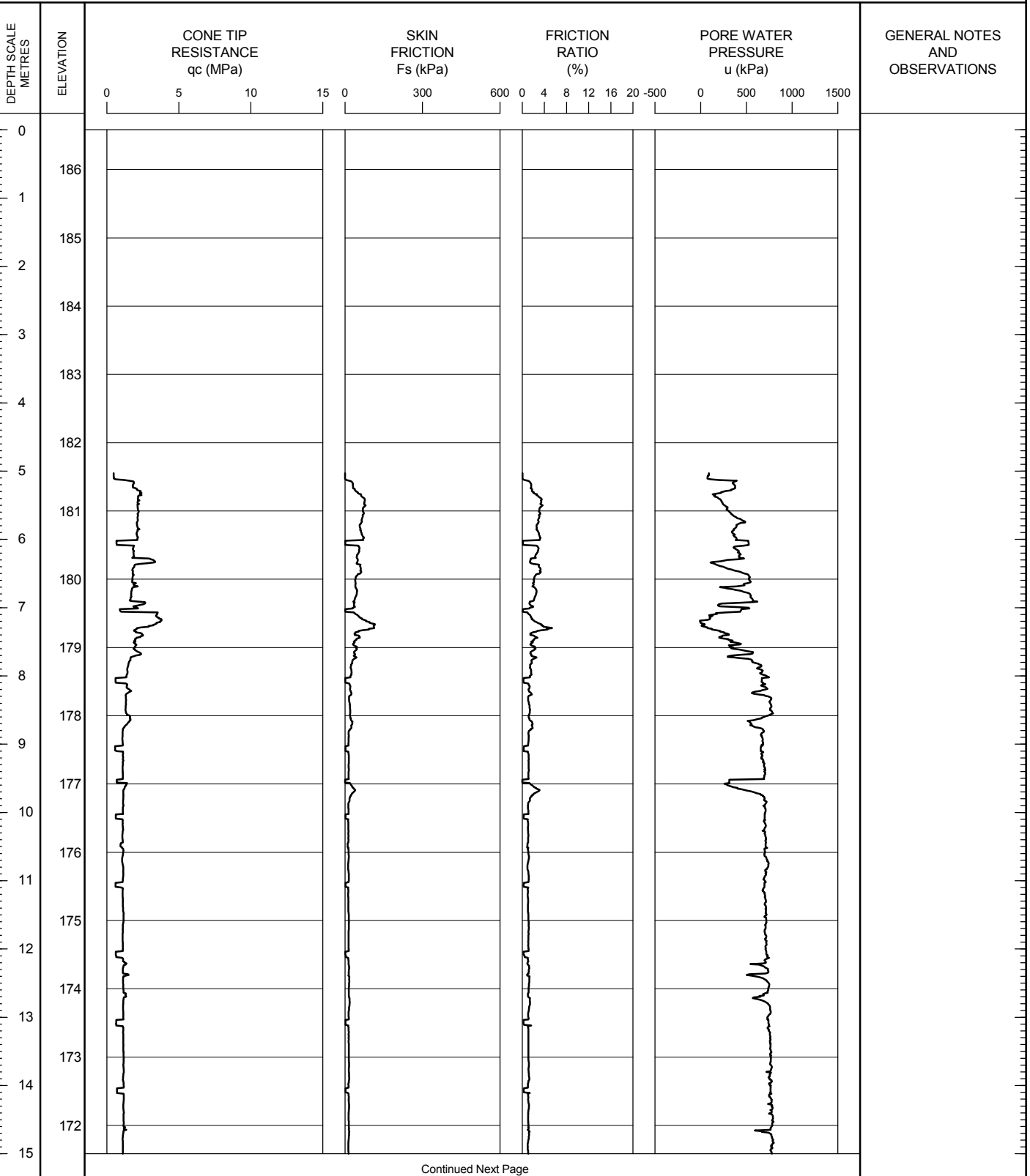
DATUM Geodetic

GROUND SURFACE ELEVATION: 186.6

PREDRILL DEPTH: 5

CORRECTION FACTOR A: 0.8

CORRECTION FACTOR B: 0



OPERATOR: TA

CHECKED: DD



# RECORD OF CONE PENETRATION TEST CPT 52-RW

**METRIC**

PROJECT Windsor-Essex Parkway

TEST DATE 5/17/2011 - 5/17/2011

SHEET 2 OF 2

LOCATION N4677681.4; E335365.2

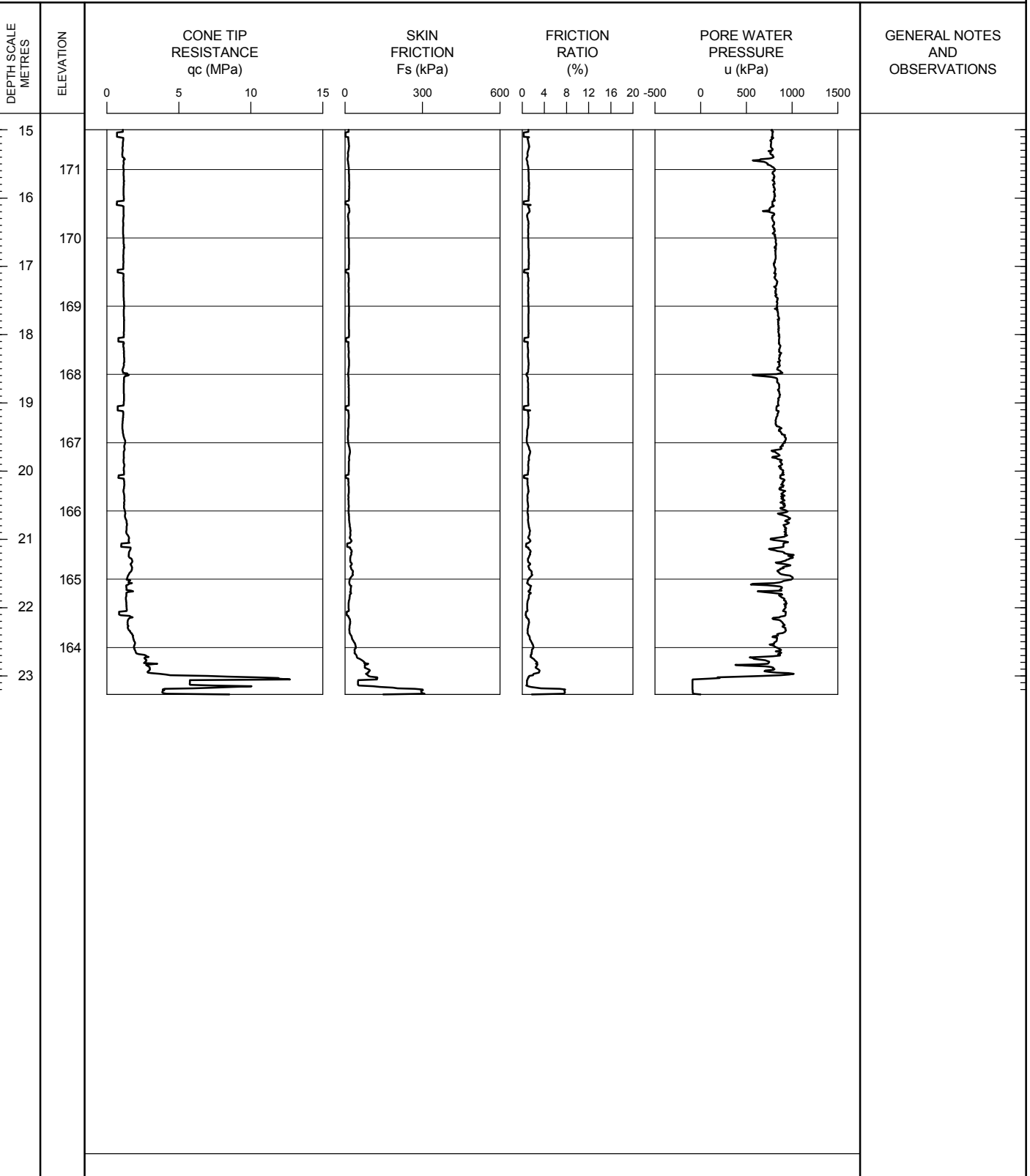
DATUM Geodetic

GROUND SURFACE ELEVATION: 186.6

PREDRILL DEPTH: 5

CORRECTION FACTOR A: 0.8

CORRECTION FACTOR B: 0



WEP CPT LOG CPT-RW.GPJ ONTARIO MOT.GDT 06/01/12

OPERATOR: TA

CHECKED: DD

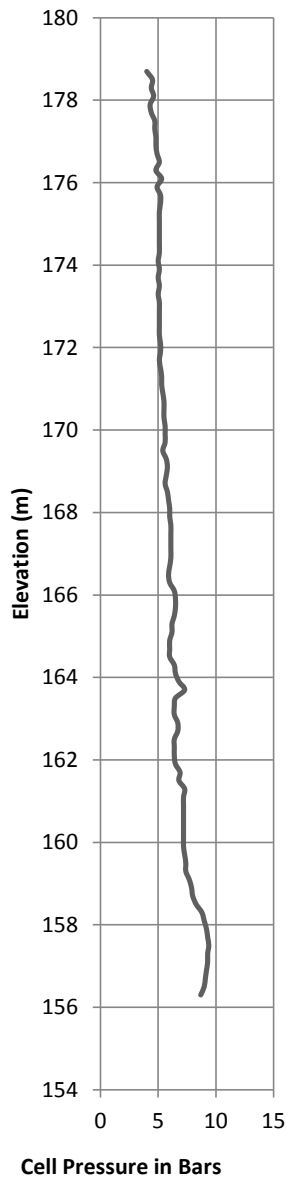
# RECORD OF DILATOMETER TEST DMT03-RW

Project : Windsor-Essex Parkway  
Location: N 4681139.6; E 331398.4  
Ground Surface Elevation : 182.3

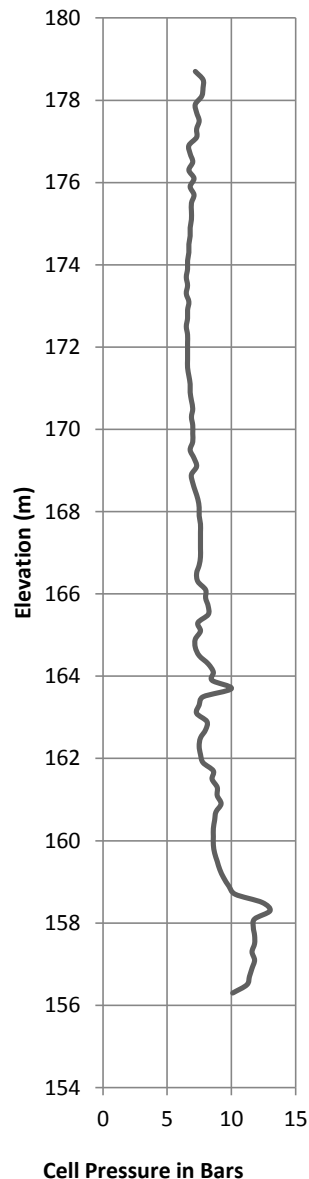
Test Date: 6/12/2011  
Predrill Depth : 3.5 m  
Delta A: 0.20 Bar

Sheet 1 of 1  
Datum Geodetic  
Delta B: 0.30 Bar

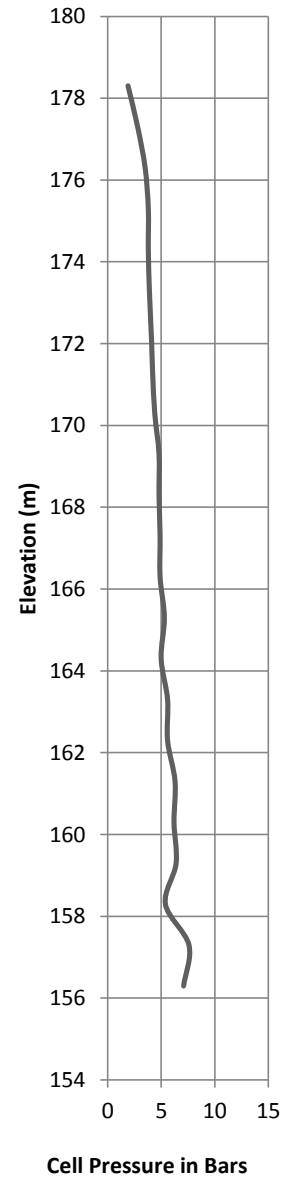
**Reading A**



**Reading B**



**Reading C**



Operator: LC

Checked: DD

# RECORD OF BOREHOLE No 7

1 OF 4

METRIC

PROJECT 04-1111-060

W.P.

LOCATION

N 4678848.0 :E 333325.0

ORIGINATED BY C.C.

DIST WEST HWY 401 / 3

BOREHOLE TYPE POWER AUGER, HOLLOW STEM

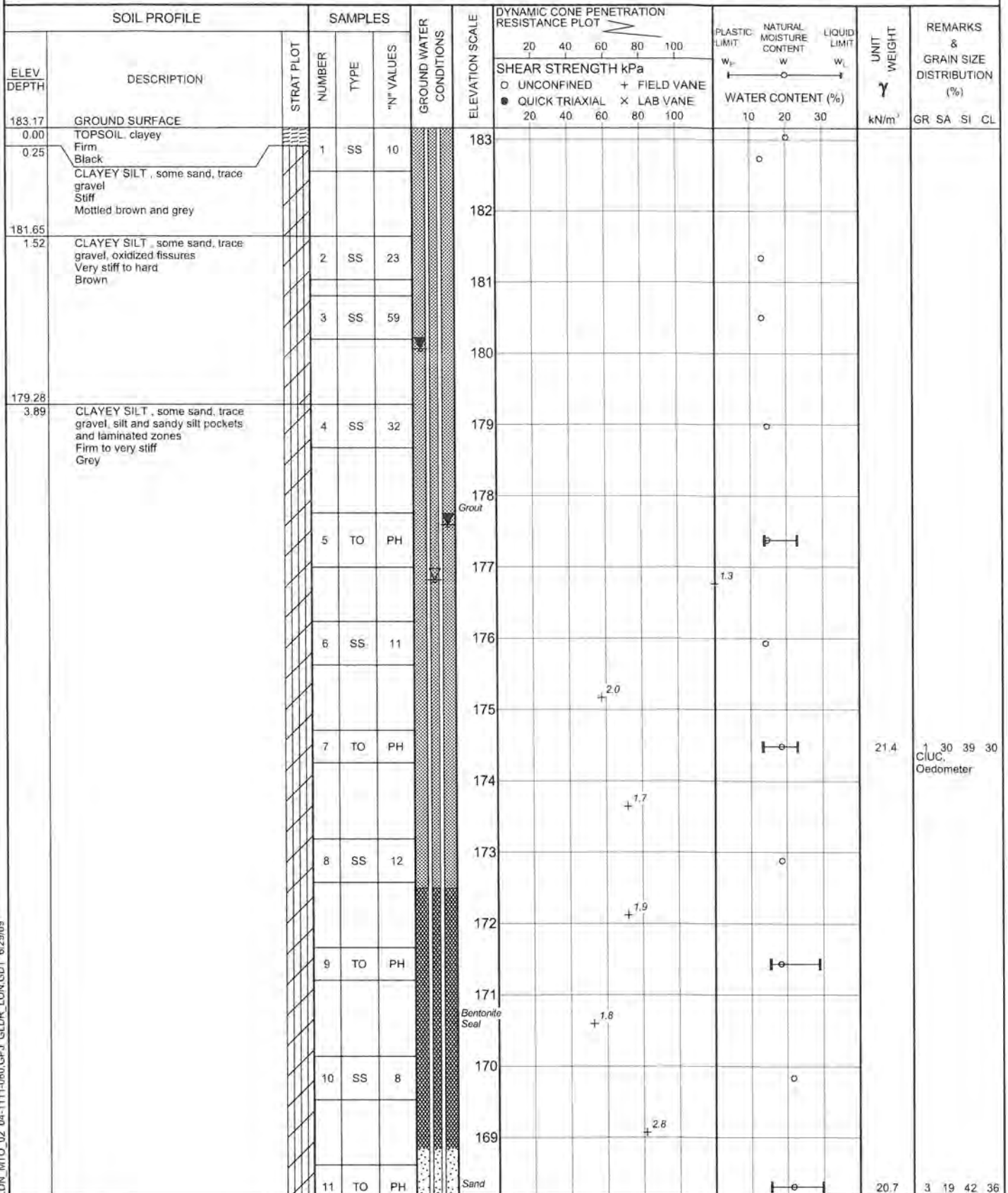
COMPILED BY T.M.

DATUM Geodetic

DATE

November 10, 2006 - November 16, 2006

CHECKED BY *SB*



Continued Next Page

+ 3 x 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

PROJECT <u>04-1111-060</u>		<b>RECORD OF BOREHOLE No 7</b>		2 OF 4	<b>METRIC</b>
W.P. _____	LOCATION <u>N 4678848.0 :E 333325.0</u>	ORIGINATED BY <u>C.C.</u>			
DIST <u>WEST</u> HWY <u>401/3</u>	BOREHOLE TYPE <u>POWER AUGER/HOLLOW STEM</u>	COMPILED BY <u>T.M.</u>			
DATUM <u>Geodetic</u>	DATE <u>November 10, 2006 - November 16, 2006</u>	CHECKED BY <u>SJS</u>			

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)												
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE									"N" VALUES	20	40	60	80	100	20	40	60	80	100	10
	CLAYEY SILT , some sand, trace gravel, silt and sandy silt pockets and laminated zones Firm to very stiff Grey						168																	CIUC, Oedometer
			12	TO	PH		167																	
							166																	
			13	SS	12		165																	
							164																	
			14	TO	PH		163																	
			15	TO	PH		162																	
			16	SS	21		161																	
							160																	
			17	SS	PH		159																	
							158																	
			18	SS	13		157																	
							156																	
			19	SS	12		155																	
			20	TO	PH		154																	
			21	SS	9																			
			22	SS	PH																			

LDN\_MTO\_02 04-1111-060.GPJ GLDR LON.GDT 6/29/03

Continued Next Page

+<sup>3</sup> ×<sup>3</sup>: Numbers refer to Sensitivity      ○<sup>3</sup>% STRAIN AT FAILURE

# RECORD OF BOREHOLE No 7

3 OF 4

METRIC

PROJECT 04-1111-060

W.P.

LOCATION

N 4678848.0 ; E 333325.0

ORIGINATED BY C.C.

DIST WEST HWY 401 / 3

BOREHOLE TYPE POWER AUGER, HOLLOW STEM

COMPILED BY T.M.

DATUM Geodetic

DATE

November 10, 2006 - November 16, 2006

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ  kN/m <sup>3</sup>	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	× LAB VANE						
						20	40	60	80	100	10	20	30		
150.02	CLAYEY SILT , some sand, trace gravel, silt and sandy silt pockets and laminated zones Firm to very stiff Grey		23	SS	13		153								
							152								
			24	SS	PH										
							151								
			25	SS	42										
33.15	LIMESTONE, fresh, medium strong, laminated, very fine grained, moderately porous, light grey  (FOR DETAILED DESCRIPTIONS REFER TO RECORD OF DRILLHOLE)		26	NQ RC			150								
			27	NQ RC			149								
			28	NQ RC			148								
							147								
145.28			29	NQ RC			146							UC	
37.89	END OF BOREHOLE  Water level in borehole at about elevation 176.82m on October 16, 2006  Lower piezometer 32mm PVC screen and riser pipe. Second (Upper) piezometer 13mm porous tip and CPVC riser pipe.  Water level in Upper Piezometer at about elevation 180.06m on November 14, 2006.  Water level in Lower Piezometer at about elevation 177.59m on November 14, 2006.														

SHEET 4 OF 4

DATUM: Geodetic

DRILLING CONTRACTOR:

[illegible]

# RECORD OF BOREHOLE No 104

1 OF 4

METRIC

PROJECT 07-1130-207-0

W.P.

LOCATION

N 4677630.3 ; E 335263.1

ORIGINATED BY MA

DIST WEST HWY 401/3

BOREHOLE TYPE POWER AUGER, MUD ROTARY WITH HQ TRICONE, NQRC

COMPILED BY BRS

DATUM GEODETIC

DATE

April 1, 2008 - April 2, 2008

CHECKED BY SJS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100					
186.15	GROUND SURFACE													
0.00	SILTY SAND, some clay, trace gravel, Loose Mottled brown and grey		1	SS	7		Concrete							
184.78							Bentonite							
1.37	CLAYEY SILT, some sand, trace gravel Very stiff Brown becoming grey at about elev. 183.1m		2	SS	23									
			3	SS	28									
			4	SS	22									
182.49														
3.66	CLAYEY SILT, some sand, trace gravel, with sandy silt layers Very stiff Grey		5	SS	16									
181.73														
4.42	CLAYEY SILT, some sand, trace gravel Very stiff Grey		6	SS	14									
			7	SS	12									
			8	SS	7									
178.85														
7.35	SAND AND GRAVEL, some silt, some clay Grey		9	TO	PH									
178.17	CLAYEY SILT, some sand, trace gravel Grey													
7.98														
8.23	SANDY SILT, trace gravel Grey		10	SS	10									
177.16	SILTY SAND, trace gravel, trace clay, with clayey silt layers Loose to compact Grey		11	SS	8		Grout							4 46 37 13
8.99														
176.09	CLAYEY SILT, some sand, trace gravel, with silt and sand partings Firm Grey													
10.06	CLAYEY SILT, some sand, trace gravel Stiff Grey		12	SS	6									2 27 43 28
			13	TO	PH									
			14	SS	7									
171.21														

Continued Next Page

+ 3, x 3, Numbers refer to Sensitivity O 3% STRAIN AT FAILURE

LDN\_MTO\_01 07-1130-207-0.GPJ LDN\_MTO.GDT 6/29/09



# RECORD OF BOREHOLE No 104

2 OF 4

METRIC

PROJECT 07-1130-207-0

W.P.

LOCATION

N 4677630.3 E 335263.1

ORIGINATED BY MA

DIST WEST HWY 401/3

BOREHOLE TYPE POWER AUGER, MUD ROTARY WITH HQ TRICONE, NQRC

COMPILED BY BRS

DATUM GEODETIC

DATE

April 1, 2008 - April 2, 2008

CHECKED BY SJB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100					
14.94	CLAYEY SILT, some sand, trace gravel, with sand partings Stiff Grey		15	TO	PH		171							
							170		1.7					
			16	SS	6		169							1 23 41 35
168.62	SILTY CLAY, trace sand, trace gravel Stiff Grey						168		1.5					
17.53			17	SS	4		167							
166.95	CLAYEY SILT, trace sand, trace gravel, with silt partings Stiff Grey						166		2.3					
19.20			18	TO	PH		165		1.8					
165.42	CLAYEY SILT, trace sand, trace gravel Stiff to hard Grey						164		1.2					
20.73			19	SS	5		163							
			20	SS	31		162							
162.53	SAND AND GRAVEL, trace silt Very dense Grey						161							
23.62			21	SS	68		160							8 74 (18)
160.85	SANDY SILT Very dense Grey						159							
25.30			22	SS	71		158							(66)
159.85	CLAYEY SILT, trace sand, trace gravel Hard Grey						157							
26.30			23	SS	39									(92)
158.35	SILT, trace sand Dense Grey													
27.80			24	SS	15									
157.65	CLAYEY SILT, trace sand, trace gravel, with sandy silt partings Stiff to very stiff Grey													
28.50														

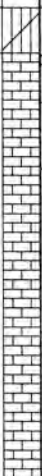
Continued Next Page

+ 3, X 3, Numbers refer to Sensitivity O 3% STRAIN AT FAILURE

LDN\_MTO\_01\_07-1130-207-0.GPJ LDN\_MTO.GDT 5/29/09



PROJECT <u>07-1130-207-0</u>		<b>RECORD OF BOREHOLE No 104</b>		3 OF 4 <b>METRIC</b>	
W.P. _____		LOCATION <u>N 4677630.3 ; E 335263.1</u>		ORIGINATED BY <u>MA</u>	
DIST <u>WEST</u> HWY <u>401/3</u>		BOREHOLE TYPE <u>POWER AUGER, MUD ROTARY WITH HQ TRICONE, NQRC</u>		COMPILED BY <u>BRS</u>	
DATUM <u>GEODETIC</u>		DATE <u>April 1, 2008 - April 2, 2008</u>		CHECKED BY <u>SJB</u>	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ  kN/m <sup>3</sup>	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	× LAB VANE						
							20	40	60	80	100					
155.70	LIMESTONE, fresh, medium strong, thinly laminated, fine grained, faintly porous Light grey  (FOR DETAILED DESCRIPTIONS REFER TO RECORD OF DRILLHOLE)		25	SS	100/76mm											
30.45			26	HQ RC				155	88	82	82					
			27	HQ RC				154	95	81	70					
			28	HQ RC				153								
151.45	END OF BOREHOLE															
34.70	Water level in borehole at about elev. 162.4m during drilling on April 1 and 2, 2008.  Water level measured in deep piezometer at elev. 177.92m on April 4, 2008.  Water level measured in deep piezometer at elev. 176.09m on September 19, 2008.  Water level measured in deep piezometer at elev. 177.25 on November 14, 2008.															

LDN\_MTO\_01\_07-1130-207-0.GPJ LDN\_MTO.GDT 6/29/09

PROJECT: 07-1130-207-0

## RECORD OF DRILLHOLE: 104

SHEET 4 OF 4

LOCATION: N 4677630.3 ; E 335263.1

DRILLING DATE: April 1, 2008 - April 2, 2008

DATUM: GEODETIC

INCLINATION: -90° AZIMUTH: —

DRILL RIG: MUD ROTARY WITH HQ TRICONE, NQRC

DRILLING CONTRACTOR: AARDVARK DRILLING INC

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV.		RUN No.	PENETRATION RATE (mm/min)	COLOUR FLUSH % RETURN	ELEVATION	RECOVERY				R.Q.D. %	FRACT INDEX PER 0.3	DISCONTINUITY DATA				HYDRAULIC CONDUCTIVITY k, cm/sec.	DIAMETRAL POINT LOAD INDEX (MPa)						NOTES WATER LEVELS INSTRUMENTATION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
				DEPTH (m)	TOTAL CORE %					SOLID CORE %	TYPE AND SURFACE DESCRIPTION	10 <sup>0</sup>	10 <sup>1</sup>			10 <sup>2</sup>	10 <sup>3</sup>	10 <sup>4</sup>	10 <sup>5</sup>		10 <sup>6</sup>	10 <sup>7</sup>	10 <sup>8</sup>	10 <sup>9</sup>	10 <sup>10</sup>																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
31	MUD ROTARY NO ROCK CORE	ROCK SURFACE		155.70																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											

# RECORD OF BOREHOLE No 104A

1 OF 1

METRIC

PROJECT 07-1130-207-0

W.P.

LOCATION

N 4677630.3 : E 335263.1

ORIGINATED BY MA

DIST

WEST

HWY 401/3

BOREHOLE TYPE

POWER AUGER, SOLID STEM

COMPILED BY BRS

DATUM GEODETIC

DATE

April 1, 2008

CHECKED BY **JS**

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100			
186.15	SOIL CONDITIONS INFERRED FROM BOREHOLE No. 104 GROUND SURFACE														
0.00	SILTY SAND, some clay, trace gravel, Loose. Mottled brown and grey						Concrete								
184.78															
1.37	CLAYEY SILT, some sand, trace gravel Very stiff Brown becoming grey at about elev. 183.1m														
182.49															
3.66	CLAYEY SILT, some sand, trace gravel, with sandy silt layers Very stiff Grey						Bentonite								
181.73															
4.42	CLAYEY SILT, some sand, trace gravel Very stiff Grey														
178.85															
7.35	SAND AND GRAVEL, some silt, some clay Grey														
178.17															
7.98	CLAYEY SILT, some sand, trace gravel Grey						Sand								
8.23	SANDY SILT, trace gravel Grey														
177.16															
8.99	SILTY SAND, trace gravel, trace clay, with clayey silt layers Loose to compact Grey						Piezometer								
176.09															
10.06	CLAYEY SILT, some sand, trace gravel, with silt and sand partings Firm Grey														
	END OF BOREHOLE														
	Water level measured in shallow piezometer at elev. 183.01m on April 4, 2008.														
	Water level measured in shallow piezometer at elev. 183.76m on September 19, 2008.														

LDN\_MTO\_01 07-1130-207-0.GPJ LDN\_MTO.GDT 8/29/09

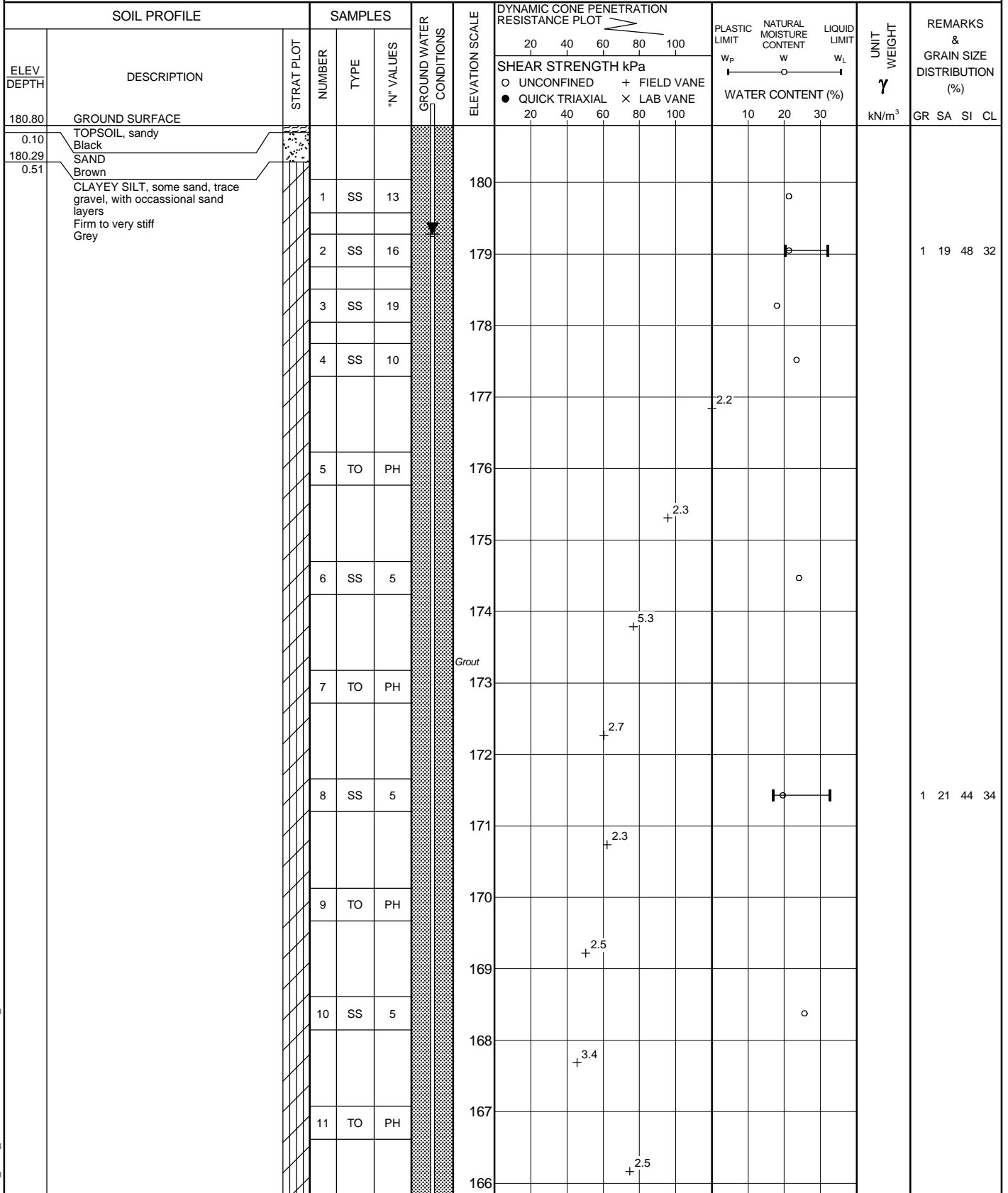
PROJECT 07-1130-207-0		<b>RECORD OF BOREHOLE No 143</b>		1 OF 1	<b>METRIC</b>
W.P. _____		LOCATION N 4681191 B, E 331295.2		ORIGINATED BY SM	
DIST WEST HWY 401/3		BOREHOLE TYPE POWER AUGER, SOLID STEM		COMPILED BY BRS	
DATUM GEODETIC		DATE August 18, 2008		CHECKED BY <i>SJB</i>	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
181.26	GROUND SURFACE													
0.00	TOPSOIL, sandy Black													
180.65														
0.61	SAND Loose Brown		1	SS	5									
180.19														
1.07	SILTY CLAY, trace sand, trace organics Firm to stiff Mottled brown and grey		2	SS	9									
179.13														
2.13	CLAYEY SILT, some sand, trace gravel Firm to stiff Grey		3	SS	14									
			4	SS	13									
			5	SS	10									
			6	SS	11									
			7	SS	9									
			8	SS	7									
			9	SS	6									
173.18	END OF BOREHOLE													
8.08	Borehole dry during drilling on August 18, 2008.  Water level measured in piezometer at elev. 176.44m on September 19, 2008.  Water level measured in piezometer at elev. 179.17m on January 28, 2009.													

LDN MTO 01 07-1130-207-0.GPJ LDN MTO GDT 6/29/09



PROJECT <u>09-1132-0080</u>		<b>RECORD OF BOREHOLE No 325</b>		1 OF 4		<b>METRIC</b>	
W.P. _____		LOCATION <u>N 4679787.7 ; E 331972.9</u>		ORIGINATED BY <u>SM</u>			
DIST <u>WEST</u> HWY <u>401 / 3</u>		BOREHOLE TYPE <u>POWER AUGER, MUD ROTARY WITH HQ TRICONE, NQRC</u>		COMPILED BY <u>LMK/DMB</u>			
DATUM <u>GEODETIC</u>		DATE <u>December 16, 2009 - December 17, 2009</u>		CHECKED BY _____			

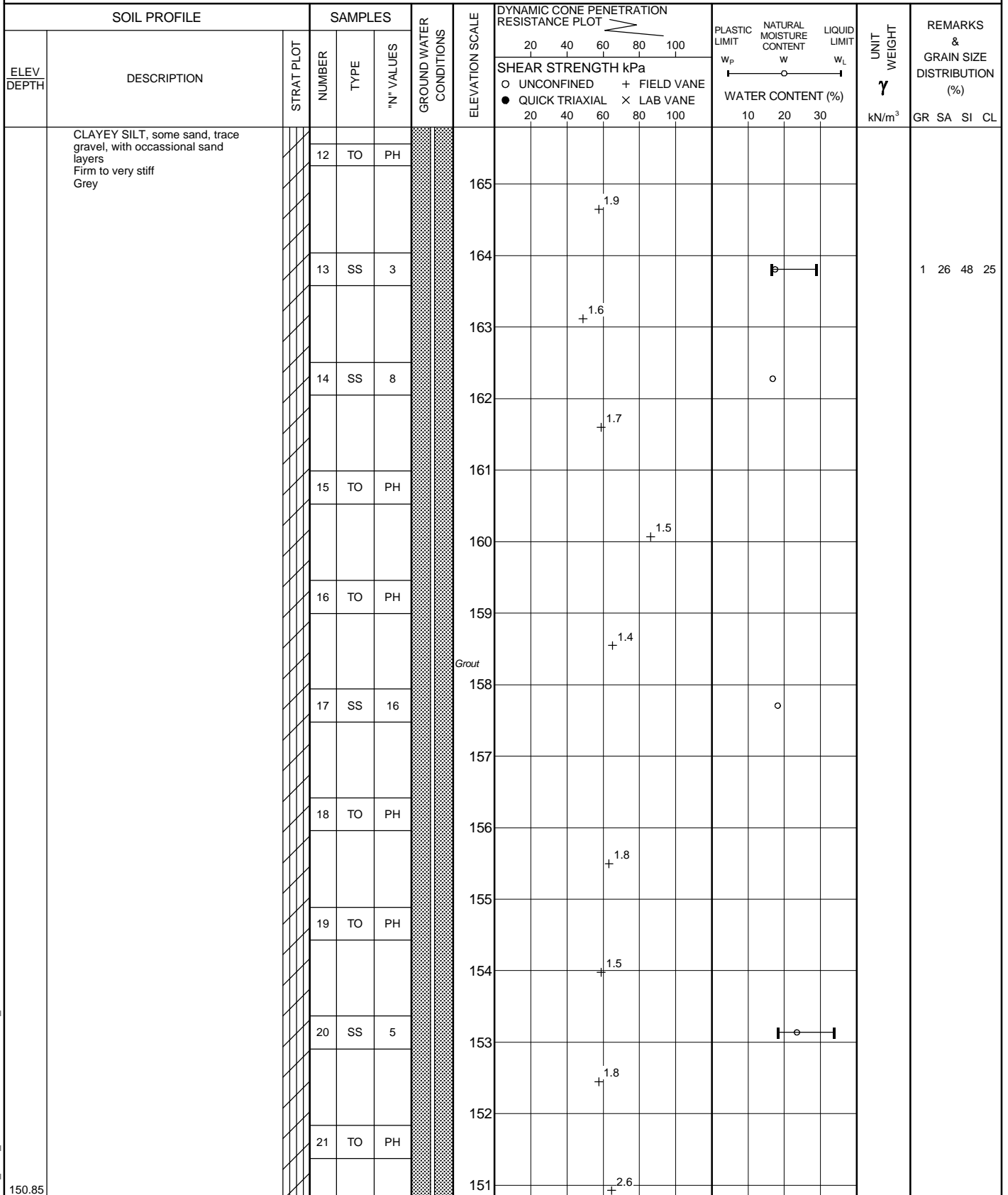


LDN\_MTO\_06 09-1132-0080.GPJ LDN\_MTO.GDT 11/03/10

Continued Next Page

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

PROJECT <u>09-1132-0080</u>		<b>RECORD OF BOREHOLE No 325</b>		2 OF 4	<b>METRIC</b>
W.P. _____		LOCATION <u>N 4679787.7 ; E 331972.9</u>		ORIGINATED BY <u>SM</u>	
DIST <u>WEST</u> HWY <u>401 / 3</u>		BOREHOLE TYPE <u>POWER AUGER, MUD ROTARY WITH HQ TRICONE, NQRC</u>		COMPILED BY <u>LMK/DMB</u>	
DATUM <u>GEODETIC</u>		DATE <u>December 16, 2009 - December 17, 2009</u>		CHECKED BY _____	



LDN\_MTO\_06 09-1132-0080.GPJ LDN\_MTO.GDT 11/03/10

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

PROJECT <u>09-1132-0080</u>		<b>RECORD OF BOREHOLE No 325</b>		3 OF 4		<b>METRIC</b>	
W.P. _____		LOCATION <u>N 4679787.7 ; E 331972.9</u>		ORIGINATED BY <u>SM</u>			
DIST <u>WEST</u> HWY <u>401 / 3</u>		BOREHOLE TYPE <u>POWER AUGER, MUD ROTARY WITH HQ TRICONE, NQRC</u>		COMPILED BY <u>LMK/DMB</u>			
DATUM <u>GEODETIC</u>		DATE <u>December 16, 2009 - December 17, 2009</u>		CHECKED BY _____			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ  kN/m <sup>3</sup>	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						× LAB VANE		
						20	40	60	80	100	10	20	30							
29.95	SANDY SILT, some clay, trace to some gravel Compact to very dense Grey		22	SS	17		150										10 40 38 12			
								149												
148.48			23	SS	82/ 175mm															
32.32	LIMESTONE, fresh, medium strong, weakly laminated to laminated, very fine to fine grained, faintly porous Light grey to brown  (FOR DETAILED DESCRIPTIONS REFER TO RECORD OF DRILLHOLE)		24	NQ RC	-		148	88	78	78										
			25	NQ RC	-		147	97	95	94										
			26	NQ RC	-		146	T.C.R. (%) 100	S.C.R. (%) 98	R.Q.D. (%) 86										
			27	NQ RC	-		145													
								144	100	95	88									
143.31	END OF BOREHOLE  Borehole dry during drilling between December 14 and 17, 2009.  Water level measured at elev. 179.35 on February 24, 2010.  Water level measured at elev. 179.28 on January 6, 2010.																			
37.49																				



PROJECT: 09-1132-0080

# RECORD OF DRILLHOLE: 325

SHEET 4 OF 4

LOCATION: N 4679787.7 ;E 331972.9

DRILLING DATE: December 16, 2009 - December 17, 2009

DATUM: GEODETIC

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: MUD ROTARY WITH HQ TRICONE, NQRC

DRILLING CONTRACTOR: AARDVARK

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV.	RUN No.	PENETRATION RATE (m/min)	COLOUR % RETURN	FLUSH	ELEVATION	JN - Joint FLT - Fault SHR - Shear VN - Vein CJ - Conjugate BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular PO - Polished K - Slickensided SM - Smooth Ro - Rough Br - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.										HYDRAULIC CONDUCTIVITY k, cm/sec			DIAMETRAL POINT LOAD INDEX (MPa)		NOTES WATER LEVELS INSTRUMENTATION						
				DEPTH (m)						RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.3	DISCONTINUITY DATA		TYPE AND SURFACE DESCRIPTION	10 <sup>-8</sup>	10 <sup>-6</sup>	10 <sup>-4</sup>	2	4	6									
										TOTAL CORE %	SOLID CORE %				DIP W.R.T. CORE AXIS																
												80 60 40 20	80 60 40 20	80 60 40 20	5 10 15 20	0 30 60 90															
		ROCK SURFACE		148.49																											
	MUD ROTARY NO. ROCK CORE	LIMESTONE, fresh, medium strong, weakly laminated, very fine grained, faintly porous, grey		32.31	1				148																						
33				148.03																											
		LIMESTONE, fresh, medium strong, laminated, fine grained, faintly porous, with occasional pits, brown		32.77																											
34																															
				146.11	2				147																						
35			34.69																												
	LIMESTONE, fresh, medium strong, weakly laminated, fine to very fine grained, faintly porous, light grey to grey-brown, lower 0.3m fossiliferous																														
36																															
					3				146																						
37																															
38																															
					4				145																						
39																															
40																															
41																															
					4				144																						
42																															
43																															
44																															
					4				144																						
45																															
46																															
47																															
		END OF DRILLHOLE		143.31																											
				37.49																											
38																															
39																															
40																															
41																															
42																															
43																															
44																															
45																															
46																															
47																															

DEPTH SCALE

1 : 75



LOGGED: SG

CHECKED:

LDN\_ROCK\_03 09-1132-0080-ROCK.GPJ GLDR LDN.GDT 11/03/10 DATA INPUT: LMK

**NILCON FIELD VANE SHEAR TEST RESULTS****Windsor-Essex Parkway**

Depth (m)	Elevation (m)	Undrained Shear Strength (kPa)			Sensitivity
		Natural	Post-Peak	Remoulded	

**Field Vane Location 1 (Borehole BH-1)**

5.1	181.6	145	104	93	1.6
6.1	180.6	109	94	73	1.5
7.1	179.6	81	65	66	1.2
8.1	178.6	107	90	64	1.7
9.1	177.6	90	77	62	1.4
10.1	176.6	75	60	59	1.3
11.1	175.6	84	65	62	1.4
12.1	174.6	83	60	47	1.7
13.1	173.6	60	48	55	1.1
14.1	172.6	62	45	47	1.3
15.1	171.6	50	43	49	1.0
16.1	170.6	64	45	47	1.3
17.1	169.6	60	39	51	1.2
18.1	168.6	52	35	45	1.2
19.1	167.6	60	35	53	1.1
20.1	166.6	71	33	45	1.6
21.1	165.6	58	20	42	1.4
22.1	164.6	60	19	49	1.2
23.1	163.6	43	34		

**Field Vane Location 7 (Borehole BH-7)**

6.1	177.1	108	93	76	1.4
7.1	176.1	81	58	47	1.7
8.1	175.1	80	51	36	2.2
9.1	174.1	69	41	28	2.4
10.1	173.1	61	48	17	3.6
11.1	172.1	64	47	30	2.1
12.1	171.1	65	44	32	2.0
13.1	170.1	53	28	23	2.3
14.1	169.1	50	31	19	2.6
15.1	168.1	59	44	30	1.9
16.1	167.1	46	16	15	3.1
17.1	166.1	40	17	21	1.9
18.1	165.1	22	13	15	1.5
19.1	164.1	61	36	40	1.5

**Field Vane Location 14 (Borehole BH-14)**

6.0	176.0	93	62	35	2.6
7.0	175.0	57	29	15	3.8
8.0	174.0	62	37	29	2.1
9.0	173.0	51	28	24	2.2
10.0	172.0	48	26	24	2.0
11.0	171.0	49	26	24	2.1
12.0	170.0	44	26	23	2.0
13.0	169.0	42	24	21	2.0
14.0	168.0	64	50	22	3.0
15.0	167.0	38	13	16	2.4
16.0	166.0	38	8	14	2.7

PROJECT: 07-1130-207-0

**RECORD OF CONE PENETRATION TEST CPT-7**

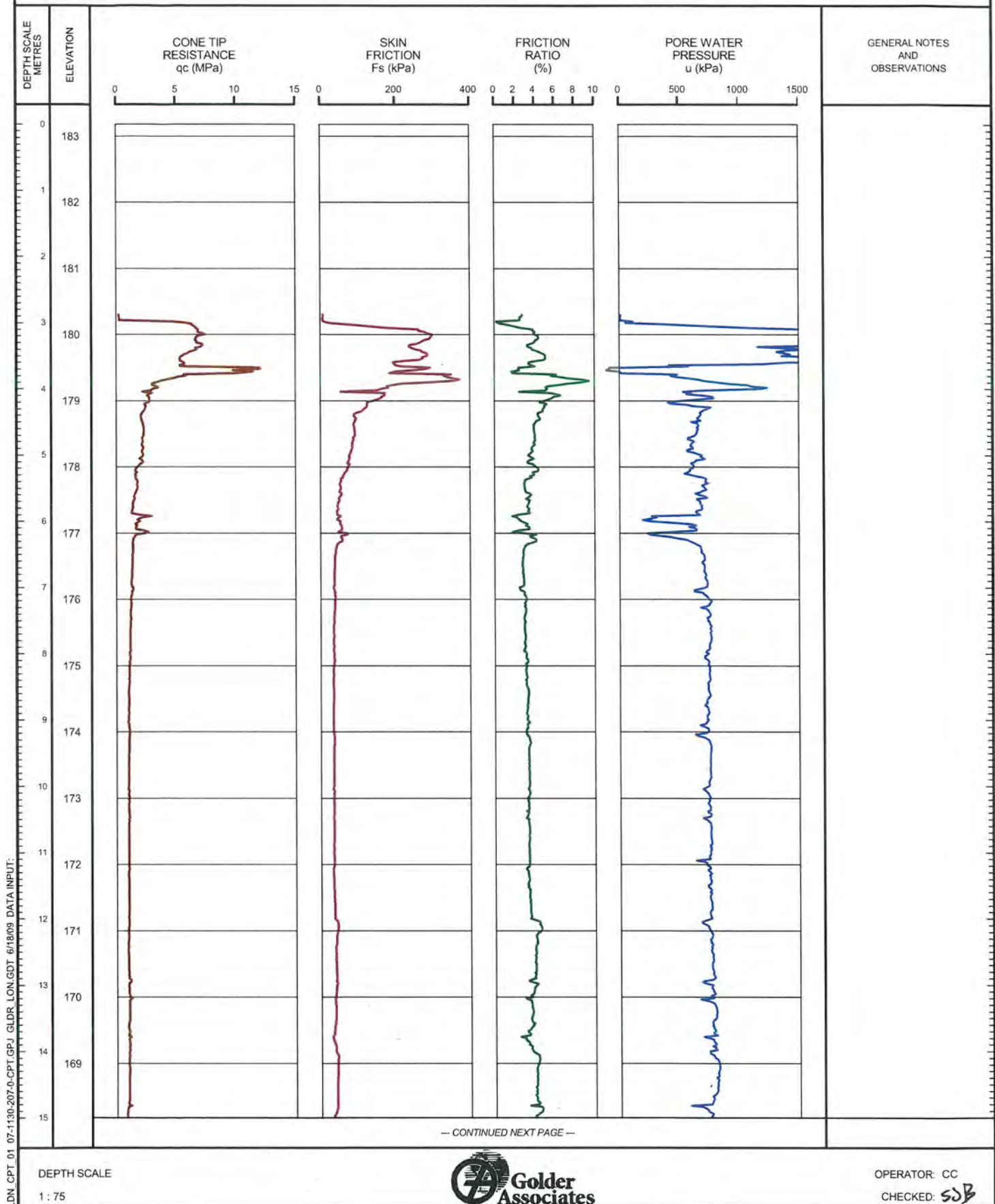
SHEET 1 OF 2

LOCATION: N 4678844.0 ;E 333327.0

TEST DATE: November 12, 2006

DATUM: GEODETIC

GROUND SURFACE ELEVATION:    PREDRILL DEPTH: 2.90m    CORRECTION FACTOR A: 0.584    CORRECTION FACTOR B: 0.012



PROJECT: 07-1130-207-0

**RECORD OF CONE PENETRATION TEST CPT-7**

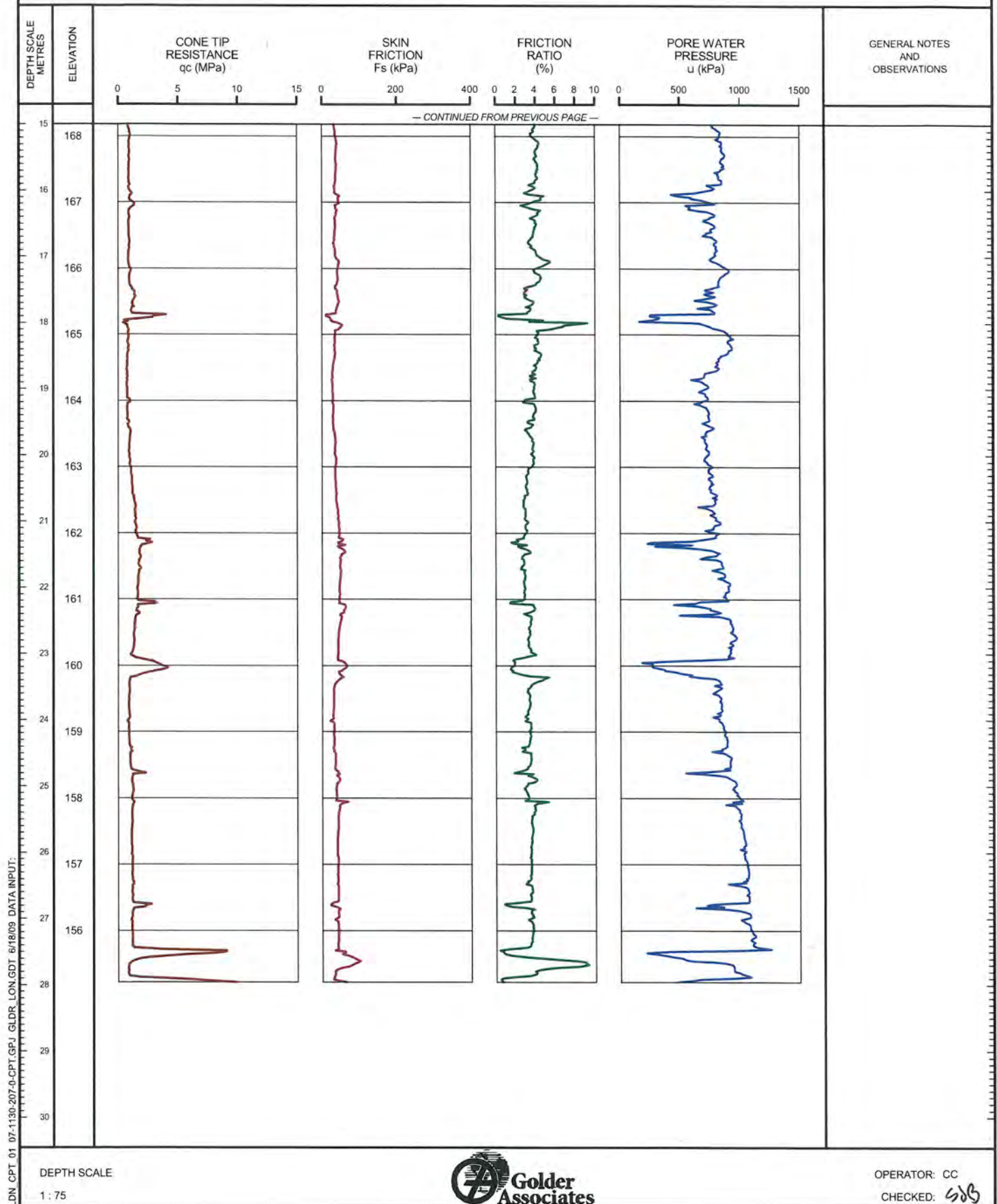
SHEET 2 OF 2

LOCATION: N 4678844.0 :E 333327.0

TEST DATE: November 12, 2006

DATUM: GEODETIC

GROUND SURFACE ELEVATION:    PREDRILL DEPTH: 2.90m    CORRECTION FACTOR A: 0.584    CORRECTION FACTOR B: 0.012



LDN CPT 01 07-1130-207-0-CPT.GPJ GLDR LON.GDT 6/18/09 DATA INPUT:

PROJECT: 07-1130-207-0

## RECORD OF CONE PENETRATION TEST CPT-103

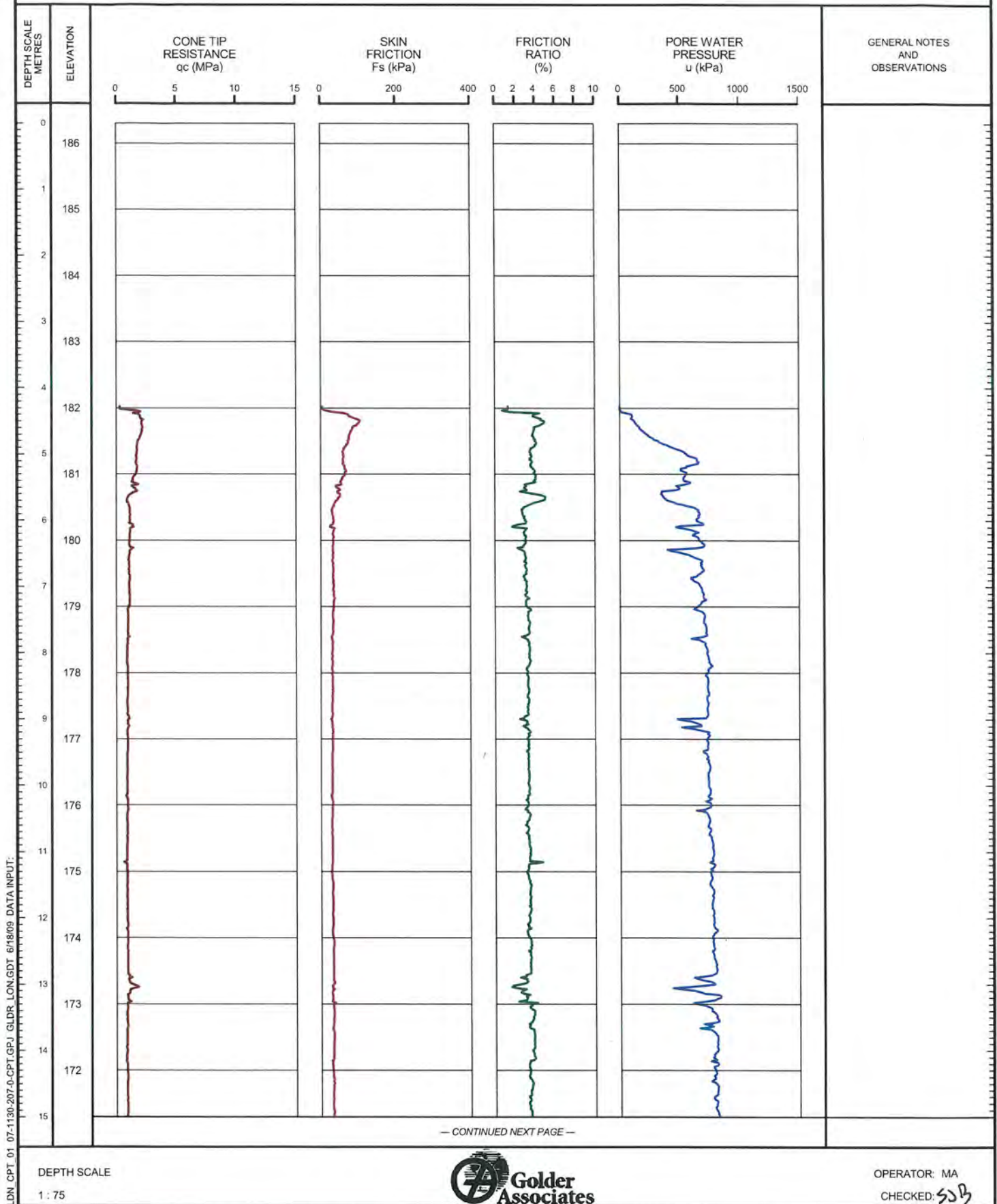
SHEET 1 OF 2

LOCATION: N 4677620.0 :E 335400.7

TEST DATE: March 31, 2008

DATUM: GEODETIC

GROUND SURFACE ELEVATION: PREDRILL DEPTH: 4.30m CORRECTION FACTOR A: 0.584 CORRECTION FACTOR B: 0.012





PROJECT: 07-1130-207-0

**RECORD OF CONE PENETRATION TEST CPT-103**

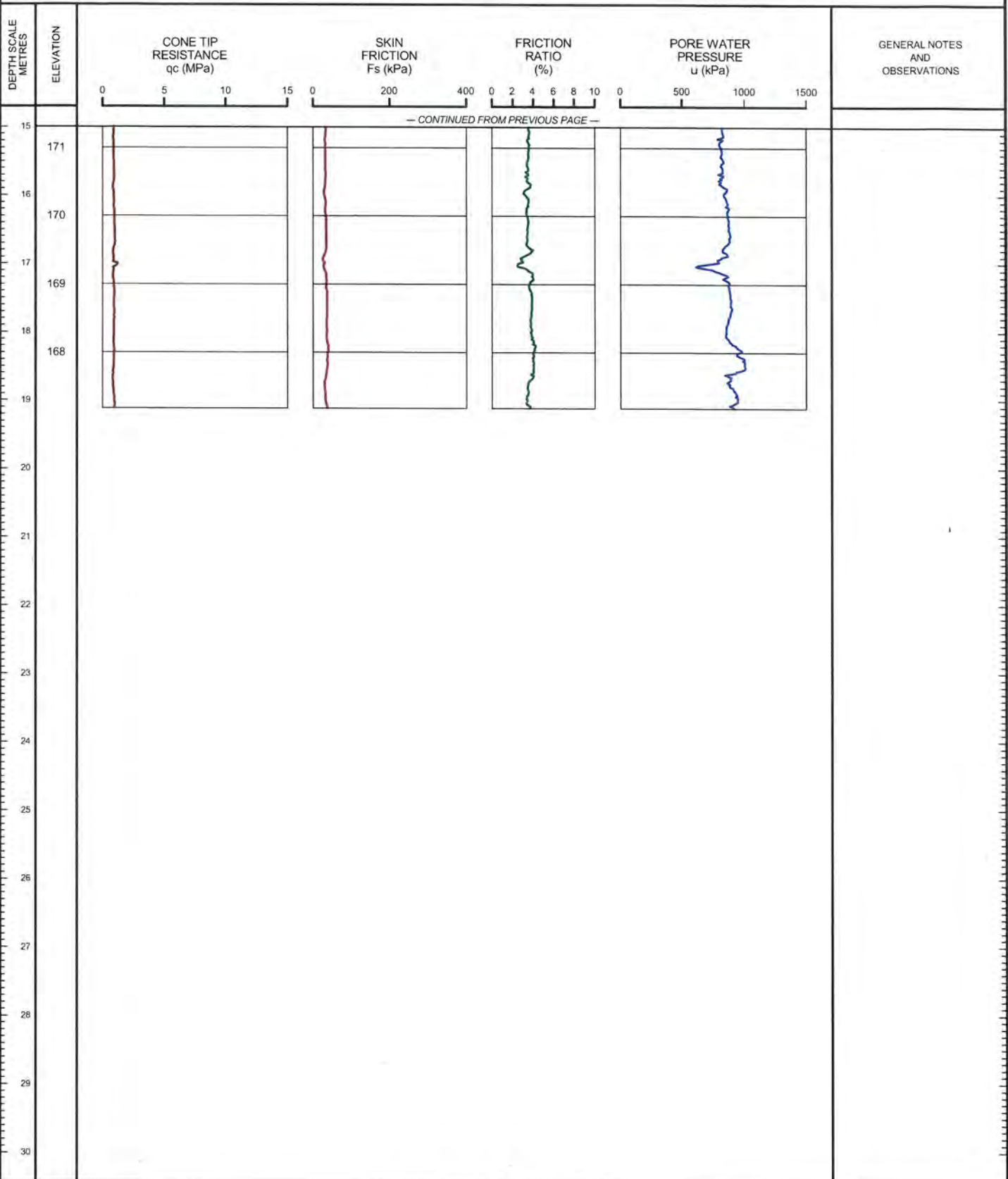
SHEET 2 OF 2

LOCATION: N 4677620.0 ; E 335400.7

TEST DATE: March 31, 2008

DATUM: GEODETIC

GROUND SURFACE ELEVATION:    PREDRILL DEPTH: 4.30m    CORRECTION FACTOR A: 0.584    CORRECTION FACTOR B: 0.012



LDN CPT 01 07-1130-207-0-CPT.GPJ GLDR LON.GDT 6/19/09 DATA INPUT:

DEPTH SCALE

1 : 75



OPERATOR: MA

CHECKED: *GSB*

PROJECT: 07-1130-207-0

# RECORD OF CONE PENETRATION TEST CPT-110

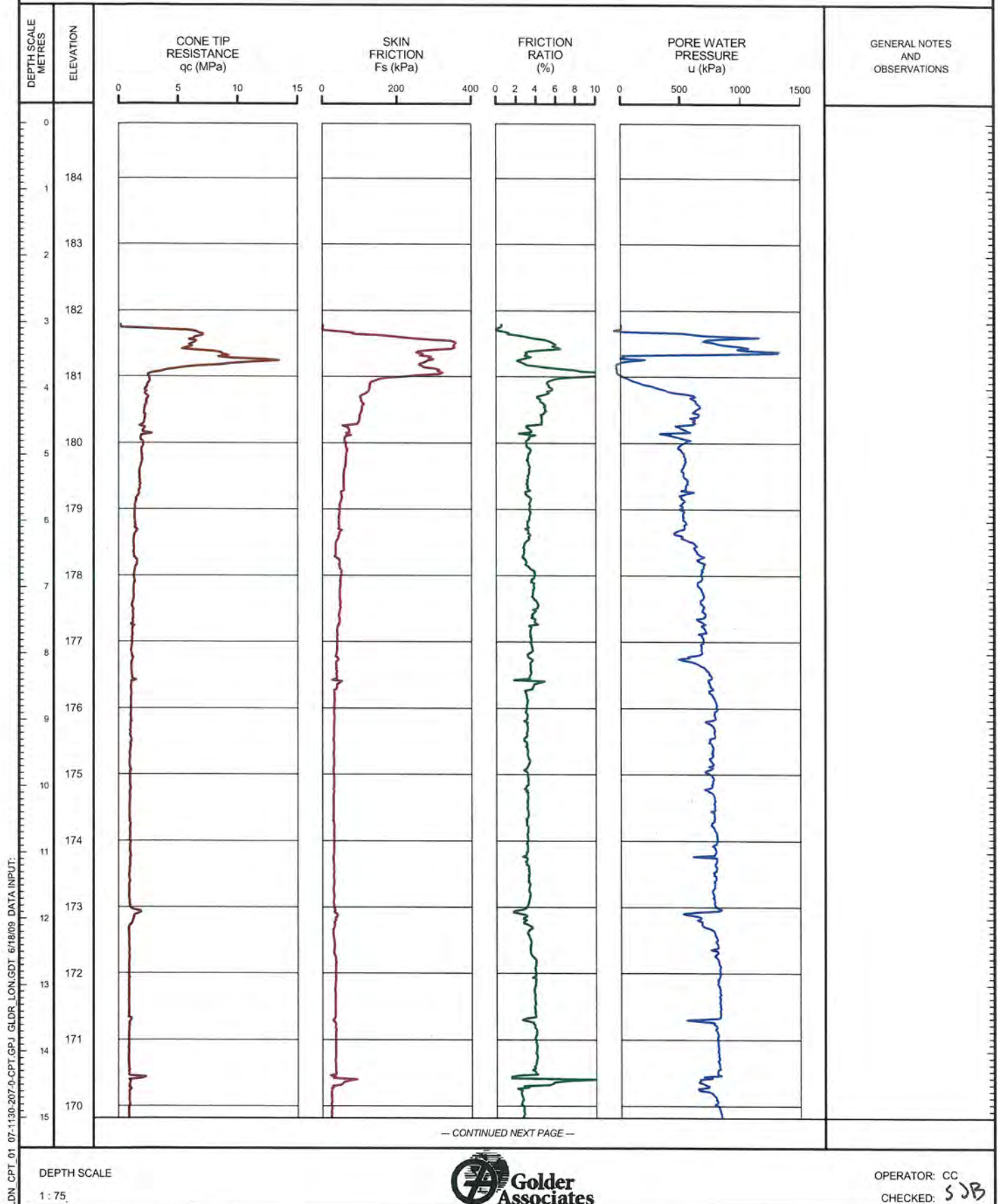
SHEET 1 OF 2

LOCATION: N 4678297.8, E 334448.6

TEST DATE: September 9, 2008

DATUM: GEODETIC

GROUND SURFACE ELEVATION:    PREDRILL DEPTH: 3.05m    CORRECTION FACTOR A: 0.584    CORRECTION FACTOR B: 0.012



PROJECT: 07-1130-207-0

**RECORD OF CONE PENETRATION TEST CPT-110**

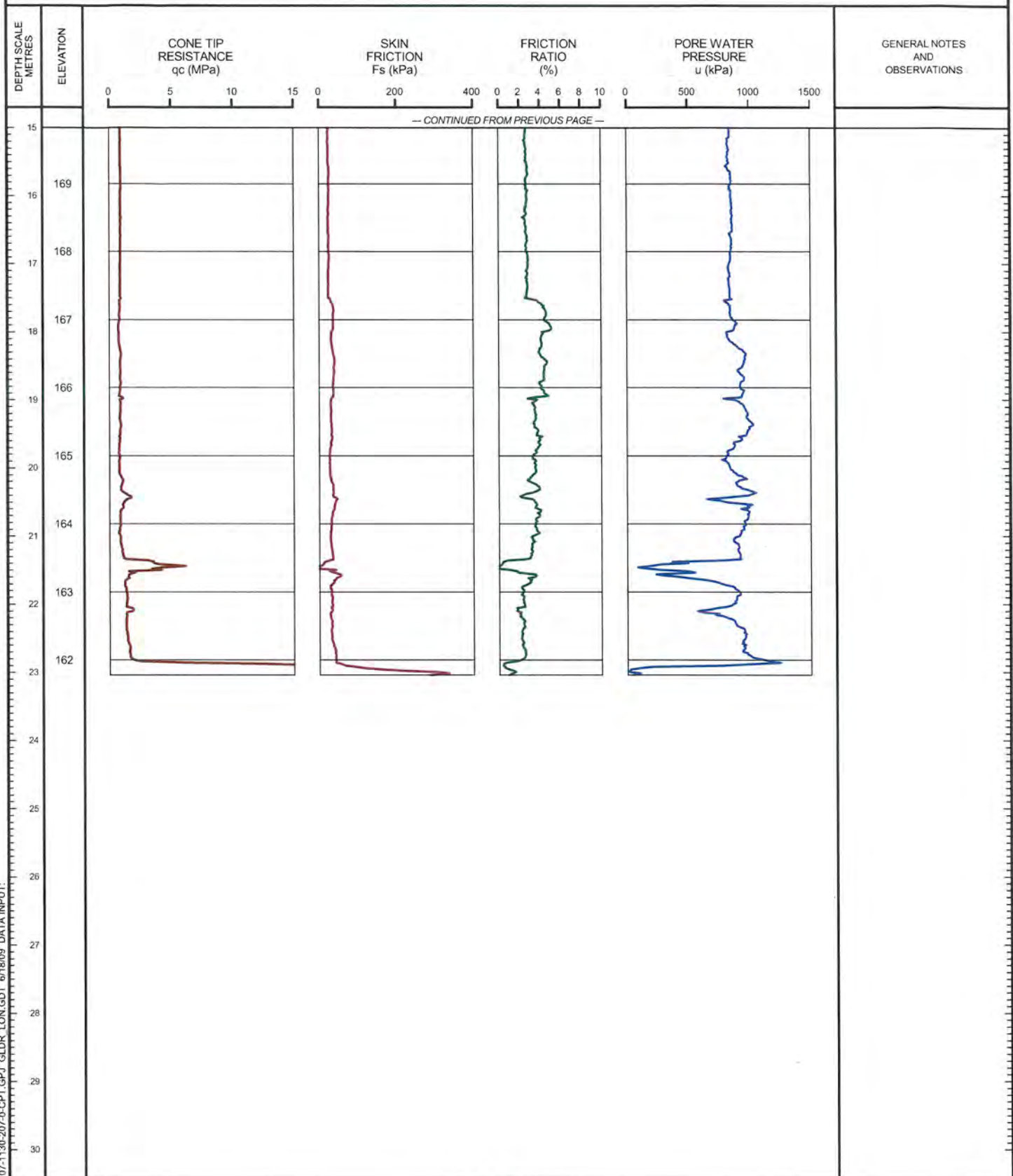
SHEET 2 OF 2

LOCATION: N 4678297.8 :E 334448.6

TEST DATE: September 9, 2008

DATUM: GEODETIC

GROUND SURFACE ELEVATION:    PREDRILL DEPTH: 3.05m    CORRECTION FACTOR A: 0.584    CORRECTION FACTOR B: 0.012



LDN CPT 01 07-1130-207-0-CPT.GPJ GLDR LON.GDT 6/18/09 DATA INPUT:

DEPTH SCALE

1 : 75



OPERATOR: CC

CHECKED: SJB



PROJECT: 07-1130-207-0

## RECORD OF CONE PENETRATION TEST CPT-111

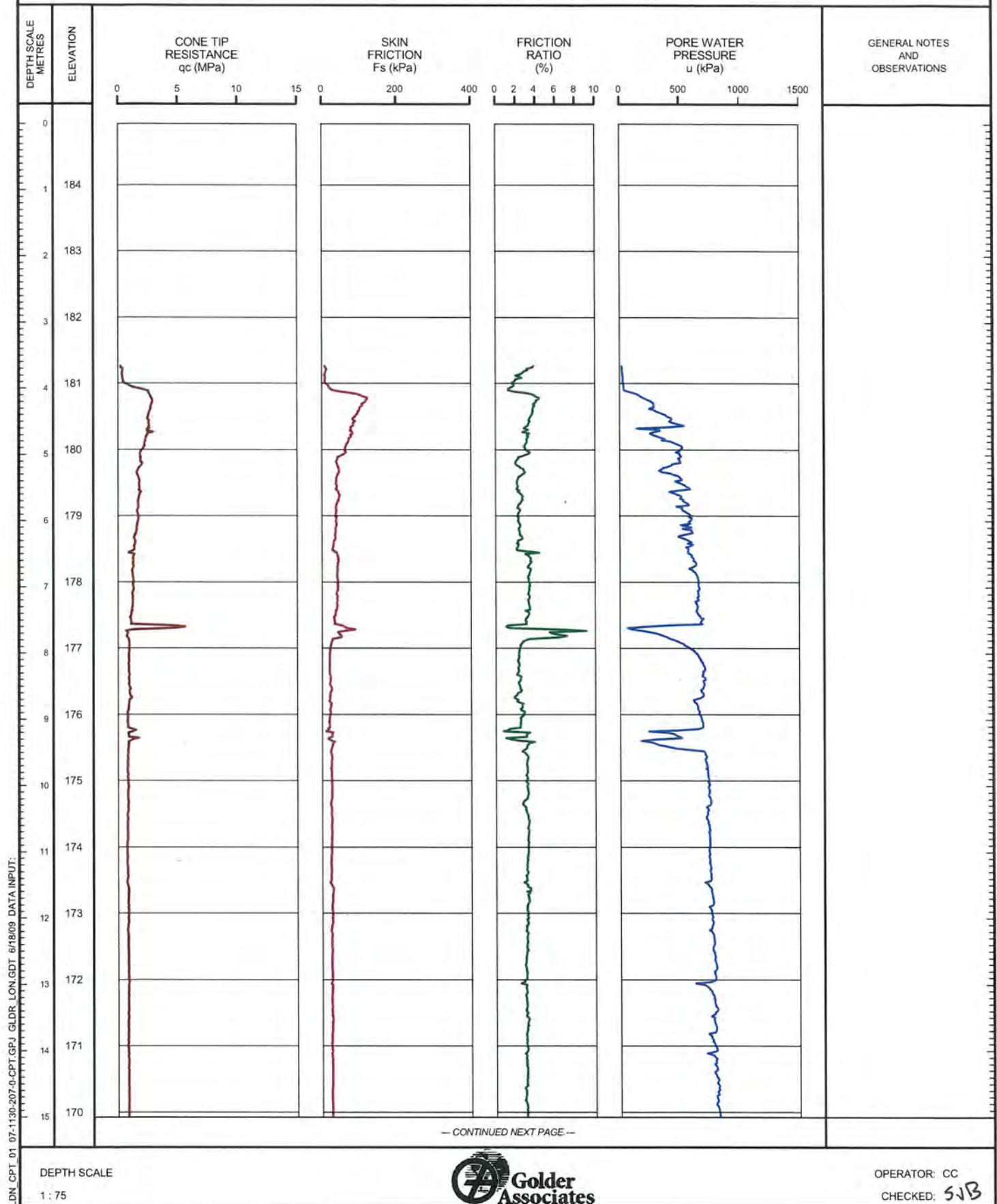
SHEET 1 OF 2

LOCATION: N 4678351.4 :E 334347.6

TEST DATE: September 9, 2008

DATUM: GEODETIC

GROUND SURFACE ELEVATION: PREDRILL DEPTH: 3.66m CORRECTION FACTOR A: 0.6 CORRECTION FACTOR B: 0.013



LDN CPT 01 07-1130-207-0-CPT.GPJ GLDR LON.GDT 6/18/09 DATA INPUT:

PROJECT: 07-1130-207-0

## RECORD OF CONE PENETRATION TEST CPT-111

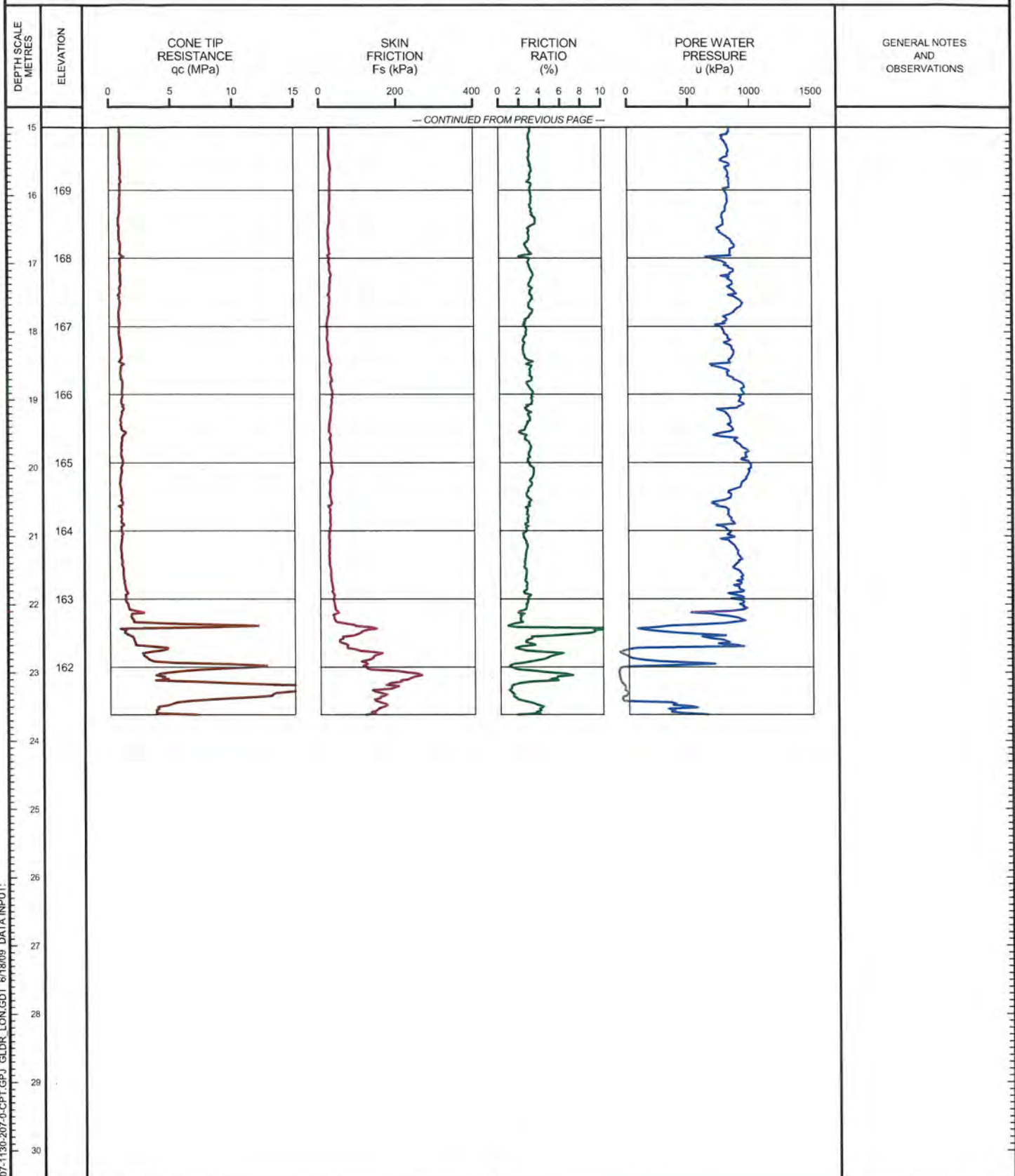
SHEET 2 OF 2

LOCATION: N 4678351.4 ; E 334347.6

TEST DATE: September 9, 2008

DATUM: GEODETIC

GROUND SURFACE ELEVATION: PREDRILL DEPTH: 3.66m CORRECTION FACTOR A: 0.6 CORRECTION FACTOR B: 0.013



LDN CPT 01 07-1130-207-0-CPT.GPJ GLDR LON.GDT 6/18/09 DATA INPUT:

DEPTH SCALE

1 : 75



OPERATOR: CC

CHECKED: *JSB*

## Appendix C      Analytical Laboratory Test Results



AMEC EARTH & ENVIRONMENTAL-  
WINDSOR

ATTN: SHANE MACLEOD  
11865 County Road 42  
TECUMSEH ON N8N 2M1

Date Received: 02-SEP-11  
Report Date: 09-SEP-11 14:39 (MT)  
Version: FINAL

Client Phone: 519-735-2499

## Certificate of Analysis

**Lab Work Order #:** L1053300  
**Project P.O. #:** NOT SUBMITTED  
**Job Reference:** SW8801.1004.101  
**C of C Numbers:** 113002  
**Legal Site Desc:**

Gayle Braun  
Senior Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 309 Exeter Road Unit #29, London, ON N6L 1C1 Canada | Phone: +1 519 652 6044 | Fax: +1 519 652 0671  
ALS CANADA LTD Part of the ALS Group A Campbell Brothers Limited Company

	<div>Sample ID Description Sampled Date Sampled Time Client ID</div>	L1053300-1 SOIL 01-SEP-11  PS1- 1,SS26@100',GREY SILTY CLAY				
Grouping	Analyte					
SOIL						
Physical Tests	% Moisture (%)	20.0				
	pH (pH units)	7.75				
	Redox Potential (mV)	290				
	Resistivity (ohm cm)	2090				
Leachable Anions & Nutrients	Sulphide (mg/kg)	<0.20				
Anions and Nutrients	Sulphate (mg/kg)	578				

## Reference Information

### Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
MOISTURE-WT	Soil	% Moisture	Gravimetric: Oven Dried
PH-WT	Soil	pH	MOEE E3137A
Soil samples are mixed in the deionized water and the supernatant is analyzed directly by the pH meter.			
REDOX-POTENTIAL-WT	Soil	Redox Potential	APHA 2580
RESISTIVITY-WT	Soil	Resistivity	MOEE E3137A
SO4-WT	Soil	Sulphate	EPA 300.0
SULPHIDE-WT	Soil	Sulphide	APHA 4500S2D

\*\* ALS test methods may incorporate modifications from specified reference methods to improve performance.

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

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

### Chain of Custody Numbers:

113002

### GLOSSARY OF REPORT TERMS

*Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.*

*mg/kg - milligrams per kilogram based on dry weight of sample.*

*mg/kg wwt - milligrams per kilogram based on wet weight of sample.*

*mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.*

*mg/L - milligrams per litre.*

*< - Less than.*

*D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).*

*N/A - Result not available. Refer to qualifier code and definition for explanation.*

*Test results reported relate only to the samples as received by the laboratory.*

*UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.*

*Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.*

## Quality Control Report

Workorder: L1053300

Report Date: 09-SEP-11

Page 1 of 3

Client: AMEC EARTH & ENVIRONMENTAL-WINDSOR

11865 County Road 42

TECUMSEH ON N8N 2M1

Contact: SHANE MACLEOD

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
<b>MOISTURE-WT</b>								
	Soil							
Batch	R2246130							
WG1342214-2	LCS							
% Moisture			94		%		70-130	02-SEP-11
WG1342214-1	MB							
% Moisture			<0.10		%		0.1	02-SEP-11
<b>PH-WT</b>								
	Soil							
Batch	R2246414							
WG1343256-5	CVS							
pH			99		%		80-120	06-SEP-11
<b>RESISTIVITY-WT</b>								
	Soil							
Batch	R2248587							
WG1345734-1	CVS							
Resistivity			100		%		70-130	09-SEP-11
<b>SO4-WT</b>								
	Soil							
Batch	R2247979							
WG1343886-3	LCS							
Sulphate			100		%		60-140	07-SEP-11
WG1343886-1	MB							
Sulphate			<20		mg/kg		20	07-SEP-11
<b>SULPHIDE-WT</b>								
	Soil							
Batch	R2247559							
WG1344742-1	CVS							
Sulphide			101		%		50-120	07-SEP-11
WG1344739-1	MB							
Sulphide			<0.20		mg/kg		0.2	07-SEP-11

# Quality Control Report

Workorder: L1053300

Report Date: 09-SEP-11

Page 2 of 3

## Legend:

---

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

## Sample Parameter Qualifier Definitions:

---

Qualifier	Description
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

---



# Quality Control Report

Workorder: L1053300

Report Date: 09-SEP-11

Page 3 of 3

## Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
<b>Physical Tests</b>							
Redox Potential	1	01-SEP-11	09-SEP-11	24	194	hours	EHTL
Resistivity	1	01-SEP-11	09-SEP-11	7	8	days	EHT

## Legend & Qualifier Definitions:

EHTR-FM: Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.  
EHTR: Exceeded ALS recommended hold time prior to sample receipt.  
EHTL: Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.  
EHT: Exceeded ALS recommended hold time prior to analysis.  
Rec. HT: ALS recommended hold time (see units).

### Notes\*:


Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.  
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L1053300 were received on 02-SEP-11 09:15.

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

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

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

50 NORTHLAND ROAD, UNIT 1  
WATERLOO, ON N2V 2B8  
Phone: (519) 886-6910  
Fax: (519) 886-9047  
Toll Free: 1-800-668-9878



Environmental

COMPANY NAME  
Amec E+I

OFFICE  
Windsor

PROJECT MANAGER  
Sharon Macleod

PROJECT #  
SW5801.1004.101

PHONE  
519-735-1499 FAX  
519-735-9669

ACCOUNT #  
20643

QUOTATION #  
20643 PO #  
519-735-1499

CHAIN OF CUSTODY / ANALYTICAL SERVICES REQUEST FORM

Page 1 of 1

C of C # 00000

Note: all TAT Quoted material is in business days which exclude statutory holidays and weekends. TAT samples received past 3:00 pm or Saturday/Sunday begin the next day.

Specify date required

Service requested

2 day TAT (50%)  
5 day (regular)  
3-4 day (25%)  
Next day TAT (100%)  
Same day TAT (200%)

ANALYSIS REQUEST

PLEASE INDICATE FILTERED, PRESERVED OR BOTH <--- (F, P, F/P)

SUBMISSION #:  
61053300

ENTERED BY:  
2 Sep 11

DATE/TIME ENTERED:  
2 Sep 11

BIN #:

NUMBER OF CONTAINERS

Corrosion Package

REPORT FORMAT/DISTRIBUTION  
EMAIL ☒ FAX ☐ BOTH ☐  
SELECT: PDF DIGITAL BOTH  
EMAIL 1 Sharon.Macleod@Amec.com  
EMAIL 2

SAMPLE DESCRIPTION TO APPEAR ON REPORT  
PS-1, 55260.00' grey silty clay

SPECIAL INSTRUCTIONS/COMMENTS

THE QUESTIONS BELOW MUST BE ANSWERED FOR WATER SAMPLES (CHECK YES OR NO)

Are any samples taken from a regulated DW System?  
If yes, are authorized drinking water COCs MUST be used for this submission.  
Is the water sampled intended to be potable for human consumption?

DATE & TIME RECEIVED BY:  
2 Sep 11 9:15

DATE & TIME RECEIVED AT LAB:  
2 Sep 11 9:15

SAMPLE CONDITION

FROZEN  
COLD  
COOLING INITIATED  
AMBIENT

OBSERVATIONS  
Yes ☐ No ☐  
If yes add SIF

1. Quote number must be provided to ensure proper pricing

2. TAT may vary dependent on complexity of analysis and lab workload at time of submission. Please contact the lab to confirm TATs.

3. Any known or suspected hazards relating to a sample must be noted on the chain of custody in comments section.



AMEC EARTH & ENVIRONMENTAL-  
WINDSOR  
ATTN: SHANE MACLEOD  
11865 County Road 42  
TECUMSEH ON N8N 2M1

Date Received: 02-SEP-11  
Report Date: 09-SEP-11 14:39 (MT)  
Version: FINAL

Client Phone: 519-735-2499

## Certificate of Analysis

**Lab Work Order #:** L1053298  
**Project P.O. #:** NOT SUBMITTED  
**Job Reference:** SW8801.1004.101  
**C of C Numbers:** 113003  
**Legal Site Desc:**

Gayle Braun  
Senior Account Manager

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ADDRESS: 309 Exeter Road Unit #29, London, ON N6L 1C1 Canada | Phone: +1 519 652 6044 | Fax: +1 519 652 0671  
ALS CANADA LTD Part of the ALS Group A Campbell Brothers Limited Company

		<div>Sample ID Description Sampled Date Sampled Time Client ID</div>	<div>L1053298-1 SOIL 01-SEP-11  PS2- 1,SS25@105',GRE Y SILTY CLAY</div>				
Grouping	Analyte						
SOIL							
Physical Tests	% Moisture (%)	6.97					
	pH (pH units)	7.98					
	Redox Potential (mV)	300					
	Resistivity (ohm cm)	2770					
Leachable Anions & Nutrients	Sulphide (mg/kg)	<0.20					
Anions and Nutrients	Sulphate (mg/kg)	232					

## Reference Information

### Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
MOISTURE-WT	Soil	% Moisture	Gravimetric: Oven Dried
PH-WT	Soil	pH	MOEE E3137A
Soil samples are mixed in the deionized water and the supernatant is analyzed directly by the pH meter.			
REDOX-POTENTIAL-WT	Soil	Redox Potential	APHA 2580
RESISTIVITY-WT	Soil	Resistivity	MOEE E3137A
SO4-WT	Soil	Sulphate	EPA 300.0
SULPHIDE-WT	Soil	Sulphide	APHA 4500S2D

\*\* ALS test methods may incorporate modifications from specified reference methods to improve performance.

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

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

### Chain of Custody Numbers:

113003

### GLOSSARY OF REPORT TERMS

*Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.*

*mg/kg - milligrams per kilogram based on dry weight of sample.*

*mg/kg wwt - milligrams per kilogram based on wet weight of sample.*

*mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.*

*mg/L - milligrams per litre.*

*< - Less than.*

*D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).*

*N/A - Result not available. Refer to qualifier code and definition for explanation.*

*Test results reported relate only to the samples as received by the laboratory.*

**UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.**

*Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.*

## Quality Control Report

Workorder: L1053298

Report Date: 09-SEP-11

Page 1 of 3

Client: AMEC EARTH & ENVIRONMENTAL-WINDSOR

11865 County Road 42

TECUMSEH ON N8N 2M1

Contact: SHANE MACLEOD

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
<b>MOISTURE-WT</b>								
	Soil							
Batch	R2246130							
WG1342214-2	LCS							
% Moisture			94		%		70-130	02-SEP-11
WG1342214-1	MB							
% Moisture			<0.10		%		0.1	02-SEP-11
<b>PH-WT</b>								
	Soil							
Batch	R2246414							
WG1343256-5	CVS							
pH			99		%		80-120	06-SEP-11
<b>RESISTIVITY-WT</b>								
	Soil							
Batch	R2248587							
WG1345734-1	CVS							
Resistivity			100		%		70-130	09-SEP-11
<b>SO4-WT</b>								
	Soil							
Batch	R2247979							
WG1343886-3	LCS							
Sulphate			100		%		60-140	07-SEP-11
WG1343886-1	MB							
Sulphate			<20		mg/kg		20	07-SEP-11
<b>SULPHIDE-WT</b>								
	Soil							
Batch	R2247559							
WG1344742-1	CVS							
Sulphide			101		%		50-120	07-SEP-11
WG1344739-1	MB							
Sulphide			<0.20		mg/kg		0.2	07-SEP-11

# Quality Control Report

Workorder: L1053298

Report Date: 09-SEP-11

Page 2 of 3

## Legend:

---

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

## Sample Parameter Qualifier Definitions:

---

Qualifier	Description
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

---

# Quality Control Report

Workorder: L1053298

Report Date: 09-SEP-11

Page 3 of 3

## Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
<b>Physical Tests</b>							
Redox Potential	1	01-SEP-11	09-SEP-11	24	194	hours	EHTL
Resistivity	1	01-SEP-11	09-SEP-11	7	8	days	EHT

## Legend & Qualifier Definitions:

EHTR-FM: Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.  
EHTR: Exceeded ALS recommended hold time prior to sample receipt.  
EHTL: Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.  
EHT: Exceeded ALS recommended hold time prior to analysis.  
Rec. HT: ALS recommended hold time (see units).

### Notes\*:

Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.  
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L1053298 were received on 02-SEP-11 09:15.

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

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

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



60 NORTHLAND ROAD, UNIT 1  
WATERLOO, ON N2V 2B8

Phone: (519) 886-6910

Fax: (519) 886-9047

Toll Free: 1-800-668-9878



# CHAIN OF CUSTODY / ANALYTICAL SERVICES REQUEST FORM Page \_\_\_\_ of \_\_\_\_

Note: all TAT Quoted material is in business days which exclude statutory holidays and weekends. TAT samples received past 3:00 pm or Saturday/Sunday begin the next day.

Specify date  
required

Service requested

2 day TAT (50%)

5 day (regular)

Next day TAT (100%)

3-4 day (25%)

Same day TAT (200%)

COMPANY NAME

Amec E+I

CRITERIA

Criteria on report YES \_\_\_ NO \_\_\_

OFFICE

Windsor

Reg 153/04 ☐

Reg 511/09 ☐

Table 1 2 3 4 5 6 7 8 9

PROJECT MANAGER

Shane Macleod

TCLP \_\_\_ MISA \_\_\_ PWQO \_\_\_

ODWS \_\_\_ OTHER \_\_\_

PROJECT #

SW5501.1004.101

PHONE

519-735-2499 FAX 519-735-9069

REPORT FORMAT/DISTRIBUTION

ACCOUNT #

EMAIL ☒ FAX \_\_\_ BOTH \_\_\_

QUOTATION # 02EG43

PO #

SELECT: PDF \_\_\_ DIGITAL \_\_\_ BOTH \_\_\_

EMAIL 1 Shane.Macleod@Amec.com

EMAIL 2

## SAMPLING INFORMATION

Sample Date/Time

TYPE

MATRIX

Date (dd-mm-yy)	Time (24hr) (hh:mm)	COMP	GRAB	WATER	SOIL	OTHER
01/09/11					<input checked="" type="checkbox"/>	

SAMPLE DESCRIPTION TO APPEAR ON REPORT

P3751, 5525 @ 105' (grey silty clay)

NUMBER OF CONTAINERS

Corrosion Package

## ANALYSIS REQUEST

PLEASE INDICATE FILTERED, PRESERVED OR BOTH  
← (F, P, F/P)

SUBMISSION #:

L1053298

ENTERED BY: *AS*

DATE/TIME ENTERED:

28 Sept 11

BIN #:

COMMENTS

LAB #

## SPECIAL INSTRUCTIONS/COMMENTS

## THE QUESTIONS BELOW MUST BE ANSWERED FOR WATER SAMPLES (CHECK Yes OR No)

## SAMPLE CONDITION

Are any samples taken from a regulated DW System?

Yes ☐ No ☐

If yes, an authorized drinking water COC MUST be used for this submission.

Is the water sampled intended to be potable for human consumption?

Yes ☐ No ☐

FROZEN	<input type="checkbox"/>	MEAN TEMP 5
COLD	<input checked="" type="checkbox"/>	
COOLING INITIATED	<input checked="" type="checkbox"/>	
AMBIENT	<input type="checkbox"/>	

SAMPLED BY:

DATE & TIME

RECEIVED BY:

DATE & TIME

RELINQUISHED BY:

DATE & TIME

RECEIVED AT LAB BY: *Shane Macleod*

DATE & TIME

28 Sept 11 9:15

OBSERVATIONS

Yes ☐ No ☐

If yes, add \$IF

Notes

1. Quote number must be provided to ensure proper pricing

2. TAT may vary dependent on complexity of analysis and lab workload at time of submission. Please contact the lab to confirm TATs.

3. Any known or suspected hazards relating to a sample must be noted on the chain of custody in comments section.



AMEC EARTH & ENVIRONMENTAL-  
WINDSOR  
ATTN: SHANE MACLEOD  
11865 County Road 42  
TECUMSEH ON N8N 2M1

Date Received: 16-SEP-11  
Report Date: 23-SEP-11 06:20 (MT)  
Version: FINAL

Client Phone: 519-735-2499

## Certificate of Analysis

**Lab Work Order #:** L1059696  
**Project P.O. #:** NOT SUBMITTED  
**Job Reference:** SW8801.1004.101  
**C of C Numbers:** 112774  
**Legal Site Desc:**

Gayle Braun  
Senior Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 309 Exeter Road Unit #29, London, ON N6L 1C1 Canada | Phone: +1 519 652 6044 | Fax: +1 519 652 0671  
ALS CANADA LTD Part of the ALS Group A Campbell Brothers Limited Company

# ALS ENVIRONMENTAL ANALYTICAL REPORT

		<b>Sample ID</b> <b>Description</b> <b>Sampled Date</b> <b>Sampled Time</b> <b>Client ID</b>	L1059696-1 SOIL 25-AUG-11  PS5- 1,SS23@90',GREY SILTY CLAY				
Grouping	Analyte						
<b>SOIL</b>							
<b>Physical Tests</b>	% Moisture (%)	16.6					
	pH (pH units)	7.90					
	Redox Potential (mV)	230					
	Resistivity (ohm cm)	2580					
<b>Leachable Anions &amp; Nutrients</b>	Sulphide (mg/kg)	<0.20					
<b>Anions and Nutrients</b>	Sulphate (mg/kg)	486					

## Reference Information

### Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
MOISTURE-WT	Soil	% Moisture	Gravimetric: Oven Dried
PH-WT	Soil	pH	MOEE E3137A
Soil samples are mixed in the deionized water and the supernatant is analyzed directly by the pH meter.			
REDOX-POTENTIAL-WT	Soil	Redox Potential	APHA 2580
RESISTIVITY-WT	Soil	Resistivity	MOEE E3137A
SO4-WT	Soil	Sulphate	EPA 300.0
SULPHIDE-WT	Soil	Sulphide	APHA 4500S2D

\*\* ALS test methods may incorporate modifications from specified reference methods to improve performance.

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

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

### Chain of Custody Numbers:

112774

### GLOSSARY OF REPORT TERMS

*Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.*

*mg/kg - milligrams per kilogram based on dry weight of sample.*

*mg/kg wwt - milligrams per kilogram based on wet weight of sample.*

*mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.*

*mg/L - milligrams per litre.*

*< - Less than.*

*D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).*

*N/A - Result not available. Refer to qualifier code and definition for explanation.*

*Test results reported relate only to the samples as received by the laboratory.*

*UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.*

*Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.*

## Quality Control Report

Workorder: L1059696

Report Date: 23-SEP-11

Page 1 of 3

Client: AMEC EARTH & ENVIRONMENTAL-WINDSOR

11865 County Road 42

TECUMSEH ON N8N 2M1

Contact: SHANE MACLEOD

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
<b>MOISTURE-WT</b>								
	Soil							
Batch	R2254382							
WG1351428-2	LCS							
% Moisture			94		%		70-130	19-SEP-11
WG1351428-1	MB							
% Moisture			<0.10		%		0.1	19-SEP-11
<b>PH-WT</b>								
	Soil							
Batch	R2254003							
WG1351581-1	CVS							
pH			101		%		80-120	19-SEP-11
<b>RESISTIVITY-WT</b>								
	Soil							
Batch	R2255410							
WG1353108-1	CVS							
Resistivity			102		%		70-130	21-SEP-11
<b>SO4-WT</b>								
	Soil							
Batch	R2255430							
WG1352527-3	LCS							
Sulphate			101		%		60-140	20-SEP-11
WG1352527-1	MB							
Sulphate			<20		mg/kg		20	20-SEP-11
<b>SULPHIDE-WT</b>								
	Soil							
Batch	R2254650							
WG1352442-1	CVS							
Sulphide			107		%		50-120	20-SEP-11
WG1352431-1	MB							
Sulphide			<0.20		mg/kg		0.2	20-SEP-11

# Quality Control Report

Workorder: L1059696

Report Date: 23-SEP-11

Page 2 of 3

## Legend:

---

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

## Sample Parameter Qualifier Definitions:

---

Qualifier	Description
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

---

# Quality Control Report

Workorder: L1059696

Report Date: 23-SEP-11

Page 3 of 3

## Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
<b>Physical Tests</b>							
% Moisture	1	25-AUG-11	19-SEP-11 10:40	14	25	days	EHTR
Redox Potential	1	25-AUG-11	21-SEP-11	24	651	hours	EHTR
Resistivity	1	25-AUG-11	21-SEP-11	7	27	days	EHTR
<b>Leachable Anions &amp; Nutrients</b>							
Sulphide	1	25-AUG-11	20-SEP-11 13:10	7	26	days	EHTR

## Legend & Qualifier Definitions:

EHTR-FM: Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.  
EHTR: Exceeded ALS recommended hold time prior to sample receipt.  
EHTL: Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.  
EHT: Exceeded ALS recommended hold time prior to analysis.  
Rec. HT: ALS recommended hold time (see units).

### Notes\*:

Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.  
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L1059696 were received on 16-SEP-11 09:00.

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C of C # 00000

CHAIN OF CUSTODY / ANALYTICAL SERVICES REQUEST FORM Page 1 of 1[illegible]

## Notes

**1. Quote number must be provided to ensure proper pricing**

2. TAT may vary dependent on complexity of analysis and lab workload at time of submission. Please contact the lab to confirm TATs.

3. Any known or suspected hazards relating to a sample must be noted on the chain of custody in comments section.





AMEC EARTH & ENVIRONMENTAL-  
WINDSOR

ATTN: SHANE MACLEOD  
11865 County Road 42  
TECUMSEH ON N8N 2M1

Date Received: 16-SEP-11  
Report Date: 23-SEP-11 06:20 (MT)  
Version: FINAL

Client Phone: 519-735-2499

## Certificate of Analysis

**Lab Work Order #:** L1059704  
**Project P.O. #:** NOT SUBMITTED  
**Job Reference:** SW8801.1004.101  
**C of C Numbers:** 112775  
**Legal Site Desc:**

Gayle Braun  
Senior Account Manager

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ADDRESS: 309 Exeter Road Unit #29, London, ON N6L 1C1 Canada | Phone: +1 519 652 6044 | Fax: +1 519 652 0671  
ALS CANADA LTD Part of the ALS Group A Campbell Brothers Limited Company

# ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1059704-1 SOIL 26-AUG-11  PS6- 1,SS20@80',GREY SILTY CLAY				
Grouping	Analyte					
SOIL						
Physical Tests	% Moisture (%)	12.7				
	pH (pH units)	7.77				
	Redox Potential (mV)	227				
	Resistivity (ohm cm)	3600				
Leachable Anions & Nutrients	Sulphide (mg/kg)	<0.20				
Anions and Nutrients	Sulphate (mg/kg)	221				

## Reference Information

### Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
MOISTURE-WT	Soil	% Moisture	Gravimetric: Oven Dried
PH-WT	Soil	pH	MOEE E3137A
Soil samples are mixed in the deionized water and the supernatant is analyzed directly by the pH meter.			
REDOX-POTENTIAL-WT	Soil	Redox Potential	APHA 2580
RESISTIVITY-WT	Soil	Resistivity	MOEE E3137A
SO4-WT	Soil	Sulphate	EPA 300.0
SULPHIDE-WT	Soil	Sulphide	APHA 4500S2D

\*\* ALS test methods may incorporate modifications from specified reference methods to improve performance.

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

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

### Chain of Custody Numbers:

112775

### GLOSSARY OF REPORT TERMS

*Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.*

*mg/kg - milligrams per kilogram based on dry weight of sample.*

*mg/kg ww - milligrams per kilogram based on wet weight of sample.*

*mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.*

*mg/L - milligrams per litre.*

*< - Less than.*

*D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).*

*N/A - Result not available. Refer to qualifier code and definition for explanation.*

*Test results reported relate only to the samples as received by the laboratory.*

*UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.*

*Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.*

## Quality Control Report

Workorder: L1059704

Report Date: 23-SEP-11

Page 1 of 3

Client: AMEC EARTH & ENVIRONMENTAL-WINDSOR

11865 County Road 42

TECUMSEH ON N8N 2M1

Contact: SHANE MACLEOD

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
<b>MOISTURE-WT</b>								
	Soil							
Batch	R2254382							
WG1351428-2	LCS							
% Moisture			94		%		70-130	19-SEP-11
WG1351428-1	MB							
% Moisture			<0.10		%		0.1	19-SEP-11
<b>PH-WT</b>								
	Soil							
Batch	R2254003							
WG1351581-1	CVS							
pH			101		%		80-120	19-SEP-11
<b>RESISTIVITY-WT</b>								
	Soil							
Batch	R2255410							
WG1353108-1	CVS							
Resistivity			102		%		70-130	21-SEP-11
<b>SO4-WT</b>								
	Soil							
Batch	R2255430							
WG1352527-3	LCS							
Sulphate			101		%		60-140	20-SEP-11
WG1352527-1	MB							
Sulphate			<20		mg/kg		20	20-SEP-11
<b>SULPHIDE-WT</b>								
	Soil							
Batch	R2254650							
WG1352442-1	CVS							
Sulphide			107		%		50-120	20-SEP-11
WG1352431-1	MB							
Sulphide			<0.20		mg/kg		0.2	20-SEP-11

# Quality Control Report

Workorder: L1059704

Report Date: 23-SEP-11

Page 2 of 3

## Legend:

---

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

## Sample Parameter Qualifier Definitions:

---

Qualifier	Description
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

---

# Quality Control Report

Workorder: L1059704

Report Date: 23-SEP-11

Page 3 of 3

## Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
<b>Physical Tests</b>							
% Moisture	1	26-AUG-11	19-SEP-11 10:41	14	24	days	EHTR
Redox Potential	1	26-AUG-11	21-SEP-11	24	627	hours	EHTR
Resistivity	1	26-AUG-11	21-SEP-11	7	26	days	EHTR
<b>Leachable Anions &amp; Nutrients</b>							
Sulphide	1	26-AUG-11	20-SEP-11 13:11	7	25	days	EHTR

## Legend & Qualifier Definitions:

EHTR-FM: Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.  
EHTR: Exceeded ALS recommended hold time prior to sample receipt.  
EHTL: Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.  
EHT: Exceeded ALS recommended hold time prior to analysis.  
Rec. HT: ALS recommended hold time (see units).

### Notes\*:

Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.  
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L1059704 were received on 16-SEP-11 09:00.

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

112775

C of C # 00000

60 NORTHLAND ROAD, UNIT 1  
WATERLOO, ON N2V 2B8  
Phone: (519) 886-6910  
Fax: (519) 886-9047  
Toll Free: 1-800-668-9878

CHAIN OF CUSTODY / ANALYTICAL SERVICES REQUEST FORM Page 1 of 1

Note: all TAT Quoted material is in business days which exclude statutory holidays and weekends. TAT samples received past 3:00 pm or Saturday/Sunday begin the next day.		Specify date required	Service requested		2 day TAT (50%)				
			5 day (regular)	<input checked="" type="checkbox"/>	Next day TAT (100%)				
			3-4 day (25%)		Same day TAT (200%)				
COMPANY NAME <b>AMEC E &amp; I</b>		CRITERIA Criteria on report YES ___ NO ___		ANALYSIS REQUEST			PLEASE INDICATE FILTERED, PRESERVED OR BOTH ← (F, P, F/P)		
OFFICE <b>Windsor</b>		Reg 153/04 <input type="checkbox"/> Reg 511/09 <input type="checkbox"/> Table 1 2 3 4 5 6 7 8 9							
PROJECT MANAGER <b>Shane Macleod</b>		TCLP ___ MISA ___ PWQO ___		NUMBER OF CONTAINERS Corrosion Package			SUBMISSION # <b>L 105 9704</b>		
PROJECT # <b>SW85061004101</b>		ODWS ___ OTHER ___					ENTERED BY: <b>P. Stastny</b>		
PHONE <b>(519) 735-2499</b>		FAX <b>(519) 735-9669</b>					DATE/TIME ENTERED: <b>16 Sept - 11</b>		
ACCOUNT #		REPORT FORMAT/DISTRIBUTION		BIN #: <b>159</b>			COMMENTS		
QUOTATION # <b>028643</b>		EMAIL <input checked="" type="checkbox"/> FAX ___ BOTH ___							
PO #		SELECT: PDF ___ DIGITAL ___ BOTH ___							
SAMPLING INFORMATION		EMAIL 1 <b>shane.macleod@amec.com</b>		SAMPLE DESCRIPTION TO APPEAR ON REPORT <b>P36-1, S3 200 Po', gr. silty clay</b>			LAB ID		
Date (dd-mm-yy)		EMAIL 2							
Time (24hr) (hh:mm)									
TYPE		MATRIX							
COMP		GRAB							
WATER		SOIL							
OTHER									
SPECIAL INSTRUCTIONS/COMMENTS		THE QUESTIONS BELOW MUST BE ANSWERED FOR WATER SAMPLES (CHECK Yes OR No)						SAMPLE CONDITION	
		Are any samples taken from a regulated DW System? Yes <input type="checkbox"/> No <input type="checkbox"/>						FROZEN <input type="checkbox"/>	
		If yes, an authorized drinking water COC MUST be used for this submission.						COLD <input type="checkbox"/>	
		Is the water sampled intended to be potable for human consumption? Yes <input type="checkbox"/> No <input type="checkbox"/>						COOLING INITIATED <input type="checkbox"/>	
SAMPLED BY:		DATE & TIME		RECEIVED BY:		DATE & TIME		OBSERVATIONS	
RELINQUISHED BY:		DATE & TIME		RECEIVED AT LAB BY:		DATE & TIME		Yes <input type="checkbox"/> No <input type="checkbox"/>	
								If yes add SIF	

Notes

1. Quote number must be provided to ensure proper pricing

2. TAT may vary dependent on complexity of analysis and lab workload at time of submission. 3. Any known or suspected hazards relating to a sample must be noted on the chain of custody in comments section.

Please contact the lab to confirm TATs.



AMEC EARTH & ENVIRONMENTAL-  
WINDSOR  
ATTN: SHANE MACLEOD  
11865 County Road 42  
TECUMSEH ON N8N 2M1

Date Received: 02-SEP-11  
Report Date: 09-SEP-11 14:40 (MT)  
Version: FINAL

Client Phone: 519-735-2499

## Certificate of Analysis

**Lab Work Order #:** L1053302  
**Project P.O. #:** NOT SUBMITTED  
**Job Reference:** SW8801.1004.101  
**C of C Numbers:** 113002  
**Legal Site Desc:**

Gayle Braun  
Senior Account Manager

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ALS CANADA LTD Part of the ALS Group A Campbell Brothers Limited Company



		<div>Sample ID Description Sampled Date Sampled Time Client ID</div>	<div>L1053302-1 SOIL 01-SEP-11  PS7- 1,SS25@100',GRE Y SILTY CLAY</div>				
Grouping	Analyte						
SOIL							
Physical Tests	% Moisture (%)	19.0					
	pH (pH units)	7.72					
	Redox Potential (mV)	285					
	Resistivity (ohm cm)	9710					
Leachable Anions & Nutrients	Sulphide (mg/kg)	<0.20					
Anions and Nutrients	Sulphate (mg/kg)	29					

## Reference Information

### Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
MOISTURE-WT	Soil	% Moisture	Gravimetric: Oven Dried
PH-WT	Soil	pH	MOEE E3137A
Soil samples are mixed in the deionized water and the supernatant is analyzed directly by the pH meter.			
REDOX-POTENTIAL-WT	Soil	Redox Potential	APHA 2580
RESISTIVITY-WT	Soil	Resistivity	MOEE E3137A
SO4-WT	Soil	Sulphate	EPA 300.0
SULPHIDE-WT	Soil	Sulphide	APHA 4500S2D

\*\* ALS test methods may incorporate modifications from specified reference methods to improve performance.

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

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

### Chain of Custody Numbers:

113002

### GLOSSARY OF REPORT TERMS

*Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.*

*mg/kg - milligrams per kilogram based on dry weight of sample.*

*mg/kg ww - milligrams per kilogram based on wet weight of sample.*

*mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.*

*mg/L - milligrams per litre.*

*< - Less than.*

*D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).*

*N/A - Result not available. Refer to qualifier code and definition for explanation.*

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## Quality Control Report

Workorder: L1053302

Report Date: 09-SEP-11

Page 1 of 3

Client: AMEC EARTH & ENVIRONMENTAL-WINDSOR

11865 County Road 42

TECUMSEH ON N8N 2M1

Contact: SHANE MACLEOD

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
<b>MOISTURE-WT</b>								
<b>Soil</b>								
Batch	R2246130							
WG1342214-2	LCS							
% Moisture			94		%		70-130	02-SEP-11
WG1342214-1	MB							
% Moisture			<0.10		%		0.1	02-SEP-11
<b>PH-WT</b>								
<b>Soil</b>								
Batch	R2246414							
WG1343256-5	CVS							
pH			99		%		80-120	06-SEP-11
WG1343256-6	DUP	L1053302-1						
pH		7.72	7.68		pH units	0.52	20	06-SEP-11
<b>RESISTIVITY-WT</b>								
<b>Soil</b>								
Batch	R2248587							
WG1345734-1	CVS							
Resistivity			100		%		70-130	09-SEP-11
<b>SO4-WT</b>								
<b>Soil</b>								
Batch	R2247979							
WG1343886-3	LCS							
Sulphate			100		%		60-140	07-SEP-11
WG1343886-1	MB							
Sulphate			<20		mg/kg		20	07-SEP-11
<b>SULPHIDE-WT</b>								
<b>Soil</b>								
Batch	R2247559							
WG1344742-1	CVS							
Sulphide			101		%		50-120	07-SEP-11
WG1344739-2	DUP	L1053302-1						
Sulphide		<0.20	<0.20	RPD-NA	mg/kg	N/A	20	07-SEP-11
WG1344739-1	MB							
Sulphide			<0.20		mg/kg		0.2	07-SEP-11

# Quality Control Report

Workorder: L1053302

Report Date: 09-SEP-11

Page 2 of 3

## Legend:

---

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

## Sample Parameter Qualifier Definitions:

---

Qualifier	Description
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

---

# Quality Control Report

Workorder: L1053302

Report Date: 09-SEP-11

Page 3 of 3

## Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
<b>Physical Tests</b>							
Redox Potential	1	01-SEP-11	09-SEP-11	24	194	hours	EHTL
Resistivity	1	01-SEP-11	09-SEP-11	7	8	days	EHT

## Legend & Qualifier Definitions:

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